GOLDER

REPORT

Nestlé Waters Canada - Aberfoyle

Technical Study for Permit To Take Water Renewal Application

Submitted to:

Ministry of the Environment, Conservation and Parks
West Central Region
119 King St. W., 12th Floor
Hamilton, ON L8P 4Y7

Submitted by:

Golder Associates Ltd.
S.S. Papadopulos & Associates, Inc.
C. Portt & Associates
Beacon Environmental

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Executive Summary

Nestlé Waters Canada (Nestlé) is submitting this Technical Study Report in support of its Permit To Take Water (PTTW) renewal application. The current PTTW (Number 1381-95ATPY) was issued in December 2013 and expired on July 31, 2016. The PTTW renewal application was submitted to the Ministry of the Environment, Conservation and Parks (MECP, formerly the Ministry of the Environment and Climate Change) in April 2016. Well TW3-80 continues to operate under the terms of the existing PTTW in accordance with the Ontario Water Resources Act Section 34.1 (6) until a decision is made regarding the renewal. Key facts and findings presented in the Technical Study Report are as follows:

- The supply well, TW3-80, referred to as the Aberfoyle well, is used for the purpose of bottling water and facility operations, and is permitted to pump at 2,500 L/min (3,600,000 L/day). A second supply well, referred to as TW2-11, is located on the property and is permitted for miscellaneous purposes such as providing water to the on-site pond for firefighting purposes, although it has not been used. Nestlé proposes to continue the water taking from TW3-80 and not to take water from TW2-11.
- TW3-80 has been permitted and operating since 2001.
- Comprehensive annual monitoring reports are prepared for the Aberfoyle well (TW3-80) under the conditions of the PTTW that remains in effect.
- In 2014 bottled water consumption surpassed carbonated soft drinks in Canada and continues to grow. Nestlé wants to continue to provide a healthy beverage alternative from its water source in Aberfoyle.
- The daily water takings at TW3-80 over the past 10 years (2009 – 2018) have ranged from 0 L/day to 3,517,550 L/day. The daily water takings generally increase during the first half of the year and then decrease during the remainder of the year. Daily groundwater withdrawals from Aberfoyle well TW3-80 have averaged 1,810,470 L over the last 10 years (2009 – 2018).
- The annual water takings have ranged from a minimum of 267.5 million litres in 2001 to a maximum of 875.0 million litres in 2007. Since 2002, the annual groundwater takings have ranged from approximately 43% to 67% of the current permitted annual taking of 1,314,000,000 L.
- TW3-80 pumps water from the Lower Bedrock Aquifer which is overlain by a Middle Bedrock Aquitard, an Upper Bedrock Aquifer and an overburden aquifer/aquitard.
- TW3-80 is located outside of municipal water quality wellhead protection areas (WHPAs) but within the City of Guelph water quantity protection zone (WHPA-Q). A review by the Source Protection Committee found that TW3-80 does not interfere, to any measurable degree, with the municipal wells and is estimated to be responsible for 1% of the drawdown at the closest municipal well (Burke Well) (Matrix Solutions, 2018a).
- There have been no well interference complaints arising from the water takings from TW3-80.
- The variations in water levels in TW3-80 were due mainly to short-term changes in the pumping rate. The average changes in the water levels in TW3-80 follow closely the overall water taking from the well. Water levels in TW3-80 recover relatively rapidly when pumping stops. The fact that the water levels recover when

pumping rates are reduced supports that the water taking is sustainable. On-going pumping from TW3-80 has not led to a long-term declining trend in water levels in the well.

- Water levels in the Lower Bedrock Aquifer, over both the short-term and long-term, are influenced mainly by pumping of TW3-80. The effects of long-term variability in pumping are observed more in the wells closer to TW3-80 where water level changes from year to year correlate with overall annual water takings (i.e., increased water takings result in lower water levels). The influence of pumping decreases with distance away from the pumping well and water levels recover when pumping rates are reduced, indicating that the water taking is sustainable. There is also some influence on the water levels from recharge and external influences, to varying degrees.
- Water levels in the Upper Bedrock Aquifer around the property are influenced from pumping at TW3-80 (i.e., there is hydraulic connection between the Upper Bedrock and Lower Bedrock Aquifers); however, the connection is limited (i.e., there is less response than in the Lower Bedrock Aquifer). The magnitude of influence varies based on distance from TW3-80 and existing hydrogeologic conditions, reflecting complexity in the subsurface and changes in permeability. While there is an influence on water levels in the Upper Bedrock Aquifer from pumping TW3-80, there are also seasonal and long-term trends in water levels that are reflective of recharge trends (i.e., lower water levels during years of below normal precipitation and higher water levels during years of above normal precipitation).
- Water levels in the overburden are affected both by natural events (recharge) and to a much lesser degree from pumping at TW3-80. The response to pumping in the overburden is muted compared to the responses in the Upper and Lower Bedrock Aquifers and only observed in the immediate vicinity of the pumping well.
- Water levels in mini-piezometers installed in the shallow subsurface have been similar over the past 11 years, with water levels generally increasing in the spring, declining through the summer, and then increasing in the fall. In addition to the seasonal trend, short-term changes (“spikes”) in water level in the shallow groundwater are influenced by individual precipitation events. Overall, the water levels are influenced primarily by precipitation events, which overwhelm any changes due to changes in pumping.
- Surface water levels in the creeks fluctuate in response to natural events (i.e., precipitation, snow melt and evapotranspiration) with no measurable effects from changes in pumping. In general, surface water levels are higher in the winter/spring and lower in the summer and then increase slightly into the fall. “Spikes” in the water levels are related to precipitation events or spring melt.
- Surface water flows in Aberfoyle Creek at the upstream end of the property (SW1) and downstream end of the property (SW2) have been similar over the years. Stream flows are higher in the spring following precipitation and melt events and then decline through the summer with less variability in flow. Most of the time flows are higher or similar at SW2 compared to the flow at SW1. Surface water flows at SW1 and SW2 are not measurably affected by pumping.
- Water quality at TW3-80 has been consistent over the 17 years of monitoring and is characterized as a calcium-magnesium-bicarbonate type, consistent with a carbonate aquifer.
- Biological monitoring of the Aberfoyle property has been conducted on an annual basis since 2007. The biological monitoring program is a condition of the PTTW. The biological monitoring program has characterized the aquatic, wetland and terrestrial ecosystems, evaluated changes to ecological communities over time, and made recommendations related to resource management. Over the period of the biological

monitoring program, there has been no evidence that would indicate the water taking is adversely affecting the aquatic, wetland and terrestrial ecosystems on the property. The vegetation and wildlife communities have remained stable over the monitoring period with only minor variation observed, which is attributable to seasonal variation, natural succession and sampling accuracy. Based on the species composition data, there has been no evidence to indicate that the hydrology of the wetlands has been affected by pumping from TW3-80.

- Annual salmonid spawning survey data have consistently found that trout do not spawn in the reach of Aberfoyle Creek on the property. The absence of spawning trout is attributable to the elevated summer stream temperatures along this reach, which render it unsuitable for trout. The elevated temperatures are attributable to thermal loading from the online Aberfoyle Mill Pond located immediately upstream of the property. Any potential reductions in flow of Aberfoyle Creek associated with groundwater withdrawals have negligible effects on stream temperature relative to the Mill Pond.
- There are no long-term adverse impacts to other water users and the environment from the historical water takings from TW3-80 (2001-2018). The water takings do not prevent water users from continuing their established pattern of use and the groundwater withdrawal from TW3-80 does not significantly interfere with existing municipal uses.

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1.0 INTRODUCTION

Nestlé Waters Canada (Nestlé) has retained Golder Associates Ltd. (Golder), S.S. Papadopulos & Associates, Inc. (SSPA), C. Portt and Associates and Beacon Environmental (Beacon) to prepare this Technical Study Report in support of a Permit To Take Water (PTTW) renewal application for well TW3-80 at its Aberfoyle facility. The current PTTW (Number 1381-95ATPY) was issued in December 2013. The PTTW renewal application was submitted to the Ministry of the Environment, Conservation and Parks (MECP, formerly the Ministry of the Environment and Climate Change) 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 continues to operate TW3-80 under the terms of the existing PTTW until a decision is made regarding the renewal.

On December 16, 2016, Ontario Regulation 463/16 (Taking Groundwater to Produce Bottled Water) came into effect. The regulation prohibits a Director from issuing a new or amended permit that would authorize the taking of groundwater for the purpose of producing bottled water, unless the old permit already authorized the taking of the same or a greater amount of groundwater from the same location and for the same purpose. The PTTW authorizes water takings from two bedrock wells located on the Nestlé property in Aberfoyle. Water from TW3-80 is taken for the purpose of bottling water and water from TW2-11 is permitted for taking for miscellaneous purposes such as providing water to the on-site pond for firefighting purposes, although it has not been used. Nestlé proposes to continue with the water taking from TW3-80 and not include the water taking from TW2-11 in the latest permit application. There is no increase in the proposed water taking.

This report provides the technical background in support of the PTTW renewal application. The study conforms to the requirements outlined in the Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements prepared by the MECP in April 2017 to evaluate long-term impacts to other water users and the environment from the water taking. The PTTW renewal process and technical study requirements conform with the MECP's Statement of Environmental Values, which are in place "to protect, conserve and where reasonable, restore the integrity of the environment".

With increased focus on health and wellness, Canadians are actively managing their lifestyles and drinking more water, which is considered the most affordable "healthy" beverage. In 2014, bottled water consumption surpassed carbonated soft drinks in Canada and continues to grow. Nestlé wants to continue to provide a healthy beverage alternative from its water source in Aberfoyle.

1.1 Setting

The Aberfoyle bottling facility is located on a 46.75 hectare parcel owned by Nestlé in Lot 23 and 24, Concession 7 in Puslinch Township, Wellington County. The facility is approximately 5 km southeast of Guelph and 12 km northeast of Cambridge (Figure 1). The facility is located in the Mill Creek subwatershed, which is within the Grand River watershed.

The Aberfoyle facility consists of a bottling plant, warehouse, paved parking and access drives, ponds, and open fields, and is bordered by wooded areas and wetlands. Figure 2 is a recent aerial photograph showing the Aberfoyle property and land uses on adjacent properties.

1.2 Historical Summary

TW3-80 was constructed in April 1980 for an aquaculture (fish farming) operation. In December 2000, the Perrier Group of America, a Nestlé Company, purchased the property. Six consecutive PTTWs have been issued for TW3-80 since that time, allowing for water takings for the purpose of bottling water. The PTTWs in the early 2000s allowed for a water taking at a maximum rate of 1,818 L/min. In June 2005, the permitted water taking was increased to a maximum instantaneous pumping rate of 2,500 L/min for a total maximum daily water taking of 3,600,000 L/day.

A second production well, TW2-11, was constructed on the property in 2011. This well was added to the current PTTW to provide water for miscellaneous purposes (such as water for firefighting purposes) but not bottling water. No water has been taken from TW2-11 since it was added to the PTTW.

The current PTTW allows water to be taken as outlined in Table 1. The combined permitted water taking from TW3-80 and TW2-11 is 3,600,000 L/day. The current PTTW (Number 1381-95ATPY) is provided in Appendix A.

Table 1: Permitted Water Takings at Aberfoyle

Source	Maximum Instantaneous Rate	Maximum Number of Hours of Water Taking per Day	Maximum Daily Water Taking	Maximum Number of Days of Water Taking per Year
TW3-80	2,500 L/min	24	3,600,000 L	365
TW2-11	475 L/min	24	684,000 L	365
Total			**3,600,000 L**	

1.3 Previous Studies

Numerous investigations have been conducted to assess the hydrology and potential impacts of the Aberfoyle water taking on nearby water users and the environment. Investigations that have been requirements of previous PTTWs have been completed to the satisfaction of the MECP. The key investigations are summarized in the following reports:

- Hydrogeologic Investigation and Test Well Evaluations (CRA, 1980);
- Test Pumping Investigation Supply Well TW3-80 (CRA, 2004);
- Supplemental Hydrogeologic Investigation (CRA, 2008);
- 2010 Annual Monitoring Report (CRA, 2011);
- Test Pumping Investigation for TW2-11 (CRA, 2012); and
- Examination of the Temperature Suitability of Aberfoyle Creek for Resident Fishes: 2006 – 2013 (C. Portt and Associates, 2014).

In 2000, Nestlé initiated a Long-Term Monitoring (LTM) program to evaluate both natural and pumping-induced changes in water resources. Annual reports of the LTM program have been provided to MECP as required by the PTTWs.

2.0 BACKGROUND

2.1 Description of Taking

The daily water takings at TW3-80 over the past 10 years (2009 through 2018) ranged from 0 L/day to 3,517,550 L/day which is 98% of the permitted daily water taking of 3,600,000 L/day. The daily water takings generally increase during the first half of the year and then decrease during the remainder of the year.

The current permitted annual taking from TW3-80 is 1,314 million litres. The annual water takings have ranged from a minimum of 267.5 million litres in 2001 to a maximum of 875.0 million litres in 2007. Since 2002, the annual groundwater takings have ranged from approximately 43% to 67% of the current permitted annual taking (Figure 3).

Groundwater withdrawals from Aberfoyle well TW3-80 have averaged 1,810,470 L/day over the last 10 years (2009 through 2018) as shown in Table 2. This rate is 50% of the maximum permitted withdrawal rate of 3,600,000 L/day. In 2018, the equivalent average daily withdrawal rate was 1,854,648 L/day, 52% of the maximum permitted withdrawal rate.

Table 2: Aberfoyle Annual Withdrawals

Year	Total Annual Withdrawal (Litres)	Annual Average Rate (L/day)	Annual Average Percent of PTTW
2009	583,378,660	1,598,298	44
2010	603,265,228	1,652,781	46
2011	568,025,080	1,556,233	43
2012	583,823,567	1,595,146	44
2013	600,537,587	1,645,308	46
2014	678,452,126	1,858,773	52
2015	762,363,664	2,088,668	58
2016	783,540,441	2,140,821	59
2017	767,883,336	2,103,790	58
2018	676,946,402	1,854,648	52
10-year Average (2009-2018)	660,821,609	1,810,470	50

Nestlé also has two Environmental Compliance Approvals (ECA) for discharging water to the environment (Appendix A). ECA Number 2766-8Z6QHV allows for the discharge of process wastewater and stormwater to a pond on the property that discharges to Aberfoyle Creek. The water is treated before its eventual discharge to the creek. The existing on-site sewage works, which allows for treatment prior to subsurface disposal, is approved under ECA Number 6373-AUXPNA.

2.2 Justification of Bottled Water Taking

According to A.C. Nielsen (2019), the following key points have been identified regarding the value of bottled water:

- In terms of volume, water is the number one consumed beverage in Canada;
- 74% of Canadians are actively managing their health and wellness lifestyles and are trying to drink more water;
- Water is considered as the most affordable “healthy” beverage, with a repeat purchase rate of 80% amongst consumers;
- Over the past three years, the bottled water category grew by 16%;
- Household penetration of bottled water (defined as the number of households who have purchased bottled water) is approximately 74% in Canada; and
- Household penetration for bottled water consumption has been steadily increasing and in 2014, bottled water consumption exceeded carbonated soft drinks.

In addition, Health Canada recommends water as the preferred drink of choice in Canada’s Food Guide.

Bottled water is not only important from an economic and health perspective, it is essential in time of emergencies. In 2017 and 2018, Nestlé donated over 2 million bottles of water to Canadians in crises during floods and fires, charitable donations and homelessness initiatives. Nestlé also has a partnership with the Canadian Red Cross to support the organization in times of need.

The above information indicates how important the bottled water industry is and based on the current consumer demand Nestlé is requesting that the water taking be kept at the same daily rate and amount as in the current permit (with the removal of TW2-11). At present, there are days when Nestlé takes near the permitted amounts to meet consumer demands during peak periods. Over the past five years, there have been days when Nestlé has taken 85% or greater of their maximum daily permitted takings to meet these peak demands. The volume of water withdrawn fluctuates based on demand. That demand varies from day to day and week to week so having flexibility is key to running an efficient business that enables Nestlé to respond to consumer and customer needs.

Also, Nestlé is located in an area without municipal water supply; therefore, a portion of the water is also used to run the daily operations (i.e., silo sanitation, employee use, maintenance and other purposes at the plant). Nestlé is committed to continuously improving its water efficiency; however, this needs to be factored in to the overall water usage.

2.3 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 grade, and 2.4 m of fine-to-medium sand overlying bedrock. Any coarse-grain sediments at surface may have been removed in the past. The well was originally completed to a depth of 42.4 m below grade, 27.8 m into the bedrock.

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

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

In 1999, the bottom 11.3 m of TW3-80 was sealed with gravel, bentonite grout, and a cement cap so that the well would pump water with more favourable natural water quality from within the Guelph to Goat Island/Gasport Formations. The revised finished depth is 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. 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 4.

Currently, a nominal 203 mm diameter Grundfos pump (Model 800S750-3) with a 75 hp, 575 V, 3 phase motor, is installed in well TW3-80. The submersible pump is suspended on 24.4 m of nominal 127 mm diameter schedule 40 stainless steel riser pipe with a 152 mm x 127 mm reducing bushing at the top of the pump.

2.4 Land Use

The Aberfoyle bottling facility is located on a 46.75 hectare parcel of land with ponds and open fields (Figure 2). Local land uses surrounding the Nestlé property are illustrated on Figure 5 and include:

- Interspersed commercial, institutional and residential to the north (Hamlet of Aberfoyle);
- A residential subdivision (the Meadows of Aberfoyle) and older residential lots to the northeast;
- Rural residential, agriculture, and wooded wetlands to the northwest;
- Aggregate extraction to the southeast, south, and southwest; and
- Industrial/commercial to the southeast, beyond adjacent aggregate properties (i.e., southeast of McLean Road and east of Brock Road).

Nestlé is committed to preserving the natural environment and protecting the water supply within the land area that it controls.

2.5 Characterization of the Regional Setting

2.5.1 Topography

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 6. Within a 1 km radius of the Nestlé property, ground surface elevations typically range from 310 to 330 masl (metres above sea level) with the lows occurring along Aberfoyle Creek and Mill Creek. The streambed elevation of the portion of Aberfoyle Creek that traverses Nestlé's property is approximately 310.5 masl (+/- 1 m).

2.5.2 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 (Figure 6). The Nestlé property is situated mainly within an outwash gravel plain situated between the two moraines. 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.

2.5.3 Ecological Setting

The northwestern half of the Nestlé property is in a natural condition and supports a diversity of forest and wetland habitats as well as a watercourse and fish habitat (Figure 2). Most of these habitats are relatively undisturbed and support a diverse range of flora and fauna, including some that are locally significant.

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

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

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

2.6 Geology

The following sections provide a summary of the regional and local geology. 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 have been installed as part of previous field investigations (borehole logs included in Appendix B). The bedrock interpretation has been updated to follow the revised nomenclature of the OGS (Brunton, 2008 and 2009, Brunton and Brintnell, 2011).

2.6.1 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 7. The surficial overburden of the area is characterized by the following units:

- Outwash gravel;
- Ice-contact gravel: kames and eskers; and
- Stony, 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. 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.

2.6.2 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 8. As noted above, the bedrock nomenclature shown on Figure 8 has since been revised based on work by the OGS over recent years (Brunton, 2008 and 2009, Brunton and Brintnell, 2011). In general, the previous Guelph Formation is now divided into the Guelph Formation and the Eramosa Formation (Stone Road Member and Reformatory Quarry Member); the previous Amabel Formation (Eramosa Member) is now the Eramosa Formation (Vinemount Member); and the previous Amabel Formation (Unsubdivided Member) is divided into the Goat Island, Gasport and Irondequoit Formations. The bedrock hydrogeologic units underlying the property, which are relevant to this study, 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. Due to it's low hydraulic conductivity, the top of the Cabot Head Formation is interpreted to be the base of the active groundwater flow system.
- **Merritton Formation:** The Merritton Formation consists of a pinkish-brown, finely crystalline dolostone unit with dark shaley partings (Brunton, 2008). 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:** The Irondequoit Formation is a thickly to medium-bedded crinoidal grainstone (Brunton, 2008). The unit has a fairly consistent thickness of approximately 3 m throughout the area.
- **Gasport Formation:** The Gasport Formation is a cross-bedded crinoidal grainstone-packstone with sequences of reef mound and coquina (shell bed) lithofacies. This unit has commonly been referred to as the Amabel Formation (Unsubdivided Member) in previous studies in the area (Turner, 1978). Wells in the vicinity of the 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 its thickness at the regional scale.

2.7 Hydrogeology

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

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

The designations of aquifers and aquitards is a simplification of the hydrostratigraphy for conceptual purposes. In reality, portions of the bedrock aquifers can act as aquitards.

Two hydrostratigraphic cross-sections (A-A’ and B-B’) through the property are included on Figures 10 and 11 with the locations shown on Figure 9. Hydrostratigraphic 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.

2.7.1 Pumping Tests

To better understand the hydraulic characteristics of the aquifers to support the interpretation of the local groundwater system, five pumping tests have been completed at the property as follows:

- TW3-80 - 24-hour initial test in November 1980;
- TW3-80 - 72-hour test in October 2004;
- TW3-80 - 31 day test in November/December 2007;
- TW3-80 - 43 day test in August to October 2010; and
- TW2-11 - 11 day test in August/September 2012.

A summary of the testing is as follows. Copies of the pumping test reports are included on CD.

1980 Pumping Test

- 24-hour pumping of TW3-80 at 3,955 L/min;
- Drawdown at TW3-80 stabilized at 9.4 m after 5 hours of pumping; and
- A sustained yield of 3,955 L/min was demonstrated and it was expected that a yield of 5,455 L/min could be maintained without causing excessive drawdown in the neighbouring wells. The capacity of the well has been reduced since 1980, following the installation of the liner and plugging of the bottom of the well.

2004 Pumping Test

- 72-hour pumping of TW3-80 at 3,182 L/min with 30 hours of shutdown prior to the test and 47 hours of shutdown following the test;
- Drawdown at TW3-80 stabilized at 18.5 m after 19 hours of pumping;
- Groundwater flow in the bedrock under static conditions was interpreted to be to the southwest and the area affected by pumping elongated to the northwest;
- Water levels in bedrock wells declined in response to pumping of TW3-80 with the area affected extending about 750 m to the southwest, 250 m to the southeast, 850 m to the northeast and on the order of 1,350 m to the northwest (based on a water level decline of 1.0m). Areas in the bedrock that are less hydraulically connected to the pumping well were inferred;
- At some locations, shallow overburden water levels were affected by pumping (up to 0.3 m declines) within a radius of influence of approximately 300 m. Weak vertical gradient changes occurred with reversals from upwards or near-zero to downwards. Shallow groundwater flow directed towards the creek was essentially unchanged despite lowered water levels and gradient reversals;
- Surface water levels did not appear to be influenced by pumping and therefore associated riparian vegetation and wetlands were interpreted to remain unaffected by pumping TW3-80;
- Surface water flow at the upstream and downstream property boundaries did not appear to be influenced by pumping;
- No complaints were received during the test; and
- It was concluded that TW3-80 could support long-term pumping of 2,955 L/min.

2007 Pumping Test

- 31-day pumping test of TW3-80 (7 day stabilization period at 1,600 L/min, 21.15 day maximum rate test period at 2,470 L/min followed by 3 day recovery period at 1,600 L/min);
- The additional drawdown at TW3-80 from increasing pumping from 1,600 to 2,470 L/min was 6.7 m, with stabilization after 32 hours;
- Water levels in the Lower Bedrock Aquifer declined in response to pumping, with stabilization after 48 hours of pumping. The zone of influence was elongated towards the northwest with an additional 2 m of drawdown extending approximately 425 m to the southwest and 750 m to the north when the pumping rate increased;

- The incremental drawdown in the Upper Bedrock Aquifer due to pumping TW3-80 was less than in the Lower Bedrock Aquifer with a maximum incremental drawdown of 0.7 m at the closest monitoring well. The response was muted by the Middle Bedrock Aquitard;
- No complaints of water loss were received;
- The incremental drawdown in the overburden was less than in the bedrock. The water level changes in the overburden were influenced by the distance from TW3-80, the depth of the installation, the amount of aquitard material underlying the installation and precipitation. The dominant influence on water levels in the overburden during the pumping test was precipitation. Overburden water levels beneath or near Aberfoyle Creek at five locations northwest of TW3-80 responded to the increased pumping. The influence of pumping was conservatively estimated to extend for a 755 m stretch of Aberfoyle Creek;
- The estimated change in flow of Aberfoyle Creek due to increased pumping from 1,600 to 2,471 L/min was approximately 0.19 L/sec based on estimated vertical hydraulic conductivity and observed vertical hydraulic gradient values. This change in creek flow represents less than one percent of the lowest flow rate historically measured at Aberfoyle Creek during monthly monitoring between 2001 and 2007 (30 L/s). At the maximum permitted rate of 2,500 L/min, the total change in flow due to pumping would be approximately 0.6 L/sec;
- Surface water levels in Aberfoyle Creek were not measurably influenced by the increased pumping and no discernable reduction in surface water flow at the upstream and downstream property boundaries was observed that was correlated with the pumping test;
- Stream temperature was not measurably affected; and
- It was recommended to continue with a permitted rate of 2,500 L/min since no adverse effects of the water taking could be observed.

2010 Pumping Test

- 46-day pumping test of TW3-80 (3 day stabilization period at 1,700 L/min, 39.6 day pumping period at 2,460 L/min followed by 3.4 day recovery period at 0 L/min);
- The observed drawdown at TW3-80 when pumping was increased from 1,700 to 2,460 L/min was 5.3 m and a recovery of 14.3 m was observed when pumping at 2,460 L/min ceased;
- A response to pumping was interpreted to occur at the monitoring wells in the Lower Bedrock Aquifer, with the greatest response observed at MW2A-07 (6.9 m of recovery when the rate was reduced from 2,460 to 0 L/min);
- A response to pumping was interpreted to occur at some of the monitoring wells in the Upper Bedrock Aquifer;
- Vertical gradients between the Upper and Lower Bedrock Aquifers were downward at six locations during pumping and reversed to upward at four locations during the recovery period, indicating the potential for upward flow under non-pumping conditions;
- Significant precipitation events resulted in increases in water levels at surface water locations and wells installed in the overburden and Upper Bedrock Aquifer;

- The greatest response to pumping observed in the overburden, was at MW2D-07, where water levels recovered 0.64 m when pumping stopped;
- The zone of influence in the Lower Bedrock Aquifer, as defined by a drawdown of 1 m or more, extended 1,400 m to the north-northwest, 1,100 m to the northeast, and 800 m to the southwest of TW3-80;
- The zone of influence in the Upper Bedrock Aquifer, as defined by a drawdown of 1 m or more, extended 1,200 m to the north-northwest, a maximum distance of 550 m to the west, and 220 m to the east of TW3-80;
- There was no measurable change in stream flow in Aberfoyle Creek related to pumping TW3-80; and
- The potential for temperature change in Aberfoyle Creek was anticipated for a reduction in groundwater discharge to the creek. Under the existing creek conditions, the potential temperature change would not be observed because Aberfoyle Mill Pond has such a large effect on the water temperatures in Aberfoyle Mill Creek downstream at the Nestlé property due to the relatively large surface area and shallow depth of the pond causing heating of the pond in the summer.

2012 Pumping Test

- 17-day pumping test of TW2-11 (3 day stabilization period at 0 L/min, 10.9 day pumping period at 940 L/min followed by 3 day recovery period at 0 L/min; TW3-80 was pumped at a constant rate of 1,590 L/min during the entire testing period);
- The maximum drawdown in TW2-11 during the test was about 13.1 m;
- The zone of influence in the Lower Bedrock Aquifer, as defined by a drawdown of 1 m or more, extended about 1,725 m to the north, 1,200 m to the northeast, and 1,000 m to the south of TW2-11;
- The zone of influence in the Upper Bedrock Aquifer, as defined by a drawdown of 1 m or more, extended about 650 m to the north, 100 m to the south, and a maximum of 200 m to the west and east of TW2-11;
- A 780 m reach of Aberfoyle Creek was influenced by pumping based on a change in water levels and increase in downward vertical gradient;
- Surface water flows in Aberfoyle Creek did not appear to be influenced by pumping TW2-11;
- The magnitude of the response in the Upper Bedrock Aquifer and in the overburden was notably dampened relative to the response in the Lower Bedrock Aquifer. It was inferred that the Middle Bedrock Aquitard limited the effects in overlying units; and
- Data from nested monitoring locations suggested that the vertical hydraulic gradient between the Upper Bedrock and Lower Bedrock Aquifers was influenced by pumping.

Transmissivity Estimates at TW3-80

In addition to providing important insights into the performance of TW3-80, the records of monthly average water levels and monthly average withdrawals between 2008 and 2018 provide a basis for estimating the transmissivity around TW3-80. Specifically, the transmissivity can be estimated from the specific capacity of the well.

An analysis of the TW3-80 performance is included in a memo in Appendix C (TW3-80 Drawdown Analysis, Golder Associates Ltd., February 25, 2019). As shown on Figure C1 in Appendix C, the monthly performance data for TW3-80 are consistent with the stabilized drawdowns and pumping rates that have been observed during the extended pumping tests conducted on TW3-80. The specific capacity is estimated to be 156 L/min/m of drawdown as described further in Section 5.2.1. Following the approach of Driscoll (1986), a preliminary estimate of the transmissivity (T) can be obtained from the specific capacity (SC) as follows:

$$\mathrm{T} \sim 1.6\ SC$$

Therefore, as a first approximation:

$$\mathrm{T} \sim 1.6\ \left(156\ \frac{\mathrm{L/min}}{\mathrm{m}}\right)\left|\frac{\mathrm{m}^3}{1000\ \mathrm{L}}\right|\left|\frac{1440\ \mathrm{min}}{\mathrm{day}}\right| = 360\ \mathrm{m}^2/\mathrm{d}$$

Since the drawdowns plotted on Figure C1 correspond to stable conditions, and the data approximate a straight line, as a second approximation the transmissivity can be estimated with the steady-state Thiem solution [see Bear (1979), page 304, for example]:

$$\mathrm{T} = \mathrm{SC}\ \frac{1}{2\pi}\ \ln\left\{\frac{\mathrm{R}}{\mathrm{r_w}}\right\}$$

Here r_w denotes the well radius of TW3-80 and R represents its effective radius of influence. It is not possible to estimate the radius of influence of TW3-80 from the drawdown data for only the well; however, as shown on Figure C2 in Appendix C the estimated transmissivity is not particularly sensitive to assumed value. Over a relatively wide range of the assumed values of R/r_w the transmissivity is on the order of 300 m^2/d, which is reasonably consistent with the value estimated from the specific capacity.

The drawdown patterns inferred from the pumping tests of extended duration and comprehensive monitoring conducted in 2004, 2007 and 2010 highlight the complexity of the bedrock formations from which TW3-80 obtains its supplies. Interpreted distributions of drawdown in the pumped interval of the bedrock during the 2004 and 2010 testing are reproduced on Figures C3 and C4 in Appendix C. The figures illustrate the complex structure of the bedrock in the vicinity of TW3-80.

The complexity of the bedrock is also suggested in the recovery data for TW3-80 and the MW2-07 multi-level monitoring cluster that were collected following the end of pumping during the October 2010 test (Figure C5 in Appendix C). In this test, the 40-day duration of pumping was sufficiently long that stabilized conditions were attained. Therefore, the recovery data collected after the end of pumping effectively correspond to a pumping test that is run in reverse. In an ideal aquifer that is homogeneous, isotropic and perfectly confined, the responses from the pumping well and the monitoring wells fall on parallel straight lines with offsets related solely to the distances between each observation well and the pumping well. Instead, as shown on Figure C6 in Appendix C, the data suggest a complex evolution of the recovery. The dashed lines shown in the semi-log plot do not represent lines of best fit; rather, they are constructed to be parallel so that they yield consistent transmissivity estimates from Cooper Jacob straight line analyses (Cooper and Jacob, 1946). The data appear to approximate two different responses, with the effects of pumping propagating from a zone around TW3-80 that has one transmissivity into another zone of relatively higher transmissivity (Butler, 1990). The outer zone may reflect a change in properties of the Lower Bedrock Aquifer or an extension of the effects of pumping into underlying more permeable rocks. The slope of the first portion of the response yields a transmissivity of about 460 m^2/day:

$$\mathrm{T} = 2.303\ \frac{\mathrm{Q}}{4\pi}\frac{1}{\mathrm{SLOPE_1}}$$

$$= 2.303\ \frac{(2\ 460\ \mathrm{L/min})}{4\pi}\frac{1}{(1.4\ \mathrm{m/\log cycle\ time})}\left|\frac{\mathrm{m}^3}{1000\ \mathrm{L}}\right|\left|\frac{1440\ \mathrm{min}}{\mathrm{day}}\right| = 460\ \mathrm{m}^2/\mathrm{day}$$

This transmissivity estimate is of the same order of magnitude as the preliminary estimates derived from the specific capacity and the matching with the Thiem solution.

On Figure C7 in Appendix C, the observed recoveries in the Lower Bedrock Aquifer at the end of the October 2010 test are plotted against the distance from TW3-80. The variability of the observations provides further indications of the complexity of the bedrock. The dashed lines in the figure are constructed to have parallel slopes that correspond to a transmissivity of 300 m^2/day.

The analyses presented here provide preliminary estimates of the transmissivity around TW3-80. The responses to pumping highlight the complexity of the bedrock in this area. Development of more definitive estimates require matching of the observations with a numerical groundwater flow model that incorporates the structure of the bedrock and the variability of its properties.

2.7.2 Groundwater Flow Under Non-Pumping Conditions

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

- The overburden water table interpretation is presented on Figure 12, 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) indicated that this flow configuration was similar to the pattern previously presented for the October 2004 and November 2006 shutdowns.
- The Upper Bedrock Aquifer interpretation is shown on Figure 13 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 14 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.

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

2.8 Surface Water Features

Well TW3-80 is situated in the Grand River watershed. More specifically, TW3-80 is located in the Mill Creek subwatershed of the Grand River. The following sections discuss surface water features and flows measured in parts of the regional (Grand River) and local (Mill Creek) watersheds.

2.8.1 Regional Watershed – Grand River

The Grand River flows 290 km through southern Ontario, from its source near the village of Dundalk south of Georgian Bay, to Port Maitland at Lake Erie. Together with its major tributaries, it drains 6,965 square kilometres and is the largest watershed in southern Ontario. The Grand River traverses through wetlands, gorges, farmlands gravel moraines, Carolinian Forest, and broad marshes (Grand River Conservation Authority, 2019 and Canadian Heritage Rivers System, 2019).

The nearest Grand River gauging station to Aberfoyle is located in Galt, downstream of where Mill Creek flows into the Grand River. From 2008 through 2018, the average flow at this station was 46,876 L/s and the median flow was 26,850 L/s. Over the same time period, the flow has ranged from a minimum flow of 6,441 L/s to a maximum flow of 780,000 L/s.

2.8.2 Local Subwatershed

TW3-80 is located in the Mill Creek subwatershed (Figure 1) of the Grand River watershed. The creek originates northeast of Aberfoyle and flows generally in a northeast to southwest direction through Puslinch Township. Mill Creek joins the Grand River in the City of Cambridge. The catchment area of the Mill Creek subwatershed is 106.75 square kilometres. Much of the creek runs through forests and provincially significant wetlands.

Flows in Mill Creek are monitored by the Grand River Conservation Authority (GRCA) at three stations: one near Aberfoyle, one in the middle of the watershed at Sideroad 10, and one at the Shade's Mills Dam near the Grand River (Figure 1). Data are publicly available for all three stations. The stream flow records for the station near Aberfoyle and the station at Sideroad 10 are presented on Figure 15. The average flow near Aberfoyle for the last 10 years (January 2009 through December 2018) is 401 L/s and the median flow is 284 L/s. The average flow at Sideroad 10 during the same period is 1,014 L/s and the median flow is 823 L/s.

Surface water features in the vicinity of the Nestlé property include Mill Creek, Aberfoyle Creek, Aberfoyle Mill Pond and numerous large ponds associated with adjacent aggregate extraction operations (Figure 6). Mill Creek flows approximately 400 m north of the plant at its nearest point. Approximately 1.2 km north and upstream of the Nestlé property, a portion of Mill creek flow is diverted into Aberfoyle Mill Pond. The Aberfoyle Mill Pond is also fed by Aberfoyle Creek, which flows into the northeast corner of the pond. From the Aberfoyle Mill Pond dam, Aberfoyle Creek (supplemented with the diversion from Mill Creek) flows southwest and directly behind the bottling plant, as close as 30 m at its nearest point.

Nestlé monitors flows in Aberfoyle Creek at the upstream end of the property (gauging station SW1) and the downstream end of the property (gauging station SW2), as shown on Figure 16. The average flow (based on manual measurements) of Aberfoyle Creek on the property since 2002 is 173 L/s at station SW1 and 197 L/s at station SW2 (Figure 17). The median flow recorded at the stations is 129 L/s at SW1 and 150 L/s at SW2. Additional analysis of the continuous flow record over the past 10 years is included in Section 5.4.

2.9 Water Use

Local groundwater use consists of low-capacity residential use, commercial/industrial use, aggregate washing, and communal water supply. The higher water uses are for aggregate washing and bottling water. There are no known withdrawals directly from Mill Creek or Aberfoyle Creek.

On a regional scale, the City of Guelph (5 km northwest) draws water from approximately 25 high-capacity groundwater wells with the closest well being approximately 7 km away.

2.9.1 Private Wells

There are some water takers that use less than 50,000 L/d, including commercial and institutional use. The majority of wells in the vicinity of TW3-80 are private residential wells for typical household use. These wells are completed within the overburden, Upper Bedrock Aquifer, Lower Bedrock Aquifer, or extend across both bedrock aquifers.

To gain a better understanding of the number of wells in the area, the water well records were downloaded from the MECP website and plotted on Figure 18. There are 255 water well records within 1.5 km of TW3-80 (Table B1 in Appendix B). The reported uses of those wells include 60 monitoring/test wells, 154 water supply wells, 33 abandoned wells and 8 with no use listed. Of the 154 water supply wells, the uses include 101 domestic, 21 industrial, 17 commercial, 7 livestock, 3 public, 2 municipal, 1 irrigation and 2 with no use specified. There are 36 water supply wells completed in the overburden and 118 completed in the bedrock.

Private well surveys are typically conducted to identify existing water users, collect well construction details and well use data and confirm the location of the wells to help assess potential impacts of the proposed water taking. Private well surveys have been conducted in the past around the Aberfoyle facility to identify wells for monitoring, as part of the data collection during pumping tests and/or as part of previous studies. As part of this study, a private well survey was conducted to update and/or provide additional information on private wells in the area.

Since there are a large number of private wells in the area, and previous surveys have been completed, a subset of the wells was identified and assessed for this study. The approach adopted to identify the subset is described below:

1) Identify water well records within 1.5 km of TW3-80 (approximate zone of influence);
2) Select water well records that are used for water supply (active wells);
3) Remove wells monitored by Nestlé (already monitored);
4) Remove water well records that plot in the wrong location (unknown reliability);
5) Remove water well records that are located in subdivisions with a water supply (wells likely not used anymore); and
6) Remove water well records constructed prior to 2000 (start of Nestlé water taking).

Following the screening, 15 wells were selected for the private well survey. The private well survey was conducted on June 20, 2018 during the daytime working hours. At business locations, Golder staff talked to an employee regarding the private well survey and why it was being conducted. The employee received a letter and the survey (copy in Appendix B) to complete and return at a future date should they want to participate. At private residential locations, there was no one home during the day and the letter and survey were left in the door or mailbox. Exceptions to this occurred when the house was gated and there was no mailbox. A second attempt to survey the domestic wells was conducted during the evening of July 5, 2018. A summary of the private well survey is included in Table B2 in Appendix B. Of the surveys delivered only one survey was completed for the location with Well ID 7150603.

2.9.2 Permitted Water Takings

A search of the MECP database indicates that there are nine property owners within 2 km of TW3-80 with a PTTW. Details of the PTTWs are listed in Table 3.

Table 3: Permits To Take Water within 2 km of TW3-80

Name	PTTW Number	Purpose	Source	Maximum Litres per Day	Maximum Days of Taking per Year
Capital Paving Inc.	4373-8TXQK3	Industrial	Well A	114,600	300
			Well B	515,600	300
			Well C	802,000	300
			Pond B	16,939,200	200
CBM Aggregates	5550-9V7HXS	Aggregate Washing	McNally Supply Pond	23,568,000	365
Con-Cast Pipe Inc.	8724-9GFPQE	Industrial	WSW 1	250,000	365
			WSW 2	200,000	365
CRH Canada Group Inc.	5153-A48MT9	Industrial	Supply Well	72,800	365
	7510-A34KZH	Aggregate Washing	Pond 6	8,182,800	235
			Pond 5	8,182,800	235
Wellington Common Elements Condominium Corporation (Mini Lakes)	7137-AG7SV2	Communal Water Supply	PW1	146,880	365
			PW2	196,560	365
			PW3	319,680	365
			PW4	294,840	365
Morguard Brock McLean Ltd.	7431-96LRQ6	Industrial	TW1 and TW2	653,760	365
Royal Canin Canada Company	3782-AB6MMX	Food Processing	PW-1	240,000	365
St. Marys Cement Inc.	7028-7LTNV9	Industrial	Aberfoyle Main Pit Pond	23,568,000	365
Wellington Vacant Land Condominium	2003-AQWHTC	Communal Water Supply	PW6	500,000	365
			PW7	500,000	365

2.10 Source Water Protection

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

In addition to protecting water quality, water quantity is also a concern and is being 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 municipal water supplies. This is important because when more water is taken from an area than can be naturally replenished water supplies are threatened and water shortages are possible. The Aberfoyle property falls within a Water Quantity Protection Zone (WHPA-Q) for the City of Guelph municipal wells. The WHPA-Q zone for the City of Guelph has been assigned a significant risk level (Matrix Solutions, 2017). The Tier 3 Assessment scenarios predicted that the City's municipal wells can meet current needs. However, the assessment predicted that the City's Queensdale municipal well would be unable to meet projected increased future demands under normal climate conditions and during prolonged drought (Matrix Solutions, 2017). There is also a high level of uncertainty with the results for the City's Arkell Well 1. It is for these reasons that the City's WHPA-Q is assigned a significant risk level with respect to water quantity. The Source Protection Committee reviewed all existing water takings within the WHPA-Q to evaluate their contribution to water quantity stress in the area. The study showed that municipal wells have the greatest impact on themselves (i.e., pumping at a municipal well influences the water levels in other municipal wells). TW3-80 was not found to interfere with the municipal wells ability to supply water (Matrix Solutions, 2018a). TW3-80 is estimated to be responsible for 1% of the drawdown at the closest municipal well (Burke Well) (Matrix Solutions, 2018a). With a drawdown in the order of approximately 10.8 m at the Burke Well, pumping from TW3-80 is estimated to be responsible for approximately 0.1 m of the drawdown observed at the Burke Well. The Water Quantity assessment conducted for the Nestlé takings at TW1-88 as described in Section 4.3. The assessment was completed using the Guelph Tier 3 Model, which has been updated and used for this study.

2.11 Potential Contaminated Sites

Land use within 1.5 km of TW3-80 consists of a wide variety of uses (vacant, agriculture, residential, commercial, industrial, aggregate and institutional). Potential sources of contamination can come from industrial or agricultural land uses. Based on the land use mapping, there are 6 automotive/fuel stations, 29 industrial properties, and 9 agricultural properties within 1.5 km of the Nestlé pumping well (Figure 5). Nestlé is aware of the potential threats to the quality of the water pumped from TW3-80 and as a highly-regulated source of untreated water for human consumption, it monitors the quality of the pumped water continuously; however, Nestlé cannot control activities at these locations. Nestlé monitors surrounding land uses to identify potential future concerns that may arise with respect to source water protection.

Nestlé does not use any pesticides or herbicides on its property and reduces salt usage for de-icing in the winter as much as possible (i.e., preference to use sand). Further discussion on water quality monitoring (Section 4.2), water quality results (Section 5.6) and potential impacts (Section 6.3) are provided below.

2.12 Climate

Daily weather statistics have been recorded at the Waterloo Wellington weather station, which is approximately 20 km west of the property, since 1970. Meteorological data were recorded at the Waterloo Wellington A station (ID #6149387) from 1970 to 2003 and at the Waterloo Wellington 2 station (ID #6149389) from 2003 to 2017. The weather stations are part of the Environment Canada network.

Climatic normals discussed in the following sections, calculated as statistical averages of weather data from the previous 30 years, are currently based on the 1981 to 2010 period of record.

The following sections discuss temperature and precipitation statistics using data obtained from the Waterloo Wellington stations.

2.12.1 Temperature

The average yearly temperature over the 1981 to 2010 period is 7ºC. Daily average temperatures range from -6.5ºC in January to 20ºC in July. The extreme maximum temperature recorded at the Waterloo Wellington station was 36.5ºC in August 2001 and the extreme minimum was -31.9ºC in January 1984. The daily average, maximum, and minimum temperatures at Waterloo Wellington are summarized in Table 4.

Table 4: Average Temperatures at Waterloo Wellington (1981-2010)

Month	Daily Average Temperature (ºC)	Daily Average Maximum Temperature (ºC)	Daily Average Minimum Temperature (ºC)
January	-6.5	-2.6	-10.3
February	-5.5	-1.2	-9.7
March	-1.0	3.6	-5.6
April	6.2	11.5	0.8
May	12.5	18.5	6.4
June	17.6	23.6	11.5
July	20.0	26.0	14.0
August	18.9	24.8	12.9
September	14.5	20.4	8.6
October	8.2	13.5	2.9
November	2.5	6.3	-1.4

Month	Daily Average Temperature (ºC)	Daily Average Maximum Temperature (ºC)	Daily Average Minimum Temperature (ºC)
December	-3.3	0.2	-6.8
Year	7.0	12.0	2.0

2.12.2 Precipitation

Precipitation recorded at the Waterloo Wellington meteorological station is used as a component of the Long-Term Monitoring (LTM) program. Precipitation data from the Waterloo Wellington station is augmented with data from the Kitchener Waterloo station (and other stations as necessary) since a complete record is not available from the Waterloo Wellington station. Data have not been recorded at the Waterloo Wellington meteorological station since April 2017. Nestlé now obtains the data from the Kitchener/Waterloo meteorological station.

In 2017, Nestlé had a dialogue 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 sometimes due to localized precipitation events in the form of thunderstorms or snow squalls. 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 changes is conducted to see if there is a correlation with water level changes. 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 for 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 (SWB) 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 C.

2.12.2.1 Annual Precipitation

The annual average (1981-2010) precipitation from the Waterloo Wellington Station is 916.5 mm (Environment Canada Historical Climate Data website). A summary of the total annual precipitation over the past ten years is provided in Table 5. Annual precipitation is also shown graphically on Figure 19 along with the 30-year normal. More than 10% below average precipitation occurred in 2012, 2015 and 2018 with more than 10% above average precipitation occurring in 2011 and 2013. Total precipitation declined over the period from 2013 to 2015.

Table 5: Annual Precipitation

Year	Precipitation (mm)	Difference Between Actual and Average Precipitation (mm)	% Difference from Average
2009	964.9	48.4	5.3
2010	833.1	-83.4	-9.1
2011	1081	164.5	17.9
2012	770.6	-145.9	-15.9
2013	1088.6	172.1	18.8
2014	973.8	57.3	6.3
2015	795.8	-120.7	-13.2
2016	931.9	15.4	1.7
2017	949.4	32.9	3.6
2018	807.1	109.4	-11.9
Normal (1981-2010)	916.5		

2.12.2.2 Monthly Precipitation

Monthly average precipitation is summarized in Table 6. The driest month of the year at the Waterloo Wellington station is February, with an average precipitation of 54.9 mm. The wettest month is July, with an average precipitation of 98.6 mm.

Table 6: Normal (1981 - 2010) Monthly Precipitation at Waterloo Wellington

Month	Rainfall (mm)	Snowfall (cm)	Precipitation (mm)
January	28.7	43.7	65.2
February	29.7	30.3	54.9
March	36.8	26.5	61.0
April	68.0	7.3	74.5
May	81.8	0.4	82.3
June	82.4	0	82.4
July	98.6	0	98.6

Month	Rainfall (mm)	Snowfall (cm)	Precipitation (mm)
August	83.9	0	83.9
September	87.8	0	87.8
October	66.1	1.4	67.4
November	75.0	13.0	87.1
December	38.0	37.2	71.2
Year	776.8	159.7	916.5

3.0 CONSULTATION

There is value in involving those with a potential interest or those who may be affected by the water taking proposal to have opportunities to provide input during the application process. This consultation protects those interested and helps ensure concerns are identified early and addressed where possible. This consultation was conducted during the pre-submission phase of the application process and a summary is included in the application package.

4.0 METHODOLOGY

4.1 Summary of Long-Term Monitoring Field Program

This section describes the field activities that are performed as per the conditions of PTTW Number 1381-95ATPY (for TW3-80 and TW2-11) or performed per the conditions of previous PTTWs.

4.1.1 Groundwater and Surface Water Monitoring Program

Groundwater and surface water monitoring was initiated in 2000 and has evolved over the years with the objectives to 1) characterize the existing hydrogeologic setting, and 2) document potential long-term changes to the groundwater and surface water resources in the area. The monitoring program includes measurement and record-keeping of water takings, groundwater levels, mini-piezometer levels, surface water levels, surface water flows and surface water temperatures. The monitoring program includes the following instrumentation, with the locations shown on Figure 16:

- Groundwater levels and pumping volumes in 2 production wells (although TW2-11 has never been used);
- Groundwater levels in 38 monitoring wells at 16 sites (11 consisting of multiple monitoring intervals) with monitors in the Lower Bedrock Aquifer, Upper Bedrock Aquifer, and overburden;
- Groundwater levels in 11 private wells (1 of the 11 is no longer monitored since 2018 due to access restrictions);
- Shallow groundwater levels in 9 mini-piezometers with a total of 18 monitors;
- Surface water levels at 7 stations (1 of the 7 is no longer monitored after it was destroyed in 2018);
- Stream flows measured at 2 locations; and
- Stream temperature measured at 6 locations.

Data are recorded at most stations on an hourly basis, and manual groundwater and surface water monitoring are conducted on a monthly basis when the data are collected from the dataloggers.

4.1.1.1 Water Taking

Water taking from TW3-80 is measured using a Krohne magnetic flow meter that is wired to an Allen-Bradley industrial Programmable Logic Controller. The instantaneous water flow and volume pumped are recorded every minute. The flow meter was most recently calibrated on November 5, 2018 by Endress+Hauser (per Nestlé).

The water takings from TW3-80 are described in Section 2.1. No water has been taken from TW2-11 during the duration of the PTTW.

4.1.1.2 Groundwater Monitoring Program

Groundwater levels have been measured at various locations for varying periods of time on the property and off the property since December 1980. Following the purchase of the property 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.

The monitoring locations for the groundwater monitoring program are shown on Figure 16 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 well (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) (no longer accessible),

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 also be noted that none of the wells that Nestlé owns are open across multiple units.

4.1.1.3 Surface Water Monitoring Program

The surface water monitoring program includes the following components, with the locations shown on Figure 16:

Surface Water Levels

Measurement of surface water levels was initiated in December 2001 as part of Nestlé's monthly monitoring program. Currently, surface water levels are 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 (destroyed); and
  - SW10 - located in the Dufferin Aggregates owned pond at the entrance to the Nestlé property.

Water levels are measured at all locations using a water level meter.

Stream Flow

Measurement of surface water flows was initiated in December 2001 as part of Nestlé's monthly monitoring program. Surface water flows are 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. Stream flow velocities are measured using a Valeport electromagnetic flow meter and the surface water flows are calculated using the cross-sectional area-velocity method.

In addition, the monthly surface water elevations ("stage") and stream flow measurements ("discharge") are used to update and/or re-establish the stage-discharge relationships (rating curves) at SW1 and SW2. The rating curves are used to estimate stream flow from the continuous water level measurements at SW1 and SW2. These need to be continuously updated due to changing channel conditions, falling trees, debris, etc.

Mini-Piezometers

Mini-piezometers were initially installed in 2004 with additional mini-piezometers being installed since that time. Currently, water levels are measured in mini-piezometers at ten locations, each containing a shallow and a deep monitor. The average elevation difference between the middle of the shallow screen and the middle of the deep screen is 1.2 m with actual separation differences ranging from approximately 0.3 to 2.0 m. 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, which is constructed in organic material on the bank beside the stream as opposed to in the stream, similar to other mini-piezometer nests and 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 April 2016 in the main branch of Aberfoyle Creek, near SW3 at Gilmour Road. Mini-piezometer nests are located along Aberfoyle Creek on the Nestlé property to Mill Creek downstream of the confluence of the two creeks as follows (see locations on Figure 16):

- 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

Temperature

Measurement of surface water temperatures began in 2005. Currently, surface water temperatures are 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 16):

- 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 MECP in October 2011 and recommendations from the report were implemented by CRA at that time, and continued by Golder since May 2014. The temperature data are analyzed by C. Portt and Associates using ThermoStat software. A report on the surface water temperature is included in the annual report each year.

4.1.1.4 Monitoring Stations Which Have Become Inaccessible

In 2018, a property owner requested that monitoring be discontinued at their well and another land owner accidentally destroyed one of the monitoring stations. A list of these monitoring locations along with a recommended replacement are provided in Table 7.

Table 7: Inaccessible Monitoring Locations

Monitoring Location	Reason for Inaccessibility	Recommendation	Documented in Letter to MECP
SW9	In April 2018, the station was destroyed when part of the aggregate wash pond was filled in.	No additional station to be established since the pond levels vary due to aggregate operation and nearby SW10 can be used for monitoring in the same area.	April 30, 2018

Monitoring Location	Reason for Inaccessibility	Recommendation	Documented in Letter to MECP
W2	In August 2018, the land owner notified Nestlé that they would no longer like their well monitored.	Install a monitoring well on a neighbouring property if land access is granted.	August 9, 2018

4.1.2 Biological Monitoring

As part of its natural resource management program, Nestlé conducts biological monitoring at its source properties. Biological monitoring at the Aberfoyle property was initiated in 2007 and is conducted on an annual basis. In 2008, the requirement for biological monitoring was included as a condition of the PTTW for TW3-80.

The biological monitoring program is intended to compliment the monitoring of physical resources (surface and groundwater resources). Information collected through the biological monitoring program is used to document the condition of the aquatic, wetland, and terrestrial ecosystems associated with the Aberfoyle property to assist with sustainable management of the resources.

The specific objectives of the biological monitoring program are to characterize existing aquatic, wetland and terrestrial resources and document changes over time. Monitoring of aquatic resources (salmonid spawning along reaches of Aberfoyle Creek) is undertaken by C. Portt and Associates and monitoring of terrestrial resources (vegetation and wildlife) is undertaken by Beacon Environmental. Findings and recommendations from each year of monitoring are summarized in annual reports which are provided to MECP and Nestlé's stakeholders.

4.1.2.1 Aquatic Resources Monitoring

Monitoring of aquatic resources in Aberfoyle Creek has been conducted variably on an annual basis since 2007. Aberfoyle Creek was electrofished between Brock Road and the confluence with Mill Creek in January and September of 2008. Beginning in 2007, salmonid spawning surveys have been conducted annually on Aberfoyle Creek, from the upstream limit of the Nestlé property to the confluence of Aberfoyle Creek with Mill Creek. The spawning surveys consist of visual inspections for spawning fish and/or areas of disturbed gravel (redds) where spawning has occurred. The site is surveyed twice during the spawning period each year.

Additionally, since 2006 water temperatures have been monitored in Aberfoyle Creek between Brock Road and the confluence of Aberfoyle Creek and Mill Creek. Beginning in 2012, when data from 2006 through 2012 were analyzed, and annually since, the summer water temperature data have been analyzed by C. Portt using ThermoStat, a software package developed by the Ontario Ministry of Natural Resources and the Institute for Watershed Science at Trent University that calculates the thermal suitability for individual fish species based on laboratory determined optimal and lethal temperatures.

4.1.2.2 Terrestrial Resources Monitoring

Monitoring of terrestrial resources was initiated on the Aberfoyle property in 2007 and is focused on documenting vegetation, amphibians, birds and reptiles. The core terrestrial monitoring parameters of the program are described in the subsections below. Supplemental to these key core parameters has been characterization of the ecological communities using the provincial Ecological Land Classification System (ELC), marsh surveys, monitoring populations of invasive Common Reed (*Phragmites australis*), and specialized surveys for owls and odonates (dragonflies).

Vegetation Monitoring

Six permanent vegetation sampling plots have been established in select wetland communities on the property in 2007 to monitor changes to wetland vegetation over time. These sampling plots have been monitored in 2008, 2010, 2013, 2014 and 2016 using standardized vegetation sampling protocols of the ELC for Southern Ontario (Lee *et al.* 1998). Within each sampling plot, information is collected on the composition of structure of the vegetation, be estimating the cover abundance at various height classes.

Vegetation plot data are then subjected to a Floristic Quality Assessment (FQA) that allows for the comparisons of two or more natural areas or vegetation types (Oldham *et al.*, 2009) or to evaluate changes in vegetation within a natural area over time and, thus, can be used for long-term monitoring of natural area quality.

Using the FQA values, a Floristic Quality Index (FQI) value can be generated. Generally, higher FQI values are indicative of higher floristic quality and lower levels of disturbance, whereas lower FQI values indicate poorer quality and higher disturbance. FQI values are determined for each of the six monitoring plots by calculating the mean Coefficient of Conservatism (CC) for each plot and multiplying it by the square root of the total number of species.

FQI values are calculated using both the total number of species per plot and for native species only. The FQI values are then used to assess changes over time.

The Wetness Index (WI) for each plot is also calculated. Each plant species in Ontario has been assigned a Coefficient of Wetness (CW) (Wilhelm 1992) based on their probability of occurring in wetlands. CW values range from -5 to 5. Species with negative CW values favour wetter conditions and typically occur in wetlands; species with positive CW values prefer drier conditions and tend to occur in uplands. The WI is calculated by averaging the CW values of each species observed in the plot. The WI can also be informative as a potential indicator of hydrological change.

Amphibian Monitoring

Amphibian surveys are undertaken annually to document the diversity and abundance of frog and toad populations associated with the property and changes to the communities over time. As there are variations in the breeding periods during which frog and toad species are calling and are audible, surveys are completed at three different periods between March and June, depending on weather and temperatures, to maximize detection.

Call surveys have been completed annually between 2008 and 2011 and again between 2015 and 2018. Surveys follow standard protocols developed for the Marsh Monitoring Program (MMP) (Bird Studies Canada 2009). The locations of amphibian monitoring stations are illustrated in Figure 20.

Bird Monitoring

Breeding bird surveys have been undertaken annually from 2008 through 2011 and again from 2015 through 2018. The surveys document the diversity and abundance of avian populations associated with the property and changes to the communities over time. There are five permanent point count stations on the property that have been established in locations that provide coverage for most of the property. Point count stations were selected to allow coverage of calling individuals within 125 m. The locations of the point count stations are illustrated in Figure 20.

A modified point count methodology is utilized to complete breeding bird surveys, 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).

Turtle Monitoring

Turtle monitoring consists of surveying for basking turtles. Surveys have been completed annually between 2010-2012 and between 2015-2018. Surveys are focused on the large pond near the western property boundary (Figure 20). Generally, two to three surveys are completed during spring and fall. The surveys consist of slowly walking along the outer edge of the pond using binoculars to scan its entire perimeter and any other potential basking sites. Surveys are conducted between 8:00 am and 5:00 pm during sunny periods when air temperature exceeds 10°C. When possible, surveys are completed when air temperature is higher than water temperature and after inclement weather. Brief surveys of the other ponds on the subject property are also completed.

4.2 Water Quality Monitoring

Groundwater quality from well TW3-80 has been monitored by Nestlé since the well has been used as a spring water bottling source, to ensure water quality standards established by Nestlé, the Canadian Food Inspection Agency (CFIA) and the Canadian Bottled Water Association (CBWA) continue to be met. Furthermore, Nestlé is vigilant with respect to the aesthetic character of groundwater and is very much aligned with the Province's requirements to preserve water quality in the vicinity of the water source (i.e., source water protection). Nestlé monitors its water supply for changes and/or long-term trends in the water quality.

4.3 Tier 3 Modelling

An assessment of the potential cumulative impacts that could be caused by the bottled water takings at the Nestlé facilities at Aberfoyle is required under the Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements (Ontario Ministry of the Environment and Climate Change Operations Division, April 2017). The following requirements are extracted from the Interim Procedural and Technical Guidance Document:

> *All applications for water bottling shall consider the potential for cumulative effects, under both current conditions and various climate change or drought scenarios. Unless instructed otherwise or agreed to by the Director, the cumulative effects assessment shall use information obtained through watershed water budget evaluations completed under the Clean Water Act, 2006, where available. The highest tier of water budget completed for the location should be used to evaluate the potential for cumulative effects.*

TW3-80 is located within the model area of the City of Guelph and Township of Guelph/Eramosa (GGET) Tier Three Water Budget and Local Area Risk Assessment study area (Matrix Solutions, 2017; Figure 1-1). Following the recommendations of the Interim Procedural and Technical Guidance Document, the groundwater model developed for the GGET Tier Three Assessment has been applied for the analyses to support the PTTW application for TW3-80. The GGET Tier Three model builds on the integrated water budget analysis for the Grand River watershed (AquaResource Inc., 2009). The Tier Three groundwater model is documented in detail in

Appendix B of the final Local Area Risk Assessment report (Matrix Solutions, 2014). The GGET Tier Three model has been peer reviewed and has been approved by the Lake Erie Source Protection Region.

The approach to applying the GGET Tier Three groundwater model was discussed during a meeting held on July 10, 2017 between Nestlé, the MECP, GRCA and the City of Guelph. It was agreed that it is appropriate to use the existing GGET Tier Three model to support the impact assessment requirements for the Nestlé PTTW application. During the July 10, 2017 meeting, it was also agreed that the most effective approach for the modeling would be for the developers of the GGET Tier Three model, Matrix Solutions, to be subcontracted to conduct the modeling. This would eliminate the need to address any concerns regarding model ownership and distribution. More importantly, this approach would ensure that any refinements in the representation of conditions around the Nestlé facilities would be retained in any future analyses. The City of Guelph is the custodian of the GGET Tier Three model. Nestlé contracted with the City, and the City subcontracted Matrix Solutions for the analyses.

The GGET Tier Three groundwater model was designed to encompass the entire hydrogeological system that influences the City of Guelph's municipal water supply wells. The model covers the entire Speed River and Eramosa River watersheds. The model was designed to simulate detailed local groundwater flow conditions around the city's municipal wellfields, and regional-scale conditions outside the city. The application of the GGET Tier Three model for the Nestlé assessment is documented in a stand-alone report prepared for this study (Matrix Solutions, 2019) and is included in Appendix M. The discussion of the modeling methodology here is limited to a summary of the refinements made to the GGET Tier Three model for this study.

For the present application, the finite-element mesh of the model has been refined in the vicinity of TW3-80. The addition of nodes around TW3-80 has allowed for an increased resolution of hydraulic gradients around the well, more accurate locations of monitoring wells, and incorporation of additional local-scale zones to represent variations in hydraulic conductivity values.

Surface water features were originally represented in the Tier Three model by assigning a specified-head boundary condition to each model node along each river reach. The surface water level (head) for each feature was set equal to the estimated surface water elevation at that location, and this was estimated using the 10 m Digital Elevation Model (DEM) of the ground surface that was available at the time of the Tier Three Assessment. Observed water level elevation data were used for assigning specified head boundaries for larger water bodies in the model (e.g., lakes and reservoirs) where that data was available.

For this current model update, the addition of new and refinement of existing specified boundary conditions representing surface water courses and water bodies was important for the Aberfoyle area, especially for Aberfoyle Creek, which runs through the Nestlé Aberfoyle property. Aberfoyle Creek was not previously represented in the Tier Three model due to its small size; however, water levels and flows have been regularly recorded for Aberfoyle Creek as part of Nestlé's annual monitoring program. Spatial water course data from the online GRCA GRIN dataset were used to approximate the location and path of the creek, and average observed water levels (Golder 2018) were used to assign specified head boundary conditions at surface water monitoring stations SW1 and SW2. Boundary conditions along Aberfoyle Creek between these stations were linearly interpolated using tools in the modelling software. Other parts of Aberfoyle Creek, as well as other local water bodies (e.g., Aberfoyle Mill Pond and Mini Lakes) and streams were assigned specified-head values guided by where 1 m ground surface topography contours, available through the GRCA GRIN dataset, crossed the surface water features. Similar interpolation techniques were used to apply boundary conditions between these locations and the surface water stations, and to link newly assigned boundary conditions with pre-existing boundary conditions located further away from the Aberfoyle site.

In general, Mill Creek was already well represented in the numerical model in the area of the Nestlé property. A segment of boundary conditions further downstream for a tributary of Mill Creek was missing and was added during the model refinement. A portion of a Mill Creek tributary that enters Mill Creek approximately 3 km downstream of the Aberfoyle site was previously not represented in the numerical model. Boundary conditions along this stretch were assigned using the existing model ground surface in this area.

Updates were made to the ground surface elevations where new specified boundary conditions were applied and the elevations were found to be less than ground surface elevation. In these areas, the simulated ground surface elevation was set equal to the new specified-head value to ensure that the surface water feature was represented as a localized low in the surrounding topography.

The representation of the ponds and aggregate pits in the vicinity of TW3-80 has been modified from the Tier Three model. These features are now represented as zones of elevated hydraulic conductivity. The hydraulic conductivities have been set such that the gradients across the features are negligible. This change was made so that these larger features could not provide or withdraw unlimited amounts of water. The ponds and pits are assumed to extend across the thickness of the coarse grained materials in the overburden and the depths vary from 1 m to 10 m. The ponds and pits are not lined, but they do sit on finer-grained till materials.

To support the refinement of the GGET Tier Three model in the area potentially affected by pumping from TW3-80, Nestlé provided Matrix Solutions with the following data and interpretations.

- Nestlé Annual Monitoring Reports;
- Nestlé pumping test reports (TW3-80 and TW2-11);
- Maps of surface water features;
- Table of elevations of strata (SSP&A regional interpretation);
- Table of elevations of strata (Nestlé monitoring wells);
- Hydrographs for Nestlé monitoring wells from the Aberfoyle Annual Monitoring Reports (2010 - 2017);
- Groundwater level targets: Average water levels from Nestlé monitoring wells, 2009 - 2015 (Overburden, Upper Bedrock, Lower Bedrock);
- Drawdown targets: TW3-80 October 2010 pumping test (the drawdowns represent recoveries after 3.4 days following 40 days of pumping at 2,460 L/min). SSP&A supplemented the drawdown targets with estimates of drawdowns at Nestlé monitoring wells installed post 2010. These targets were estimated from an analysis of data from a later shutdown period (Overburden, Upper Bedrock, Lower Bedrock);
- Interpreted map of drawdowns in the Lower Bedrock (Amabel), pumping at 2,500 L/min (CRA 2011, 2010 Annual Monitoring Report; Figure 5.5); and
- Interpreted map of drawdowns in the Upper Bedrock [Guelph], pumping at 2,500 L/min (CRA 2011, 2010 Annual Monitoring Report; Figure 5.8).

4.4 Drought and Cumulative Effects Water Quantity Risk Assessment

Water is vital to health and integrity of ecosystems. Drought, climate change and water needs associated with increases in population have raised concerns related to water security in Ontario, particularly communities that depend on groundwater. For this reason, the potential effects of drought and climate change are considered as part of this assessment. The potential for cumulative effects, under both current and drought conditions and various climate change scenarios has been investigated with the refined GGET Tier Three model.

Cumulative effects are defined here as the potential combined effects of changes in pumping from the Nestlé production well TW3-80, changes in conditions that may arise during sustained periods of below-average precipitation (drought) and the potential effects of long-term changes in the climate of southern Ontario. Cumulative impacts are quantified in terms of potential changes in groundwater levels and groundwater discharge to surface water features with respect to pre-defined baseline conditions.

A long-term hydrologic analysis was conducted for the GGET Tier Three study to assess the variability of precipitation. As shown Figure 4.1 from the 2017 Annual Report for Aberfoyle, the annual takings for 2015 through 2017 have been similar. To establish baseline conditions, TW3-80 was assigned a constant pumping rate corresponding to the average annual takings over this period.

With respect to the potential impacts of an increase in TW3-80 pumping, analyses are conducted with the pumping rate increased from its current average to the maximum rate in the current PTTW.

The results of the analysis indicated that the longest sustained period on record of below average precipitation occurred in the early to mid-1960s. This is well before Nestlé began operations at Aberfoyle. The analysis of cumulative effects during drought is based on the assumption that current or increased Nestlé pumping continues during a reoccurrence of the early to mid-1960s period of sustained below average precipitation. This is, in effect, a worst-case scenario.

The approach developed for the Guelph Guelph/Eramosa Water Quantity Policy Study to analyze the potential effects of long-term climate change has been adopted for the present study (Matrix Solutions 2018b). Following the climate change methodology developed in the Guide for the Assessment of Hydrologic Effects of Climate Change in Ontario (EBNFLO and AquaResource 2010), existing information was leveraged to achieve the overall outcome of constructing and analyzing an ensemble of future climate projections for temperature and precipitation variables. The effects of changes in TW3-80 pumping are added to any changes predicted with the climate change modeling.

5.0 MONITORING PROGRAM RESULTS

5.1 Water Taking

The water takings from TW3-80 are summarized in Section 2.1. Over the last 10 years (2009 through 2018) the annual water takings have ranged from a minimum of 568.0 million litres in 2011 to a maximum of 783.5 million litres in 2016 (Figure 3). Over that time period, the annual taking remained consistent between 2009 and 2013, increased between 2013 and 2015, remained consistent between 2015 and 2017 and decreased in 2018. Groundwater withdrawals from Aberfoyle well TW3-80 have averaged 1,810,470 L/day over the last 10 years, with water takings between 2014 and 2018 higher than the 10-year average (Table 2).

5.2 Groundwater Levels

Hydrographs with the manual or transducer water level data for the monitoring wells are included in Appendix D. To support the inference of long-term trends in the groundwater levels and relationship, if any, to variations in pumping and precipitation, hydrographs of average monthly water levels, monthly volume pumped from TW3-80 and monthly precipitation over the past eleven years (2008 through 2018) have been prepared and are included in Appendix E. The average monthly water level data were calculated from the near-continuous record of water levels recorded with pressure transducer dataloggers.

5.2.1 TW3-80

The pumping rate and water level in TW3-80 are monitored continuously. Water levels and average daily pumping rates for TW3-80, along with daily precipitation, from 2005 through 2018 are shown on Figure D1 (Appendix D). Water levels measured since 2005 at TW3-80 range from approximately 297 to 313 masl (or approximately 3.5 to 19.5 m below ground surface) under pumping and non-pumping conditions, respectively. An analysis of average water levels at TW3-80 versus average pumping at TW3-80 was undertaken to assess how pumping water levels are related to pumping rates. A linear regression of the data indicates that changes in the pumping rate account for approximately 90% of the variation in water levels. A technical memorandum on the analysis (TW3-80 Drawdown Analysis, Golder, 2019) is included in Appendix C and described below.

Operational 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 since 2005 range from approximately 305 to 313 masl (Figure D1). It should be noted that in most cases, non-pumping water levels do not represent “true” conditions that would be observed if there was no pumping at TW3-80 for an extended period. Instead, they represent partially recovered conditions, with the amount of recovery depending 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 water levels during pumping since 2005 range from approximately 297 to 308 masl (Figure D1). Based on a static water level of 313 masl, the estimated drawdown since 2005 has ranged from approximately 5 to 16 m. The total available drawdown to the top of the pump intake is about 20.7 m (based on a static water elevation of 313 masl and a pump intake elevation of approximately 292.3 masl).

The records of average monthly water levels, monthly withdrawals and monthly precipitation between 2005 and 2017 are shown on the hydrograph for TW3-80 (Figure E1). The hydrograph extends back to 2005 to include the period of increased pumping up to 2008. The data provide important insights into the performance of the well and the long-term sustainability of pumping. The water levels and pumping volumes can be categorized into three periods with a year of transition between each period as follows: 2005 through 2007 when pumping rates were higher and water levels were lower; 2009 through 2013 when pumping rates were lower and water levels were higher; and 2015 through 2017, when pumping rates were higher and water levels were lower. In general, the water level changes in TW3-80 corresponds to the changes in the overall water taking from the well (i.e., lower water levels during periods of higher water takings (e.g., 2007) and higher water levels during periods of lower water takings (e.g., 2011)) with this relationship shown on Figure E1. This is also evident when pumping decreased at the end of 2018 and water levels in TW3-80 increased over the same period. Overall, the water levels respond to pumping as expected and the on-going groundwater taking at TW3-80 has not led to a long-term declining trend in the TW3-80 water levels.

The performance of TW3-80 is shown on Figure 1 in the memorandum in Appendix C which presents the average monthly water levels versus the average monthly withdrawal (pumping) rate. The performance data are consistent and approximate a straight line of the following form:

$$\mathrm{WL} = \mathrm{WL}_0 - \frac{1}{\mathrm{SC}}\mathrm{Q}$$

where – WL = monthly average water level in TW3-80;

WL_0 = the non-pumping water level in the well (fully recovered conditions);

SC = specific capacity of TW3-80; and

Q = monthly average pumping rate.

The non-pumping level estimated from the regression (WL_0) is 313.6 masl. This value is close to the static water level of 313.8 masl inferred from the information reported during the construction of TW3-80. The specific capacity of TW3-80 is estimated as the reciprocal of the slope of the regression line, 1/0.0064 = 156 L/min per m of drawdown. As previously indicated, the value of the goodness-of-fit statistic for the regression, R^2, indicates that 90% of the variations in the pumping level can be explained by the variations in the pumping rate. Additional details on the regression analysis of the TW3-80 performance data are presented in Appendix C.

The consistency of the performance data with the straight line in Figure 1 of the memorandum in Appendix C confirm that the aquifer response is linear. This indicates that nonlinear well losses are negligible. More significant with respect to the sustainability of pumping, the linear response indicates that TW3-80 is effectively confined, with the water level in the well during operating conditions remaining at all times above the top of the pumped aquifer (the top of the Lower Bedrock Aquifer at TW3-80 is at an elevation of about 292.3 masl).

Pumping tests of extended duration and comprehensive monitoring have been conducted on TW3-80 as described in Section 2.7.1. The observations from these tests conducted under controlled conditions highlight the consistency of the long-term performance data. The stabilized conditions inferred from the pumping tests are presented in Table 8.

Table 8: Water Levels from Pumping Tests

Pumping Test	TW3-80 Pumping Rate (L/min)	TW3-80 Pumping Level (masl)
October 2004	3,182	293.5
November-December 2007	1,600	303.0
November-December 2007	2,470	296.4
November-December 2007	1,600	303.7
August-October 2010	1,700	303.2
August-October 2010	2,460	297.9
August-October 2010	0	312.1

On Figure C8 in Appendix C, the near-stable conditions inferred from the long-term pumping tests are superimposed on the monthly-average data. As shown on Figure C8, the data from the pumping tests are consistent with the operating performance of TW3-80. It is important to note that the pumping tests involved rates significantly larger than the average monthly operating rates. Rates of 2,460 and 2,470 L/min were maintained during the 2007 and 2010 pumping tests, close to the maximum permitted rate of 2,500 L/min for TW3-80. The highest rate maintained during the testing was 3,180 L/min, about 27% higher than the maximum permitted operating rate. Even at this rate the water level in TW3-80 was consistent with the regression equation.

The consistent and predictable response from year to year is a necessary line of evidence that the pumping from TW3-80 has been sustainable. The water levels respond to pumping as expected and the on-going groundwater taking at TW3-80 has not led to a long-term declining trend in the TW3-80 water levels.

5.2.2 Lower Bedrock Aquifer

An example of the regional groundwater potentiometric surface in the Lower Bedrock Aquifer is shown on Figure 21. The potentiometric surface was prepared based on the water levels measured on July 20, 2018. This represents a time when pumping volumes at TW3-80 were relatively high 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.

Hydrographs for wells completed in the Lower Bedrock Aquifer are included on Figures D2 through D18 in Appendix D (showing manual or transducer water levels) and Figures E2 through E5 in Appendix E (showing average monthly water levels).

A review of the hydrographs indicate that water levels in the Lower Bedrock Aquifer are influenced by pumping at TW3-80 over the short-term and long-term, by recharge and by other external influences to varying degrees as summarized below.

- Water levels in portions of the Lower Bedrock Aquifer near TW3-80 are influenced by short-term fluctuations in TW3-80 pumping. The short-term pumping effects are evident in the water levels fluctuating in response to daily changes in pumping rates and are observed in monitoring wells closer to TW3-80 (e.g., MW2A-07 and MW4A-07). In comparison, wells located further away (upgradient – MW6A-08, MW8A-08, MW10C-09 and MW10D-09; downgradient – MW15A-12, MW16A-12 and MW17A-12) show only minor differences between daily high and low water levels.
- Water levels in the Lower Bedrock Aquifer are influenced by longer term trends in TW3-80 pumping. The long-term pumping effects are evident in the wells closer to TW3-80 where water level changes from year to year correlate with overall annual water takings (i.e., increased water takings result in lower average water levels). During periods of reduced pumping, the water levels recover with no long-term increasing or decreasing trends. The effects of variations in total annual pumping decrease with distance from TW3-80, as can be seen by comparing the hydrographs for MW2A-07 and MW8A-08. The exception to this is at MW7A-08 (located approximately 1,050 m north of TW3-80) where there appears to be a stronger hydraulic connection with TW3-80 compared to the connection between TW3-80 and MW14A-11 (located approximately 750 m northwest of TW3-80) and TW3-80 and MW18A-12 (located approximately 750 m southwest of TW3-80)).
- Changes in water levels in the Lower Bedrock Aquifer further away from TW3-80 show the effects of external influences. Some of these ’fringe‘ wells show a correlation of changes in water levels to changes in cumulative annual pumping (e.g., MW10C/D-09); however, changes due to daily fluctuations in pumping or even seasonal changes in pumping (i.e., increased pumping in the summer) are not observed in the water level records. There are also responses in water level observed in monitoring wells closer to TW3-80 (i.e., the rise in water levels at the end of 2018) that are not seen in these wells.
- Water levels in the Lower Bedrock Aquifer show some correlation with seasonal patterns of infiltration. During the spring, infiltration is greatest and the water levels in some wells (MW6A-08, MW8A-08, MW10C/D-09, MW15A-12, and MW16A-12) are stable or on increasing trends while pumping is increasing. In contrast, some of the lowest water levels are observed during the summers of 2012 and 2016 when drier conditions existed.

In summary, the water levels in the Lower Bedrock Aquifer are influenced primarily by pumping at TW3-80. The effects of pumping at TW3-80 diminish with distance away from the well, and beyond about a kilometre water levels are predominantly affected by other factors such as regional recharge and pumping at other locations. In addition, water levels recover when pumping rates are reduced. This is another line of evidence that the water taking is sustainable.

5.2.3 Upper Bedrock Aquifer

An example of the regional groundwater potentiometric surface in the Upper Bedrock Aquifer is shown on Figure 22. The potentiometric surface was prepared based on the water levels measured on July 20, 2018. This represents a time when pumping volumes at TW3-80 were relatively high 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.

Hydrographs for wells completed in the Upper Bedrock Aquifer are included on Figures D20 to D30 in Appendix D (showing manual or transducer water levels) and Figures E6 through E10 in Appendix E (showing average monthly water levels).

A review of the hydrographs indicates that water levels in the Upper Bedrock Aquifer around the property are influenced by pumping at TW3-80 and by recharge to varying degrees, as summarized below.

- Water levels in the Upper Bedrock Aquifer around the area show some effects from pumping at TW3-80 (i.e., there is hydraulic connection between the Upper Bedrock and Lower 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.
- The relationship between the long-term average pumping rates and water levels (i.e., lower water levels during periods of increased pumping) is only observed in the monitoring wells on the property (e.g., MW2C-07, MW4B-07 and MWI/D) and MW7B-08 (upgradient).
- While there is an influence on water levels in the Upper Bedrock Aquifer from pumping TW3-80, there are also long-term water level fluctuations that are reflective of 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 is instead due to spring recharge. This indicates that recharge to the aquifer has more of an effect on water levels than pumping during this period of time. There are also short-term fluctuations in water levels that reflect changes in barometric pressure.

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

5.2.4 Overburden

Hydrographs for wells completed in the overburden are included on Figures D31 through D35 in Appendix D (showing manual or transducer water levels) and Figures E11 through E13 in Appendix E (showing average monthly water levels). 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 and gravel.

A review of the hydrographs indicates water levels in the overburden are affected by both natural events (recharge) and pumping at TW3-80, to varying degrees, as summarized below.

- Water levels in the overburden are affected by natural events (recharge). The water levels in some of the wells are more influenced by total precipitation (i.e., lower water levels observed in 2012, 2015 and 2016 when precipitation during the summer was low).

- Water levels in the overburden are also affected, but to a lesser degree, by pumping at TW3-80. The response to pumping in the overburden is muted compared to the responses in the Upper and Lower Bedrock Aquifer but there is a correlation with long-term variation in pumping. It should also be noted that measurable drawdown in the water levels in the overburden during the 2010 pumping test was limited to within the Nestlé property.

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

5.2.5 Comparison of Groundwater Levels

As indicated above, there is a damped response to pumping in the Upper Bedrock Aquifer and overburden compared to the Lower Bedrock Aquifer. Two well nests, MW2-07 close to TW3-80 and MW8-08 further away, were selected to show this relationship (Figures E14 and E15, respectively). At MW2-07 the response to pumping is greatest in the Lower Bedrock Aquifer and decreases moving up into the Upper Bedrock Aquifer and overburden. Moving further away from TW3-80, at MW8-08 the responses in the Upper and Lower Bedrock Aquifers are similar and do not show either clear responses to pumping or long-term declining trends.

5.2.6 Vertical Gradients

Vertical gradients between the Upper Bedrock and Lower Bedrock Aquifers over the past 11 years are plotted on Figures F1 through F11 in Appendix F for 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 potential 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 hydrographs 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.

Gradients are described as follows:

- MW2A/C-07, MW4A/C-07 – positive gradient (potential downward flow) that increases with increased pumping. There are brief periods when the gradient is reversed, coinciding with reduced pumping. The long-term gradient trend correlates with the long-term pumping trend (i.e., increased pumping results in an increasing positive gradient). Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping (i.e., higher pumping during the summer months). Daily changes in the vertical gradient are greater than at wells further away from TW3-80;
- MW6A/B-08 – positive gradient (potential downward flow) that generally correlates with long-term pumping trend. 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. There is a daily fluctuation in the positive gradient that relates to the daily pumping at TW3-80 but there is not a long-term change in the gradient that can be correlated with long-term changes in pumping of TW3-80. The positive gradient increased slightly in 2017 and 2018 compared to previous years. 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 location such as the Mini-Lakes). This other pumping may also be partially responsible for the increased gradient observed at MW7-08 in 2017 and 2018;
- MW8A/B-08 – negative gradient (potential upward flow) that occasionally reverses to a positive gradient (potential downward flow) mainly during the summer. The gradient has been similar over the past eleven 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 the increase in water taking from TW3-80 over the same period or other water takings in the area (i.e., Meadows of Aberfoyle);
- MW14A/C-11 – positive gradient (potential downward flow) that increases with increased pumping and correlates with the long-term pumping trend. Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping;
- MW15A/B-12 – negative gradient (potential upward flow) that does not change with increased pumping;
- MW16A/B-12 – positive gradient (potential downward flow) that does not change with increased pumping; and
- MW17A/B-12, MW18A/B-12 – positive gradient (potential downward flow) that reverses to a negative gradient (potential upward flow) during times of decreased pumping. Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping.

Most of the area around TW3-80 is characterized by positive gradients (potential downward flow) in the bedrock. A negative gradient (potential 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 (potential upward flow) is also present at MW2-07, MW4-07, MW17-12 and MW18-12 when pumping at TW3-80 is lower. Seasonal changes in gradients that correspond to the seasonal changes in pumping at TW3-80 are observed in the wells closest to TW3-80.

5.3 Surface Water Levels

5.3.1 Mini-Piezometer Water Levels

Hydrographs for the mini-piezometer locations extending over the last 11 years (2008 through 2018) are presented on Figures G1 through G9 in Appendix G. We note that the mini-piezometer nests were surveyed in 2015 to validate the reference elevations. The water elevation data for these stations was corrected back to April 2014 which resulted in a slight shift at some of the monitoring points (e.g., MP11).

A review of the hydrographs for the mini-piezometers indicates the following:

- Water levels have been similar over the 11-year period;

- The water levels have generally increased in the spring, declined through the summer, and then increased in the fall;
- Lower water levels have been observed in the summers of 2010, 2012, 2015, 2016 and 2018 when below-average precipitation was recorded;
- In addition to the seasonal trends, short-term changes ("spikes") in water level in the shallow groundwater reflect the influence of precipitation;
- A slight decline in water levels occurred at the mini-piezometers from 2013 to 2015. This coincided with increased pumping from TW3-80 and a period of declining annual precipitation (2013 to 2015). It should be noted that a decrease in water levels was not observed during the period of higher pumping in 2008. The water levels have stabilized over the past four years; during this period pumping rates from TW3-80 have been similar. In addition, when pumping decreased in 2018 a significant rise in water levels at the end of 2018 was not observed; and
- Overall the water levels are influenced primarily by variations in precipitation, overwhelming any minor changes due to pumping.

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 for 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 property. The location of MP1-16 is more representative of shallow groundwater conditions near the creek than the MP11 nest.

The changes in water levels at MP11 are less than 0.2 m. The water levels were relatively stable over the 11-year period with small seasonal fluctuations (i.e., these changes in water level are influenced by natural seasonal patterns). The potential for vertical flow at the MP11 nest is consistently upward (i.e., water levels in MP11D-04 exceeded those in MP11S-08). For comparison, and based on the data available, the water levels at MP1-16S have fluctuated just over 0.7 m in 2017 and 2018. The fluctuation is similar to that observed in the downgradient mini-piezometers. The data collected at MP1-16 indicates that response at MP11 is more subtle or muted. This is due to the location of the mini-piezometers (i.e., in main creek versus tributary) and how they were constructed (i.e., in stream bed versus outside of the stream). Despite the qualitative differences in the responses at MP11 and MP1-16, a negative vertical gradient is inferred at both locations.

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 water levels in the mini-piezometer nests located upgradient and downgradient of TW3-80 have fluctuated by approximately 1.3 m during the 11-year period. As previously indicated, changes in water levels correspond more with natural events rather than with changes in pumping in TW3-80; the changes are mainly due to precipitation, snow melt and evaporation.

Shallow gradients observed in the mini-piezometers are shown on Figures H1 through H4 in Appendix H. Beginning upstream and moving downstream, the 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) that changes seasonally. 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) changing to no gradient or weak positive gradient (potential downward flow) since 2015. There are also historical periods when the gradient reverses throughout the year;
- MP12 – weak negative gradient (potential upward flow) changing to no gradient or weak positive gradient (potential downward flow) since 2015. There are also historical periods when the gradient reverses throughout the year;
- MP14 – weak negative gradient (potential upward flow) most of the time with some weak positive gradient (potential downward flow). A strong negative gradient (potential upward flow) was observed in 2018;
- MP8 – highly variable oscillating between negative gradient (potential upward flow) and positive gradient (potential downward flow);
- MP19 – weak negative gradient (potential upward flow) with some periods of positive gradient (potential downward flow);
- MP17 – weak positive gradient (potential downward flow) with some periods of negative gradient (potential upward flow); and
- MP18 – weak positive gradient (potential downward flow) with some periods of negative gradient (potential upward flow).

There is no measurable influence from TW3-80 pumping (i.e., changes in gradient do not correlate with changes in pumping). No long-term changes or trends in the mini-piezometer gradients have been noted. Weak gradients exist at most of the mini-piezometers on the property that switch between positive and negative. When TW3-80 is pumped sufficiently hard, the gradient in the bedrock becomes increasingly positive. In contrast, the gradients in the mini-piezometers are generally weak and switch between positive and negative, indicating that shallow flow is still directed towards the creeks, but some of the deeper groundwater flow is diverted towards TW3-80 instead of also being directed toward the creeks.

Potential changes to the shallow water levels from pumping TW3-80 are not distinguishable from the more significant changes due to precipitation, snow melt and evapotranspiration

5.3.2 Surface Water Levels

Hydrographs for the surface water level monitoring locations are included on Figures I1 through I7 in Appendix I for the last 11 years (2008 through 2018). We note that the surface water monitoring locations were surveyed in 2015 to validate the reference elevations. The water elevation data for these stations was corrected back to April 2014 which resulted in a slight shift at some of the monitoring points (e.g., SW1).

A review of the hydrographs indicates the following:

- Generally surface water levels have been higher in the winter/spring and lower in the summer and then have increased slightly into the fall;
- “Spikes” in the water levels are related to precipitation events or spring melt; and
- Surface water levels in the creeks have fluctuated in response to natural events (i.e., precipitation, snow melt and evapotranspiration) with no measurable effects from changes in pumping. Specifically, the surface water levels at the on-Site stations (SW1 and SW2) generally follow a similar trend with the seasonal changes notes above.

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

The review of the hydrographs indicates surface water levels in the creeks have been relatively stable over time with no long-term increasing or decreasing trend observed. However, there are some short-term changes such as a slight decline in water levels at SW1 and SW2 in 2014 and during the summers of 2016 and 2018. We note that the water levels recorded during the summers of 2016 and 2018 are some of the lowest and correlate with “dry” summers. An analysis was conducted to examine to further examine what might be a physical cause of the creek level changes. This included an analysis of infiltration to assess the likely variability in annual infiltration and how the infiltration is distributed across the area around TW3-80 (Appendix C). The results of the analysis were used to test the hypothesis that the recent trends in water levels at SW1 and SW2 might be due to changes in infiltration patterns. The additional analysis was intended to supplement the presentation of the annual precipitation data, as it is recognized that shallow groundwater levels and stream flows are not affected exclusively by changes in precipitation. In addition to being affected by daily precipitation and when that precipitation occurs, infiltration is affected by temperature and soil water holding capacity. The results of the analysis suggest that there has been a decline in infiltration between 2016 and 2018, consistent with the lower water levels observed. Over the past three years, relatively long periods of zero infiltration are predicted with increasing frequency and also that the periods of intense infiltration are predicted earlier in each year. These changes have partially influenced the water levels in Aberfoyle Creek.

In addition to the influence of natural events on surface water levels, the most likely cause of the apparent declines in surface water levels at SW1 and SW2 is changing hydraulic conditions in Aberfoyle Creek (i.e., stream water levels may be affected by changes in stream geometry and hydraulic characteristics). The complexity of the hydraulics of Aberfoyle Creek is illustrated by the fact that it has been necessary to update the stage:discharge relations at SW1 and SW2 over time.

It is important to note that although pumping has negligible effect on Aberfoyle Creek, changes in conditions elsewhere may affect the water level and stream flow measurements. Modifications of the channel of Aberfoyle Creek that have been carried out downstream from the Nestlé property may have had the potential to alter surface water elevations, and thus the stage:discharge relationship. The potential effect of deepening the center of the channel would be lowering of the surface water levels at the edge of the stream where the surface stations may be located. To understand the causes of any additional changes in stream level it would also be necessary to investigate whether there were any changes to the amount of flow diverted from Mill Creek through Mini Lakes. It is our understanding that these diversions have happened in the past.

Water levels are also measured in two ponds on the neighbouring property (SW9 and SW10). SW9 was destroyed in April 2018 and is no longer available for monitoring. 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 change in water levels is likely due to a combination of changes in precipitation and aggregate operations.

5.4 Surface Water Flow

Stream flow measured at SW1 and SW2 over the past 11 years are shown on Figure J1 in Appendix J. SW1 is located on Aberfoyle Creek near the upstream part of the property while SW2 is located on 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 are used to estimate stream flow from the continuous water level elevation data. Due to changing channel geometry, individual stage-discharge curves sometimes have required revision. Stage-discharge curves have been 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 best fit curves for the measured data at each station. Data outliers (i.e., measurements with lower confidence) due to suspected winter conditions or measurement error have been identified and excluded from the fitting. 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:

- The trends in surface water flow at SW1 and SW2 over the years have been similar;
- Stream flows have been higher in the spring following precipitation and melt events and then have declined through the summer with less variability in flow;
- The calculated flows from the rating curves indicate that flow in the creek is usually higher or similar at SW2 compared to SW1 with some brief periods when flow is higher at SW1 compared to SW2. In some instances, when flow at SW2 is less than SW1, the measurements are within the margin of error indicating that flow at SW2 may be higher than SW1; and
- There is no apparent correlation between increases in pumping and decreases in stream flow indicating that this is another line of evidence that the TW3-80 pumping is sustainable. The on-going monitoring shows that the stream flows are influenced by precipitation events and fluctuate seasonally.

The average flow (based on near-continuous flow estimates from the stage data) of Aberfoyle Creek on the property over the last 11 years (2008 through 2018) is 199 L/s at station SW1 and 213 L/s at station SW2 (Figure J1). The median flow recorded at the stations is 153 L/s at SW1 and 170 L/s at SW2. The measurements of stream flows suggest that the flows in Aberfoyle Creek at SW2 are typically higher or the same as at SW1.

Baseflow estimates have been prepared using the ranked flow duration method following the approach suggested by the GRCA for the Arkell Spring Grounds groundwater model (Gartner Lee, 2003). The method uses a ranked flow duration plot for the observed stream flows, and calculates an average annual baseflow rate from the observations. The average annual baseflow is estimated as the streamflow corresponding to a rank of 46.7%

(this corresponds to the location of the centroid of a triangle from 20% to 100%). As shown on Figures J2 and J3, this results in an estimate of the average annual baseflow at SW1 and SW2 of 162 L/s and 183 L/s, respectively.

5.5 Surface Water Temperature

Surface water temperature is monitored at six stations across the Nestlé property. The average daily water and air temperature data for 2010 to 2017 are shown on Figure K1 in Appendix K. Review of the data indicates the seasonal trend in stream temperature levels is similar from year to year and relatively stable. Average daily ambient air temperature ranges from around -21ºC to 30ºC. Average daily surface water temperature ranges from around 0ºC to 30ºC. Surface water temperatures generally decrease across the property, moving downstream. 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.

5.6 Water Quality

The following section discusses groundwater quality monitoring conducted at the Aberfoyle facility. The relative distribution of anions and cations at TW3-80 is presented on a tri-linear Piper plot (Figure L1 in Appendix L) and time series graph (Figure L2 in Appendix L).

Water quality at TW3-80 has remained relatively stable over the years and parameters tested have remained below the Ontario Drinking Water Aesthetic Objectives. Groundwater is characterized as a calcium-magnesium-bicarbonate type, consistent with a carbonate aquifer.

Nestlé also monitors TW3-80 annually for volatile organic compounds (VOCs) that are some of the most common environmental contaminants, and the most readily transported through groundwater. To date, no VOCs have been detected in the groundwater at TW3-80.

5.7 Biological Monitoring

A summary of the findings of the biological monitoring program are presented in the subsections below. For results of annual monitoring, refer to the annual biological monitoring reports.

5.7.1 Aquatic Resources

Aquatic resources have been monitored at the Aberfoyle property since 2007. Monitoring activities have included baseline electrofishing and habitat characterization, annual trout spawning surveys, and analysis of summer water temperature data to assess the thermal suitability of Aberfoyle Creek across the Nestlé property for various fish species.

The Aberfoyle Mill Pond, which is located upstream from the Nestlé property, plays a major role in causing the warm summer water temperatures in Aberfoyle Creek through the Nestlé property. Any potential reductions in flow of Aberfoyle Creek associated with groundwater withdrawals would have negligible effects on stream temperature relative to the Aberfoyle Mill Pond.

Baseline electrofishing in September of 2007 and January of 2008 indicated that the fish community in the Aberfoyle Creek through the Nestlé property is dominated by common, cool-water fish species (Creek Chub, Common Shiner, and Johnny Darter). No spawning trout or redds have been observed in Aberfoyle Creek between the upstream limit of the Nestlé property and the confluence of Aberfoyle and Mill Creeks since the annual surveys began in 2007.

Water temperature is logged every half hour at six locations in Aberfoyle Creek and air temperature is logged at one location. The summer water temperature data are analyzed to evaluate the suitability for the fish species that occur in Aberfoyle Creek within the Nestlé property. The water temperature is best suited for species with intermediate temperature requirements, such as Creek Chub and Common Shiner, and those are the most abundant species in the creek. The water temperature periodically exceeds the lethal limit for both Brook Trout and Brown Trout during the summer, which explains their low numbers. The mean annual June – August water temperature is highly correlated with the mean annual June – August air temperature.

5.7.2 Terrestrial Resources

Terrestrial resources have been monitored regularly at the Aberfoyle property since 2007. The terrestrial resources monitoring is intended to provide a comprehensive inventory of flora and fauna associated with the site, to monitor changes to select parameters over time and to identify potential management needs. Wetland vegetation communities are monitored, as are the local populations of amphibians, birds and reptiles.

The following subsections provide a summary of the key findings of the terrestrial monitoring program spanning 2007-2018. For more detailed information, refer to the annual biological monitoring reports.

Vegetation Plot Monitoring

Vegetation plots were established in different wetland community types (i.e., marsh, conifer swamp, mixed swamp and hardwood swamp) to be representative of the wetland diversity of the site. Since 2008, 156 species have been recorded from the six permanent vegetation sampling plots. An additional 11 taxa have only been identified to the genus level. Over this monitoring period, the observed changes in the vegetation composition and structure are considered to be within the expected range of natural variation for the types of wetland communities represented on the Aberfoyle property.

Analyses of the vegetation sampling plot data have revealed some variation in species richness over the monitoring period. Since 2008, there have been minor changes in floristic composition observed for each sampling plot. Such variation is normal and expected. Wetland vegetation communities are naturally dynamic as species respond to variations in climate from year to year and also undergo natural succession over time. Based on the findings of the analyses, most of the observed variation in the parameters monitored (i.e., species richness, FQI, mean CC, and wetness index) is attributable to variability in sampling (e.g., species detection and bias in visually estimating cover abundance values). Natural variation related to succession, climate (temperature and precipitation), species competition, herbivory, wind throw, and natural dieback is considered a secondary factor in explaining the observed variation.

In reviewing the monitoring data, notable increases to species richness were recorded between 2008 and 2009 (41.5% increase) and between 2009 and 2010 (22.6%). These changes are attributable to species detection rather than environmental factors as observations made in subsequent years were more consistent. In plot-based monitoring, it is typical that more species are observed as an area is sampled over time, but eventually the number levels off. In this case, it appears that average species richness per plot has plateaued near 38 species based on the last three monitoring events.

Additionally, when individual plants are small or present in low numbers, they can be easily overlooked and not reliably detected. Additionally, plants identified only to genus are excluded from the analysis; however, if the plant is identified the next year it would be treated as a new species (increase in species richness), when in fact it was present the previous year(s). Notably, 2008 was an anomalous year, with species richness noticeably lower than the following four monitoring years, which is likely due to survey effort rather than a marked change in the composition of the plant community due to environmental change.

When data from 2008 are excluded from the analysis of variation, no statistically significant differences in the means of any of the floristic parameters from 2010 to 2016 are observed (Table 9).

Table 9: Comparison of Floristic Quality Assessment Parameter Means for All Plots, 2008-2016*

Parameter	2008	2010	2013	2014	2016	ANOVA (2008-2016) P	ANOVA (2010-2016) P
Mean Overall Species Richness	21.50 ±2.04	45.67 ±5.42	36.50 ±3.29	38.33	38.33	**0.002**	0.422
Mean Native Species Richness	19.00 ±1.87	39.17 ±5.23	30.33 ±2.78	34	32.33	**0.006**	0.432
Mean Exotic Species Richness	2.50 ±0.22	6.50 ±0.88	6.17 ±1.05	5.17	5.83	**0.006**	0.704
Mean Native CC	3.95 ±0.18	3.96 ±0.22	3.74 ±0.22	3.99	3.90	0.904	0.819
Mean Total CC	3.49 ±0.17	3.49 ±0.27	3.12 ±0.26	3.41	3.26	0.762	0.729
Mean Native FQI	17.06 ±0.9	24.94 ±2.13	20.51 ±1.65	22.83	22.1	**0.027**	0.375
Mean Total FQI	16.03 ±0.90	23.79 ±2.21	18.68 ±1.66	20.93	20.31	**0.038**	0.210
Mean Wetness Index	-1.28 ±0.28	-1.49 ±0.44	-1.21 ±0.19	-1.42	-1.29	0.981	0.947

***Results significant when p<0.05; significant values highlighted in bold.**

In addition to the analysis of variance, regression analyses were performed on the mean FQA parameters obtained from all plots for the period 2008 to 2016 and no temporal trends were observed.

Amphibian Monitoring

A total of eight amphibian species have been recorded on the subject property since the initiation of nocturnal amphibian call surveys on the property in 2008. Species observed include Spring Peeper (*Pseudacris crucifer*), Gray Treefrog (*Hyla versicolor*), Green Frog (*Rana clamitans*), Western Chorus Frog (*Pseudacris triseriata*), Wood Frog (Rana sylvatica), American Toad (*Anaxyrus americanus*), Northern Leopard Frog (*Lithobates pipiens*) and American Bullfrog (*Lithobates catesbeianus*).

Spring Peeper, Gray Tree Frog, and Green Frog have been observed each year monitoring has been completed. Species not detected annually include Western Chorus Frog, Wood Frog, American Toad, Northern Leopard Frog and American Bullfrog. The large pond at the west end of the property and the group of three small ponds/shallow aquatic features located just west of the parking lot have been identified as the primary amphibian areas on the property.

A summary of the years in which these species have been documented on the property is included in Table 10.

Table 10: Amphibian Monitoring Summary

Year	SPPE	GRTR	GRFR	CHFR	WOFR	AMTO	NLFR	BUFR
2008	X	X	X	X	X	-	-	-
2009	X	X	X	-	-	-	-	-
2010	X	X	X	-	-	-	X	-
2011	X	X	X	X	X	X	-	-
2015	X	X	X	-	X	-	X	X
2016	X	X	X	-	X	X	X	-
2017	X	X	X	-	X	X	X	X
2018	X	X	X	-	-	X	-	-

SPPE = Spring Peeper, GRTR = Gray Treefrog, GRFR = Green Frog, CHFR = Western Chorus Frog, WOFR = Wood Frog, AMTO = American Toad, NLFR = Northern Leopard Frog, BUFR = American Bullfrog

Overall the results of these surveys have been relatively consistent with minor variations from year to year, which are to be expected based on the types of habitat present on the property and daily and annual species variations, as some adult amphibian species are very mobile and often travel over upland areas to other suitable habitats.

Bird Monitoring

A total of 84 species of birds has been documented on or over the property since the beginning of the terrestrial monitoring program in 2008. A summary of the total number of species observed to be breeding, foraging or flying over the property is provided in Table 11. A complete listing of all bird species observed is provided in the annual monitoring report.

Table 11: Breeding Bird Monitoring Summary

	2008	2009	2010	2011	2015	2016	2017	2018
Total # of Birds Observed	40	45	48	50	39	48	51	39
Total # of Breeding Birds	34	39	36	38	33	40	37	32
Total # of Birds Foraging / Flying Over Property	6	6	12	12	6	8	14	7

The only species with conservation status that has been observed breeding on the property is Eastern Wood-Pewee (*Contopus virens*). This species is designated as 'Special Concern' in Canada (COSEWIC 2015) and

Ontario (MNRF 2015). No other breeding species are designated as Special Concern, Threatened or Endangered. All breeding species documented from the property have a conservation rank of S5 (Secure) or S4 (Apparently Secure) (NHIC 2015).

Sixteen (16) of the breeding bird species are considered significant in Wellington County (Dougan and Associates 2008). Thirteen (13) of the breeding species are considered area sensitive by the MNRF. The findings suggest that the bird community on the property has remained more or less consistent from year to year. The observed variation can be attributed to natural seasonal variation in avian population.

Turtle Monitoring

Two species of turtle, Midland Painted Turtle (*Chrysemys picta*) and Snapping Turtle (*Chelydra serpentine*), have been documented from the property since biological monitoring was initiated at the property. Midland Painted Turtle has recently been listed as a species of Special Concern by the COSEWIC but is not listed under the provincial *Endangered Species Act* or the federal *Species at Risk Act*. Snapping Turtle is listed as Special Concern under both the provincial *Endangered Species Act* and the federal *Species at Risk Act*. A summary of the observations of turtles on the property by year is provided in Table 12. Generally, two to three surveys are completed in spring and fall.

Table 12: Numbers of Turtles Observed*

Year	Snapping Turtle	Midland Painted Turtle
2008	1	0
2010	0	8 (5)
2011	1	38 (23)
2015	2 (1)	80 (36)
2016	5 (4)	42 (23)
2017	5	44 (25)
2018	1	30 (13)

* Maximum number observed per survey event are noted in parentheses.

All observations were made from the constructed ponds on the property. The data indicate that there is a relatively large population utilizing the ponds on the property. Some of the observed increases can be attributed to changes to the timing of the basking surveys made in 2016 that involved shifting the early summer surveys to be earlier in the spring when turtles were first emerging from overwintering and are more easily detectable as they are more likely to not be in the water.

5.7.3 Biological Monitoring Summary

Monitoring has revealed that the forests and wetlands on the Aberfoyle property support a high level of species diversity and many species that are indicators of high-quality habitats and some species that are recognized as provincially and regionally significant.

Vegetation monitoring over the last 10 years has identified some minor changes to the composition of several of the wetland vegetation sampling plots. These changes are consistent with the expected patterns attributable to natural variation. There have been no significant changes observed in the composition of the species assemblages that would indicate shifts to species composition that would be attributable to alterations in wetland hydrology. The wetness indices of the plant communities remain similar as does the composition of the wildlife communities.

The most notable changes observed since 2007 have been the increase in turtle populations that are resident in the constructed ponds on the site and the expansion of colonies of Common Reed, a highly aggressive invasive plant species that has the potential to displace native wetland species. This species is common in the adjacent landscape and difficult to control. The more effective control methods require application of herbicides or some form of mechanical removal. As the populations are in such proximity to TW3-80, the use of such control methods is discouraged due to the potential risk of impacting the source. Monitoring of the Common Reed colonies in 2016 revealed a decrease in the rate of expansion of these colonies, but an increase in the colony size was observed in 2017. Monitoring of Common Reed will continue to be undertaken at the site and alternative management approaches researched to inform future management actions.

The results of the biological monitoring that has been completed to date on the Aberfoyle property suggests that there have not been any significant changes to the terrestrial and aquatic monitoring parameters that would be attributable to pumping TW3-80. Since initiating the biological monitoring program, there has been no evidence observed in the monitoring data to suggest altered hydrology. Observed changes in species richness, abundance, and distribution are generally within those expected due to natural variation. The property continues to support high-quality habitat for a diversity of wildlife. This finding is another line of evidence that the takings from TW3-80 are sustainable.

6.0 IMPACT ASSESSMENT

The Technical Guidance Document notes that a water taking may result in some degree of impact to an established water use or to the natural functions of the ecosystem. When the impact affects an established water use, this is also referred to as interference. An unacceptable impact is normally considered to occur when 1) an impact hinders the ability of the water resource to support existing natural functions of the ecosystem, and/or 2) an impact prevents an established water user from continuing their established pattern of use.

Water taking shall not cause unacceptable impacts to the following:

- Natural functions of the ecosystem – this includes any function of the aquifer to provide baseflow to streams, maintain water levels in wetlands or lakes, support habitat and species or provide recharge to other aquifers;
- Established pattern of water use – this includes water taking for which a PTTW is required and any uses for which a PTTW is not required; and
- Irreversible impacts – this includes impacts such as those that might occur if an aquifer is over-pumped or a taking that results in the deterioration of groundwater quantity or quality on a neighbouring property.

6.1 Impact to Groundwater Users

The Long-Term Monitoring program indicates that variation in pumping from TW3-80 causes the water levels to fluctuate, locally, within the pumped bedrock aquifer. The effects from pumping decline with distance away from the pumping well and no long-term declining trends have been observed.

6.1.1 Municipal Groundwater Users

The closest municipal well to TW3-80 is the City of Guelph Burke Well. The Burke Well is located approximately 7 km north-northwest of TW3-80. The results of the GGET Tier 3 modelling prior to its updating for this study suggested that TW3-80 is responsible for 1% of the drawdown at the Guelph Burke Well (Matrix Solutions, 2018a). This level of interference is considered to be acceptable.

Maps of the potential additional drawdown caused by an increase in the TW3-80 pumping from the current average to the maximum permitted rate, created with the updated model, are presented in Matrix Solutions (2019; Figures 16, 17 and 18). The drawdown at the Burke Well is predicted to be less than 0.02 m. During the GGET and Region of Waterloo Tier Three water quantity risk assessments, a contour interval of 2 m was specified to delineate the drawdown cones of municipal wells (WHPA-Q1) (Matrix Solutions and S.S. Papadopulos & Associates, 2014). The contour interval of 2 m was selected as a threshold to account for the natural seasonal variability inferred from monitoring wells located beyond the effects of municipal pumping. The 2 m threshold represents a “detection limit” for the effects of additional declines in groundwater levels caused by increased pumping. The predicted additional drawdown of 0.02 m at the Burke Well is well below the 2 m threshold, suggesting that it is unlikely that the effects of an increase in NWC pumping could be detected.

The groundwater withdrawal from TW3-80 does not significantly interfere with existing municipal uses. There are no existing municipal systems within the zone of influence of TW3-80. The majority of growth in the area is to be directed to the Aberfoyle Urban Centre. A Feasibility Study for Municipal Water and Sewage Servicing was conducted by CIMA (2018) for the Township of Aberfoyle. The study identified two options: intra-municipal water or sewage servicing and inter-municipal water or sewage servicing. Although the City of Guelph is open to discussions, there appears to be limited available capacity in the Guelph system and significant capital upgrades would be required. An intra-municipal system would result in a financial burden on the benefitting property owners. On a preliminary basis, the inter-municipal option was preferred, indicating that the likelihood of future systems within the zone of influence TW3-80 is low.

6.1.2 Private Groundwater Users

Nestlé monitors water levels in 11 private wells in the area to track long-term changes or trends in the water levels. The monitoring has not shown an impact to private well use. Nestlé has not received any interference complaints from neighbours with wells completed in the bedrock aquifers.

6.2 Impact to Surface Water and Natural Functions of the Ecosystem

Aberfoyle Creek upstream from the Mill Pond and Mill Creek are both cold-water streams that support trout. During the summer, the Mill Pond on Aberfoyle Creek increases the water temperature downstream, and the lethal temperatures for trout are periodically exceeded. This is consistent with the low numbers of trout that have been captured by electrofishing the reach of Aberfoyle Creek between Brock Road and the confluence of Aberfoyle and Mill Creeks. During the summer, discharging groundwater is cooler than surface water and therefore can reduce stream temperatures. In the absence of pre-pumping data, it is not possible to determine the magnitude of the effect that pumping has on the Aberfoyle Creek temperature. There is little doubt, however, that the increase due to the Mill Pond is the dominant factor influencing the stream temperature through the Nestlé property. It should be noted that the water temperatures in this reach of Aberfoyle Creek do not pose a threat at the population level, as suitable habitat for trout is present in both Mill Creek and the upstream reaches of Aberfoyle Creek.

The GRCA maintains a continuous record of flows in Mill Creek at a gauge at Sideroad 10 (2GAC19). In a letter to Nestlé dated July 30, 2010, the Ministry of the Environment indicated that “the station of Mill Creek at Sideroad 10 provides the best and longest term data for which to make a determination of suitable criteria for low flow (MOE, 2010). Consistent with this guidance, potential changes in stream flows that may be attributable to Nestlé pumping have been assessed based on simulated changes in the accumulated groundwater discharge to Mill Creek up to the Sideroad 10 gauge.

Referring to Matrix Solutions (2019; Table 10), for an increase in Nestlé pumping at TW3-80 from the current average to the maximum permitted rate, the predicted reduction in the accumulated groundwater discharge at the Sideroad 10 gauge is about 1,300 m^3/day. The reduction in the groundwater discharge corresponds to 3% of the groundwater discharge for current average conditions. The predicted reduction in the accumulated groundwater discharge to the Sideroad 10 gauge is substantially less than the threshold of 10% of the results for baseline conditions indicated in the Interim Procedural and Technical Guidance Document.

The predicted changes in accumulated groundwater discharge at Sideroad 10 for the drought scenarios are presented in Matrix Solutions (2019; Figures 22 and 23, and Table 11). As shown in Figure 22 of the Matrix report included here in Appendix M, the differences in simulated groundwater discharge between average and maximum permitted TW3-80 pumping are negligible. For accumulated groundwater discharges that are equal or exceeded 20%, 50% and 80% of the time, the reductions in groundwater discharge are predicted to be 3%, 3% and 6% respectively. These predicted reductions in the accumulated groundwater discharge to the Sideroad 10 gauge are less than the threshold of 10% indicated in the Interim Procedural and Technical Guidance Document and it is unlikely they could be detected.

Additionally, the MECP indicates that the withdrawal and use cannot result in potential physical and ecological impacts to surface water systems resulting from losses of groundwater input. The potential losses of groundwater input have not resulted in ecological impacts to the surface water system.

6.3 Water Quality Impacts

As discussed in previous sections, well TW3-80 withdraws water from deep fractures in the Lower Bedrock Aquifer. Stainless steel casing with grout backfill installed from the ground surface to 28.4 m below grade prevents any water in the overlying Upper Bedrock Aquifer or overburden from entering the borehole. Water withdrawn from the Lower Bedrock Aquifer at TW3-80 is understood to be recharged within the Mill Creek sub-watershed, primarily in areas of elevated topography such as the moraines that form the northwestern and southeastern perimeters of the watershed.

Nestlé also constructs its monitoring wells so that the well screens are completed in individual aquifers with the remaining portions of the holes sealed so that water can't move up or down through the borehole. This prevents the movement of water between aquifers.

According to Appendix 2 of the Technical Guidance Document, the bottled water taking shall not result in water quality impacts that unacceptably interfere with existing or future municipal groundwater uses, or with natural functions of the ecosystem. Specific examples of unacceptable water quality impacts cited in the Technical Guidance Document include (1) mixing of groundwater of different (poor) quality that can potentially change the overall water quality, and therefore impact the taste or appearance of the water; and (2) induced migration of contaminated groundwater across nearby properties, such as dissolved-phase organic contaminants related to petroleum releases, or industrial processes.

According to the land use mapping, there are 29 industrial properties and 6 automotive/fuel stations within 1.5 km of TW3-80 with potential petroleum or industrial solvent contaminants. Nestlé monitors TW3-80 water quality for VOCs, which are among the most common and mobile of anthropogenic contaminants. No VOCs have been detected at well TW3-80 at any point during its operation as a Nestlé bottled water source. The water quality results presented in Section 5.6 indicate that water quality has been consistent over the years. The water quality at TW3-80 does not show any impacts from mixing of water or capturing contaminated water from surface.

Nestlé has never received any complaints from neighbouring properties or private well owners regarding water quality.

Additionally, the MECP indicates that the withdrawal and use cannot result in physical impacts to surface waters associated with discharge water (i.e., turbidity resulting from erosion or sedimentation). The discharged water, allowed for in the ECA, has not resulted in physical impacts to the surface water system.

In order to reduce or eliminate water quality impacts, Nestlé controls the actions that take place on its property (i.e., no pesticide or herbicide use and reduced road salt use). Water quality from the spring water source is regulated by CFIA and CBWA.

6.4 Drought and Cumulative Effects Water Quantity Risk Assessment

Environment Canada monitors drought conditions across Canada. In the 16 ½ year record (198 months, November 2002 – April 2019), available online, there has never been an "Exceptional Drought (D4)" condition anywhere in Southern Ontario. Additionally, in only 5 of 198 months (2.5%) has an "Extreme Drought (D3)" been reported anywhere in Southern Ontario. Of those five months experiencing "Extreme Drought", four included the area around Guelph/Aberfoyle (September and October of 2007, and July and August of 2012), while the last (September 2012) included areas to the west of Guelph/Aberfoyle (Figure 23). There have been other drought periods prior to 2002, such as the drought in the 1960's.

A review of stream flow and groundwater levels was conducted for the period during the second drought event in July and August 2012. Some of the lowest flows observed at SW1 occurred during this period, with an average flow during July and August 2012 of 33 L/s (Figure J1). Continuous surface water levels were not recorded at SW2 during that time period and therefore a continuous record of flow is not available. The flows at the Sideroad 10 Station were also some of the lowest observed during that time period; however, it should be noted that other similar, or lower, low-flow events have occurred, typically during the summer months (Figure 15).

A review of the average water levels in the overburden, Upper Bedrock Aquifer and Lower Bedrock Aquifer (Appendix E) indicate declining water levels during the 2012 drought period. The end of the period also coincided with the pumping test conducted at TW2-11. Lower water levels have been observed in the Lower Bedrock Aquifer in other years when pumping at TW3-80 was higher. The water levels in the overburden and Upper Bedrock Aquifer were lowest during the drought period. This indicates that the water levels in the Lower Bedrock Aquifer fluctuate more in response to pumping at TW3-80 whereas water levels in the overburden and Upper Bedrock Aquifer are influenced primarily by changes in precipitation.

The analysis of drought addresses the question: How might water levels change if Nestlé increased its pumping and there was a reoccurrence of the period of sustained below-average precipitation that was observed in the early to mid-1960s. A plot of the simulated water levels in the Burke Well for this hypothetical condition is presented in Matrix Solutions (2019; Figure 21). As shown in the figure, the effects of the increased Nestlé pumping are predicted to be negligible. Water levels at the Burke Well are predicted to decline by approximately 3 m during the drought period, from about 324 m to 321 m. The effects of drought are predicted to overwhelm the effects of an increase in TW3-80 pumping.

A plot of the predicted water levels in the Burke well under conditions of long-term climate change is presented in Matrix Solutions (2019; Figure 25). As shown in the figure, the future climate change simulations predict that groundwater levels at the City of Guelph Burke Well will increase by 0.5 m to 1.5 m as compared to historical climate. This increase in groundwater levels is higher than at the Nestlé Aberfoyle facility, reflecting the fact that at the Burke Well there is a greater connection to shallow overburden and changes in groundwater recharge.

7.0 CONCLUSIONS

The following key facts provide evidence of the sustainability of pumping at TW3-80:

- Water levels in TW3-80 remain above the top of the pumped aquifer during operating conditions.
- Variations in water levels at TW3-80 correspond to pumping in the well and water levels recover to near-static conditions when pumping ceases. The response is consistent and predictable.
- There are no ongoing long-term declining trends in water levels measured in monitoring wells in the Lower Bedrock Aquifer, Upper Bedrock Aquifer or overburden.
- There have not been any declines in water levels in neighbouring private wells that impaired the ability of the wells to produce water and there have been no well interference complaints.
- There is no apparent correlation between increases in pumping and decreases in stream flow resulting from declines in groundwater discharge to streams that are sufficient to affect the ecology of the stream.

The following conclusions are presented based on the findings of the study and the long-term monitoring:

- The water taking does not hinder the ability of the water resource to support existing natural functions of the ecosystem. The withdrawal does not result in physical and ecological impacts to the adjacent Mill Creek and Aberfoyle wetlands.
- The water taking does not prevent water users from continuing their established pattern of use. The groundwater withdrawal from TW3-80 does not interfere with existing municipal uses or private uses. There have been no well interference complaints at Aberfoyle due to the water taking from TW3-80.
- No irreversible impacts have been observed due to over-pumping of the aquifer or deterioration of groundwater quantity or quality on neighbouring properties.

8.0 RECOMMENDED MONITORING PLAN

It is recommended that the existing monitoring program be kept in place with the following changes:

1) Production Well changes:

    a. Nestlé has indicated that they will no longer require a water taking from TW2-11. In addition, the Fireflow well is no longer used because a surface water pond is used for fire suppression. Nestlé would like to decommission the Fireflow well. 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. The Fireflow well should be decommissioned following regulated abandonment procedures, so that the well will not act as a potential pathway. The Fireflow well should then be replaced by TW2-11 for monitoring.

2) Surface Water Monitoring changes:

    a. SW9 is used to monitor water levels in a pond used by the aggregate extraction industry on the property south of the site. The pond is used for water taking and therefore its level is not a meaningful measure with respect to the potential influence of pumping TW3-80 on the pond. SW9 was destroyed when part of the pond was filled in and it is recommended that SW9 not be replaced and be removed from the monitoring conditions.

    b. SW10 is also used to monitor water levels in a pond on the property south of the site that is used for aggregate extraction. There has been no influence in the water levels at the pond from pumping TW3-80. SW10 should be removed from the monitoring conditions.

3) Mini-piezometer changes:

    a. The mini-piezometer nest MP11 is used as background monitoring. Due to concerns about the location of MP11, a new mini-piezometer nest (MP1-16) was installed in the main branch of Aberfoyle Creek and is situated within the creek. Moving forward MP1-16 should be used for monitoring background conditions and MP11 should be removed from the monitoring conditions.

    b. The mini-piezometer nests MP17S/D and MP18S/D are both located downstream of the confluence of Aberfoyle Creek and Mill Creek west of the Nestlé property. The monitoring points provide similar data and do not show any influence from pumping TW3-80. MP18S/D should be removed from the monitoring conditions.

    c. MP19S/D is located outside of Aberfoyle Creek and does not show any influence from pumping TW3-80. MP8S/D is located in Aberfoyle Creek and close to MP19S/D and provides sufficient monitoring data in the area. MP19S/D should be removed from the monitoring conditions.

4) Overburden Monitoring Well changes:

    a. TW1-99 is located near MW2-07 and TW3-80. The monitoring well provides similar data to the nearby MW2-07 monitoring well, which is a multi-level well with monitoring points in both the overburden and bedrock. Monitoring at TW1-99 should be discontinued as monitoring at MW2-07 provides sufficient coverage for the area.

b. TW1-93 is located near MW-S and both wells provide similar data. Monitoring at TW1-93 should be discontinued as monitoring at MW-S provides sufficient coverage for the area.

5) Bedrock Private Well changes:

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. Based on this, we suggest that monitoring of the private wells (as outlined below) be replaced with dedicated monitoring wells.

a. Discontinue monitoring at M1 and W2, which are private wells completed in the Lower Bedrock Aquifer. The owner of W2 does not want to be part of the monitoring program. A new monitoring well (MW21-18 (SWP BH1)) has been completed on the northeast corner of the Nestlé property (see draft water well record and geophysical log in Appendix B). A monitoring point in the Lower Bedrock Aquifer at this location can effectively replace monitoring at M1 and W2.

b. Discontinue monitoring at 8 Maple Leaf Lane, Private Well “I” (50 Brock Road), 58 Brock Road and MOE WWR #67-08740 (27 Old Brock Road). A new monitoring well (MW20-19 (SWP BH3)) has been completed at the Aberfoyle School (see draft water well record and geophysical log in Appendix B). Monitoring points in both the Upper Bedrock and Lower Bedrock Aquifers at this location can effectively replace monitoring at the four noted wells.

c. Discontinue monitoring at MOE WWR #67-07589 (7404 County Road 34), Private Well “B” (7425 County Road 34) and 2 Brock Road. A new monitoring well (MW19-18 (SWP BH2)) has been completed at the Township Office (see draft water well record and geophysical log in Appendix B). Monitoring points in both the Upper Bedrock and Lower Bedrock Aquifers at this location can effectively replace the monitoring at the three noted wells.

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

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 (note that this well is recommended to be replaced with a dedicated monitoring well and neither Private Well “I” or “J” should be included on the permit).

c. MP17S/D-12 and MP18S/D-12 should be renamed MP17S/D-11 and MP18S/D-11 (note that MP18S/D is recommended to be removed from the monitoring program).

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

7) The frequency interval for monitoring certain terrestrial resource parameters as part of the biological monitoring program should be reduced as there is very little variation observed from year to year. Proposed changes are as follows:

a. Frequency of breeding bird and turtle surveys should be reduced from annually to once every two (2) years.

b. Vegetation plot monitoring frequency should be reduced to once every five (5) years.

9.0 CONTINGENCY PLAN

The following sub-sections provide contingency plans that provide mitigative measures to be taken in the event that unforeseen or unacceptable impacts occur as a result of the takings from TW3-80.

9.1 Low Flow Response Plan

Below-normal rainfall, and hot conditions, which increase evapotranspiration, can result in relatively low stream flows and low groundwater levels in the overburden and Upper Bedrock Aquifers. The GRCA coordinates and supports Ontario’s Low Water Response Program. The program is directed at those who hold a PTTW to support water conservation for drinking water, agriculture, industry, and the health of the ecosystem during low-water conditions. Nestlé is part of the GRCA Low Water Response Team representing the bottled water industry. The Low Water Response Program has three condition levels which are based on trends in flows and rainfall, which are summarized as follows (from the GRCA website):

- Level 1 – flows are less than 70% of their normal summer low flow and/or precipitation has been less than 80% of average. Water users are asked to voluntarily reduce consumption by 10%;
- Level 2 – flows are less than 50% of their normal summer low flow and/or precipitation has been less than 60% of average. The MECP will send out letters to holders of PTTWs to ask them to voluntarily reduce their consumption by 20%; and
- Level 3 – flows are less than 30% of their normal summer low flow and/or precipitation has been less than 40% of average. There is also potential for economic harm to water takers and/or significant harm to the ecosystem. The Water Response Team may ask the province to impose mandatory restrictions on those holding PTTW.

Trigger levels are reviewed along with other information (e.g., weather forecasts, local water use and time of year) by the Low Water Response Team (including the GRCA) to determine if a low-water response should be recommended. The low-water response can occur on the subwatershed level or over the entire watershed.

Level 1 declarations were issued in 2005, 2007, 2012, 2015, 2016, 2017 and 2018. Grand River watershed-wide Level 2 declarations were issued in 2007, 2012, 2016 and 2017. A Level 3 declaration has never been issued for the Mill Creek subwatershed. There are additional times when the low-flow thresholds were exceeded but the Low Water Response was not declared based on the review of other information.

Because the volume of water withdrawn by Nestlé fluctuates daily based on demand and other operational aspects of the bottling facility, there are days when the withdrawal is near the permitted amount and days when it is well below the permitted amount. The production typically increases in the summer as the demand increases during the warmer weather periods. Nestlé monitors the withdrawals during the summer (including during drought conditions) to ensure that the water taking does not negatively affect groundwater levels in the bedrock and overburden aquifers. These rates were established from testing to determine the maximum water taking allowed in the PTTW.

Nestlé withdraws water from a deeper aquifer that has been monitored for 18 years, including both dry and wet years. This extensive amount of monitoring has confirmed that the source is being managed for long-term sustainability. The data have shown that the effects of below-average precipitation are more evident in shallow groundwater and surface water compared to the deep bedrock aquifer where pumping occurs.

Therefore, Nestlé’s commitment to reducing takings during times of drought are as follows:

- During a Level 1 Condition Nestlé voluntarily limits the water taking to 90% of the monthly maximum permitted volume;
- During a Level 2 Condition Nestlé voluntarily limits the water taking to 80% of the monthly maximum permitted volume; and
- During a Level 3 Condition Nestlé voluntarily limits the water taking to 70% of the monthly maximum permitted volume.

Nestlé’s bottled water products are for human consumption and are essential for human hydration. Bottled water is also essential in time of emergencies. In 2017 and 2018, Nestlé donated over 2 million bottles of water to Canadians in crises during floods and fires, charitable donations and homelessness initiatives. Nestlé also has a partnership with the Canadian Red Cross to support the organization in times of need. Nestlé is a highly efficient water user and only bottles what is needed to meet customer demand. However, that demand varies from day to day and week to week and, consequently, Nestlé needs some flexibility in running an efficient business. Since the drought conditions came into effect, Nestlé has been committed to limiting the monthly maximum withdrawal by the percentages noted above.

9.2 Well Interference Plan

Nestlé has a well interference plan with the Township and is currently working to update the plan. A copy of the current and updated plans are included in Appendix N. The well interference plan details the steps to be taken when a complaint is received.

9.3 Other Impacts Identified by the MECP

Should the MECP determine that unacceptable interference is occurring, Nestlé will work with the MECP to investigate the cause of the interference until the problem is resolved.

10.0 REFERENCES

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Signature Page

Golder Associates Ltd.

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

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

S.S. Papadopulos & Associates, Inc.

Christopher J. Neville, M.Sc., P.Eng.
Hydrogeologist

C. Portt & Associates

Cam Portt, M.Sc.
Fisheries Consultant

Beacon Environmental

Ken Ursic, M.Sc.
Senior Ecologist

GRP/JAP/ll

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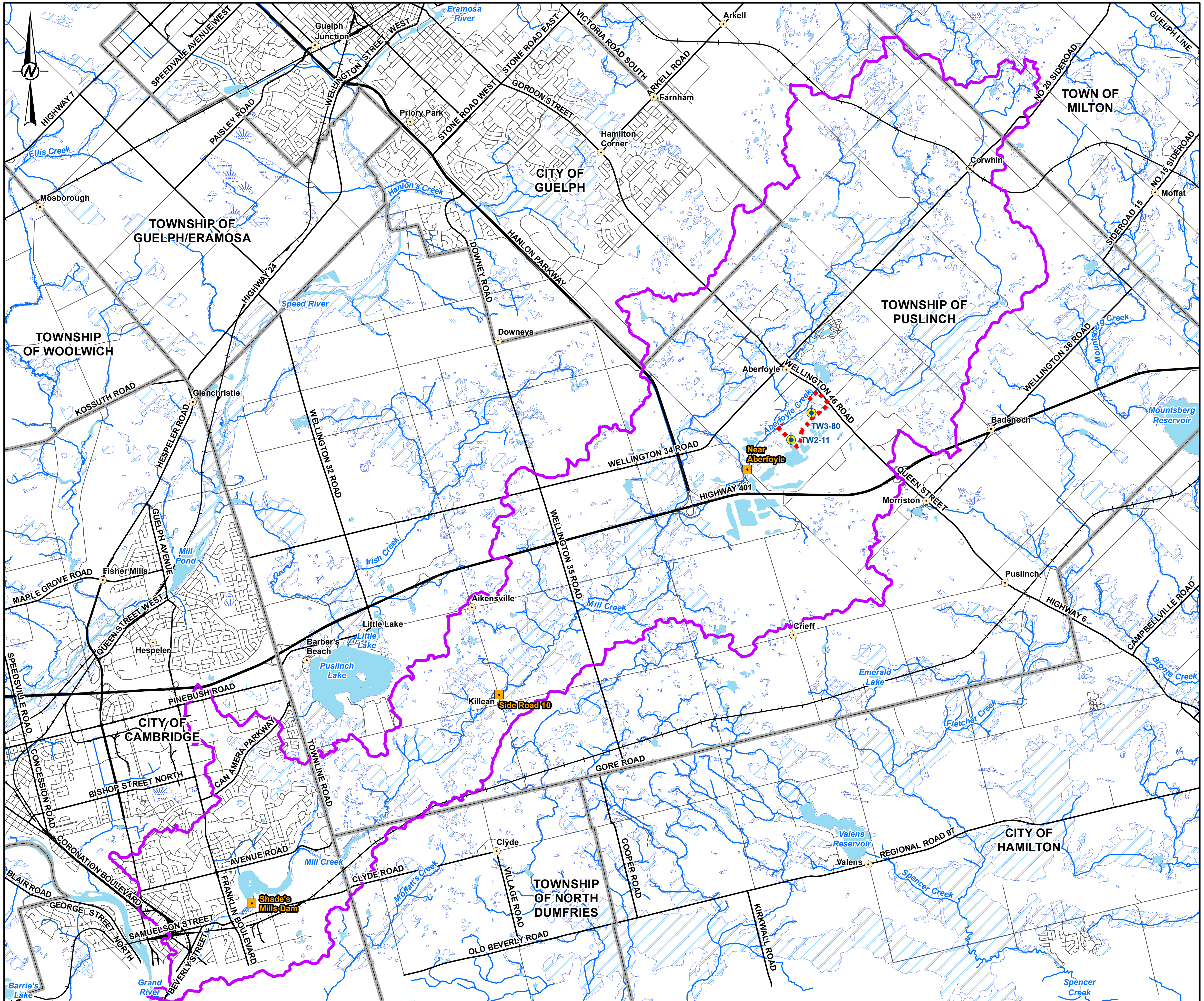
FIGURES



LEGEND

- Nestle Production Well
- Surface Water Flow Stations
- 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
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PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
SITE LOCATION

CONSULTANT
GOLDER

YYYY-MM-DD	2018-07-17
DESIGNED	KD
PREPARED	KD
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
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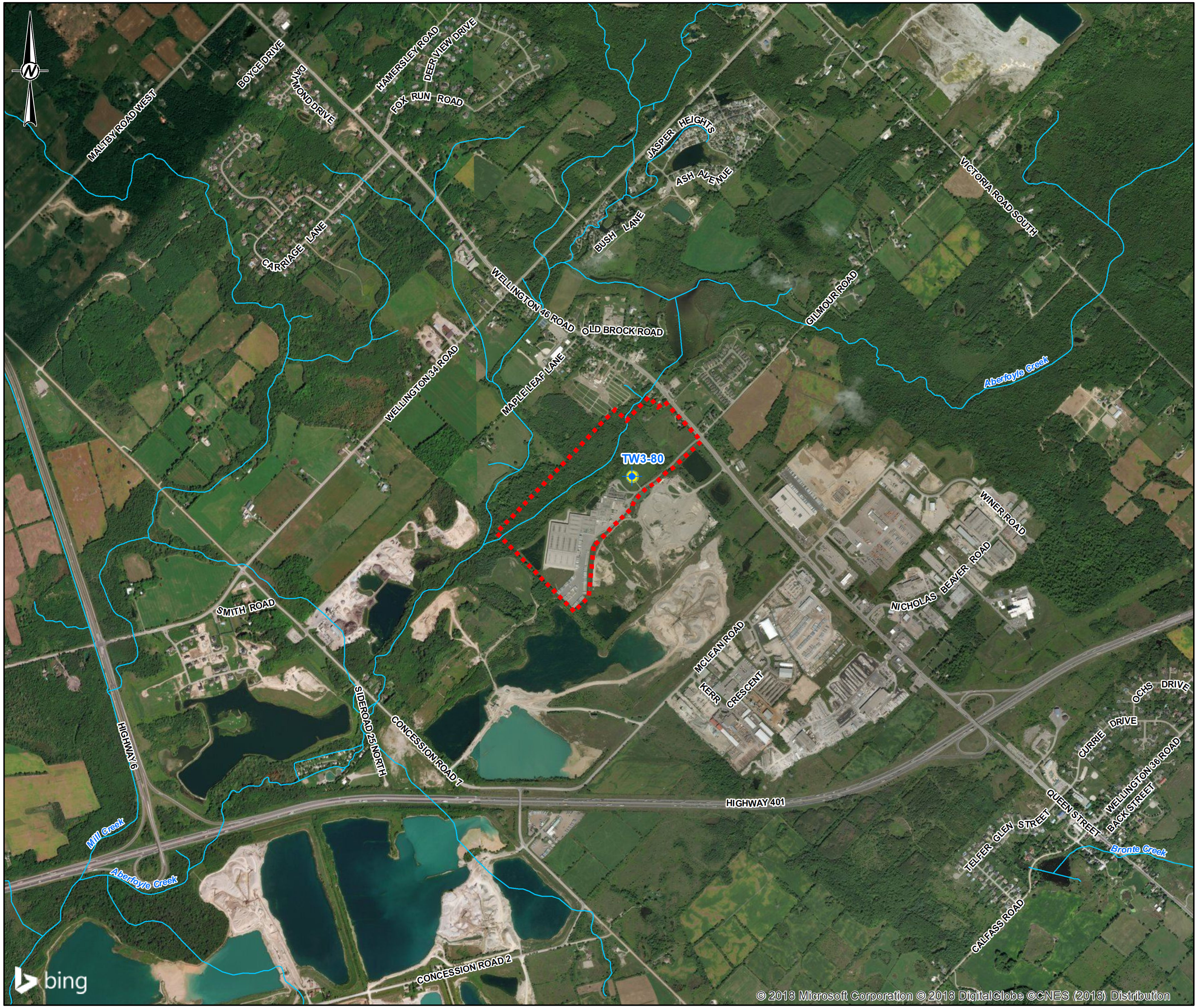

LEGEND

- Production Well
- Watercourse
- Property Boundary

0 0.5 1

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REFERENCE(S)
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CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
SITE SETTING

CONSULTANT: GOLDER

YYYY-MM-DD	2018-07-17
DESIGNED	KD
PREPARED	PR
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
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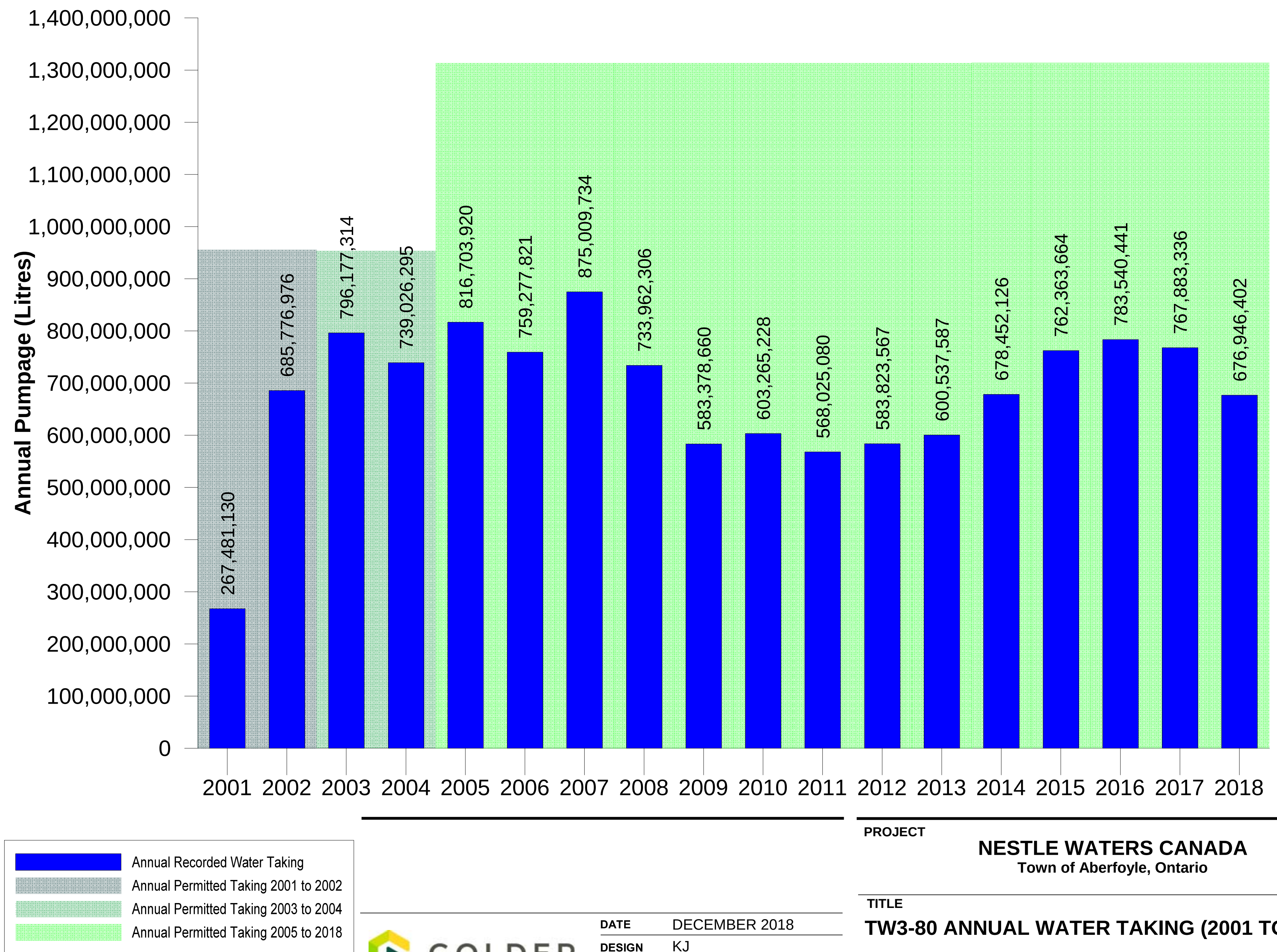

GOLDER

DATE	DECEMBER 2018
DESIGN	KJ
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

TW3-80 ANNUAL WATER TAKING (2001 TO 2018)

PROJECT NO.	REV	FIGURE
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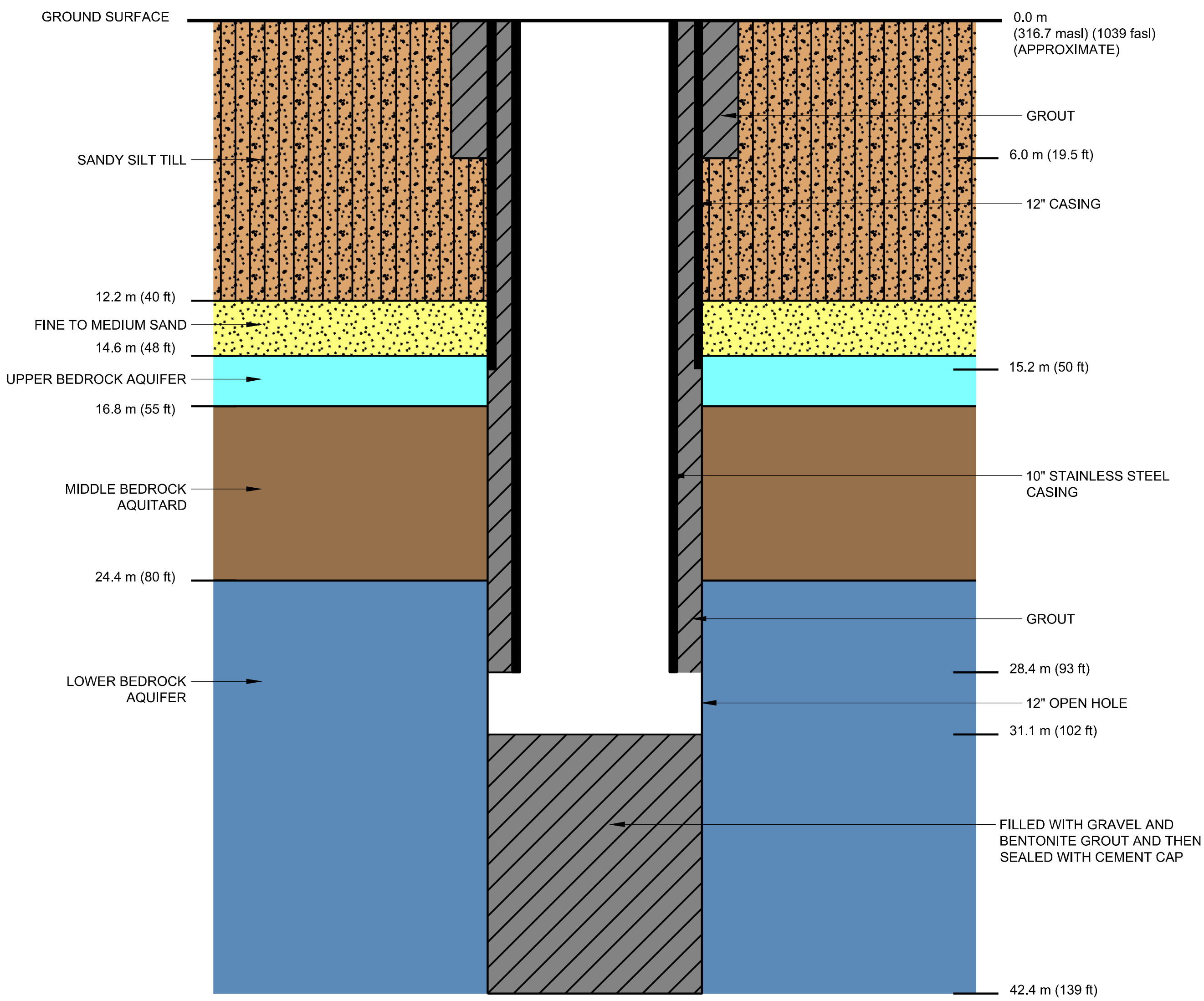

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

CONSULTANT

GOLDER

YYYY-MM-DD	2015-11-05
PREPARED	MR
DESIGN	MR
REVIEW	GP
APPROVED	GP

TITLE
ABERFOYLE TW3-80 SCHEMATIC

PROJECT No.	CONTROL	Rev.	FIGURE
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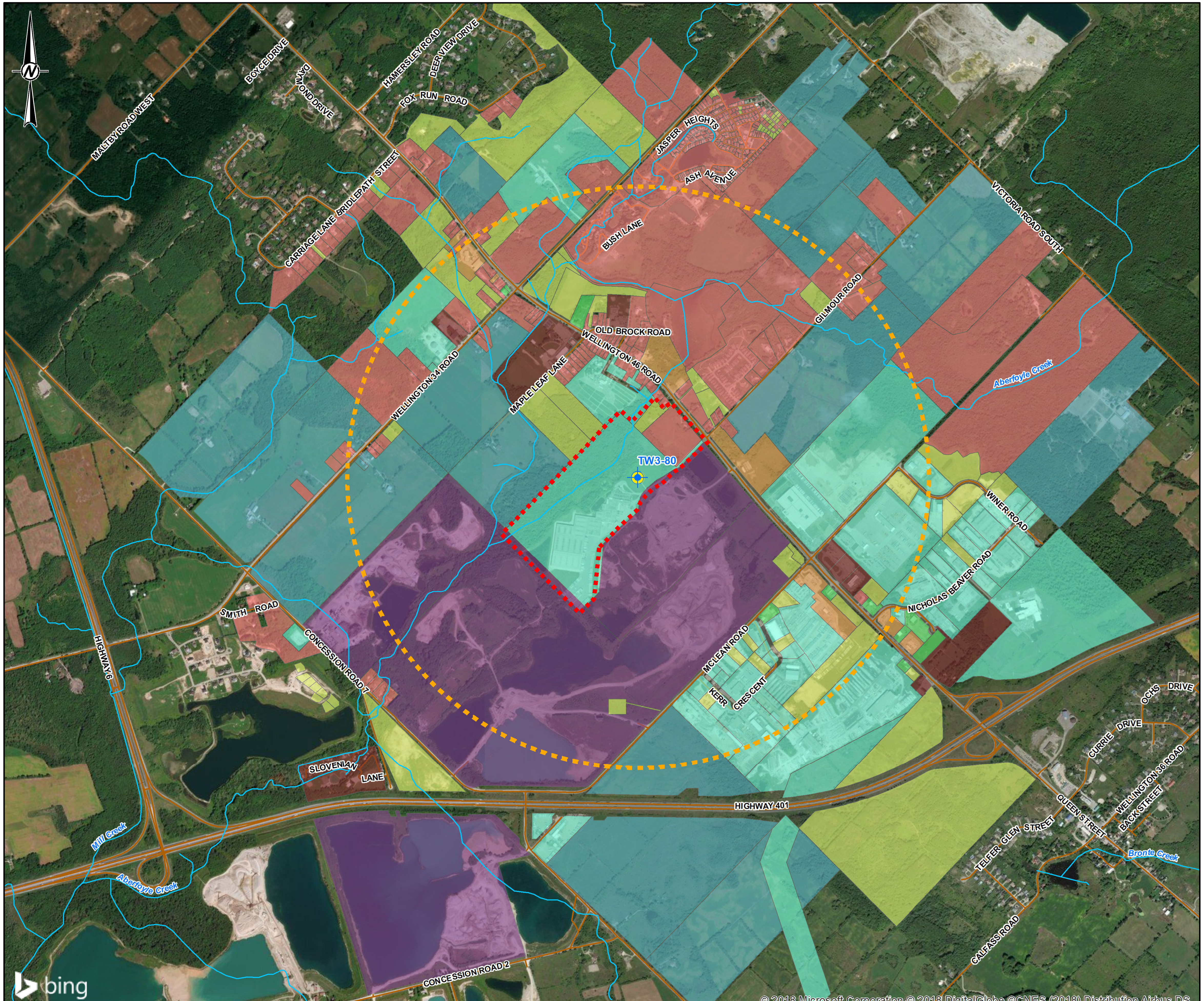

LEGEND

- Production Well
- Watercourse
- TW3-80 1.5km Buffer
- Property Boundary

Landuse Category

- Aggregate
- Automotive or Fuel Station
- Commercial
- Farm/Agriculture
- Industrial
- Institutional
- Residential
- Vacant or Conservation Authority Land

0 200 400 600 800

1:20,000 METERS

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
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CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
LAND USE

CONSULTANT

GOLDER

YYYY-MM-DD	2018-07-17
DESIGNED	JMC
PREPARED	JMC
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
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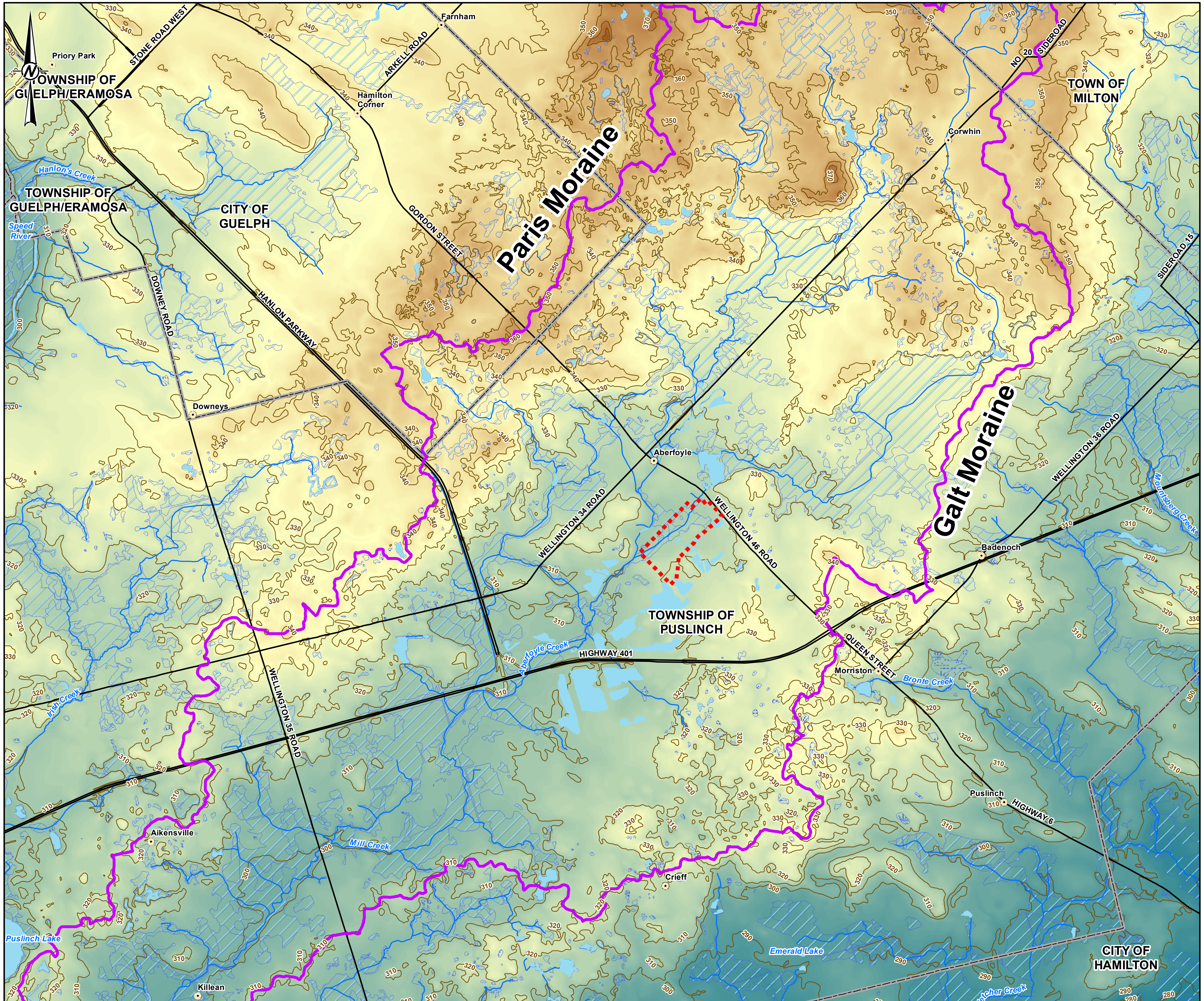

LEGEND

- 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 : 386

Low : 278

0 1 2 3 4

1:50,000 Kilometres

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
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CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
TOPOGRAPHY AND DRAINAGE

CONSULTANT
GOLDER

YYYY-MM-DD	2018-07-18
DESIGNED	KD
PREPARED	KD
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
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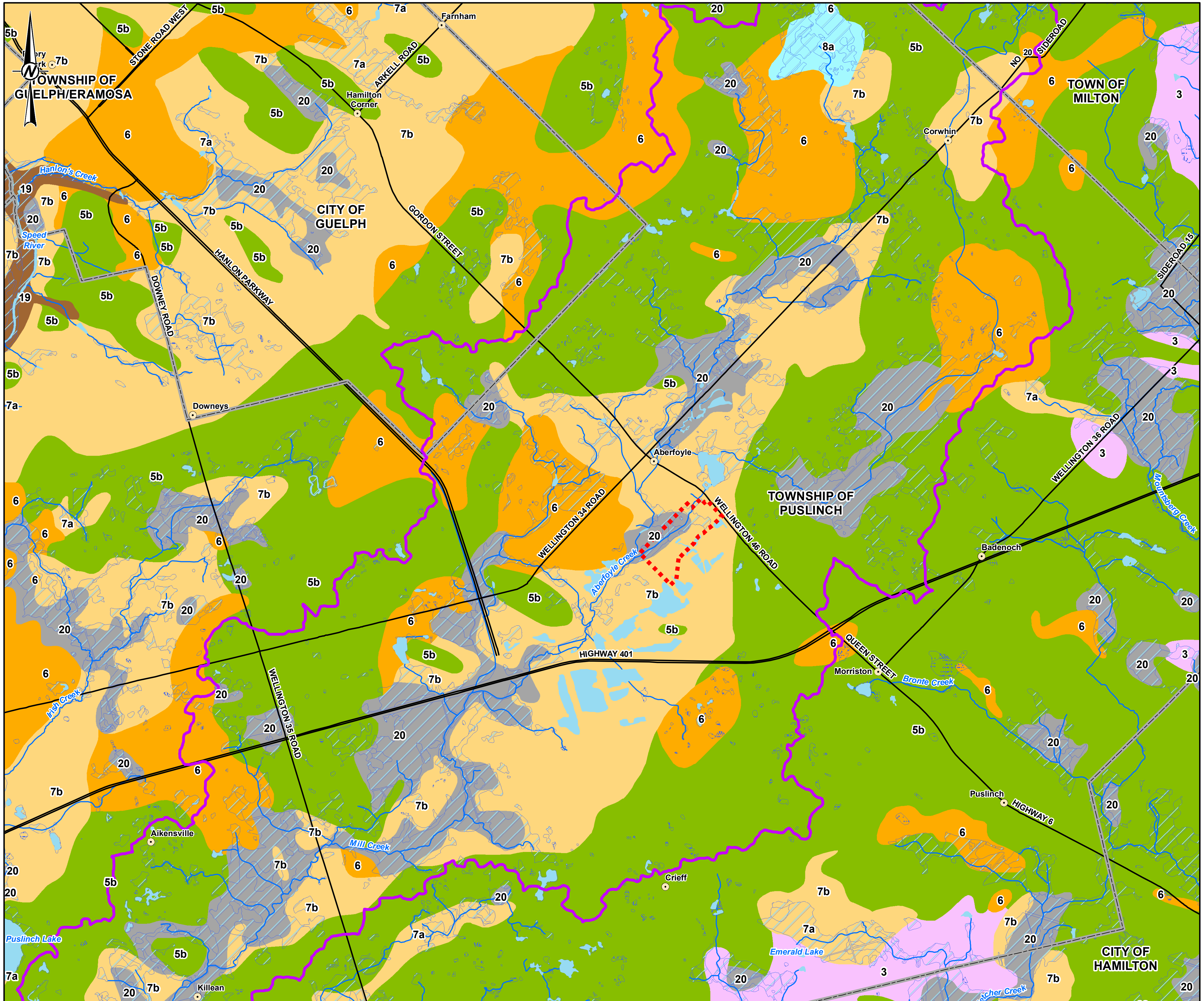

LEGEND

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

REFERENCE(S)
BASE DATA - MNR LIO, OBTAINED 2013
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ONTARIO GEOLOGICAL SURVEY 2010. SURFICIAL GEOLOGY OF SOUTHERN ONTARIO;
ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE—DATA 128 – REVISED.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
REGIONAL QUATERNARY GEOLOGY

CONSULTANT
GOLDER

YYYY-MM-DD	2018-07-17
DESIGNED	KD
PREPARED	KD
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
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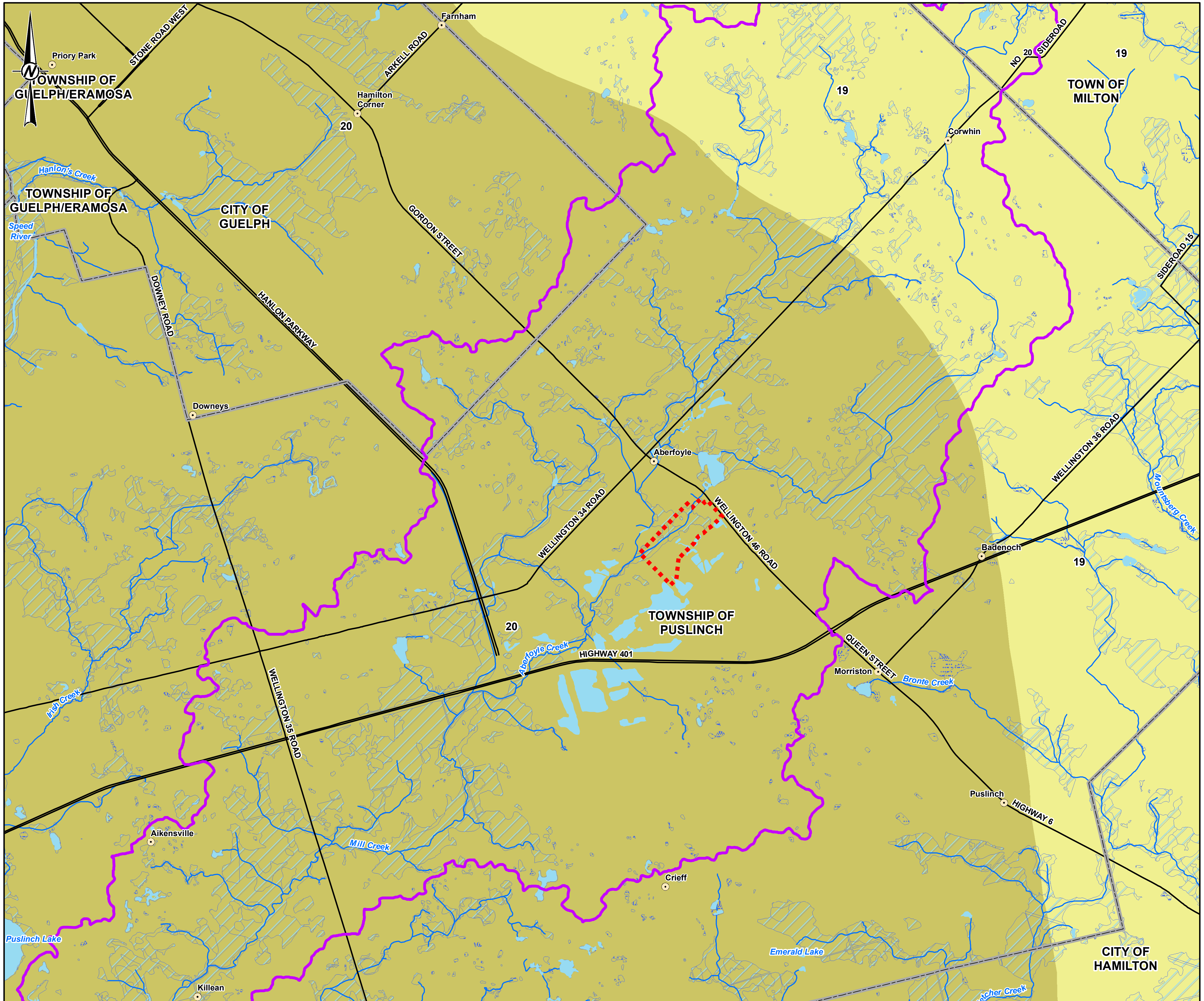

LEGEND

- 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)

0 1 2 3 4

Kilometres

1:50,000

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2013
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ARMSTRONG, D.K. AND DODGE, J.E.P. 2007. PALEOZOIC GEOLOGY OF SOUTHERN ONTARIO; ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE--DATA 219. ISBN 978-1-4249-4526-9

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
REGIONAL BEDROCK GEOLOGY

CONSULTANT

GOLDER

YYYY-MM-DD	2018-07-17
DESIGNED	KD
PREPARED	KD
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
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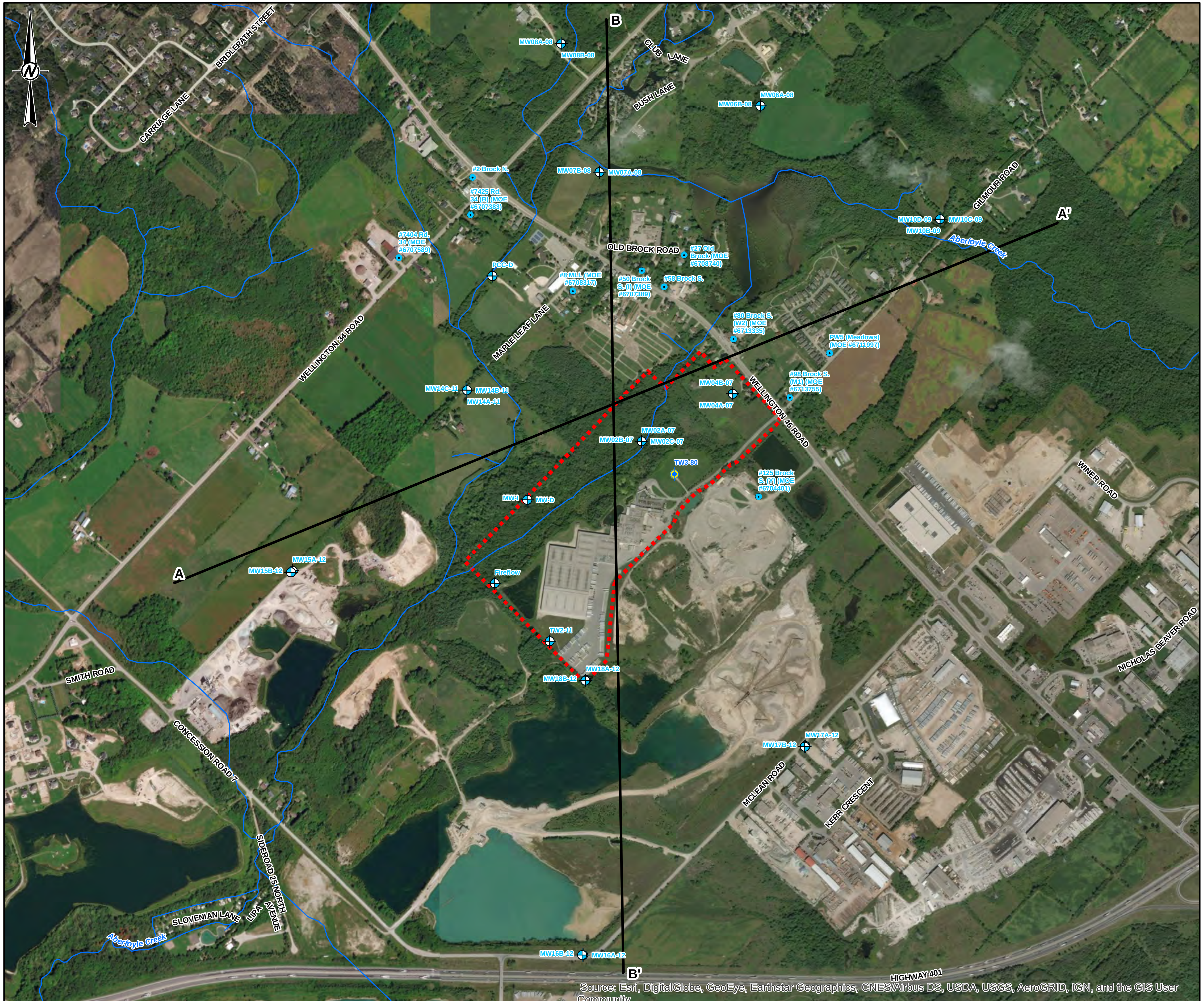

LEGEND

- Production Well
- Monitoring Well (Bedrock)
- Private Well (Bedrock)
- Watercourse
- Property Boundary
- Cross-Section Location

0 200 400 600 800 1,000

1:13,000 METERS

REFERENCE(S)
BASE DATA - MNR LIO, OBTAINED 2013
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PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
CROSS-SECTION LOCATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2018-07-17
DESIGNED	JMC
PREPARED	JMC
REVIEWED	GP
APPROVED	GP

PROJECT NO.	CONTROL	REV.	FIGURE
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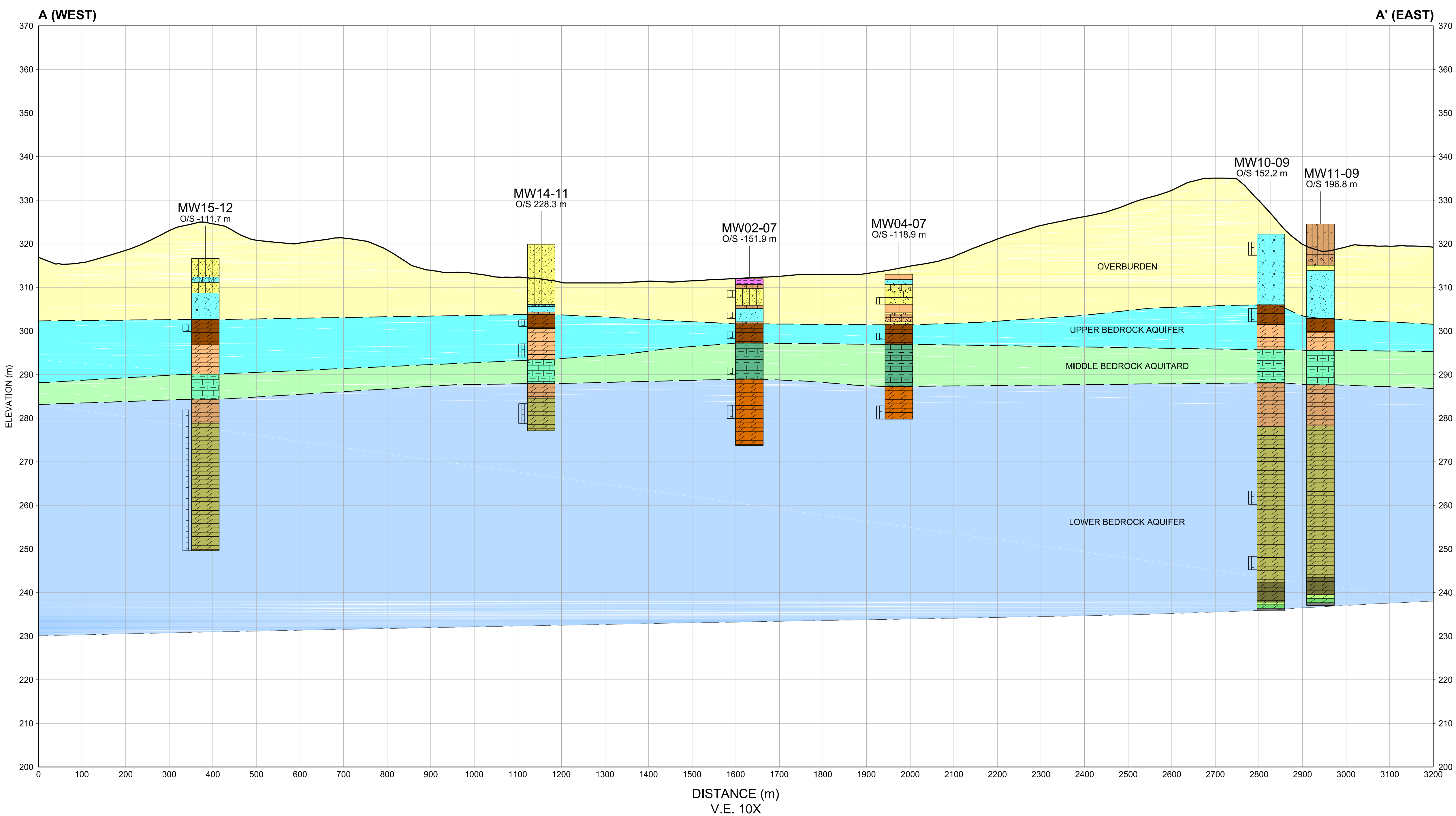


LEGEND

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

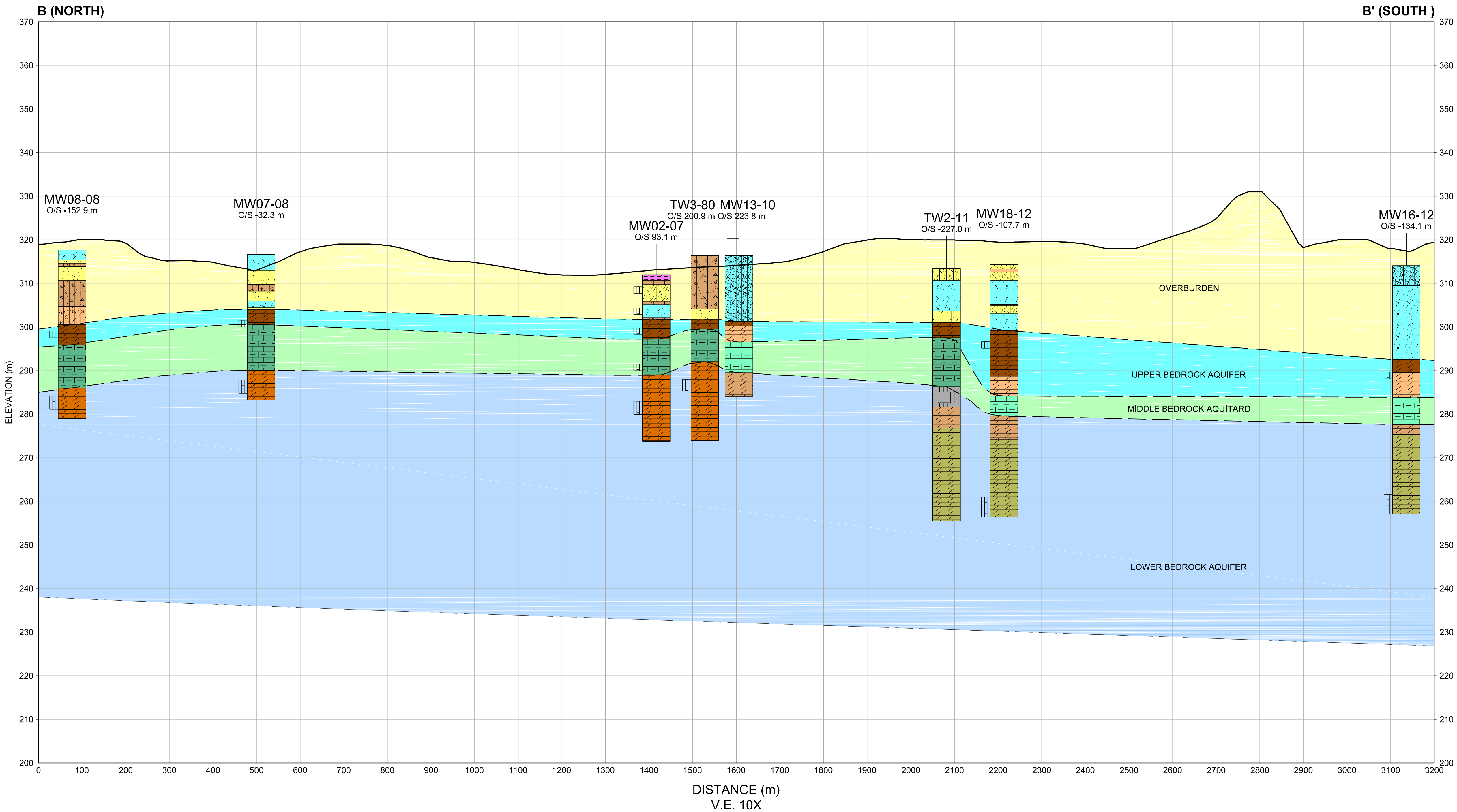
PROJECT
HYDROGEOLOGICAL STUDY

TITLE
CROSS SECTION A - A'

CONSULTANT
GOLDER

YYYY-MM-DD	2018-06-29
DESIGNED	
PREPARED	DD
REVIEWED	GP
APPROVED	

PROJECT NO.	PHASE	REV.	FIGURE
13-1152-0250	(8000)	A	10



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
HYDROGEOLOGICAL STUDY

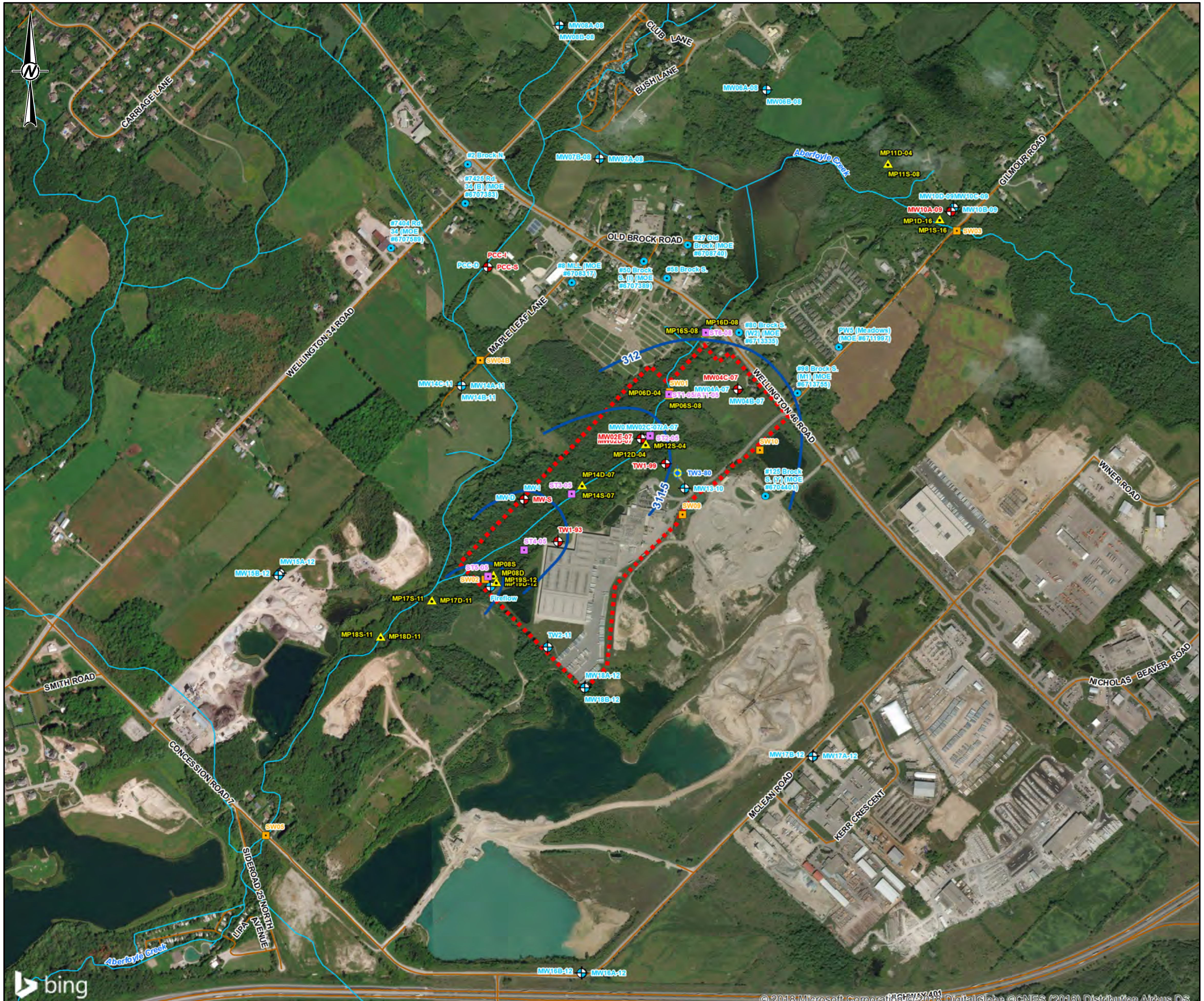
TITLE
CROSS SECTION B - B'

CONSULTANT

GOLDER

YYYY-MM-DD	2018-06-29
DESIGNED	
PREPARED	DD
REVIEWED	GP
APPROVED	

PROJECT NO.	PHASE	REV.	FIGURE
13-1152-0250	(8000)	A	11



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
PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.
WATER LEVEL ELEVATION CONTOURS OBTAINED FROM CRA 2013 ANNUAL MONITORING REPORT, MARCH 2014.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

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

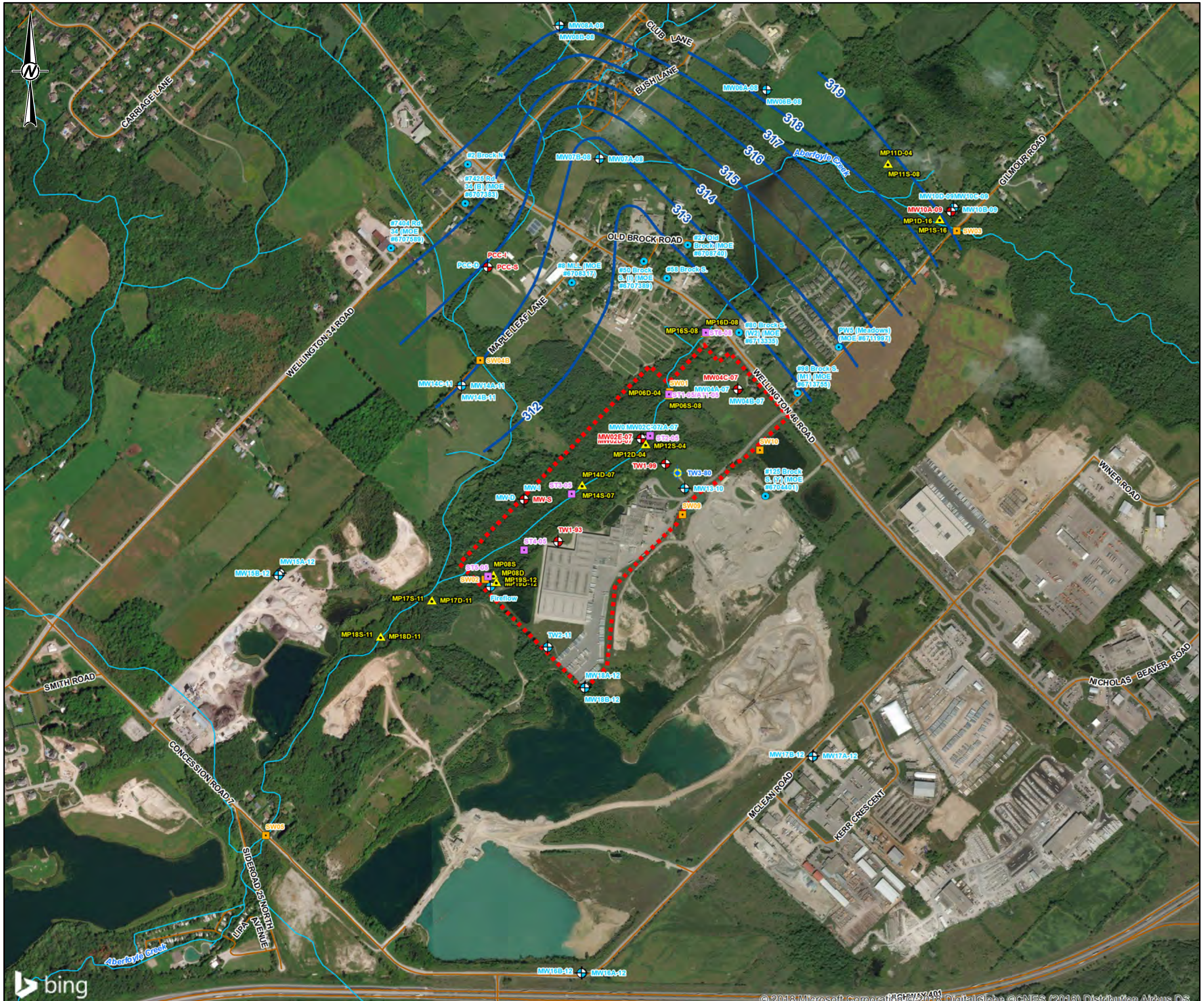
CONSULTANT

GOLDER

YYYY-MM-DD	2018-07-18
DESIGNED	KD
PREPARED	KD
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0017	1.0	12

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
PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.
WATER LEVEL ELEVATION CONTOURS OBTAINED FROM CRA 2013 ANNUAL MONITORING
REPORT, MARCH 2014.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

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

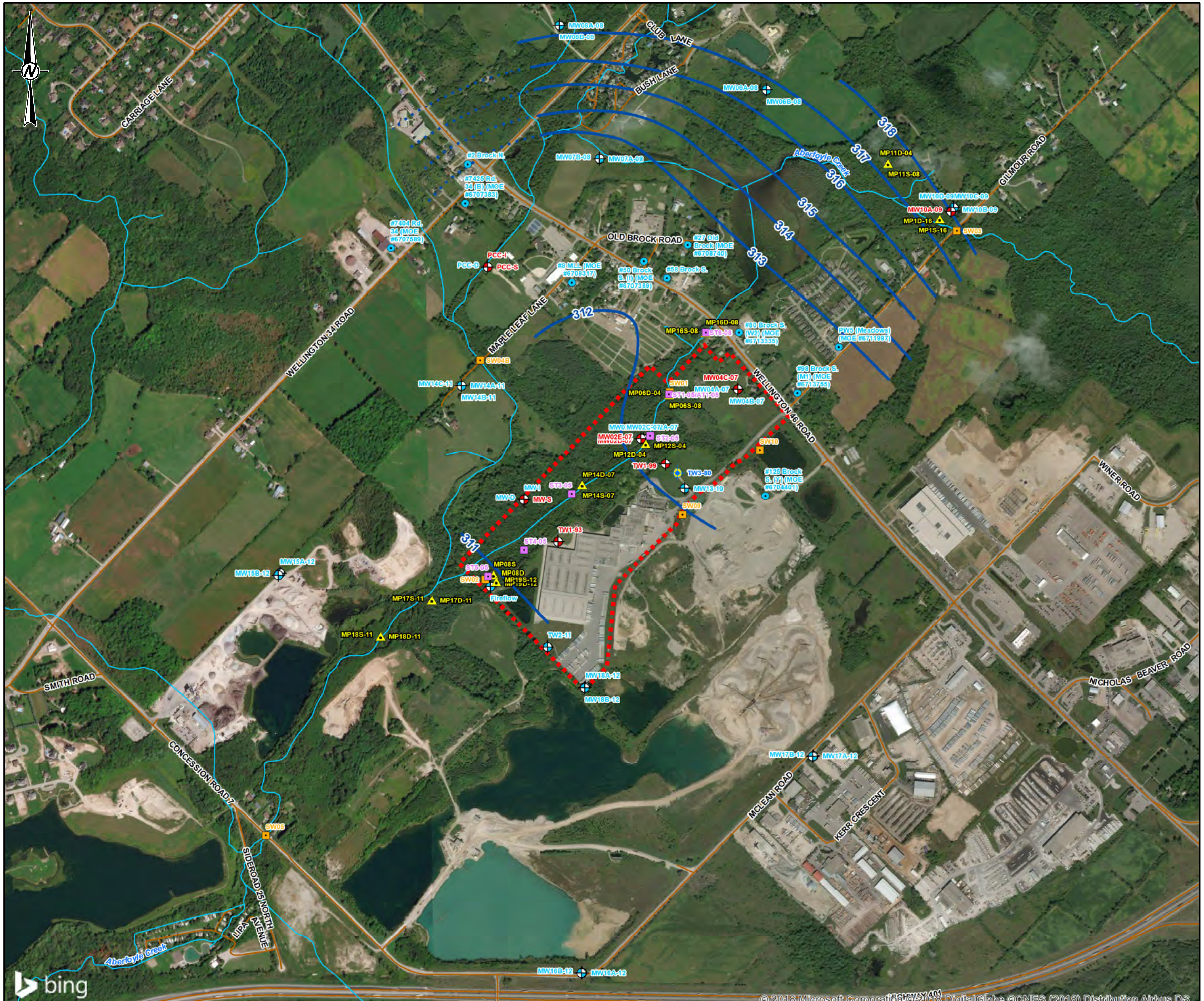
CONSULTANT

GOLDER

YYYY-MM-DD	2018-07-18
DESIGNED	KD
PREPARED	KD
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0017	1.0	13

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
PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.
WATER LEVEL ELEVATION CONTOURS OBTAINED FROM CRA 2013 ANNUAL MONITORING REPORT, MARCH 2014.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

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

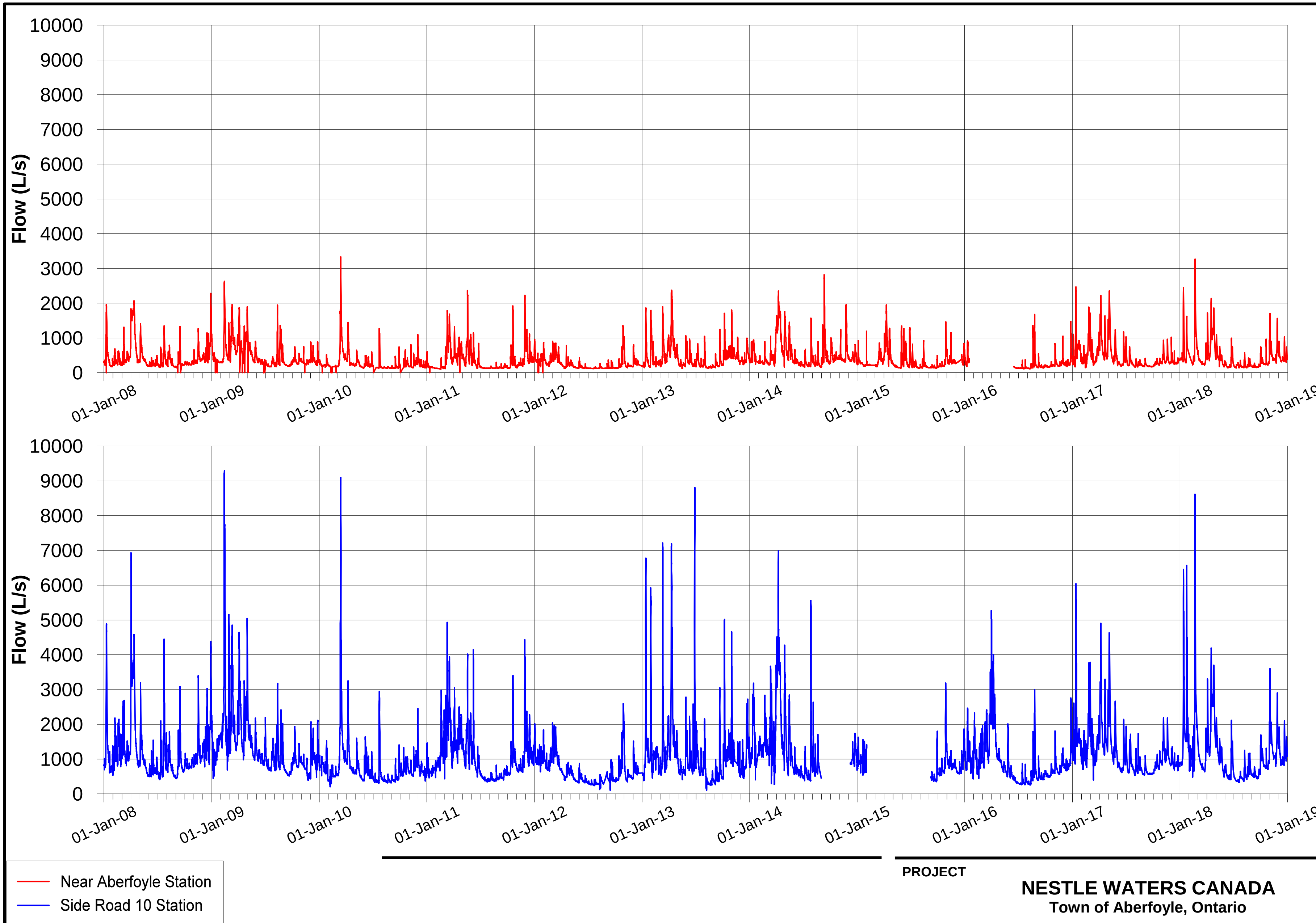
CONSULTANT

GOLDER

YYYY-MM-DD	2018-07-18
DESIGNED	KD
PREPARED	KD
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0017	1.0	14

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



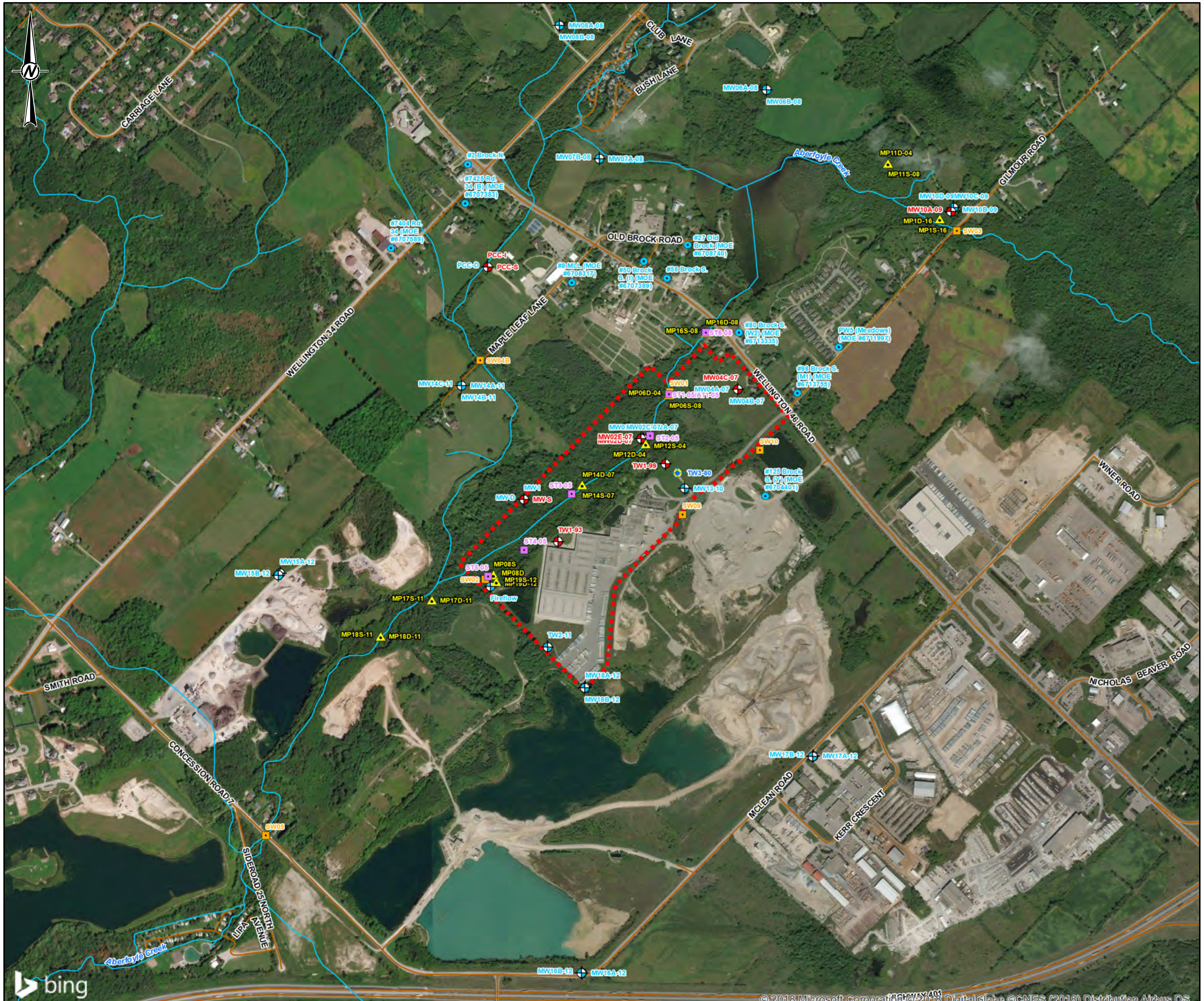
GOLDER

DATE	DECEMBER 2018
DESIGN	KJ
REVIEW	GP
APPROVED	GP

PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
FLOW IN MILL CREEK

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	15



LEGEND

- Production Well
- Monitoring Well (Bedrock)
- Monitoring Well (Overburden)
- Private Well (Bedrock)
- 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
PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.
WATER LEVEL ELEVATION CONTOURS OBTAINED FROM CRA 2013 ANNUAL MONITORING REPORT, MARCH 2014.

CLIENT
NESTLE WATERS CANADA

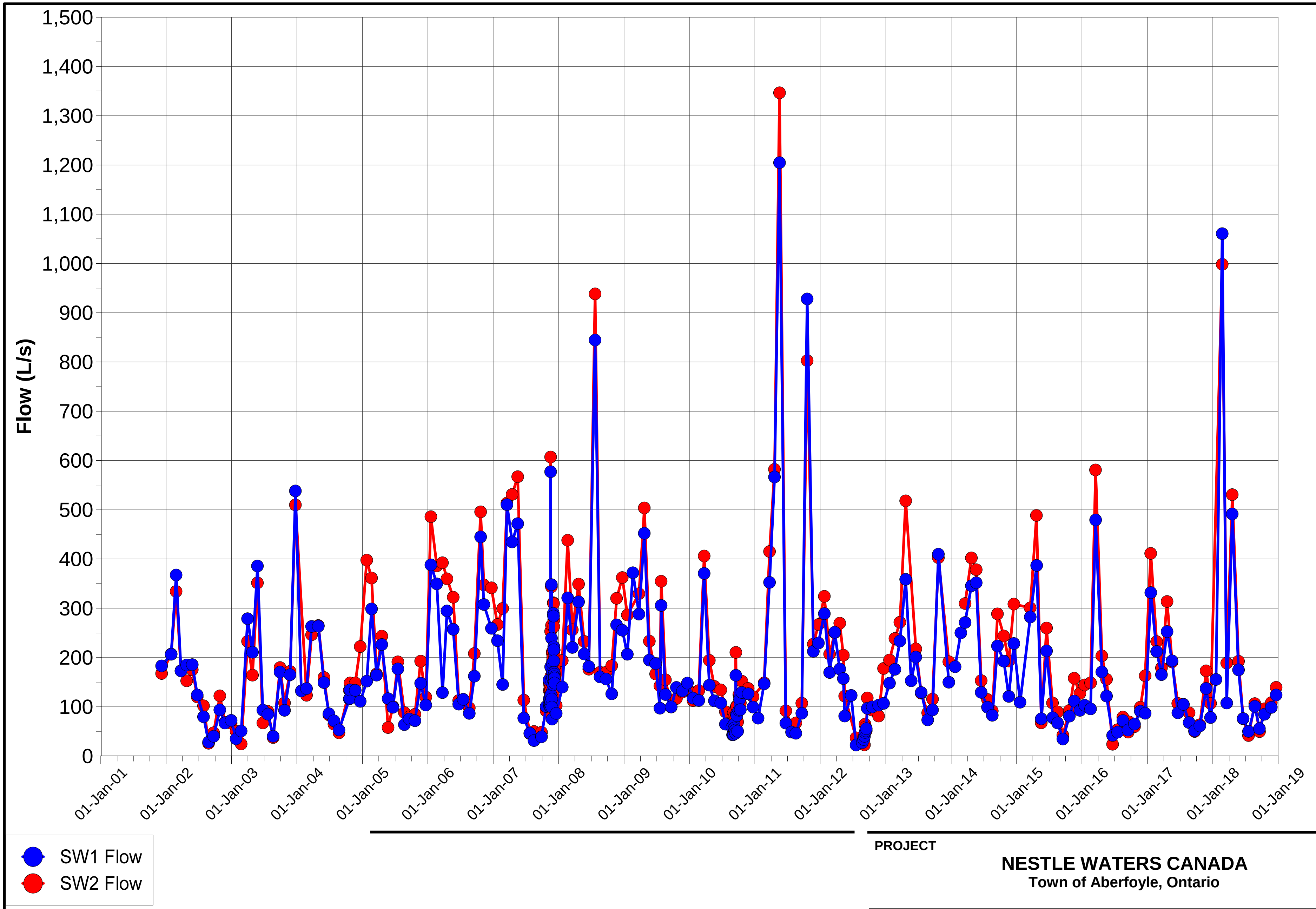
PROJECT
HYDROGEOLOGICAL STUDY

TITLE
MONITORING LOCATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-07-18
DESIGNED	KD
PREPARED	KD
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0017	1.0	16



GOLDER

DATE	DECEMBER 2018
DESIGN	KJ
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

FLOW IN ABERFOYLE CREEK
AT THE NESTLE PROPERTY

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	17

LEGEND

- Production Well
- MECP Water Well Location
- 2018 Well Survey Location
- Private Wells Monitored by Nestle
- Watercourse
- TW3-80 1.5km Buffer
- Property Boundary

0 200 400 600 800

1:15,000 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.
MECP WATER WELL LOCATION - WATER WELL INFORMATION SYSTEM (WWIS) – WELL RECORD DATA, MECP FORMERLY MOECC, 2018

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
MECP WATER WELL RECORDS

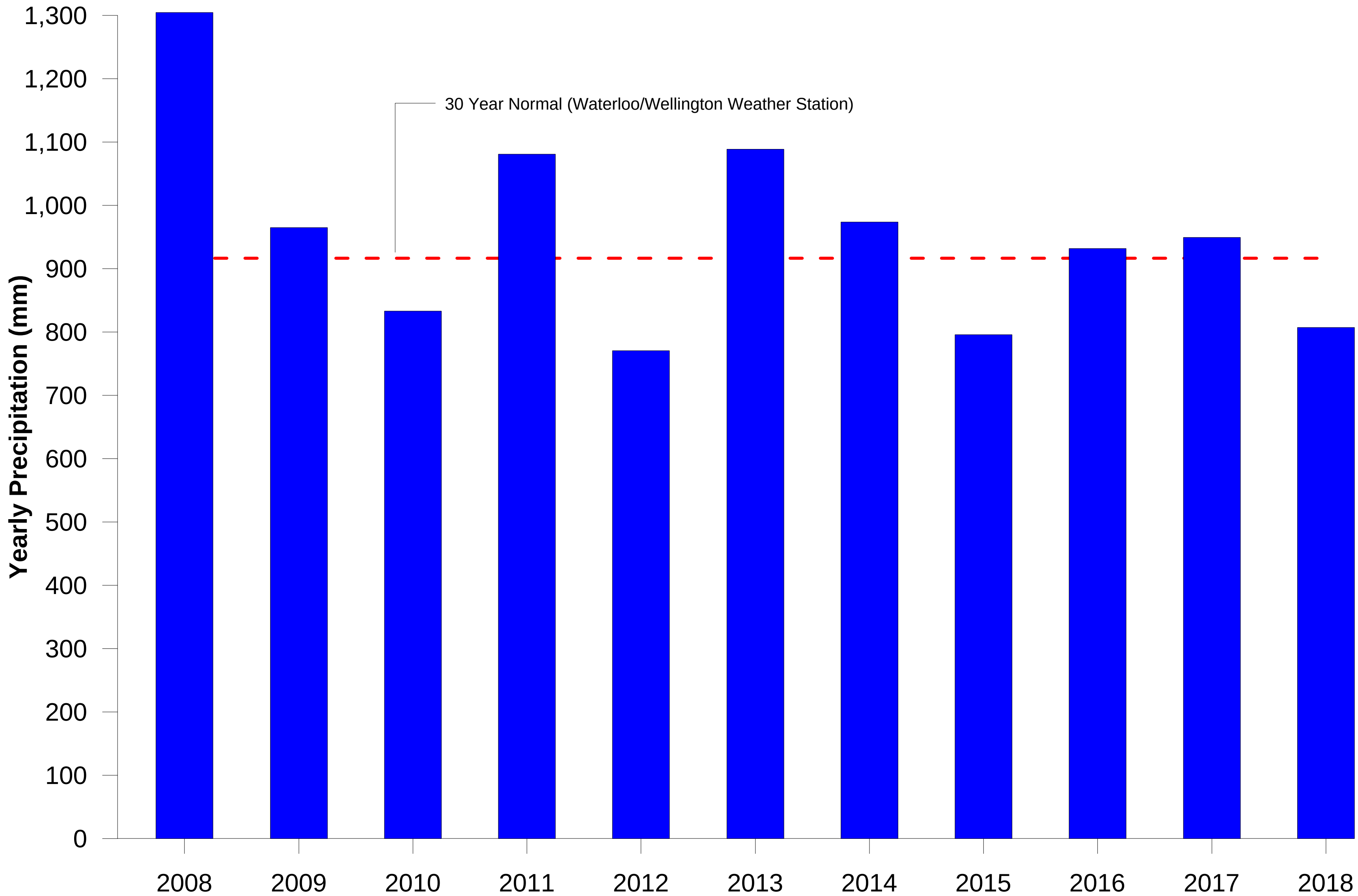
CONSULTANT

GOLDER

YYYY-MM-DD	2018-08-14
DESIGNED	JMC
PREPARED	JMC/PR
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0017	1.0	**18**

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



DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

GOLDER

PROJECT

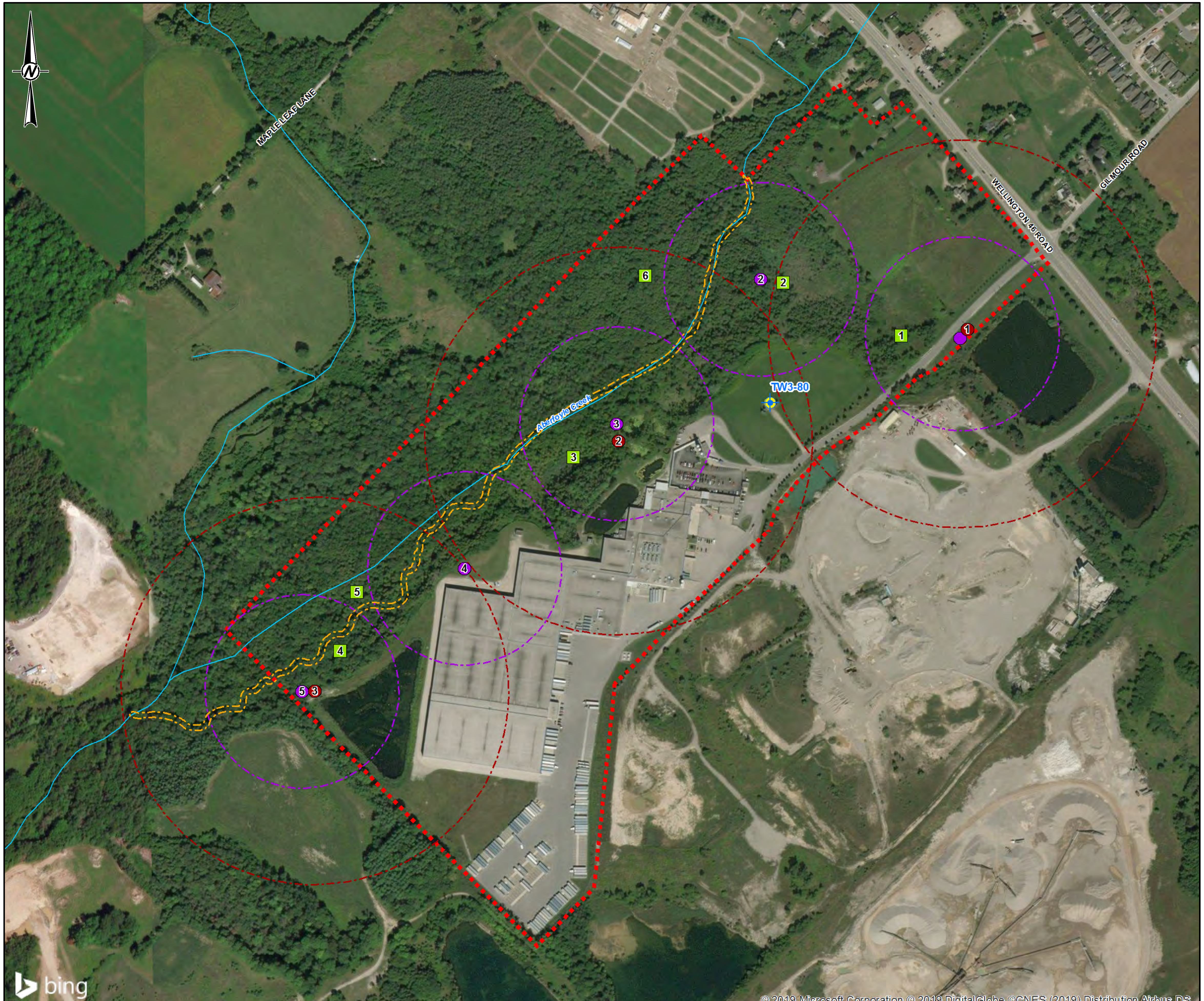
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

HISTORICAL YEARLY PRECIPITATION (2008 TO 2018)

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	19



LEGEND

- Production Well
- Watercourse
- Property Boundary
- Vegetation Monitoring Station
- Amphibian Call Monitoring Station (with 250 m radius)
- Breeding Bird Monitoring Station (with 125 m radius)
- Salmonid Spawning Survey

0 100 200

1:5,000 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
HYDROGEOLOGICAL STUDY

TITLE
NATURAL ENVIRONMENT MONITORING

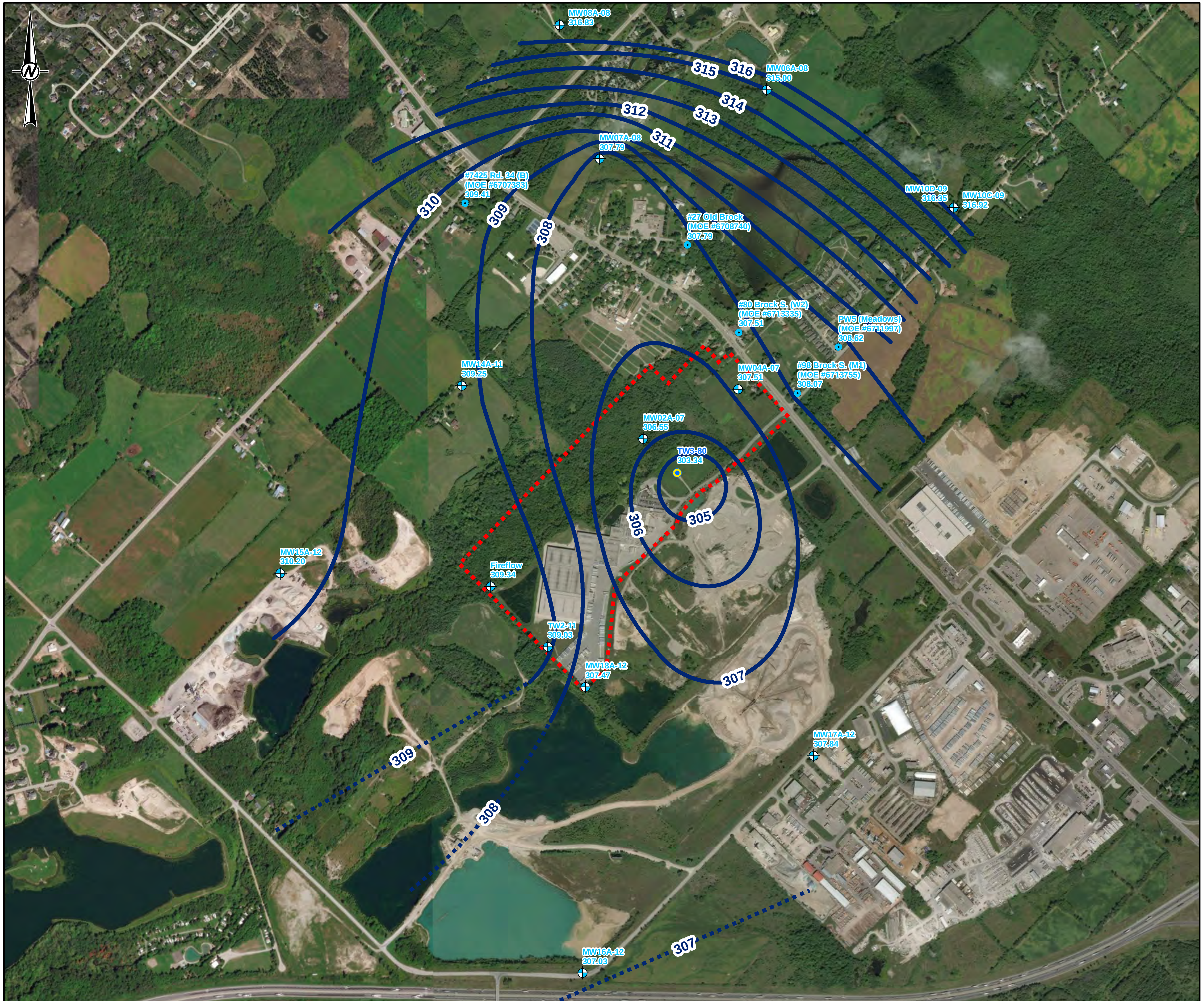
CONSULTANT

GOLDER

YYYY-MM-DD	2019-06-06
DESIGNED	JMC
PREPARED	JMC
REVIEWED	GP
APPROVED	JAP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0017	1.0	20

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
- 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
HYDROGEOLOGICAL STUDY

TITLE
POTENTIOMETRIC SURFACE OF LOWER BEDROCK AQUIFER (JULY 2018)

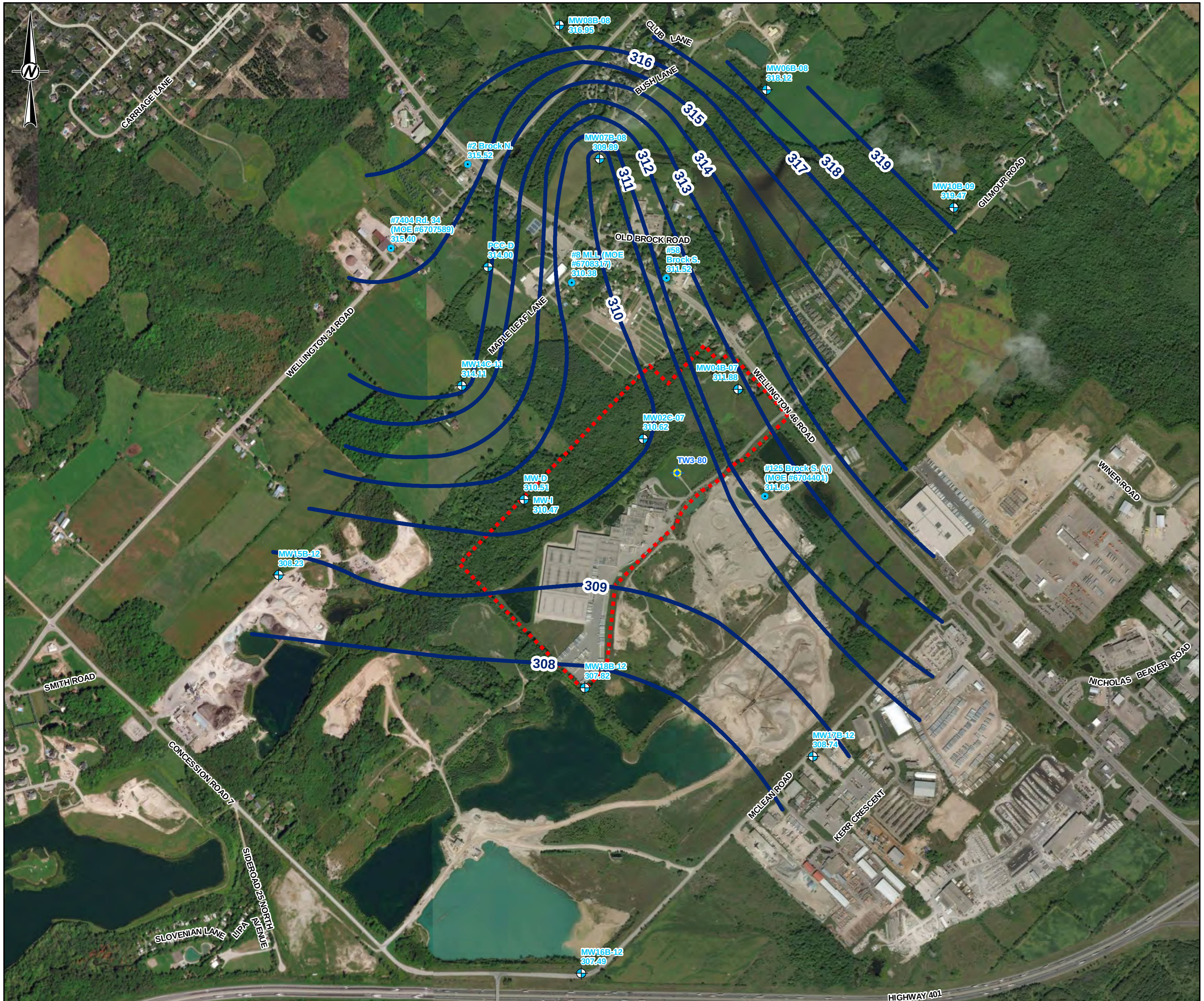
CONSULTANT

GOLDER

YYYY-MM-DD	2019-05-14
DESIGNED	JMC
PREPARED	PR
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	21

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



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
HYDROGEOLOGICAL STUDY

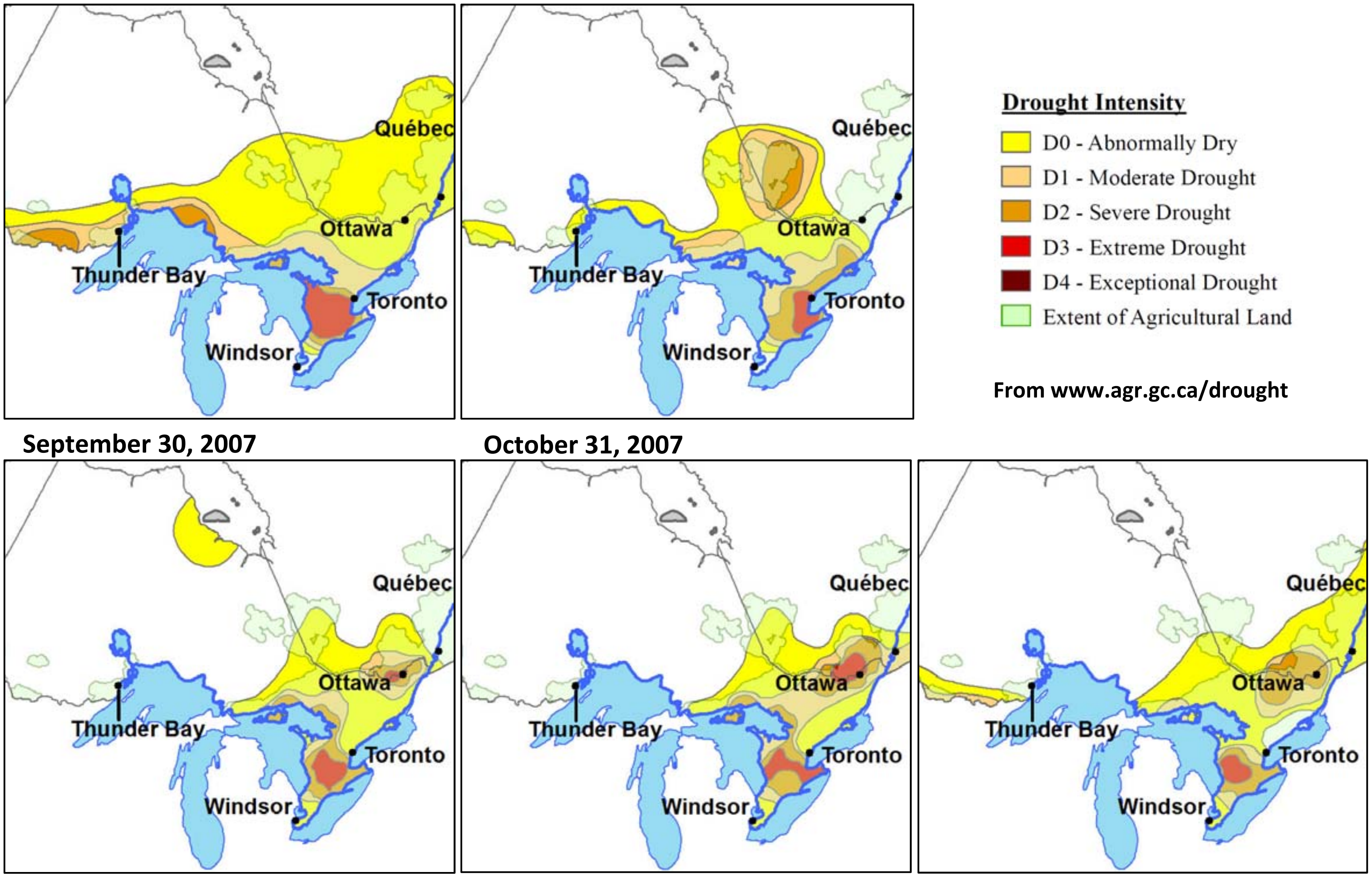
TITLE
POTENTIOMETRIC SURFACE OF UPPER BEDROCK AQUIFER (JULY 2018)

CONSULTANT
GOLDER

YYYY-MM-DD	2019-05-14
DESIGNED	JMC
PREPARED	PR
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	22

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



September 30, 2007 **October 31, 2007**

July 31, 2012 **August 31, 2012** **September 30, 2012**

GOLDER

Figure 23
Environment Canada
Drought Monitoring

APPENDIX A

Permit To Take Water and Environmental Compliance Approval

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

Ontario

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

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)

<u>Overburden Wells</u>

(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:

<u>Surface Water Levels</u>

(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 *<u>Ontario Water Resources Act</u>*, *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* *<u>Ontario Water Resources Act</u>*, *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

<u>AND</u>

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

<u>AND</u>

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 <u>www.ert.gov.on.ca</u>***

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

Ministry of the Environment
Ministère de l'Environnement

AMENDED ENVIRONMENTAL COMPLIANCE APPROVAL
NUMBER 2766-8Z6QHV
Issue Date: February 19, 2013

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

Site Location: 101 Brock Road South
Nestle Waters Aberfoyle
Lot 23, Concession 7
Guelph City, County of Wellington
N1H 6H9

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

additions to the existing sewage works for the collection, transmission, treatment, and disposal of process wastewater at an approximate peak flow rate of 1,444 m^3 per week and stormwater to Aberfoyle Creek from a water bottling plant having a catchment area of approximately 9.28 hectares, located at the above site location and consisting of the following *Works*:

PROPOSED WORKS

- discharge of backwash and forward flush wastewater of approximate peak flow rate of 48 cubic metres per week via the existing 20.32 centimetre (8") process wastewater drains that discharge wastewater to storage Pond-2 as a result of the installation of Granular Activated Carbon (GAC) treatment system;

EXISTING WORKS

- one (1) electronically monitored oil/water interceptor with storage tank, to handle a flowrate of 4.7 L/s and provide a 387 L of storage capacity, proposed to be installed in the waste/recycling room, to provide additional emergency spill containment and shall receive negligible amount of condensate from the air compressors during the summer months and discharging to the South Pond;

- installation of one (1) additional production line named Line # 8 with an approximately 23 m^3/week of wastewater discharge to the storage pond network;

- all other controls, electrical equipment, instrumentation, piping, pumps, valves, flowmeter and appurtenances essential for the proper operation of the aforementioned sewage works.

- two (2) seven inch diameter porous aerators installed in Pond 1 and Pond 2 supplied with air from two (2) 0.25 HP rotary vane type air compressors;

- five (5) 600 x 600 millimetre stormwater catchbasins and associated sewers for the collection and transmission of surface run-off to the South Pond;

- six (6) wastewater storage ponds, with volumetric capacities of 32,235 cubic metres (South Pond), 6,269 cubic metres (Pond 1), 1,331 cubic metres (Pond 2), 797 cubic metres (Pond 3), 1,174 cubic metres (Pond 4), and 1,143 cubic metres (Pond 5), operated in series for storage of process wastewater and storm water. The South Pond discharges into Pond 1 via a pump station, which discharges sequentially to Ponds 2, 3, 4, and 5;

- one (1) 75 millimetre low flow orifice and a 300 millimetre high flow orifice controlled discharge outlet from Pond 5 which discharges indirectly to Aberfoyle Creek via a 9,000 square metre vegetated area between Pond 5 and Aberfoyle Creek (no defined outlet);

- two (2) stormceptor units to treat storm water collected from the truck loading and parking areas on the southwest and east areas of the plant;

- one (1) 75 metre long grassed triangular swale to collect storm water collected from the parking area on the north side of the plant;

- one (1) 17 metre x 10 metre forebay, with 3:1 slopes on the ends and 2:1 side slopes, equipped with one 2 metre long 400 millimetre perforated discharge pipe to pre-treat storm water collected in the swale;

- one (1) 600 x 600 millimetre ditch inlet catchbasin with grating draining via 8.4 metre of 300 millimetre PVC pipe to the pump station;

- one (1) 1,800 millimetre diameter wetwell/pump station to convey water from the South Pond to Pond 1 equipped with two (2) 0.95 litres per second submersible pumps to be operated separately or in tandem to address peak flows;

- one (1) 420 metre long, 76 millimetre diameter HDPE forcemain piping network to transfer process wastewater and storm water from the pump station to Pond 1;

- one (1) 76 millimetre diameter stormwater transfer pump outlet equipped with a flap gate for discharge into Pond 1;

- discharge of approximately 51 m^3/week of backwash water to Pond 2 from the three (3) new replacement 1,270 L/min spring water filters; and,

- all other controls, electrical equipment, instrumentation, piping, pumps, valves, and appurtenances essential for the proper operation of the aforementioned sewage works.

all in accordance with the submitted supporting documents in Schedule "A".

For the purpose of this environmental compliance approval, the following definitions apply:

"Approval" means this entire document and any schedules attached to it, and the application;

"District Manager" means the District Manager of the Guelph District Office of the Ministry;

"Director" means a person appointed by the Minister pursuant to section 5 of the *EPA* for the purposes of Part II.1 of the *EPA;*

"EPA" means the Environmental Protection Act, R.S.O. 1990, c.E.19, as amended;

"Ministry" means the ministry of the government of Ontario responsible for the *EPA* and *OWRA* and includes all officials, employees or other persons acting on its behalf;

"Owner" means Nestle Canada Inc. and its successors and assignees;

"OWRA" means the Ontario Water Resources Act, R.S.O. 1990, c. O.40, as amended;

"Existing Works" means those portions of the sewage works previously constructed and approved under an *Approval*;

"Proposed Works" means the sewage works described in the Owner's application, this Approval, to the extent approved by this *Approval;*

"Regional Director" means the Regional Director of the West Central Region of the Ministry;

"Source Protection Plan" means a drinking water source protection plan prepared under the Clean Water Act, 2006;

"*BOD5*" (also known as TBOD5) means five day biochemical oxygen demand measured in an unfiltered sample and includes carbonaceous and nitrogenous oxygen demand; and,

"Works" means the sewage works described in the *Owner*'s application, and this *Approval*, and includes both *Proposed Works* and *Existing Works.*

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL CONDITION

(1) Except as otherwise provided by these Conditions, the *Owner* shall design, build, install, operate and maintain the *Works* in accordance with the description given in this *Certificate*, the application for approval of the *Works* and the submitted supporting documents and plans, and specifications as listed in this *Certificate*.

(2) Where there is a conflict between a provision of any submitted document referred to in this *Certificate* and the Conditions of this *Certificate*, the Conditions in this *Certificate* shall take precedence, and where there is a conflict between the listed submitted documents, the document bearing the most recent date shall prevail.

(3) The *Owner* shall make all necessary investigations, take all necessary steps and obtain all necessary approvals so as to ensure that the physical structure, siting and operations of the *Works* do not constitute a safety or health hazard to the general public.

2. CHANGE OF OWNER

(1) The *Owner* shall notify the *District Manager* and the *Director*, in writing, of any of the following changes within thirty (30) days of the change occurring:

(a) change of *Owner*;

(b) change of address of the *Owner*;

(c) change of partners where the *Owner* is or at any time becomes a partnership, and a copy of the most recent declaration filed under the Business Names Act, R.S.O. 1990, c.B17 shall be included in the notification to the *District Manager*; and

(d) change of name of the corporation where the *Owner* is or at any time becomes a corporation, and a copy of the most current information filed under the Corporations Information Act, R.S.O. 1990, c. C39 shall be included in the notification to the *District Manager.*

(2) In the event of any change in ownership of the works, the *Owner* shall notify in writing the succeeding owner of the existence of this certificate, and a copy of such notice shall be forwarded to the *District Manager*.

(3) The *Owner* shall ensure that all communications made pursuant to this condition will refer to this *Certificate's* number.

3. CHANGES IN PROCESSES OR PROCESS MATERIALS

(1) The *Owner* shall give written notice to the *District Manager* of any plans to change the processes or process materials in the *Owner's* enterprise serviced by the *Works* where the change may significantly alter the

quantity or quality of the influent to or effluent from the *Works*, and no such change(s) shall be made unless with the written concurrence or approval of the *District Manager*.

4. <u>OPERATIONS MANUAL</u>

(1) The *Owner* shall prepare an operations manual prior to the commencement of operation of the sewage works, that includes, but not necessarily limited to, the following information:

(a) operating procedures for routine operation of the *Works*;

(b) inspection programs, including frequency of inspection, for the *Works* and the methods or tests employed to detect when maintenance is necessary;

(c) repair and maintenance programs, including the frequency of repair and maintenance for the *Works*;

(d) contingency plans and procedures for dealing with potential spill, bypasses and any other abnormal situations and for notifying the *District Manager*; and

(e) complaint procedures for receiving and responding to public complaints.

(2) The *Owner* shall maintain the operations manual up to date through revisions undertaken from time to time and retain a copy at the location of the *Works*. Upon request, the *Owner* shall make the manual available for inspection and copying by *Ministry* personnel.

5. <u>EFFLUENT - VISUAL OBSERVATIONS</u>

(1) Notwithstanding any other condition in this *Certificate*, the *Owner* shall ensure that the effluent from the *Works* is essentially free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible film, sheen or foam on the receiving waters.

6. <u>MONITORING AND RECORDING</u>

(1) The *Owner* shall, upon continue with the following monitoring program:

(a) all samples and measurements taken for the purposes of this certificate are to be taken at a time and in a location characteristic of the quality and quantity of the effluent stream over the time period being monitored.

(b) for the purposes of this condition, "quarterly" means all or part of a period of three consecutive months beginning on the first day of January, April, July or October.

(c) samples shall be collected and analyzed at the following sampling point(s), at the sampling frequencies and using the sample type specified for each parameter listed:

Table 1 - Effluent Monitoring at Pond 5 (Sampling point at the outlet of Pond 5)		
Parameters	**Sample Type**	**Minimum Frequency**
Total Suspended Solids	Grab	Quarterly
BOD5	Grab	Quarterly
Total Phosphorus	Grab	Quarterly
Total Kjeldahl Nitrogen	Grab	Quarterly
Total Ammonia (Ammonia + Ammonium) Nitrogen	Grab	Quarterly
Oil and Grease	Grab	Quarterly

Table 2 - Aberfoyle Creek Monitoring (Samples shall be taken upstream and downstream of the discharge location of the effluent from the *Works* in Aberfoyle Creek)		
Parameters	**Sample Type**	**Minimum Frequency**
Total Suspended Solids	Grab	Quarterly*
Total Phosphorus	Grab	Quarterly

* The samples shall be collected within 24 hours of the start of a representative storm event.

(2) The methods and protocols for sampling, analysis, and recording shall conform, in order of precedence, to the methods and protocols specified in the following:

(a) the Ministry's publication "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater" (August 1994), ISBN 0-7778-1880-9, as amended from time to time by more recently published editions; and

(b) the publication "Standard Methods for the Examination of Water and Wastewater" (21st edition) as amended from time to time by more recently published editions.

(3) The monitoring program specified in subsection (1) is a minimum requirement, which may, after three (3) years of monitoring in accordance with this Condition, be modified by the *District Manager* in writing from time to time.

(4) The *Owner* shall measure and record daily volume(s) of effluent being disposed of from Pond 5.

(5) Based on the results of the monitoring reports as per Condition 7 (4), The *District Manager* may require additional limitations to be included in this *Certificate* through an amendment.

7. <u>REPORTING</u>

(1) One week prior to the start up of the operation of the *Works* after the additions are installed, the *Owner* shall notify the *District Manager* (in writing) of the pending start up date.

(2) The *Owner* shall report to the *District Manager* in writing if a visible sheen of oil and grease is observed in Pond 5.

(3) In addition to the obligations under Part X of the *Environmental Protection Act*, the Owner shall, within 10 working days of the occurrence of any reportable spill as defined in Ontario Regulation 675/98, bypass or loss

of any product, by-product, intermediate product, oil, solvent, waste material or any other polluting substance into the environment, submit a full written report of the occurrence to the *District Manager* describing the cause and discovery of the spill or loss, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation.

(4) The Owner shall prepare and submit a performance report to the *District Manager* on an annual basis within ninety (90) days following the end of the period being reported upon. The first such report shall cover the first annual period following the commencement of operation of the works and subsequent reports shall be submitted to cover successive annual periods following thereafter. The reports shall contain, but shall not be limited to, the following information:

(a) a summary and interpretation of all monitoring data, including an overview of the success and adequacy of the sewage works;

(b) a description of any operating problems encountered and corrective actions taken;

(c) a summary of all maintenance carried out on any major structure, equipment, apparatus, mechanism or thing forming part of the sewage works;

(d) a summary of any effluent quality assurance or control measures undertaken in the reporting period;

(e) a tabulation of daily volumes of effluent through the pond system during the reporting period; and,

(f) a summary of the calibration and maintenance carried out on all effluent monitoring equipment.

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

1. Condition No. 1 is imposed to ensure that the *Works* are built and operated in the manner in which they were described for review and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the *Certificate* and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review

2. Condition No. 2 is included to ensure that the *Ministry* records are kept accurate and current with respect to approved works and to ensure that subsequent *Owners* of the *Works* are made aware of the *Certificate* and continue to operate the *Works* in compliance with it.

3. Condition No. 3 is included to ensure that the *Works* is operated in accordance with the information submitted by the *Owner* relating to the process and materials which are served by the *Works*, and to ensure that any contemplated changes in them which could potentially affect the characteristics of effluent from the *Works* will be properly reviewed and approved.

4. Condition No. 4 is included to ensure that the *Works* is operated and maintained in a manner enabling compliance with the terms and conditions of this *Certificate*, such that the environment is protected and deterioration, loss, injury or damage to any person or property is prevented. This condition is also included to ensure that a comprehensive operations manual governing all significant areas of operation, maintenance and repair is prepared, implemented and kept up-to-date by the owner and made available to the *Ministry*. Such a manual is an integral part of the operation of the *Works*. Its compilation and use should assist the *Owner* in staff training, in proper plant operation and in identifying and planning for contingencies during possible abnormal conditions. The manual will also act as a benchmark for *Ministry* staff when reviewing the owner's operation of the *Works*.

5. Condition 5 is imposed to ensure that the effluent discharged from the *Works* to the Aberfoyle Creek meets the Ministry's effluent quality requirements thus minimizing environmental impact on the receiver.

6. Condition 6 is included to require the *Owner* to demonstrate on a continual basis that the quality and quantity of the effluent from the approved *Works* does not cause any impairment to the receiving watercourse.

7. Condition 7 is included to provide a performance record for future references and to ensure that the *Ministry* is made aware of problems as they arise, so that the *Ministry* can work with the *Owner* in resolving the problems in a timely manner.

SCHEDULE "A"

1. The Application for Approval of Industrial Sewage Works submitted by Michel McArthur of Nestle Waters Canada dated January 18, 2007 along with all supporting documents including a letter submission dated January 18, 2007 prepared by Conestoga-Rovers & Associates.

2. The Application for Approval of Industrial Sewage Works submitted by Michel McArthur of Nestle Canada Inc., dated January 18, 2008 and all supporting documents.

3. Environmental Compliance Approval Application submitted by Dwight Carey, EHS Manager, Nestle Canada Inc., dated October 5, 2012 and all supporting information.

Upon issuance of the environmental compliance approval, I hereby revoke Approval No(s). 6540-7EVR38 issued on July 10, 2008.

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

1. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval 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.

Pursuant to subsection 139(3) of the Environmental Protection Act, a hearing may not be required with respect to any terms and conditions in this environmental compliance approval, if the terms and conditions are substantially the same as those contained in an approval that is amended or revoked by this environmental compliance approval.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The environmental compliance approval number;
6. The date of the environmental compliance approval;
7. The name of the Director, and;
8. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary* Environmental Review Tribunal 655 Bay Street, Suite 1500 Toronto, Ontario M5G 1E5	AND	The Director appointed for the purposes of Part II.1 of the Environmental Protection Act Ministry of the Environment 2 St. Clair Avenue West, Floor 12A Toronto, Ontario M4V 1L5

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

Tel: (416) 212-6349, Fax: (416) 314-4506 or www.ert.gov.on.ca

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 19th day of February, 2013

Mansoor Mahmood, P.Eng.
Director
appointed for the purposes of Part II.1 of the
Environmental Protection Act

KD/
c: District Manager, MOE Guelph.
Dilan Singaraja, Conestoga-Rovers & Associates.

Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique

AMENDED ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER 6373-AUXPNA
Issue Date: March 19, 2018

Nestlé Waters Canada, a division of Nestlé Canada Inc.
101 Brock Rd S
Puslinch, Ontario
N1H 6H9

Site Location: 101 Brock Road South
Plan 61R-4486
Lot Part Lots 23, 24, Concession 1
Puslinch Township, County of Wellington

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

Proposed improvements to an existing sewage Works with a rated capacity of 15,875 L/d for collection, treatment and subsurface disposal system of domestic sewage to service existing washrooms and lunchroom facilities at the Nestlé Waters Canada, a division of Nestlé Canada Inc. Bottled Water Plant at the above noted site location, and comprising of the following:

PROPOSED WORKS

Proposed Waterloo Biofilter Sewage Treatment Units

two (2) Waterloo Biofilter Treatment Units (2.3 m dia x 2.7 m high), located in the proposed insulated treatment building;

Proposed Anoxic / MBR Tank

one (1) package treatment module (H2Flow Equipment Inc. or Equivalent), a steel tank consisting of an anoxic denitrification zone (Anoxic Tank) and a membrane bioreactor zone (MBR Tank, low pressure gravity discharge membrane) located inside the proposed treatment building; the anoxic zone is dosed with a carbon source (for denitrification), and the membrane is dosed with alum (for precipitation of phosphorous);

Suspended solids from membrane are periodically discharged to a proposed sludge holding tank as described below;

The permeate from the membrane bioreactor flows by gravity to a relocated existing dosing chamber and effluent pumping to three (3) existing disposal fields (Existing Works), as described below;

Proposed Sludge Holding Tank

one (1) precast concrete Sludge Holding Tank located underground in front of the new treatment building, having a total capacity of approximately 14,000 L, equipped with a decant gravity overflow to the proposed recycle chamber to deliver a clear supernatant back to treatment process, and having sludge to be periodically disposed of off-site by a licensed sewage hauler;

Proposed Anoxic Feed and Recycle Chamber

one (1) underground precast concrete two-compartment Anoxic Feed and Recycle Chamber located in front of the new building, having a total capacity of approximately 5,000 L, each compartment equipped with two (2) sewage submersible pumps, each rated at capacity of approximately of 19 L/min at a TDH of 13 m, to supply flow to/from two (2) proposed Waterloo Biofilters and anoxic tank, respectively, as described above;

Relocated Existing Dosing Chamber

one (1) one-compartment dosing chamber to be relocated to a new location (as per Project No. 1403679 by Golder Associates), having a total capacity of approximately 3,500 L, equipped with two (2) submersible effluent pumps (one duty, one stand-by), each rated at approximately 140 L/min at a TDH of 6 m, controlled by a timer dosing control to deliver treated effluent via a 3-outlet Hydrotek automatic discharge valve operated sequentially, with one outlet active during a pump discharge cycle. Two of the outlets are directed (through a common discharge header) to the existing 2-cell conventional leaching bed (described under the Existing Works) discharging treated effluent in quantity of not exceeding 10,583 L/d (2/3 of the total designed flow) to both cells (5,292 L/d per each cell). The third outlet from the Hydrotek valve is directed into the existing shallow buried trench (described under the Existing Works), discharging treated effluent in quantity of not exceeding 5,292 L/d (1/3 of the total designed flow), as described below (Existing Works);

Improvements to Existing Waterloo Biofilters

five (5) existing Waterloo Biofilters, as described in details under Existing Works section, to be upgraded by having additional media added to each biofilter unit, having air fans upgraded with higher air flow;

EXISTING WORKS,

Existing Septic Tanks No.1 and No.2

two (2) two-compartment septic tanks No.1 & 2 installed in series having a total combined capacity of approximately 21,000 L, collecting raw sewage from the washrooms and lunchroom facilities and discharging effluent to the first in-series Pumping Chamber as described below;

Existing Pumping Chambers

two (2) pumping chambers, having a total capacity of approximately 5,500 L, equipped with two (2) sewage submersible pumps (one duty, one stand-by), each rated at capacity of approximately of 140 L/min at a TDH of 10 m and discharging effluent via a 50 mm dia forcemains to a Septic Tank No.3 as described below;

Existing Septic Tank No.3

one (1) two-compartment tank No.3 having a total capacity of approximately 20,000 L equipped with two (2) effluent filters installed on two (2) separate outlets discharging to a Biofilter Dosing Tank as described below;

Existing Biofilter Dosing Tank (Feed Tank)

one (1) one-compartment biofilter dosing tank having a total capacity of approximately 5,500 L equipped with three (3) dosing pumps, each pump rated at capacity of approximately 140 L/min at a TDH of 6 m, dosing to a Waterloo Biofilter Treatment Units as described below;

Existing Waterloo Biofilter Sewage Treatment Units

five (5) Waterloo Biofilter Treatment Units, including four (4) tanks with capacity of 10,000 L and one (1) tank with capacity of 3,785 L, located in the existing insulated building (7.5 m x 5.0 m) to be upgraded by having additional media added to each biofilter unit, having air fans upgraded with higher air flow, and discharging effluent to a relocated Effluent Dosing Chamber as described above (Proposed Works);

Existing Subsurface Sewage Disposal System
a subsurface sewage disposal system consisting of the following:

- **Existing Leaching Bed** - Cell No.1: comprising of nine (9) rows of 100 mm dia perforated distribution piping with a total length of approximately 219.6 m, each pipe 24.4 m long, receiving 1/3 of the total design flow of maximum 5,292 L/d;

- **Existing Leaching Bed** - Cell No.2: comprising of nine (9) rows of 100 mm dia perforated distribution piping with a total length of approximately 219.6 m, each pipe 24.4 m long, receiving 1/3 of the total design flow of maximum 5,292 L/d; and

- **Existing Shallow Buried Trenches**: comprising of three (3) rows of 25 mm dia perforated distribution piping with total length of approximately 72 m, each pipe 24 m long, receiving 1/3 of the total sewage daily flow of maximum of 5,292 L/d.

all in accordance with Supporting Documentation submitted to the Ministry as listed in the **Schedule A** in this Approval.

For the purpose of this environmental compliance approval, the following definitions apply:

1. "Approval" means this entire Approval document and any Schedules to it, including the application and Supporting Documentation;

2. "Average daily flow" means the cumulative total sewage flow to the sewage works during a particular calendar month divided by the number of days during which sewage was flowing to the sewage works that month;

3. "BOD_5" (also known as $TBOD_5$) means five day biochemical oxygen demand measured in an unfiltered sample and includes carbonaceous and nitrogenous oxygen demand;

4. "$CBOD_5$" means five day carbonaceous (nitrification inhibited) biochemical oxygen demand measured in an unfiltered sample;

5. "Director" means a person appointed by the Minister pursuant to Section 5 of the EPA for the purposes of Part II.I of the EPA;

6. "District Manager" means the District Manager of the Guelph District Office;

7. "EPA" means the Environmental Protection Act, R.S.O. 1990, c.E.19, as amended;

8. "Equivalent Equipment" means a substituted equipment or like-for-like equipment that meets the required quality and performance standards of a named equipment;

9. "Grab Sample" means an individual sample of at least 1000 millilitres collected in an appropriate container at a randomly selected time over a period of time not exceeding 15 minutes;

10. "Licensed Installer" means a person who holds a licence under Article 2.12.3.1 of the Ontario Building Code;

11. "Ministry" means the ministry of the government of Ontario responsible for the EPA and OWRA and includes all officials, employees or other persons acting on its behalf;

12. "OBC" means the Ontario Building Code;

13. "Owner" means Nestlé Waters Canada, a division of Nestlé Canada, Inc. and its successors and assignees;

14. "OWRA" means the *Ontario Water Resources Act* , R.S.O. 1990, c. O.40, as amended;

15. "Rated Capacity" means design daily sanitary sewage flow for which the Works are approved to

handle;

16. "Regional Director" means the Regional Director of the West-Central Region of the Ministry;

17. "Professional Engineer" means a person entitled to practice as a Professional Engineer in the Province of Ontario under a licence issued under the Professional Engineers Act;

18. "Supporting Documentation" means the documents listed in Schedule A of this Approval;

19. "Works" means the sewage works described in the Owner's application and this Approval;

20. "L" means Litres;

21. "L/d" means Litres per day;

22. "L/min" means Litres per minute;

23. "dia" means diametre;

24. "m" means metres;

25. "m^2" means square metres;

26. "mm" means millimetres; and

27. "TDH" means Total Dynamic Head.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL PROVISIONS

1. The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

2. Except as otherwise provided by these conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Approval,and the application for approval of the Works.

3. Where there is a conflict between a provision of any document in the schedule referred to in this Approval and the conditions of this Approval, the Conditions in this Approval shall take precedence,

and where there is a conflict between the documents in the schedule, the document bearing the most recent date shall prevail.

4. Where there is a conflict between the documents listed in the Schedule submitted documents, and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

5. The Conditions of this Approval are severable. If any Condition of this Approval,or the application of any requirement of this Approval to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this Approval shall not be affected thereby.

2. EXPIRY OF APPROVAL

1. This Approval will cease to apply to those parts of the Works which have not been constructed within five (5) years of the date of this Approval.

3. CHANGE OF OWNER

1. The Owner shall notify the District Manager and the Director,in writing, of any of the following changes within thirty (30) days of the change occurring:

    a. change of Owner;

    b. change of address of the Owner;

    c. change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the *Business Names Act* , R.S.O. 1990, c.B17 shall be included in the notification to the District Manager;

    d. change of name of the corporation where the Owner is or at any time becomes a corporation, and a copy of the most current information filed under the *Corporations Informations Act* , R.S.O. 1990, c. C39 shall be included in the notification to the District Manager;

2. In the event of any change in ownership of the Works,other than a change to a successor municipality, the Owner shall notify in writing the succeeding owner of the existence of this Approval,and a copy of such notice shall be forwarded to the District Manager and the Director.

4. CONSTRUCTION

1. The Owner shall ensure that the construction of the Works is supervised by a licensed installer or a Professional Engineer, as defined in the *Professional Engineers Act* .

2. The Owner shall ensure that the Waterloo Biofilter Treatment system is installed in accordance with

the Manufacturer's Installation Manual.

3. Upon construction of the Works, the Owner shall prepare a statement, certified by a licensed installer or a Professional Engineer, that the Works are constructed in accordance with this Approval, and upon request, shall make the written statement available for inspection by Ministry staff.

4. Upon construction of the Works, the Owner shall prepare a set of as-built drawings showing the works “as constructed”. "As-built" drawings shall be kept up to date through revisions undertaken from time to time and a copy shall be retained at the site for the operational life of the Works.

5. MONITORING AND RECORDING

The Owner shall, upon commencement of operation of the Works, carry out the following monitoring program:

1. All samples and measurements taken for the purposes of this Approval are to be taken at a time and in a location characteristic of the quality and quantity of the effluent stream over the time period being monitored.

2. Samples shall be collected at the sampling point(s), at the sampling frequencies and using the sample type specified for each parameter listed in the Influent Monitoring Table included in **Schedule B**.

3. Samples shall be collected at the sampling point(s), at the sampling frequencies and using the sample type specified for each parameter listed in the Effluent Monitoring Table included in **Schedule B**.

4. Samples shall be collected at the sampling point(s), at the sampling frequencies and using the sample type specified for each parameter listed in the Groundwater Monitoring Table included in **Schedule B**.

5. Samples shall be collected at the sampling point(s), at the sampling frequencies and using the sample type specified for each parameter listed in the Surface Water Monitoring Table included in **Schedule B**.

6. The Owner shall employ any measurement devices to accurately measure quantity of effluent being discharged to each individual subsurface disposal system, including but not limited to water/wastewater flow meters, event counters, running time clocks, or electronically controlled dosing, and shall record the daily volume of effluent being discharged to the subsurface disposal system, or shall perform a one-time set up and measurement of flow confirming to a design daily discharge flow to each bed, by drawdown test and time measurement to balance the system;

7. The Owner shall ensure that flow of treated effluent discharged into the subsurface sewage system does not exceed 15,875 L/d.

8. The methods and protocols for sampling, analysis and recording shall conform, in order of

precedence, to the methods and protocols specified in the following:

a. the Ministry's Procedure F-10-1, “Procedures for Sampling and Analysis Requirements for Municipal and Private Sewage Treatment Works (Liquid Waste Streams Only), as amended from time to time by more recently published editions;

b. the Ministry's publication "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater" (January 1999), ISBN 0-7778-1880-9, as amended from time to time by more recently published editions; and

c. the publication "Standard Methods for the Examination of Water and Wastewater" (21st edition), as amended from time to time by more recently published editions.

9. The Owner shall retain for a minimum of five (5) years from the date of their creation, all records and information related to or resulting from the monitoring activities required by this Approval.

10. The Owner, after three (3) full years of Works operation, may make a written request to the Regional Director for making changes in monitoring program, subject to review by the Technical Support Section of the Regional Ministry's Office;

6. EFFLUENT OBJECTIVES

1. The Owner shall use best efforts to design, construct and operate the Works with the objective that the concentrations of the materials named as effluent parameters in the Effluent Objectives Table listed in **Schedule B** are not exceeded in the effluent being discharged to the subsurface disposal system.

2. For the purposes of subsection (1):

   a. The monthly average concentrations of CBOD5 and TSS named in Column 1 of Effluent Objectives Table listed in Schedule B should be compared to the corresponding concentration set out in Column 2 of Effluent Objectives Table listed in **Schedule B**.

   b. The concentrations of TP, TAN and Nitrate-Nitrogen named in Column 1 of Effluent Objectives Table listed in Schedule B, as measured at each monitoring event, should be compared to the corresponding concentration set out in Column 2 of Effluent Objectives Table listed in **Schedule B**.

7. EFFLUENT LIMITS

1. The Owner shall design, construct, operate and maintain the Works such that the concentrations of the materials named as effluent parameters in the Effluent Limits Table in **Schedule B** are not exceeded in the effluent from the Works:

2. For the purposes of determining compliance with and enforcing subsection (1):

    a. The concentration of TIN (Total Inorganic Nitrogen) named in Column 1 of Effluent Limits Table listed in **Schedule B**, as measured at each monitoring event, shall not exceed the corresponding maximum concentration set out in Column 2 of Effluent Limits Table listed in **Schedule B**.

8. OPERATIONS AND MAINTENANCE

1. The Owner shall prepare an operations manual within six (6) months of the introduction of sewage to the Works,that includes, but not necessarily limited to, the following information:

    a. operating procedures for routine operation of all the Works;

    b. inspection programs, including frequency of inspection, for all the Works and the methods or tests employed to detect when maintenance is necessary;

    c. repair and maintenance programs, including the frequency of repair and maintenance for all the Works; copies of maintenance contracts for any routine inspections & pump-outs should be included for all the tanks and treatment units;

    d. procedures for the inspection and calibration of monitoring equipment;

    e. a spill prevention control and countermeasures plan, consisting of contingency plans and procedures for dealing with equipment breakdowns, potential spills and any other abnormal situations, including notification of the District Manager; and

    f. procedures for receiving, responding and recording public complaints, including recording any follow-up actions taken.

2. The Owner shall maintain the operations manual current and retain a copy at the location of the Works for the operational life of the Works. Upon request, the Owner shall make the manual available to Ministry staff.

3. The Owner shall prepare and make available for inspection by Ministry staff, a maintenance agreement with the manufacturer for the treatment process/technology and a complete set of "as constructed" drawings within one (1) year of Substantial Completion of the Works. The maintenance agreement and drawings must be retained at the site and kept current at all times.

4. The Owner shall enter into a written Agreement with a licensed hauled sewage system operator for the disposal of septic tank sewage pump outs and sludge from the sewage treatment plant to an approved waste disposal off site, on as required basis. This Agreement must be retained at the site and kept current at all times.

5. The Owner shall ensure that all septic tanks are pumped out every 3-5 years or when the tank is 1/3

full of solids and the effluent filters are cleaned out at minimum once a year or more often if required.

6. The Owner shall ensure that grass-cutting is maintained regularly over all the subsurface disposal beds, and the drainage operations in all beds are visually observed on a monthly basis. In the event a break-out is observed from a subsurface disposal bed, the Owner shall ensure that the sewage discharge to the bed is discontinued and the incident immediately reported verbally to the District Manager, followed by a written report within one (1) week. The Owner shall ensure that during the time remedial actions are taking place the sewage generated at the site shall not be allowed to discharge to a surface water body or to the environment, and safely collected and disposed off through a licensed waste hauler to an approved waste disposal site.

7. The Owner shall ensure that adequate steps are taken to ensure that the area of the Works are protected from all forms of vehicle traffic.

8. The Owner shall employ for the overall operation of the Works a person who possesses the level of training and experience sufficient to allow safe and environmentally sound operation of the Works.

9. REPORTING

1. One week prior to the start up of the operation of the Works, the Owner shall notify the District Manager (in writing) of the pending start up date.

2. The Owner shall report to the District Manager or designate, any exceedance of any effluent limits specified in Schedule B orally, as soon as reasonably possible, and in writing within seven (7) days of the exceedance.

3. In the event that there is an exceedance of effluent limits specified in Schedule B, the Owner shall prepare and submit a contingency plan and implementation schedule, to the District Manager, no later than one (1) month following the exceedance.

4. In addition to the obligations under Part X of the *Environmental Protection Act* , the Owner shall, within 10 working days of the occurrence of any reportable spill as defined in Ontario Regulation 675/98, loss of any product, by-product, intermediate product, oil, solvent, waste material or any other polluting substance into the environment, submit a full written report of the occurrence to the District Manager describing the cause and discovery of the spill or loss, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation.

5. The Owner shall, upon request, make all manuals, plans, records, data, procedures and supporting documentation available to Ministry staff.

6. The Owner shall prepare and submit to the District Manager, a performance report, on an annual calendar basis, within ninety (90) days following the end of the calendar year being reported upon. The reports shall contain, but shall not be limited to, the following information:

a. a summary and description of efforts made and results achieved in meeting the Effluent Objectives of (Condition 6);

b. a summary and interpretation of all monitoring data and a comparison to the Effluent Limits (Condition 7) including an overview of the success and adequacy of the Works, and a Contingency Plan in the event of not in compliance with the Effluent Limits.

c. a summary and interpretation of groundwater monitoring data;

d. a summary and interpretation of surface water monitoring data;

e. a review and assessment of performance of sewage works, including all treatment units and disposal beds;

f. a description of any operating problems encountered and corrective actions taken at all sewage Works located at the property;

g. a record of all maintenance carried out on any major structure, equipment, apparatus, mechanism or thing forming part of all Works located at the property' including but not limited to: records of maintenance inspections for Waterloo Biofilter treatment System, records of septic tank pump-outs, records of septic tank effluent filters cleaning, records of septic tank pump-outs, records of sludge pump-outs accumulated from the treatment system, records of visual inspections of all disposal systems;

h. a summary of any effluent quality assurance or control measures undertaken in the reporting period;

i. a summary and interpretation of all daily flow data and results achieved in not exceeding the maximum daily sewage flow discharged into each one of the subsurface disposal system;

j. a summary of any complaints received during the reporting period and any steps taken to address the complaints;

k. a summary of all spill or abnormal discharge events;

l. any other information the District Manager requires from time to time;

Schedule A

1. Application for Approval of Municipal and Private Sewage Works, dated June 21, 2001 submitted by Robert Mustart of Aberfoyle Springs Ltd. including the Aberfoyle Springs Ltd. Wastewater Treatment Upgrade, prepared by K. Smart Associates Limited and all correspondence (letters dated July 18, 2001 and August 22, 2001 from David Harsch, P.Eng of K. Smart Associates Limited to B. Manowski, P.Eng. of the Ministry.

2. Application for Environmental Compliance Approval submitted by Mark Gurthrie, P.Eng. of Golder Associates Ltd. received on March 29, 2017 for the proposed sewage Works improvements to service existing washroom and laundry facilities at the Aberfoyle Water Plant, including Environmental Study Report, design report, final plans and specifications.

Schedule B

Influent Monitoring Table

Sampling Location	upstream of the Existing Treatment System (existing Treatment Bldg.)
Frequency	twice a month
Sample Type	Grab
Parameters	BOD5 Total Suspended Solids (TSS) Total Kjeldahl Nitrogen (TKN) Total Phosphorus (TP)

Effluent Monitoring Table

Sampling Location	on discharge from the final MBR treatment stage (proposed Treatment Bldg.)
Frequency	twice a month
Sample Type	Grab
Parameters	$CBOD_5$ Total Suspended Solids (TSS) Total Phosphorus (TP) Total Ammonia Nitrogen (TAN) Nitrate Nitrogen Nitrite Nitrogen Total Kjedhal Nitrogen (TKN) pH Temperature (ambient and wastewater)

Groundwater Monitoring Table

Sampling Location	- two (2) existing monitoring wells (MW2-02 & MW3R-05); - two (2) proposed overburden monitoring wells to be constructed at the same depth as the existing monitoring wells, located at the property boundary and west of MW2-02 & MW3R-05 within the anticipated attenuation area as shown on Fig.1 of Golder Associates Addendum dated November 1, 2017;
Frequency	quarterly
Sample Type	Grab
Parameters	Nitrate - Nitrogen Nitrite - Nitrogen Unionized Ammonia Total Kjeldahl Nitrogen (TKN) Water level

Surface water Monitoring Table

Sampling Location	Aberfoyle Creek - upstream and downstream of the leaching bed
Frequency	monthly
Sample Type	Grab
Parameters	TP Nitrate - Nitrogen Nitrite - Nitrogen Total Ammonia Unionized Ammonia (calculated) field temperature, field pH, field dissolved oxygen & field conductivity

Effluent Objectives Table

Effluent Parameter (tested on outlet from the final MBR Treatment Stage)	**Concentration Objective** (milligrams per litre unless otherwise indicated)
CBOD5	10 mg/l
Total Suspended Solids	10 mg/l
Total Phosphorous	1 mg/l
Total Ammonia Nitrogen (TAN)	17.3 mg/l
Nitrate-Nitrogen	< 10 mg/l

Effluent Limits Table

Effluent Parameter (tested on outlet from the final MBR Treatment Stage)	**Concentration Limit** (milligrams per litre unless otherwise indicated)
TIN (Total Inorganic Nitrogen)	11.63 mg/l
Nitrate-Nitrogen	10 mg/l
Unionized Ammonia	1.63 mg/l

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

1. Condition 1 is imposed to ensure that the Works are built and operated in the manner in which they were described for review and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review. The condition also advises the Owners their responsibility to notify any person they authorized to carry out work pursuant to this Approval the existence of this Approval.

2. Condition 2 is included to ensure that, when the Works are constructed, the Works will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment.

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to the approved works and to ensure that subsequent owners of the Works are made aware of the Approval and continue to operate the Works in compliance with it.

4. Condition 4 is included to ensure that the works are constructed, and may be operated and maintained such that the environment is protected and deterioration, loss, injury or damage to any person or property is prevented.

5. Condition 5 is included to enable the Owner to evaluate and demonstrate the performance of the Works, on a continual basis, so that the Works are properly operated and maintained at a level which is consistent with the design objectives specified in the Approval and that the Works does not cause any impairment to the receiving watercourse.

6. Condition 6 is imposed to establish non-enforceable effluent quality objectives which the Owner is obligated to use best efforts to strive towards on an ongoing basis. These objectives are to be used as a mechanism to trigger corrective action proactively and voluntarily before environmental impairment occurs.

7. Condition 7 is imposed to ensure that the effluent discharged from the Works to the subsurface meets the Ministry's effluent quality requirements thus minimizing environmental impact on the receiver.

8. Condition 8 is included to require that the Works be properly operated, maintained, and equipped such that the environment is protected. As well, the inclusion of an operations manual, maintenance agreement with the manufacturer for the treatment process/technology and a complete set of "as constructed" drawings governing all significant areas of operation, maintenance and repair is prepared, implemented and kept up-to-date by the owner and made available to the Ministry. Such information is an integral part of the operation of the Works. Its compilation and use should assist the Owner in staff training, in proper plant operation and in identifying and planning for contingencies during possible abnormal conditions. The manual will also act as a benchmark for Ministry staff when reviewing the Owner's operation of the work.

9. Condition 9 is included to provide a performance record for future references, to ensure that the Ministry is made aware of problems as they arise, and to provide a compliance record for all the terms and conditions outlined in this Approval, so that the Ministry can work with the Owner in resolving any problems in a timely manner.

Upon issuance of the environmental compliance approval, I hereby revoke Approval No(s). 3152-55LQ59 issued on January 4, 2002

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

Pursuant to subsection 139(3) of the Environmental Protection Act, a hearing may not be required with respect to any terms and conditions in this environmental compliance approval, if the terms and conditions are substantially the same as those contained in an approval that is amended or revoked by this environmental compliance approval.

The Notice should also include:

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;
6. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary* Environmental Review Tribunal 655 Bay Street, Suite 1500 Toronto, Ontario M5G 1E5	AND	The Director appointed for the purposes of Part II.1 of the Environmental Protection Act Ministry of the Environment and Climate Change 135 St. Clair Avenue West, 1st Floor Toronto, Ontario M4V 1P5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 19th day of March, 2018

Fariha Pannu.

Fariha Pannu, P.Eng.
Director
appointed for the purposes of Part II.1 of the *Environmental Protection Act*

BM/

c: District Manager, MOECC Guelph
Brenda Law, Township of Puslinch
Dave Featherstonhaugh, Golder Associates Ltd.
Kevin Darbelnet, Nestlé Waters North America Inc.

APPENDIX B

Well Information

Attachment 2

Project Name: ABERFOYLE FISHERIES	Borehole No. TW3-80
Job No. 979-653	Date Completed April 14/80
Client: CUSTOM AGGREGATE	Geologist/Engineer A.V.N.
Borehole Type: 12" Ø Cable Tool	Elevation 1040.90, top of casing
Location: Pit No. 1, Aberfoyle	

Depth (Elev.)	Stratigraphy	Description & Remarks	Sample Number	Sample Type	Sample 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.	Lot
Wellington	Puslinch	Con 7	23, 2

Owner	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			
Brown	" sand	Gravels		0	20
M. Br.		Rock		20	47
D. Br.		Rock		47	55
Black		Rock		55	75
M. Br.		Rock		75	85
Grey & Br.		Rock		85	95
D. Grey		Rock		95	135
				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.	Material	Wall thickness	Depth From	Depth To
12"	Steel	.250	0	48
12	Open hole		48	139

PLUGGING & SEALING RECORD

Depth From	Depth To	Material and type
102	118	Cement
118	130	bentonite grout
130	139	limestone gravel

PUMPING TEST

Pumping test method: Pump
Pumping rate: 1200 GPM; Duration of pumping: 24 hours
Static level: 11' 6"; Water level end of pumping: 50 ft.
Recovery: 11' 6"
Recommended pump type: Deep
Recommended pump setting: 100 ft.; Recommended pumping rate: 1200 GPM

LOCATION OF WELL

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

TW #3
1000'
750'
TW #1
#6 Hgh.
1/4 mile
N
Push. Twsp. Rd. #35

FINAL STATUS OF WELL

Water supply

WATER USE

Commercial

METHOD OF DRILLING

Cable tool

CONTRACTOR

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

Address: Guelph, Ont.

Name of Driller: J. Hawkins 22w

Submission date: 30 Apr. 80

CONTRACTOR'S COPY

Office Use Only

FORM NO. 7M-4-7...

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2A-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL
	TOP OF CASING	313.01
	TOP OF RISER	312.98
	GROUND SURFACE	311.99
	PT PEAT - with silt, trace clay, soft, fibrous, low plasticity, black to dark brown, moist, rootlets	
0.5	- firm at 0.76m BGS	
1.0		
1.5	SM/ML SAND AND SILT - trace gravel, trace clay, loose, slightly cohesive, fine to medium grained, poorly graded, grey with some brown, wet, slightly dilatant	310.62
2.0		
2.5	SM SILTY GRAVELLY SAND - compact, fine to coarse grained, well graded, greyish brown, wet	309.70
3.0	- with silt at 3.05m BGS	
3.5		
4.0		
4.5	- silty, wet, highly dilatant at 4.57m BGS	
5.0		
5.5	- trace gravel from 5.33 to 5.64m BGS - with gravel at 5.64m BGS	
6.0	ML SANDY SILT (TILL) - with gravel, trace clay, very stiff, low plasticity, grey, very moist to moist	305.89
6.5		
7.0	SM/GM SAND AND GRAVEL - with silt, trace clay, random cobbles, compact, fine to coarse grained, well graded, brown, wet	305.13
7.5	- greyish brown at 7.62m BGS	
8.0		
8.5		
9.0		
9.5		
		302.08

Monitoring Well:
- 254 mm Ø Borehole
- 51 mm Ø Sch 40 PVC Riser
- Cement Bentonite Grout
- Bentonite Grout
- 102 mm Ø Steel Casing

SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
1		67	2
2		50	10
3		17	7
4		37.5	15
5		0	20
6		25	16
7		6	12
8		25	9
9		12.5	26
10		37.5	17
11		12.5	12
12		37.5	25
13		4	31

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2A-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML/SM SILT AND SAND (TILL) - with gravel, trace clay, random cobbles, very dense, low plasticity, light brown to tan, moist		Cement Bentonite Grout				
10.5	END OF OVERBURDEN HOLE @ 10.36m BGS						
11.0							
11.5							
12.0							
12.5							
13.0							
13.5							
14.0							
14.5							
15.0							
15.5							
16.0							
16.5							
17.0							
17.5							
18.0							
18.5							
19.0							
19.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAINS SIZE ANALYSIS

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2A-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS: 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5

STRATIGRAPHIC DESCRIPTION & REMARKS

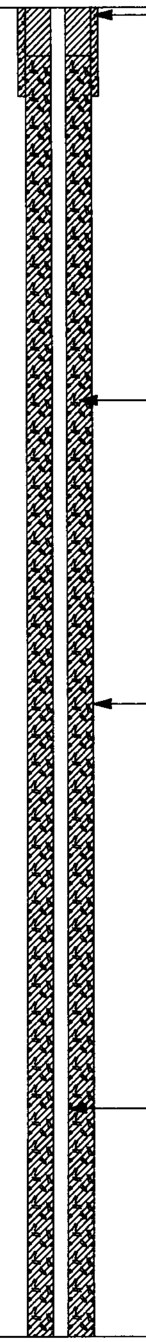
ELEV. m AMSL: 301.62

DOLOSTONE (GUELPH FORMATION) - fractured, weathered, buff to tan
- subhorizontal fracture @25° at 10.67m BGS
- thin black styolite at 10.69m BGS
- light grey with tan nodules at 10.70m BGS
- horizontal fracture thru styolite, tight, crystalline, at 10.74m BGS
- small fossil ~ 1 cm Ø at 10.77m BGS
- low to moderate fracturing, low weathering, occasional vug, tan to light grey from 10.82 to 12.34m BGS
- thin black styolites 10.86 m and at 10.87m BGS
- horizontal fracture, very close at 11.02m BGS
- vuggy zone, vugs small ~ 2 cm Ø from 11.23 to 11.94m BGS
- horizontal fracture, crystalline surface, very close at 11.30m BGS
- highly fractured horizontally and vertically, oxidized from 11.53 to 11.61m BGS
- large vug, crystalline interior, oxidized at 11.66m BGS
- horizontal fracture, crystalline interior, oxidized, very close at 11.73m BGS
- horizontal fracture, crystalline surface, very close at 12.02m BGS

ELEV. m AMSL: 297.20

- subvertical fracture ~ 80°, oxidized, very close, crystalline interior from 12.02 to 12.06m BGS
- moderately fractured, moderately weathered, vuggy, tan from 12.34 to 13.87m BGS
- horizontal fracture, very close at 12.37m BGS
- horizontal fracture, very close, crystalline surface at 12.44m BGS
- subhorizontal fracture ~ 20°, very close, crystalline interior, oxidized at 12.53 m and at 12.73m BGS
- horizontal fracture, very close, oxidized at 12.75m BGS
- grey at 12.78m BGS
- vuggy zone, vugs small ~ 2 cm Ø from 12.80 to 13.72m BGS
- thin black stylolite at 12.80m BGS
- vug ~ 5 cm Ø, crystalline interior at 13.18m BGS
- subhorizontal fracture ~ 20°, very close, crystalline interior at 13.23m BGS
- numerous small vugs, ~ 3 cm Ø, crystalline interiors at 13.31m BGS
- horizontal fracture, very close, crystalline surface at 13.36m BGS
- ~3 cm Ø vug, crystalline interior at 13.39m BGS

Monitoring Well



RUN NUMBER	CORE RECOVERY %	RQD %
1	100	100
2	100	88
3	100	83
4	100	77
5	100	97
6	100	82
7	100	86

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2A-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS: 20.5, 21.0, 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 25.5, 26.0, 26.5, 27.0, 27.5, 28.0, 28.5, 29.0, 29.5

STRATIGRAPHIC DESCRIPTION & REMARKS

- thin black styolites at 13.56 m and at 13.69m BGS
- mechanical break, crystalline interior at 13.74m BGS
- moderately fracture, moderate to low weathering, microcrystalline, light grey from 13.87 to 14.63m BGS
- subhorizontal fracture ~ 10°, very close at 13.92m BGS
- horizontal fractures, very close, at 14.00 m and at 14.12m BGS
- highly fractured horizontally and vertically, crystalline, oxidized from 14.17 to 14.30m BGS
- vuggy zone, vugs small ~ 1 cm Ø from 14.50 to 14.63m BGS
- subhorizontal fractures ~ 10°, very close, oxidized at 14.50 m and at 14.61m BGS
- horizontal fracture, very close at 14.73m BGS

SHALEY LIMESTONE (ERAMOSA FORMATION) - shaley, thinly bedded, frequent thin black styolites, microcrystalline, bitumus odour

- subhorizontal fracture ~ 10°, very close at 15.11m BGS
- vuggy zone, vugs small ~ 1 cm Ø from 15.16 to 15.24m BGS
- moderate to low fracturing, low weathering, shaley interbeds, frequent thin black stylolites, thinly bedded, slightly vuggy, dark grey to black, bitumus like odour, small light brown nodules from 15.39 to 16.92m BGS
- subhorizontal fracture ~ 5°, very close at 15.57m BGS
- subhorizontal fracture ~ 10°, very close at 16.36m BGS
- horizontal fracture, very close at 15.83 m and at 16.41m BGS
- vug, ~ 2.5 cm Ø, crystalline interior from 16.41 to 16.43m BGS
- subhorizontal fracture ~ 10°, very close at 16.56m BGS
- horizontal fracture, slightly weathered, very close at 16.69m BGS
- ~ 2 cm Ø crystalline vug, oxidized at 16.86m BGS
- moderately fractured, low to moderately weathered, dark grey, occasional vug, shaley, bitumus odour from 16.92 to 18.44m BGS
- horizontal fracture, very close, at 16.99 m and at 17.03m BGS
- ~ 3 cm Ø, crystalline interior, quartz and pyrite crystals in interior at 17.35m BGS
- subhorizontal fracture ~ 5°, very close at 17.45m BGS
- ~ 5 cm Ø vug, crystalline interior at 17.53m BGS
- horizontal fracture, crystalline, quartz crystals

ELEV. m AMSL: 288.92

Monitoring Well

- 98 mm Ø Corehole
- 51 mm Ø Sch 40 PVC Riser
- Bentonite Gravel Seal
- No. 1 Silica Sand
- 51 mm Ø Sch 40 PVC Well Screen

RUN NUMBER	CORE RECOVERY %	RQD %
8	100	92
9	100	86
10	100	82
11	100	0
12	100	93
13	100	96
14	100	88
15	100	90

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2A-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
30.5	from 17.75 to 17.78m BGS - horizontal fracture, crystalline surface, very close at 17.98m BGS - vuggy zone, vugs ~ 1 cm Ø, slightly crystalline interior from 18.06 to 18.31m BGS		51 mm Ø Sch 40 PVC Well Screen			
31.0 – 32.0	- horizontal fracture, very close, crystalline surface, saphallorite and galena crystals at 18.19m BGS - horizontal fracture, very close, fine grained fracture surface at 18.34m BGS - moderate to low fracturing, low weathering, dark grey, shaley, bitumus odour from 18.44 to 19.41m BGS		No. 1 Silica Sand	16	100	99
32.5 – 33.0	- horizontal fracture, very close at 18.54m BGS - subhorizontal fracture ~ 5°, very close at 18.75 m and at 18.80m BGS - subhorizontal fracture ~ 10°, very close at 18.59 m and at 18.92m BGS - mechanical break at 19.10m BGS			17	100	88
33.5 – 34.5	- horizontal fracture, close to very close at 19.20m BGS - ~ 2 cm Ø vug, crystalline interior at 19.30m BGS - low fracturing, low weathering, microcrystalline, tan with dark grey, occasional vug, bitumus odour from 19.41 to 21.03m BGS		98 mm Ø Corehole	18	100	100
35.0 – 36.0	- dark grey from 19.41 to 19.84m BGS - transition to light grey to tan at 19.84m BGS - subhorizontal fracture ~ 10°, very close at 20.50m BGS - thin black styolites at 20.14 m and at 20.64m BGS - horizontal fractures, very close at 20.63 m, 20.65 m, and at 20.70m BGS			19	100	98
36.5 – 38.0	- subhorizontal fracture ~ 10°, very close at 20.75m BGS - moderate to low weathering, moderate to low fracturing, dark grey with some light tan and grey zones, bitumus odour, occasional small vugs from 21.03 to 21.49m BGS - horizontal fracture, very close at 21.30m BGS - subhorizontal fracture ~ 5°, very close, rough surface at 21.31m BGS - thin black styolites at 20.96 m, 21.36 m, and at 21.39m BGS	273.73	Bentonite Gravel Seal	20	100	100
38.5 – 39.5	- low to moderate fracturing, low weathering, microcrystalline, dark grey, styolite beds, bitumus odour from 21.49 to 23.01m BGS - ~ 10° stylolite at 21.62m BGS - horizontal fracture, very close at 21.74m BGS - subhorizontal fracture ~ 10°, very close, relatively smooth surface at 22.15m BGS - horizontal fracture thru shaley zone, very close at 22.30m BGS - horizontal fracture, very close, smooth surface at 22.45m BGS		WELL DETAILS Screened interval: 282.95 to 279.91m AMSL 29.03 to 32.08m BGS Length: 3.05m Diameter: 51mm Slot Size: 10 Material: Schedule 40 PVC Seal: 301.62 to 284.33m AMSL			

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2A-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
	- ~ 45° fracture, very close, relatively smooth surface at 22.56m BGS		10.36 to 27.66m BGS			
40.5	- horizontal fractures thru shaley zones, very close at 22.63 m and at 22.66m BGS		Material: Bentonite Gravel			
	- thin black styolites at 22.86 m and at 22.88m BGS		Sand Pack: 284.33 to 278.92m AMSL			
41.0	- vertical fracture, rough, very close from 23.11 to 23.14m BGS		27.66 to 33.07m BGS			
41.5	- horizontal fracture, very close, rough at 23.11 m and at 23.14m BGS		Material: No. 1 Silica Sand			
42.0	- ~ 45° fracture, very close from 23.14 to 23.27m BGS					
42.5	DOLOMITIC LIMESTONE (AMABEL FORMATION) - fractured horizontally and vertically, microcrystalline to crystalline, buff to light brown, occasional styolite					
43.0	- thin black styolites at 23.28 m and at 23.49m BGS					
	- vertical fracture, very close, slightly oxidized from 23.55 to 24.51m BGS					
43.5	- horizontal fractures, very close, rough at 23.87 m and at 24.33m BGS					
44.0	- ~ 45°subhorizontal fracture, very close, rough from 24.38 to 24.44m BGS					
	- thin black styolites at 24.46 m and at 24.48m BGS					
44.5	- moderate to low fracturing, low weathering, microcrystalline to crystalline, occasional styolite from 24.54 to 26.06m BGS					
45.0	- thin black styolites at 24.48, 24.59, 24.66, 24.69, 24.71, 24.77, 24.79, 24.92, 24.94, and at 24.99m BGS					
45.5	- horizontal fractures, very close, rough at 25.37 and at 25.45m BGS					
46.0	- thin black styolites at 24.48, 25.53, and at 25.60m BGS					
	- horizontal fractures, very close, rough at 25.63 and at 25.83m BGS					
46.5	- ~ 5°subhorizontal fracture, very close, rough at 25.88m BGS					
47.0	- horizontal fracture, very close, rough at 25.98m BGS					
47.5	- low fracturing, low weathering, tan turning to light grey, microcrystalline, styolites from 26.06 to 27.58m BGS					
	- thin black styolite at 26.31m BGS					
48.0	- thin black styolite at 26.44m BGS					
	- thin black styolite at 26.52m BGS					
48.5	- thin black styolites at 26.31, 26.44, and at 26.85m BGS					
	- horizontal fractures, very close, rough at 26.11 and at 26.92m BGS					
49.0	- horizontal fracture thru styolite, very close, rough at 27.13m BGS					
49.5	- thin black styolites at 27.30 and at 27.43m BGS					
	- light brown from 27.58 to 28.25m BGS					
	- horizontal fractures, rough at 27.80 and at					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ☐

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2A-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
50.5	27.92m BGS - thin black styolites at 27.89, 27.98, 28.10, 28.19, and at 28.22m BGS - horizontal fracture, rough at 28.25m BGS - light to dark grey from 28.26 to 29.11m BGS					
51.0	- vuggy zones fronm 28.32 to 28.41 m BGS and from 28.68 to 28.71m BGS - horizontal fracture, trace silt infilling, oxidized at 28.74m BGS					
51.5	- horizontal fracture at 28.99m BGS - beige to light grey from 29.11 to 30.63m BGS					
52.0	- vuggy zones from 28.96 to 29.00 m BGS and from 29.20 to 29.38m BGS - horizontal fracture, rough at 29.26m BGS					
52.5	- 2.5 cm horizontal fracture, medium grained infilling, oxidized at 29.93m BGS					
53.0	- horizontal fracture with 3.8 cm near vertical fracture, oxidized at 29.99m BGS - vuggy zones from 29.60 to 29.66 m BGS, 30.08 to 30.27 m BGS, and from 30.42 to 30.51m BGS					
53.5	- horizontal fracture, slightly oxidized at 30.50m BGS					
54.0	- thin black styolite at 30.51m BGS - horizontal fracture, vuggy, high fossil content at 30.83m BGS					
54.5	- horizontal fracture, vuggy at 30.94m BGS - horizontal fracture, high fossil content at 31.27m BGS					
55.0	- horizontal fracture, vuggy, high fossil content at 32.19m BGS					
55.5	- start of high fossil content (bryozoan/brachiopod) at 32.22m BGS - slightly oxidized from 32.52 to 32.92m BGS					
56.0	- vertical fracture, slightly oxidized, highly fossilized, light beige from 33.38 to 33.68m BGS					
56.5	- light grey, highly fossilized from 33.68 to 35.20m BGS - horizontal fracture, highly fossilized at 35.23m BGS					
57.0	- horizontal fractures at 32.67, 32.92, 33.39, 33.50, 34.26, 34.66, and at 35.54m BGS					
57.5	- end of fossil content at 35.66m BGS - horizontal fracture at 37.49m BGS					
58.0	- thin black styolites at 35.63, 35.72, 35.87, 35.91, 35.97, 36.03, 36.09, 36.21, 36.24, 36.39, 36.42, 36.58, 36.79, 36.94, 37.03, 37.34, 37.64, and at 37.83m BGS					
58.5	END OF BOREHOLE @ 38.25m BGS					
59.0						
59.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ☐

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2B-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	TOP OF CASING	312.80					
	TOP OF RISER	312.77					
	GROUND SURFACE	312.06					
	PT PEAT - with silt, trace clay, soft, fibrous, low plasticity, black to dark brown, moist, rootlets						
0.5							
	- firm at 0.76m BGS						
1.0							
1.5	SM/ML SAND AND SILT - trace gravel, trace clay, loose, slightly cohesive, fine to medium grained, poorly graded, grey with some brown, wet, slightly dilatant	310.69	254 mm Ø Borehole				
2.0							
2.5	SM SILTY GRAVELLY SAND - compact, fine to coarse grained, well graded, greyish brown, wet	309.77					
3.0	- with silt at 3.05m BGS		Bentonite Grout				
3.5							
4.0							
4.5	- silty, wet, highly dilatant at 4.57m BGS		Cement Bentonite Grout				
5.0							
5.5	- trace gravel from 5.33 to 5.64m BGS - with gravel at 5.64m BGS						
6.0	ML SANDY SILT (TILL) - with gravel, trace clay, very stiff, low plasticity, grey, very moist to moist	305.96	51 mm Ø Sch 40 PVC Riser				
6.5							
7.0	SM/GM SAND AND GRAVEL - with silt, trace clay, random cobbles, compact, fine to coarse grained, well graded, brown, wet	305.20					
7.5	- greyish brown at 7.62m BGS						
8.0				1	☒	12.5	34
8.5			102 mm Ø Steel Casing				
9.0				2		0	>50
9.5							
		302.15		3		0	>50

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2B-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML/SM SILT AND SAND (TILL) - with gravel, trace clay, random cobbles, very dense, low plasticity, light brown to tan, moist						
10.5	DOLOSTONE (GUELPH FORMATION) - fractured, weathered, buff to tan, microcrystalline	301.70					
11.0			Bentonite Gravel Seal				
11.5							
	END OF OVERBURDEN HOLE @ 11.73m BGS						
12.0							
12.5							
13.0							
13.5							
14.0							
14.5							
15.0							
15.5							
16.0							
16.5							
17.0							
17.5							
18.0							
18.5							
19.0							
19.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2B-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

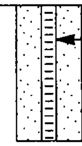
DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
11.5						
12.0	DOLOSTONE (GUELPH FORMATION) - microcrystalline, moderate fractured, low to moderate weathering, slightly vuggy - ~45 ° subhorizontal fracture, very close, rough, oxidized at 11.89m BGS - vuggy zone from 11.89 to 11.99m BGS - ~30 ° subhorizontal fracture, very close, rough, oxidized at 11.90m BGS - horizontal fracture, very close, rough, oxidized at 11.94m BGS - vug, oxidized, crystalline interior at 11.95m BGS - ~ 2 cm Ø vug, crystalline interior at 11.98m BGS - shaley zone, dark grey from 12.09 to 11.80m BGS - vuggy, microcrystalline from 12.19 to 13.72m BGS	300.32		1	89	90
12.5						
13.0			98 mm Ø Corehole	2	100	88
13.5						
14.0						
14.5				3	100	86
15.0	- thin black styolites at at 12.23, 12.28, 12.41, and at 12.53m BGS - small vugs at 12.33, 12.50 and at 12.53m BGS - horizontal fracture, very close, rough, highly weathered at 12.55m BGS - horizontal fracture, very close, smooth at 12.62m BGS - small vugs at 12.64m BGS - horizontal fracture, very close, smooth, unweathered at 12.70m BGS - thin black styolites at 12.83 and at 12.89m BGS - ~15 ° subhorizontal fracture, rough, very close, unweathered at 13.08m BGS - horizontal fracture, rough, very close, moderately weathered at 13.21m BGS - horizontal fracture, smooth, very close, unweathered at 13.31m BGS - small vugs at 13.23 and at 13.36m BGS - moderately fractured, low weathering, microcrystalline, grey, occasional vug, occasional styolite from 13.72 to 14.94m BGS - thin black styolite at 13.77m BGS - vugs, crystalline interiors at 13.88, 14.01, 14.07, and at 14.12m BGS - horizontal fracture, highly weathered, very close, rough at 14.15m BGS - vuggy zone from 14.15 to 14.40m BGS - ~80 ° subvertical fracture, oxidized, smooth from 14.33 to 14.50m BGS - subhorizontal fracture, very close, rough, unweathered at 14.43m BGS - horizontal fractures, rough, very close, unweathered at 14.47 and at 14.50m BGS	297.12				
15.5						
16.0			51 mm Ø Sch 40 PVC Riser	4	100	86
16.5						
17.0						
17.5				5	100	81
18.0						
18.5						
19.0			Bentonite Gravel Seal	6	98	93
19.5						
20.0						
20.5			No. 1 Silica Sand	7	100	93

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2B-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
21.5	- horizontal fracture, rough, brown hard infilled styolite, very close, unweathered at 14.82m BGS - vug at 14.94m BGS - horizontal fracture, rough, very close, unweathered at 15.02m BGS		 51 mm Ø Sch 40 PVC Well Screen 98 mm Ø Corehole	8	45	76
22.0	SHALEY LIMESTONE (ERAMOSA FORMATION) - microcrystalline, low fracturing, low weathering, dark grey, bitumus odour	290.04				
22.5 – 30.5	- subhorizontal fracture, rough, very close, oxidized at 15.24m BGS - horizontal fracture, rough, very close, fractured, styolite, unweathered at 15.39m BGS - vug, calcilite crystals at 15.83m BGS - vuggy zone from 15.85 to 16.48m BGS - vug at 15.90m BGS - horizontal fracture thru styolite, rough, very close, unweathered at 15.95m BGS - horizontal fracture thru styolite, rough, very close at 16.18m BGS - pyrite nodule from 16.42 to 16.46m BGS - subhorizontal fracture thru styolite, rough, very close at 16.51m BGS - ~40 ° subhorizontal fracture, rough, very close, unweathered at 16.56m BGS - horizontal fracture, rough, very close, oxidized at 16.64m BGS - vug with calcite crystal infilling at 16.79m BGS - vuggy zone, calcite crystal infilling from 16.86 to 16.93m BGS - thin black styolite at 16.86m BGS - vug, calcite crystal infilling at 16.88m BGS - subhorizontal fracture, smooth, very close, unweathered at 17.15m BGS - subhorizontal fracture, very close, smooth, unweathered at 17.22m BGS - ~30 ° subhorizontal fractures, smooth, very close, unweathered at 17.45 and at 17.53m BGS - ~30 ° subhorizontal fracture, smooth, very close, highly weathered at 17.55m BGS - vuggy zone from 17.58 to 17.98m BGS - vug, calcite crystal interior at 17.61m BGS - large vug, calcite and pyrite crystal infilling from 17.65 to 17.78m BGS - vug, calcite crystal infilling at 17.81m BGS - subhorizontal fracture, rough, very close, highly weathered at 18.04m BGS - vug, calcite and pyrite interior from 18.05 to 18.08m BGS - increase in fossil content from 18.08 to 18.14m BGS - subhorizontal fracture, smooth, very close, unweathered at 18.21m BGS - ~25 ° subhorizontal fracture, very close,		WELL DETAILS Screened interval: 291.56 to 290.04m AMSL 20.50 to 22.02m BGS Length: 1.52m Diameter: 51mm Slot Size: 10 Material: Schedule 40 PVC Seal: 301.54 to 291.94m AMSL 10.52 to 20.12m BGS Material: Bentonite Gravel Sand Pack: 291.94 to 290.04m AMSL 20.12 to 22.02m BGS Material: No. 1 Silica Sand			

Depth scale: 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 25.5, 26.0, 26.5, 27.0, 27.5, 28.0, 28.5, 29.0, 29.5, 30.0, 30.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2B-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
	unweathered at 18.29m BGS					
31.5	- ~30 ° subhorizontal fracture, smooth, very close, highly weathered at 18.44m BGS					
	- pyrite crystal at 18.45m BGS					
32.0	- thin black styolites at 18.39 and at 18.48m BGS					
	- vuggy zone from 18.67 to 18.72m BGS					
32.5	- crystalline layer, light grey, from 18.75 to 18.76m BGS					
	- ~20 ° subhorizontal fracture, smooth, very close, unweathered at 18.85m BGS					
33.0	- horizontal fracture, smooth, very close, unweathered at 18.90m BGS					
33.5	- horizontal fracture, smooth, very close, unweathered at 19.05m BGS					
	- mechanical break at 19.19m BGS					
34.0	- horizontal fracture, smooth, very close, unweathered at 19.24m BGS					
	- thin black styolites at 19.18 and at 19.38m BGS					
34.5	- vug, crystalline interior at 19.44m BGS					
	- vug, calcite interior at 19.66m BGS					
35.0	- horizontal fractures, very close, rough, moderately weathered at 19.54 and at 19.74m BGS					
35.5	- thin black styolite at 19.97m BGS					
	- trace fossils from 19.81 to 19.89 m BGS and from 19.98 to 20.04m BGS					
36.0	- vug, calcite interior at 20.03m BGS					
36.5	- ~45 ° subhorizontal fracture, rough, very close, unweathered, fossil in fracture surface at 20.10m BGS					
	- vuggy zones from 19.97 to 20.03 m BGS and from 20.14 to 20.19m BGS					
37.0	- thick black styolite from 20.24 to 20.29m BGS					
	- vuggy zone from 20.35 to 20.55m BGS					
37.5	- horizontal fracture, rough, very close, moderately weathered at 20.50m BGS					
38.0	- subhorizontal fractures, rough, very close, moderately weathered, trace fossil at 20.57 and at 20.64m BGS					
	- crynoids at 20.78m BGS					
38.5	- trace fossil from 20.82 to 20.84m BGS					
39.0	- horizontal fractures, rough, very close, moderately weathered, trace fossil at 20.88 and at 20.98m BGS					
	- thin black styolites at 20.83 and at 21.03m BGS					
39.5	- horizontal fracture, rough, very close, moderately weathered at 21.10m BGS					
40.0	- horizontal fracture, rough, very close, moderately weathered, trace fossil at 21.20m BGS					
40.5	- thin black styolites at 21.11 and at 21.41m BGS					
	- horizontal fracture, rough, very close, highly weathered at 21.42m BGS					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2B-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
41.5 – 43.0	- crynoids from 21.43 to 21.51m BGS - pyrite crystal at 21.59m BGS - horizontal fracture, very close, rough, unweathered at 21.74m BGS - horizontal fracture, smooth, very close, unweathered, trace fossil at 21.82m BGS - thin black styolites at 21.75 and at 21.87m BGS - trace fossils from 21.06 to 21.08 m BGS, 21.74 to 21.82 m BGS, and from 22.00 to 22.02m BGS					
43.0	END OF BOREHOLE @ 22.02m BGS					
43.5	Note: Overburden stratigraphy obtained during advancement of MW2A-07					
44.0						
44.5						
45.0						
45.5						
46.0						
46.5						
47.0						
47.5						
48.0						
48.5						
49.0						
49.5						
50.0						
50.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2C-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	TOP OF CASING	312.91					
	TOP OF RISER	312.88					
	GROUND SURFACE	311.92					
	PT PEAT - with silt, trace clay, soft, fibrous, low plasticity, black to dark brown, moist, rootlets						
0.5							
	- firm at 0.76m BGS						
1.0							
	SM/ML SAND AND SILT - trace gravel, trace clay, loose, slightly cohesive, fine to medium grained, poorly graded, grey with some brown, wet, slightly dilatant	310.55	254 mm Ø Borehole				
1.5							
2.0							
	SM SILTY GRAVELLY SAND - compact, fine to coarse grained, well graded, greyish brown, wet	309.63					
2.5							
3.0	- with silt at 3.05m BGS		Bentonite Grout				
3.5							
4.0							
4.5	- silty, wet, highly dilatant at 4.57m BGS		Cement Bentonite Grout				
5.0							
	- trace gravel from 5.33 to 5.64m BGS						
5.5	- with gravel at 5.64m BGS						
6.0							
	ML SANDY SILT (TILL) - with gravel, trace clay, very stiff, low plasticity, grey, very moist to moist	305.82	51 mm Ø Sch 40 PVC Riser				
6.5							
	SM/GM SAND AND GRAVEL - with silt, trace clay, random cobbles, compact, fine to coarse grained, well graded, brown, wet	305.06					
7.0							
7.5	- greyish brown at 7.62m BGS						
8.0							
8.5			102 mm Ø Steel Casing				
9.0							
9.5							
		302.01					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2C-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML/SM SILT AND SAND (TILL) - with gravel, trace clay, random cobbles, very dense, low plasticity, light brown to tan, moist						
10.5	DOLOSTONE (GUELPH FORMATION) - fractured, weathered, buff to tan - oxidized at 10.87m BGS	301.71					
11.0	END OF OVERBURDEN HOLE @ 10.82m BGS						
11.5							
12.0							
12.5							
13.0							
13.5							
14.0							
14.5							
15.0							
15.5							
16.0							
16.5							
17.0							
17.5							
18.0							
18.5							
19.0							
19.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

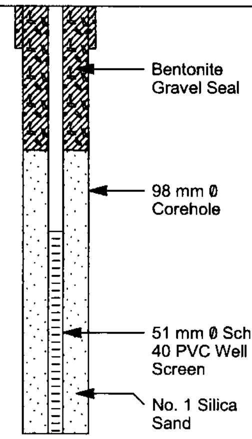
STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2C-07
DATE COMPLETED: September 25, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	RUN NUMBER	CORE RECOVERY %	RQD %
11.0	- oxidized at 10.87m BGS	301.10			
11.5	DOLOSTONE (GUELPH FORMATION) - microcrystalline, light brown to grey, moderately weathered, fossil and coral, vuggy, styolites		1	100	93
12.0	- thin styolites, changing from light brown to grey at 11.07 and at 11.10m BGS				
	- vertical fracture, sand infilling, rough, moderately weathered from 11.33 to 11.95m BGS				
12.5	- horizontal fracture, smooth, very close, slightly weathered, oxidized at 11.42m BGS				
13.0	- fossil from 11.43 to 11.66m BGS		2	100	100
	- vuggy zone, oxidized, calcite crystal interiors from 11.68 to 11.76m BGS				
13.5	- thin styolite at 11.71m BGS				
	- vug, calcite crystal interior at 11.80m BGS	298.20			
14.0	- ~30 ° subhorizontal fracture, very close, slightly weathered at 11.86m BGS				
14.5	- horizontal fracture, rough, very close, sand infilling, moderately weathered at 11.94m BGS				
15.0	- horizontal fracture, rough, very close, fossil, unweathered at 11.96m BGS				
	- vertical fracture thru vug, highly weathered, oxidized from 12.04 to 12.06m BGS				
15.5	- vertical fracture, rough, very close, unweathered from 12.06 to 12.08m BGS				
	- highly fractured horizontally and vertically, highly weathered from 12.08 to 12.12m BGS				
16.0	- oxidized at 12.34m BGS				
16.5	- horizontal fracture, smooth, very close, unweathered at 12.56m BGS				
	- subhorizontal fracture thru stylolite, very close, oxidized, slightly weathered, smooth at 13.08m BGS				
17.0	- thin styolites at 12.51, 12.73, 12.93, 13.18, and at 13.21m BGS				
17.5	- vuggy zones from 12.12 to 12.34 m BGS, 12.35 to 12.70 m BGS, and from 13.23 to 13.59m BGS				
18.0	- horizontal fracture thru stylolite, smooth, very close, unweathered at 13.44m BGS				
18.5	- horizontal fracture thru stylolite, rough, very close, unweathered at 13.58m BGS				
	- thin stylolites at 13.51, 13.59, and at 13.69m BGS				
19.0	- vugs, crystalline interiors at 13.50 and at 13.71m BGS				
19.5	END OF BOREHOLE @ 13.72m BGS				
	Note: Overburden stratigraphy obtained during advancement of MW2A-07				
20.0					

Monitoring Well



WELL DETAILS
Screened interval:
299.73 to 298.20m AMSL
12.19 to 13.72m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 10
Material: Schedule 40 PVC
Seal:
301.55 to 300.18m AMSL
10.36 to 11.73m BGS
Material: Bentonite Gravel
Sand Pack:
300.18 to 298.20m AMSL
11.73 to 13.72m BGS
Material: No. 1 Silica Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2D-07
DATE COMPLETED: September 21, 2007
DRILLING METHOD: 108 mm ID HSA
FIELD PERSONNEL: K. Vander Meulen

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL
	TOP OF CASING	312.81
	TOP OF RISER	312.77
	GROUND SURFACE	311.85
0.0	PT PEAT - with silt, dark brown, rootlets	
1.52	SM SILTY SAND - trace gravel, compact, fine grained, poorly graded, grey, wet - little to some clay at 2.07m BGS	310.33
2.13	GW GRAVEL - with to little sand, compact, medium to coarse grained, well graded, grey, wet	309.72
3.04	SM SILTY SAND - with clay, compact, fine grained, poorly graded, brown, wet, dilatant	308.81
5.12	SM/GM SILTY SAND AND GRAVEL - trace clay, compact, fine to medium grained, well graded, brown, wet - beige, no clay at 6.55m BGS - fine to coarse grained at 6.86m BGS	306.73
7.01	SW/GW SAND AND GRAVEL - dense, fine to coarse grained, well graded, grey, wet	304.84
9.45	SM SILTY SAND (TILL) - with to little silt, trace gravel, trace clay, compact, fine grained, poorly graded, beige, wet	302.40

Monitoring Well: Concrete Seal; 51 mm Ø Sch 40 PVC Riser; Bentonite Grout; 203 mm Ø Borehole; Native Sand Pack; 51 mm Ø Sch 40 PVC Well Screen

SAMPLE

NUMBER	INTERVAL	REC (%)	'N' VALUE
1	X	33	2
2	X	16	2
3	X	58	29
4	X	8	22
5	X	0	11
6	X	0	11
7	X	54	16
8	X	54	15
9	X	8	>50
10	X	32	15
11	X	40	13
12	X	63	43
13	X	100	12

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2D-07
DATE COMPLETED: September 21, 2007
DRILLING METHOD: 108 mm ID HSA
FIELD PERSONNEL: K. Vander Meulen

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	END OF BOREHOLE @ 10.06m BGS	301.79	WELL DETAILS Screened interval: 304.23 to 302.71m AMSL 7.62 to 9.14m BGS Length: 1.52m Diameter: 51mm Slot Size: 10 Material: Schedule 40 PVC Seal: 311.24 to 302.40m AMSL 0.61 to 9.45m BGS Material: Bentonite Grout Sand Pack: 305.45 to 301.19m AMSL 6.40 to 10.67m BGS Material: Native Sand Pack				
10.5							
11.0							
11.5							
12.0							
12.5							
13.0							
13.5							
14.0							
14.5							
15.0							
15.5							
16.0							
16.5							
17.0							
17.5							
18.0							
18.5							
19.0							
19.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

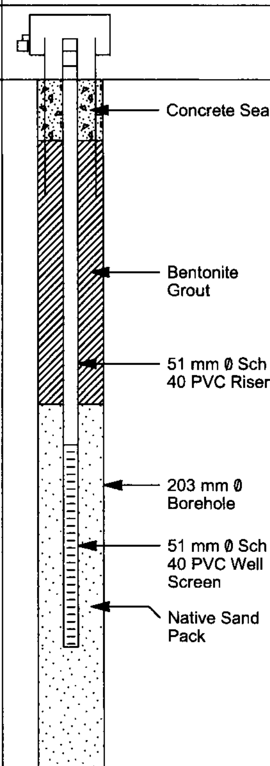
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW2E-07
DATE COMPLETED: September 21, 2007
DRILLING METHOD: 108 mm ID HSA
FIELD PERSONNEL: K. Vander Meulen

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	TOP OF CASING	312.83				
	TOP OF RISER	312.80				
	GROUND SURFACE	311.78				
	PT PEAT - with silt, dark brown, rootlets					
0.5						
1.0						
1.5	SM SILTY SAND - trace gravel, compact, fine grained, poorly graded, grey, wet	310.25				
2.0	- little to some clay at 2.07m BGS					
	GW GRAVEL - with to little sand, compact, medium to coarse grained, well graded, grey, wet	309.64				
2.5						
3.0	SM SILTY SAND - with clay, compact, fine grained, poorly graded, brown, wet, dilatant	308.73				
3.5	SW/GW SAND AND GRAVEL - compact, medium to coarse grained, well graded, grey, wet	308.12				
4.0			1	X	71	10
4.5						
5.0			2	X	92	16
	END OF BOREHOLE @ 5.18m BGS	306.59				
5.5						
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						

Monitoring Well



WELL DETAILS
Screened interval:
309.03 to 307.51m AMSL
2.74 to 4.27m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 10
Material: Schedule 40 PVC
Seal:
311.32 to 309.34m AMSL
0.46 to 2.44m BGS
Material: Bentonite Grout
Sand Pack:
309.34 to 307.51m AMSL
2.44 to 4.27m BGS
Material: Native Sand Pack

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4A-07
DATE COMPLETED: October 11, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	TOP OF CASING	313.68					
	TOP OF RISER	313.59					
	GROUND SURFACE	312.99					
0.5	ML SILT - little fine sand, trace clay, hard, low plasticity, light brown, moist, mottled, oxidized, rootlets			1		25	48
1.0	- very stiff, no rootlets at 0.76m BGS			2		12.5	27
1.5	SM/GM SAND AND GRAVEL - with silt, random cobbles, compact, fine to coarse grained, well graded, light grey, moist	311.77	254 mm Ø Borehole				
2.0	- very dense at 1.52m BGS			3		67	72
2.5	SM/GM SILTY SAND AND GRAVEL (TILL) - random cobbles, very dense, fine to coarse grained, well graded, light grey, moist, cemented	310.70		4		62.5	59
3.0	- wet at 3.05m BGS		51 mm Ø Sch 40 PVC Riser	5		0	>50
3.5							
4.0	SM SAND - with silt, with gravel, dense, fine to coarse grained, well graded, brown, wet, dilatant	309.18		6		25	31
4.5	- trace to little silt, compact, wet at 4.57m BGS		Cement Bentonite Grout				
5.0				7		67	28
5.5	SW SAND - trace to little silt, trace gravel, compact, fine to coarse grained, well graded, grey, wet	307.66		8		25	26
6.0	SP SAND - trace to little silt, compact, fine to medium grained, poorly graded, grey, wet	306.89	Bentonite Grout				
6.5				9		33	22
7.0	ML SILT - with clay, with fine sand, stiff, low to medium plasticity, brown, very moist, slightly dilatant	306.13		10		75	14
7.5	- clayey, trace fine sand, medium plasticity, very moist, dilatant, occasional SM SAND veneers 1.5 mm thick, with silt, fine grained, poorly graded, brown, very moist to wet at 7.62m BGS						
8.0				11		79	9
8.5	- very stiff, medium plasticity, reddish brown, moist, varved at 8.38m BGS		102 mm Ø Steel Casing	12		75	21
9.0	SM SILTY SAND - compact, fine to medium grained, poorly graded, grey, wet, dilatant	304.15					
	SM/ML SAND AND SILT (TILL) - little clay, trace gravel, compact, fine grained, poorly graded, cohesive, brown, moist	303.85					
9.5				13		83	25
		303.08					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

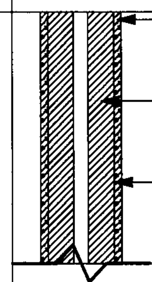
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4A-07
DATE COMPLETED: October 11, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	ML SILT (TILL) - with clay, little fine sand, trace gravel, stiff, medium plasticity, grey, moist		14	X	75	19
10.5	- becoming softner, very moist to wet at 10.36m BGS					
11.0	- with gravel at 10.97m BGS	302.09	15	X	46	>50
	SP SAND - trace gravel, trace silt, dense, medium grained, poorly graded, tan, wet					
11.5	ML SANDY SILT (TILL) - little clay, little clay, hard, low plasticity, tan, moist	301.56	16	X	12.5	>80
	DOLOSTONE (GUELPH FORMATION) - moderately fractured, moderately weathered, microcrystalline, buff to tan	301.41				
12.0	END OF OVERBURDEN HOLE @ 11.89m BGS					
12.5						
13.0						
13.5						
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
17.5						
18.0						
18.5						
19.0						
19.5						

Monitoring Well



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4A-07
DATE COMPLETED: October 11, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
		301.41				
12.0	DOLOSTONE (GUELPH FORMATION) - moderately fractured, moderately weathered, microcrystalline, buff to tan	301.10		1	100	46
12.5 – 16.0	DOLOSTONE (GUELPH FORMATION) - microcrystalline, moderately fractured, moderately weathered, light brown to buff - horizontal fractures, very close, rough at 11.96, 12.02, and at 12.19m BGS - vertical fracture, very close, rough from 12.20 to 12.24m BGS - moderately fractured, low to moderately weathered, occasional styolite from 12.27 to 13.79m BGS - horizontal fracture, very close, relatively smooth at 12.41m BGS - ~10 ° subhorizontal thin styolite at 12.50m BGS - horizontal fracture thru thin black styolite, very close, rough at 12.75m BGS - horizontal fractures, very close, rough at 12.52, 12.85, 13.13, and at 13.21m BGS - horizontal frcature along styolite, very close, rough at 13.48m BGS - thin black styolites at 12.70, 12.95, 13.01, 13.02, 13.08, 13.16, 13.26, 13.34, and at 13.66m BGS - low to moderately fractured, low weathering, microcrystalline, buff to light grey from 13.79 to 15.26m BGS - thin black styolite at 13.82m BGS - fossils at 14.02m BGS - fossil ~ 2 cm Ø at 14.25m BGS - vertical fracture, very close, rough from 14.37 to 14.39m BGS - horizontal fractures, very close, rough at 14.37 and at 14.39m BGS - ~5 ° subhorizontal fracture, very close, rough at 14.91m BGS - horizontal fracture thru stylolite, very close, rough at 15.16m BGS - mechanical break at 15.24m BGS - ~5 ° subhorizontal fracture, very close, rough at 15.49m BGS - shaley interbed from 15.65 to 15.67m BGS - fossil zone from 15.74 to 15.77m BGS - thin black styolites at 15.48, 15.85, and at 15.94m BGS - horizontal fractures, very close, rough at 15.69, 15.72, 15.83, and at 16.00m BGS		Bentonite Grout; 98 mm Ø Corehole	2 3 4	99 100 100	88 97 96
16.0 – 21.0	SHALEY LIMESTONE (ERAMOSA FORMATION) - microcrystalline, dark grey, low fracturing, low weathering, very gradual transitition - horizontal fracture, very close, rough at 16.33m BGS - frequent thin shaley interbeds from 16.40 to 16.48m BGS	296.94	51 mm Ø Sch 40 PVC Riser	5 6 7	100 100 100	 100 96

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

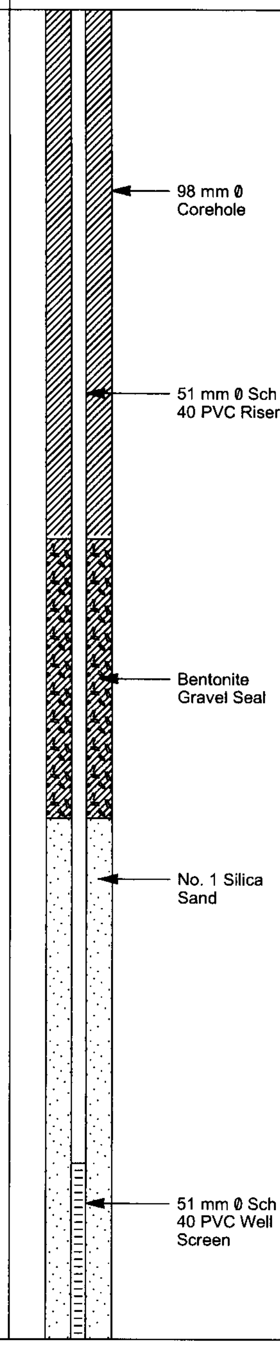
STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4A-07
DATE COMPLETED: October 11, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL
	- low fracturing, low weathering, microcrystalline, shaley, occasional styolite, occasional vug, bitumus odour from 16.61 to 18.14m BGS	
22.0	- dark brown from 16.61 to 16.79m BGS	
22.5	- thin black styolites at 16.31, 16.59, 16.82, and at 16.97m BGS	
	- ~5 ° subhorizontal fracture, very close, rough at 17.07m BGS	
23.0	- vuggy zone, vugs ~ 1 to 3 cm Ø, crystalline interiors from 17.12 to 17.37m BGS	
23.5	- horizontal fracture, very close, smooth at 17.60m BGS	
24.0	- vug, 1 cm Ø at 17.70m BGS	
	- horizontal fracture, very close, rough at 17.86m BGS	
24.5	- thin black styolites at 17.24, 17.58, and at 17.93m BGS	
	- mechanical break at 18.04m BGS	
25.0	- low fracturing, low weathering, occasional vug, bitumus odour from 18.14 to 19.66m BGS	
25.5	- ~5 ° subhorizontal fracture, very close, rough at 18.24m BGS	287.29
	- 3 cm Ø vug, calcite interior at 18.34m BGS	
26.0	- vuggy zone, vugs ~ 1 cm Ø, some fossils from 18.42 to 18.57m BGS	
26.5	- 2 cm Ø fossil, dark brown at 18.69m BGS	
27.0	- ~10 ° subhorizontal thin black styolite at 18.80m BGS	
	- thin black styolite at 18.87m BGS	
27.5	- horizontal fractures, very close, rough at 18.63 and at 18.95m BGS	
	- 1 cm Ø vug, calcite interior at 18.97m BGS	
28.0	- 3 cm Ø vug, calcite interior at 19.25m BGS	
28.5	- fossils, 1 to 3 cm Ø from 19.30 to 19.53m BGS	
29.0	- ~15 ° subhorizontal fracture, very close, rough at 19.41m BGS	
	- 2 cm Ø vug, calcite interior at 19.48m BGS	
29.5	- horizontal fractures, very close, rough at 19.18 and at 19.56m BGS	
30.0	- vuggy zone, vugs ~ 0.5 cm Ø from 19.58 to 19.61m BGS	
	- low weathering, low fracturing, bitumus odour, microcrystalline, occasional fossil, occasional vug from 19.66 to 21.08m BGS	
30.5	- occasional 1 cm Ø vug, crystalline interior from 19.68 to 19.84m BGS	
31.0	- vuggy zone, vugs ~ 1 cm Ø from 19.91 to 19.94m BGS	
	- ~10 ° subhorizontal fracture, very close,	

Monitoring Well



RUN NUMBER	CORE RECOVERY %	RQD %
8	100	100
9	100	80
10	100	85
11	100	100
12	100	0
13	100	94
14	100	100
15	100	88

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4A-07
DATE COMPLETED: October 11, 2007
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FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
	relatively rough at 19.99m BGS		51 mm Ø Sch 40 PVC Well Screen			
32.0	- vuggy zone, vugs ~ 0.5 cm Ø from 20.02 to 20.03m BGS - white fossil at 20.22m BGS					
32.5	- horizontal fracture, very close, smooth at 20.32m BGS - vuggy zone, vugs ~ 0.5 cm Ø from 20.42 to 20.47m BGS		No. 1 Silica Sand	16	100	100
33.0	- ~5° subhorizontal fracture, very close, rough at 20.66m BGS	279.77				
33.5	- vuggy zone, vugs ~ 0.5 cm Ø from 20.67 to 20.75m BGS - frequent 0.5 cm Ø white nodules, fossils from 20.73 to 20.85m BGS		WELL DETAILS Screened interval: 282.81 to 279.77m AMSL 30.18 to 33.22m BGS			
34.0	- horizontal fracture, very close, smooth at 20.78m BGS - ~ 2 cm Ø vug, calcite interior at 20.83m BGS		Length: 3.05m Diameter: 51mm Slot Size: 10			
34.5	- horizontal fractures, very close, rough at 20.43 and at 21.03m BGS		Material: Schedule 40 PVC Seal: 287.54 to 285.40m AMSL 25.45 to 27.58m BGS			
35.0	- low fracturing, low weathering, occasional vug, occasional fossil, microcrystalline, dark grey, bitumus odour from 21.08 to 22.71m BGS		Material: Bentonite Gravel Sand Pack: 285.40 to 279.77m AMSL			
35.5	- frequent small white fossils from 21.08 to 21.44m BGS		27.58 to 33.22m BGS Material: No. 1 Silica Sand			
36.0	- ~ 2 cm Ø vugs, calcite interiors at 21.24m BGS					
36.5	- ~20° subhorizontal fracture, very close, smooth at 21.59m BGS - vuggy zones, vugs ~ 0.5 cm Ø at 21.74 to 21.75 m BGS and from 21.79 to 21.81m BGS					
37.0						
37.5	- vuggy zone, vugs ~ 1 cm Ø, calcite interiors from 21.95 to 22.05m BGS - ~15° subhorizontal fracture, very close, rough at 22.07m BGS					
38.0	- ~ 1 cm Ø vug, calcite interior at 22.10m BGS					
38.5	- vuggy zone, vugs ~ 1 cm Ø, crystalline interiors, frequent small 1 cm grey to white nodules from 22.15 to 22.38m BGS					
39.0	- mechanical breaks at 22.43 and at 22.61m BGS - moderately frcatured, low weathering, vuggy zones, gradual transititon to limestone, microcrystalline, slight bitumus odour from 22.71 to 24.23m BGS					
39.5						
40.0	- shaley limestone, dense, microcrystalline from 22.71 to 22.91m BGS - ~10° subhorizontal fracture, very close, rough at 22.91m BGS					
40.5	- dolomotic limestone, vuggy, light grey, fossils from 22.91 to 23.77m BGS					
41.0	- ~15° subhorizontal fracture, very close, rough at 23.01m BGS - vuggy zone, vugs ~ 1 cm Ø, crystalline interiors from 23.06 to 23.22m					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4A-07
DATE COMPLETED: October 11, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
	BGS					
	- ~5 ° subhorizontal fracture, very close, rough at 23.32m BGS					
42.0	- ~ 3 cm Ø fossil at 23.49m BGS					
	- vuggy zone, vugs ~ 0.5 yo 1 cm/Ø, crystalline interiors from 23.57 to 23.77m BGS					
42.5						
	- ~10 ° subhorizontal fracture, crystalline surface (calcite, pyrite, galena) at 23.60m BGS					
43.0						
	- ~20 ° subhorizontal fracture along bedding plane, very close, rough, crystalline surface (calcite and pyrite) at 23.77m BGS					
43.5						
	- shaley limestone, microcrystalline, dark grey, bitumus odour from 23.78 to 24.23m BGS					
44.0	- ~80 ° subhorizontal vertical fracture, very close, rough from 23.78 to 23.98m BGS					
44.5	- white fossils at 23.98m BGS					
	- white fossils at 24.23m BGS					
45.0	- low fracturing, low weathering, alternating layers of shaley limestone and dolomotic limestone, transitional zone between Eramosa and Amabel Formations from 24.23 to 25.60m BGS					
45.5	- shaley limestone, frequent thin black styolites, bitumus odour from 24.23 to 24.77m BGS					
46.0	- horizontal fracture, very close, rough at 23.98, 24.08, and at 24.74m BGS					
46.5	- dolomotic limestone, microcrystalline, occasional vug, styolites from 24.77 to 25.24m BGS					
	- ~ 5 cm Ø vug, calcite interior at 24.82m BGS					
47.0						
	- frequent thin black styolites from 25.05 to 25.25m BGS					
47.5	- horizontal fractures along styolites, very close, rough at 24.94, 25.09, and at 25.15m BGS					
48.0	- shaley limestone, frequent thin black styolites and shale interbeds, dark grey to black, bitumus odour at 25.24m BGS					
48.5	- horizontal fracture, very close, rough at 25.30m BGS					
	- shaley from 25.37 to 25.43m BGS					
49.0	- ~ 6 cm Ø vug, purple calcite interior at 25.45m BGS					
49.5	- ~10 ° subhorizontal fracture, very close, rough at 25.50m BGS					
	- ~10 ° subhorizontal fracture, very close, rough at 25.55m BGS					
50.0	- shaley limestone from 25.60 to 25.70m BGS					
50.5	DOLOMOTIC LIMESTONE (AMABEL FORMATION) - microcrystalline, low fracturing, low weathering, light grey, frequent thin black styolites, relatively massive					
51.0	- dark grey, frequent small white fossils from 26.06 to 25.60m BGS					
	- horizontal fracture, very close, rough at					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4A-07
DATE COMPLETED: October 11, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
	26.57m BGS					
	- thin black styolites at 25.86, 25.96, 26.21, 26.52, and at 26.65m BGS					
52.0	- frequent thin black styolites from 26.77 to 27.13m BGS					
52.5	- mechanical breaks at 26.87 and at 27.41m BGS					
	- ~80 ° subhorizontal vertical fracture, very close, rough from 27.51 to 27.91m BGS					
53.0	- thin black styolites at 27.58, 27.66, 27.74, 27.80, 27.91, 28.04, and at 28.27m BGS					
53.5	- horizontal fracture along styolite, very close, rough at 28.29m BGS					
54.0	- frequent thin black styolites from 28.31 to 28.42m BGS					
54.5	- low fracturing, low weathering, microcrystalline, some minor thin shaley limestone interbeds, styolites, grey from 28.40 to 29.74m BGS					
	- thin black jagged styolite at 29.18m BGS					
55.0	- horizontal fractures, very close, rough at 29.31 and at 29.39m BGS					
55.5	- thin black styolites at 28.70, 29.27, and at 29.47m BGS					
	- mechanical break at 29.51m BGS					
56.0	- low fracturing, low weathering, microcystalline, grey from 29.74 to 30.20m BGS					
56.5	- ~5 ° subhorizontal fracture, very close, rough at 29.87m BGS					
	- shaley interbeds from 29.88 to 29.95m BGS					
57.0	- 3 mm vertical dissolution, not fractured from 30.07 to 30.18m BGS					
57.5	- moderately fractured, vuggy zones, light grey to dark grey near bottom from 30.23 to 31.78m BGS					
58.0	- thin black styolites at 30.08, 30.28, 30.50, and at 30.53m BGS					
	- ~5 ° subhorizontal fracture, very close, rough, slightly oxidized at 30.68m BGS					
58.5	- horizontal fracture, very close, rough at 30.99m BGS					
59.0	- vertical fractures, very close, rough from 30.99 to 31.09m BGS					
	- ~10 ° subhorizontal fracture, very close, rough, slightly oxidized at 31.09m BGS					
59.5	- ~ 2 cm Ø pyrite crystal at 31.11m BGS					
	- ~ 5 cm Ø vug, calcite interior at 31.14m BGS					
60.0	- vuggy zone, more shale, fossils from 31.24 to 31.39m BGS					
60.5	- ~5 ° subhorizontal fracture, very close, rough at 31.42m BGS					
61.0	- ~85 ° subhorizontal vertical fracture, very close, rough from 31.42 to 31.47m BGS					
	- horizontal fracture, very close, rough at 31.47m BGS					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4A-07
DATE COMPLETED: October 11, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
	- ~15 ° subhorizontal thin black styolite at 31.75m BGS					
62.0	- competent, vuggy at 31.78m BGS - vuggy zons, vugs ~ 0.5 cm Ø at 31.88 to 32.00 m BGS and from 32.16 to 32.28m BGS					
62.5	- thin black styolite at 32.31m BGS - ~ 6 cm Ø vug, calcite interior at 32.46m BGS					
63.0	- vuggy zones, vugs ~ 0.5 cm Ø at 32.36 to 32.44 m BGS and from 32.61 to 33.22m BGS					
63.5	- small white nodules (fossils) from 32.67 to 32.77m BGS					
64.0	- ~ 2 cm Ø vug, crystalline interior at 32.69m BGS - ~ 4 cm Ø vug, calcite interior at 32.97m BGS					
64.5	- ~ 3 cm Ø vug, calcite interior at 33.02m BGS					
65.0	- ~ 10 cm Ø vug, calcite interior at 33.17m BGS					
	END OF BOREHOLE @ 33.22m BGS					
65.5						
66.0						
66.5						
67.0						
67.5						
68.0						
68.5						
69.0						
69.5						
70.0						
70.5						
71.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

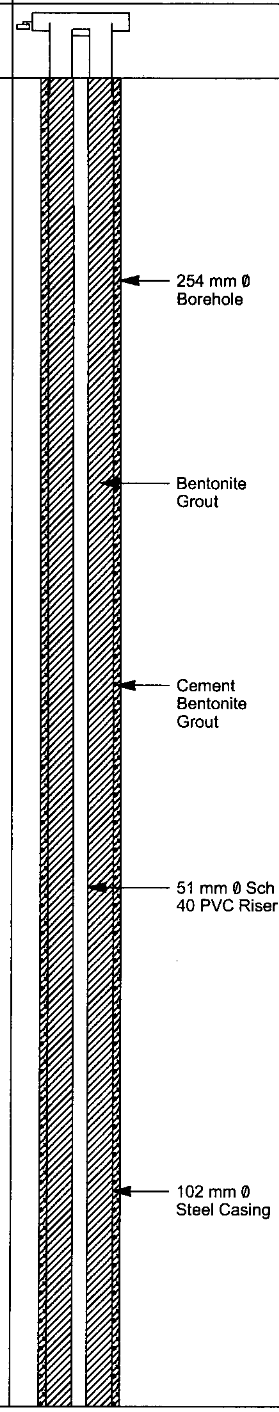
PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4B-07
DATE COMPLETED: October 11, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL
	TOP OF CASING	313.72
	TOP OF RISER	313.66
	GROUND SURFACE	313.01
0.0–1.22	ML SILT - little fine sand, trace clay, hard, low plasticity, light brown, moist, mottled, oxidized, rootlets - very stiff, no rootlets at 0.76m BGS	
	SM/GM SAND AND GRAVEL - with silt, random cobbles, compact, fine to coarse grained, well graded, light grey, moist - very dense at 1.52m BGS	311.79
	SM/GM SILTY SAND AND GRAVEL (TILL) - random cobbles, very dense, fine to coarse grained, well graded, light grey, moist, cemented - wet at 3.05m BGS	310.72
	SM SAND - with silt, with gravel, dense, fine to coarse grained, well graded, brown, wet, dilatant - trace to little silt, compact, wet at 4.57m BGS	309.20
	SW SAND - trace to little silt, trace gravel, compact, fine to coarse grained, well graded, grey, wet	307.67
	SP SAND - trace to little silt, compact, fine to medium grained, poorly graded, grey, wet	306.91
	ML SILT - with clay, with fine sand, stiff, low to medium plasticity, brown, very moist, slightly dilatant - clayey, trace fine sand, medium plasticity, very moist, dilatant, occasional SM SAND veneers 1.5 mm thick, with silt, fine grained, poorly graded, brown, very moist to wet at 7.62m BGS - very stiff, medium plasticity, reddish brown, moist, varved at 8.38m BGS	306.15
	SM SILTY SAND - compact, fine to medium grained, poorly graded, grey, wet, dilatant	304.17
	SM/ML SAND AND SILT (TILL) - little clay, trace gravel, compact, fine grained, poorly graded, cohesive, brown, moist	303.86
		303.10

Depth scale (m BGS): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5

Monitoring Well



SAMPLE: NUMBER | INTERVAL | REC (%) | 'N' VALUE

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4B-07
DATE COMPLETED: October 11, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML SILT (TILL) - with clay, little fine sand, trace gravel, stiff, medium plasticity, grey, moist		Cement Bentonite Grout	1		0	
10.5	- becoming softner, very moist to wet at 10.36m BGS		Bentonite Grout				
11.0	- with gravel at 10.97m BGS	302.11					
	SP SAND - trace gravel, trace silt, dense, medium grained, poorly graded, tan, wet		102 mm Ø Steel Casing				
11.5	ML SANDY SILT (TILL) - little clay, little clay, hard, low plasticity, tan, moist	301.58					
	DOLOSTONE (GUELPH FORMATION) - moderately fractured, moderately weathered, microcrystalline, buff to tan	301.43					
12.0							
12.5	END OF OVERBURDEN HOLE @ 11.89m BGS						
13.0							
13.5							
14.0							
14.5							
15.0							
15.5							
16.0							
16.5							
17.0							
17.5							
18.0							
18.5							
19.0							
19.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4B-07
DATE COMPLETED: October 11, 2007
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
	DOLOSTONE (GUELPH FORMATION) - moderately fractured, moderately weathered, microcrystalline, buff to tan	301.43				
12.0	DOLOSTONE (GUELPH FORMATION) - microcrystalline, buff to tan, moderately fractured, moderate to low weathering	301.12	Bentonite Gravel Seal	1	100	87
12.5	- horizontal fracture, very close, some silty sand infilling at 12.03m BGS					
13.0	- vertical fracture, very close, rough from 12.03 to 11.45m BGS		98 mm Ø Corehole	2	100	93
13.5	- horizontal fracture, very close, smooth at 12.06m BGS - ~15° subhorizontal fracture along styolite, very close, rough at 12.24m BGS					
14.0	- moderately fractured, low weathering, microcrystalline, buff, styolites from 12.27 to 13.79m BGS		51 mm Ø Sch 40 PVC Well Screen			
14.5	- thin black styolites at 12.02, 12.61, 12.73, 12.75, 12.79, 12.98, 13.01, and at 13.08m BGS		No. 1 Silica Sand	3	100	100
15.0	- some shaley interbeds from 13.13 to 13.26m BGS	298.00				
15.5	- horizontal fractures, very close, rough at 12.57, 12.90, 13.13, 13.23, and at 13.51m BGS					
16.0	- low fracturing, low weathering, microcrystalline, buff, styolites from 13.79 to 15.01m BGS					
16.5	- ~ 10 cm Ø vug, calcite interior at 14.30m BGS					
17.0	- thin black styolites 13.69, 13.82, 14.00, and at 14.40m BGS - horizontal fracture, very close, rough at 14.43m BGS					
17.5	END OF BOREHOLE @ 15.01m BGS					
18.0	Note: Overburden stratigraphy obtained during advancement of MW4A-07					
18.5						
19.0						
19.5						
20.0						
20.5						
21.0						

WELL DETAILS
Screened interval:
299.52 to 298.00m AMSL
13.49 to 15.01m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 10
Material: Schedule 40 PVC
Seal:
301.12 to 300.13m AMSL
11.89 to 12.88m BGS
Material: Bentonite Gravel
Sand Pack:
300.13 to 298.00m AMSL
12.88 to 15.01m BGS
Material: No. 1 Silica Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

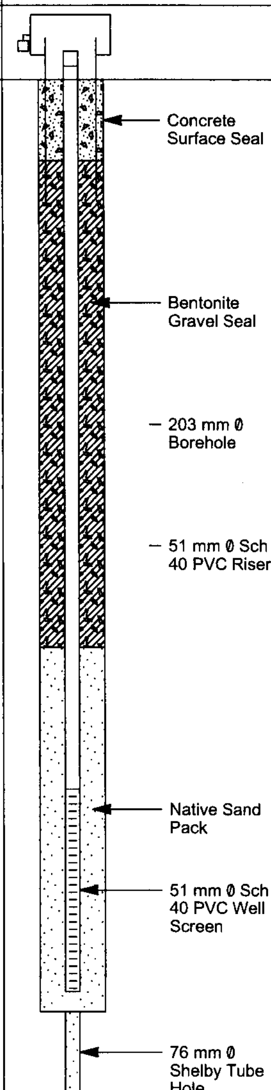
PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4C-07
DATE COMPLETED: October 11, 2007
DRILLING METHOD: 108 mm ID HSA
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL
	TOP OF CASING	313.89
	TOP OF RISER	313.80
	GROUND SURFACE	313.00
0.0–1.22	ML SILT - little fine sand, trace clay, hard, low plasticity, light brown, moist, mottled, oxidized, rootlets - very stiff, no rootlets at 0.76m BGS	311.78
1.22–2.29	SM/GM SAND AND GRAVEL - with silt, random cobbles, compact, fine to coarse grained, well graded, light grey, moist - very dense at 1.52m BGS	310.71
2.29–3.81	SM/GM SILTY SAND AND GRAVEL (TILL) - random cobbles, very dense, fine to coarse grained, well graded, light grey, moist, cemented - wet at 3.05m BGS	309.19
3.81–5.33	SM SAND - with silt, with gravel, dense, fine to coarse grained, well graded, brown, wet, dilatant - trace to little silt, compact, wet at 4.57m BGS	307.66
5.33–6.10	SW SAND - trace to little silt, trace gravel, compact, fine to coarse grained, well graded, grey, wet	306.90
6.10–6.86	SP SAND - trace to little silt, compact, fine to medium grained, poorly graded, grey, wet	306.14
6.86–7.62	ML SILT - with clay, with fine sand, stiff, low to medium plasticity, brown, very moist, slightly dilatant	305.38
7.62	END OF BOREHOLE @ 7.62m BGS	

Note:
Overburden stratigraphy obtained during advancement of MW4A-07

Monitoring Well



SAMPLE

NUMBER	INTERVAL	REC (%)	'N' VALUE
1		0	

WELL DETAILS
Screened interval:
307.66 to 306.14m AMSL
5.33 to 6.86m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 10
Material: Schedule 40 PVC
Seal:
312.39 to 308.73m AMSL
0.61 to 4.27m BGS
Material: Bentonite Gravel
Sand Pack:

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW4C-07
DATE COMPLETED: October 11, 2007
DRILLING METHOD: 108 mm ID HSA
FIELD PERSONNEL: D. Gray

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
			308.73 to 305.99m AMSL 4.27 to 7.01m BGS Material: Native Sand Pack				
10.5							
11.0							
11.5							
12.0							
12.5							
13.0							
13.5							
14.0							
14.5							
15.0							
15.5							
16.0							
16.5							
17.0							
17.5							
18.0							
18.5							
19.0							
19.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
HOLE DESIGNATION: MW6A-08
PROJECT NUMBER: 653-25
DATE COMPLETED: May 20, 2008
CLIENT: NESTLE WATERS CANADA
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	TOP OF RISER	320.05					
	GROUND SURFACE	319.16					
	SM SAND (TOPSOIL) - some silt, trace clay, medium grained, poorly graded, brown, moist	318.91					
0.5	SM/GP SAND AND GRAVEL - trace silt, fine to coarse grained, well graded, light brown, moist to wet			1		42	60
1.0				2		55	60
1.5	GW GRAVEL - with sand, trace silt, well graded, medium to coarse grained, brown to grey, wet	317.64					
2.0	- some silt, saturated at 2.29m BGS			3		50	33
2.5				4		50	54
3.0	GW/SM GRAVEL AND SAND - some silt, trace clay, medium to coarse grained, well graded, grey, moist	316.11	254 mm Ø Borehole				
3.5				5		33	22
4.0	SM SAND - with gravel, trace silt, medium grained, poorly graded, brown, wet	315.35		6		40	29
4.5	- loose, wet at 4.57m BGS						
5.0				7		75	8
5.5				8		62	11
6.0	- little oxidation, wet at 6.25m BGS		Cement Bentonite Grout				
6.5				9		63	21
7.0	- fine grained, wet, compact at 6.86m BGS			10		91	24
7.5	- trace clay, moist, compact at 7.62m BGS						
8.0				11		75	17
8.5	ML/SM SILT AND SAND (TILL) - trace clay, low plasticity, grey, moist,	310.78	51 mm Ø Sch 40 PVC Riser	12		50	13
9.0	- with gravel at 9.14m BGS						
9.5				13		33	19
	- with clay, medium plasticity, compact at						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW6A-08
DATE COMPLETED: May 20, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL
	9.91m BGS	
10.5		308.49
	ML SILT - with sand, some gravel, some clay, low plasticity, grey, wet, loose	
11.5		307.73
	CL CLAY - with silt, trace gravel, trace sand, medium plasticity, grey, moist	
12.0		306.97
	ML SANDY SILT - little clay, trace gravel, low plasticity. grey, moist to wet, loose - wet at 12.95m BGS	
14.0		305.12
	ML/CL SILT AND CLAY (TILL) - some gravel, trace sand, low plasticity, grey, moist, oxidized, very, dense - some gravel at 15.24m BGS	
16.0		303.16
	SM/GP SAND AND GRAVEL - some silt, trace clay, medium to coarse grained, poorly graded, light brown, moist - very dense at 16.76m BGS	
17.37	END OF OVERBURDEN HOLE @ 17.37m BGS	

Monitoring Well:
- Cement Bentonite Grout
- 254 mm Ø Borehole
- 51 mm Ø Sch 40 PVC Riser

SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
14	X	75	16
15	X	100	4
16	X	33	25
17	X	75	9
18	X	10	100
19	X	60	100
20	X	0	100
21	X	17	100
22	X	25	50
23	X	17	50

Depth scale (m BGS): 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
HOLE DESIGNATION: MW6A-08
PROJECT NUMBER: 653-25
DATE COMPLETED: May 20, 2008
CLIENT: NESTLE WATERS CANADA
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS: 17.5, 18.0, 18.5, 19.0, 19.5, 20.0, 20.5, 21.0, 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 25.5, 26.0, 26.5

STRATIGRAPHIC DESCRIPTION & REMARKS

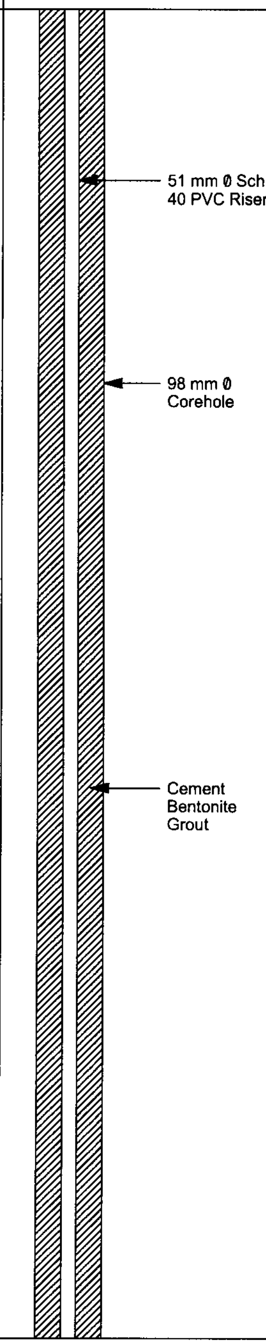
ELEV. m AMSL: 301.79

DOLOSTONE (GUELPH FORMATION) - moderately weathered, moderately fractured, microcrystalline, light grey
- subhorizontal fracture @ 45° at 17.47m BGS
- verticle mechanical fractue, oxidation at 17.73m BGS
- occasional thin styolite at 17.78m BGS
- horizontal fracture with sand infilling at 17.79m BGS
- horizontal fracture with sand infilling at 17.93m BGS
- small vug at 18.04m BGS
- vuggy at 18.14m BGS
- subhorizontal fracture with sand infilling, highly weathered at 18.18m BGS
- highly fractured, calcite infilling at 18.29m BGS
- verticle fracture at 18.52m BGS
- moderately weathered, moderately fractured at 18.59m BGS
- horizontal fracture at 18.82m BGS
- horizontal fracture at 19.03m BGS
- highly fractured at 19.05m BGS
- sand infilling at 19.07m BGS
- horizontal fracture with silt infilling at 19.51m BGS
- horizontal fracture with silt infilling at 19.81m BGS
- horizontal fracture at 19.85m BGS
- vug at 19.98m BGS
- horizontal fracture @ 20.03, 20.04 at 20.03m BGS
- verticle mechanical fracture with sand infilling, oxidation at 20.06m BGS
- horizontal fracture with oxidation at 20.47m BGS
- horizontal fracture @ 20.93, 20.95, 21.0, 21.01 at 20.93m BGS
- moderately weathered, moderately fractured, occasional vugs, microcrystalline at 21.54m BGS
- horizontal fracture with silt infilling at 21.70m BGS
- occasional vug at 21.84m BGS
- oxidation at 22.00m BGS
- horizontal fracture at 22.20m BGS

ELEV. m AMSL: 296.96

SHALEY LIMESTONE (ERAMOSA FORMATION) - moderately weathered, moderately fractured, shaley, bitumous odour
- horizontal fracture, oxidation, black staining at 22.48m BGS
- moderately weathered, moderately fractured, vuggy, frequent thin stylolites, microcrystalline from 23.04 to 23.47m BGS
- pyrite nodule at 23.24m BGS

Monitoring Well



RUN NUMBER	CORE RECOVERY %	RQD %
1	41	0
2	100	72
3	100	90
4	100	95
5	97	97
6	100	91
7	97	70
8	100	79

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW6A-08
DATE COMPLETED: May 20, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
27.5	- horizontal fracture with oxidation at 23.47m BGS - large vug with calcite interior at 23.90m BGS - horizontal fracture at 24.00m BGS					
28.0 28.5 29.0	- large vug with crystalline interior at 24.18m BGS - horizontal fracture @ 24.24, 24.49 at 24.23m BGS - vuggy with pyrite interior from 24.23 to 24.48m BGS - moderately weathered, moderately fractured, vuggy, some pyrite infilling, frequent thin styolites at 24.56m BGS		98 mm Ø Corehole	9	100	99
29.5 30.0 30.5	- horizontal fracture with black staining at 24.61m BGS - horizontal fracture at 24.84m BGS - large vug with sand infilling at 25.05m BGS - horizontal fracture with sand infilling at 25.15m BGS - horizontal fracture at 25.25m BGS		51 mm Ø Sch 40 PVC Riser	10	98	100
31.0 31.5	- horizontal fracture with pyrite nodules at 25.35m BGS - vuggy from 25.43 to 25.55m BGS - horizontal fracture @ 25.81, 25.99 at 25.80m BGS - moderately weathered, moderately fractured, vuggy, oxidized, frequent thin styolites at 26.01m BGS			11	100	99
32.0 32.5 33.0	- horizontal fracture with sand infilling at 26.08m BGS - subhorizontal fracture @ 45° at 26.14m BGS - horizontal fracture with calcite nodules at 26.26m BGS - vug with calcite interior at 26.29m BGS			12	100	100
33.5	- horizontal fracture @ 26.58, 26.83, 26.85 at 26.57m BGS - verticle mechanical fracture @ 26.88, 26.93 at 26.87m BGS		Cement Bentonite Grout	13	63	81
34.0 34.5 35.0	- horizontal fracture @ 27.05, 27.33, 27.44 at 27.05m BGS - moderately weathered, moderately fractured, frequent thin stylolites, occasional vugs at 27.61m BGS - horizontal fracture at 27.88m BGS - vug at 27.97m BGS - horizontal fracture @ 28.14, 28.30 at 28.13m BGS	284.16		14	100	95
35.5 36.0 36.5	- thin black styolites @ 28.22, 28.31 at 28.22m BGS - vug with calcite interior at 28.35m BGS - vug with calcite interior at 28.43m BGS - moderately weathered, moderately fractured, frequent thin styolites, occasional vug at 29.03m BGS - horizontal fracture at 29.16m BGS - horizontal fracture with sand infilling at 29.74m BGS		Bentonite Gravel Seal No. 3 Silica Sand	15	100	100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW6A-08
DATE COMPLETED: May 20, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
37.5	- horizontal fracture @ 29.95, 30.11 at 29.95m BGS - moderately weathered, moderately fractured, frequent thin styolites, occasional vug at 30.53m BGS		No. 3 Silica Sand	16	100	100
38.0	- thin black styolite at 30.63m BGS - vug at 31.09m BGS - horizontal fracture at 31.28m BGS		51 mm Ø Sch 40 PVC Screen			
38.5	- verticle mechanical fracture at 31.29m BGS - horizontal fracture with sand infilling at 31.70m BGS					
39.0	- moderately weathered, moderately fractured, frequent thin styolites, microcrystalline at 31.83m BGS		98 mm Ø Corehole	17	100	82
39.5	- frequent thin styolites from 31.83 to 33.02m BGS	279.54				
40.0	- verticle mechanical fracture at 31.95m BGS - horizontal fracture at 32.69m BGS					
40.5	- moderately weathered, moderately fractured, frequent thin styolites, oxidation at 33.02m BGS					
41.0	- horizontal fracture at 33.19m BGS - horizontal fracture at 33.22m BGS - horizontal fracture, calcite infilling, black staining at 33.28m BGS					
41.5	- moderately weathered, moderately fractured, frequent thin styolites, oxidized at 33.63m BGS					
42.0	- horizontal fracture @ 33.83, 33.89, 33.91 at 33.82m BGS					
42.5	- horizontal fracture with oxidation at 34.19m BGS - horizontal fracture at 34.31m BGS					
43.0	- horizontal fracture with calcite infilling at 34.56m BGS - horizontal fracture at 34.75m BGS - horizontal fracture at 34.88m BGS					
43.5	DOLOMITIC LIMESTONE (AMABEL FORMATION) - moderately weathered, moderately fractured, microcrystalline to crystalline, light grey					
44.0	- moderately weathered, moderately fractured, microcrystalline to crystalline, light grey at 35.23m BGS					
44.5	- horizontal fracture at 36.07m BGS					
45.0	- horizontal fracture at 36.32m BGS - moderately weathered, slightly fractured, microcrystalline to crystalline, light grey at 36.63m BGS					
45.5	- horizontal fracture at 37.36m BGS - horizontal fracture at 38.00m BGS					
46.0	- moderately weathered, moderately fractured, microcrystalline to crystalline, oxidized at 38.20m BGS					
46.5	- horizontal fracture @ 38.11, 38.41, 38.53, 38.62, 39.28, 39.49 at 38.25m BGS END OF BOREHOLE @ 39.62m BGS					

WELL DETAILS
Screened interval:
282.59 to 279.54m AMSL
36.58 to 39.62m BGS
Length: 3.05m
Diameter: 51mm
Slot Size: 10
Material: Schedule 40 PVC
Seal:
283.81 to 283.20m AMSL
35.36 to 35.97m BGS
Material: Bentonite Gravel
Sand Pack:
283.20 to 279.54m AMSL
35.97 to 39.62m BGS
Material: No. 3 Silica Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

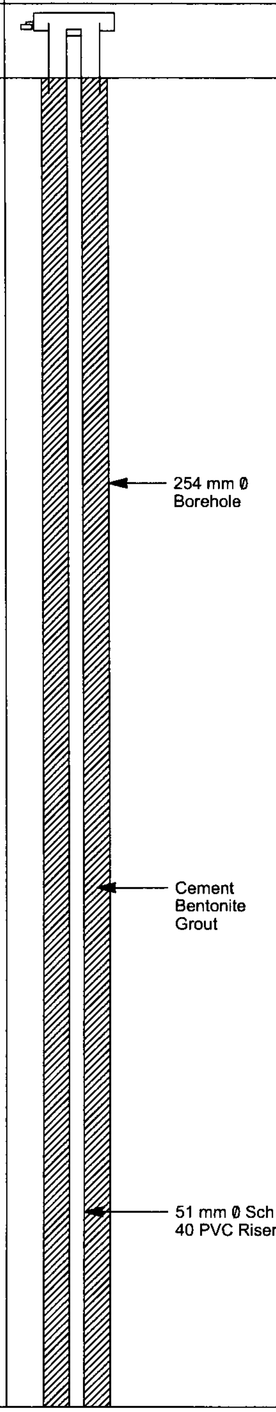
PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW6B-08
DATE COMPLETED: May 21, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL
	TOP OF RISER	319.91
	GROUND SURFACE	319.20
	SM SAND (TOPSOIL) - some silt, trace clay, medium grained, poorly graded, brown, moist	
	SM/GP SAND AND GRAVEL - trace silt, fine to coarse grained, well graded, light brown, moist to wet	318.95
1.5	GW GRAVEL - with sand, trace silt, well graded, medium to coarse grained, brown to grey, wet	317.68
	- some silt, saturated at 2.29m BGS	
3.0	GW/SM GRAVEL AND SAND - some silt, trace clay, medium to coarse grained, well graded, grey, moist	316.15
	SM SAND - with gravel, trace silt, medium grained, poorly graded, brown, wet	315.39
	- loose, wet at 4.57m BGS	
	- little oxidation, wet at 6.25m BGS	
	- fine grained, wet, compact at 6.86m BGS	
	- trace clay, moist, compact at 7.62m BGS	
	ML/SM SILT AND SAND (TILL) - trace clay, low plasticity, grey, moist,	310.82
	- with gravel at 9.14m BGS	
	- with clay, medium plasticity, compact at	

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5

Monitoring Well



SAMPLE			
NUMBER	INTERVAL	REC (%)	'N' VALUE

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

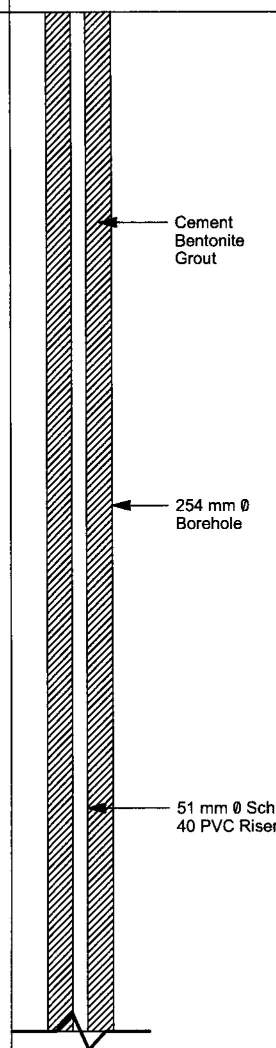
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW6B-08
DATE COMPLETED: May 21, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
10.5	9.91m BGS	308.53				
11.0	ML SILT - with sand, some gravel, some clay, low plasticity, grey, wet, loose	307.77				
11.5 / 12.0	CL CLAY - with silt, trace gravel, trace sand, medium plasticity, grey, moist	307.01				
12.5 / 13.0 / 13.5	ML SANDY SILT - little clay, trace gravel, low plasticity. grey, moist to wet, loose - wet at 12.95m BGS	305.16				
14.0 / 14.5 / 15.0 / 15.5	ML/CL SILT AND CLAY (TILL) - some gravel, trace sand, low plasticity, grey, moist, oxidized, very, dense - some gravel at 15.24m BGS	303.20				
16.0 / 16.5 / 17.0	SM/GP SAND AND GRAVEL - some silt, trace clay, medium to coarse grained, poorly graded, light brown, moist - very dense at 16.76m BGS	301.83				
17.5 / 18.0 / 18.5 / 19.0 / 19.5	END OF OVERBURDEN HOLE @ 17.68m BGS					

Monitoring Well



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

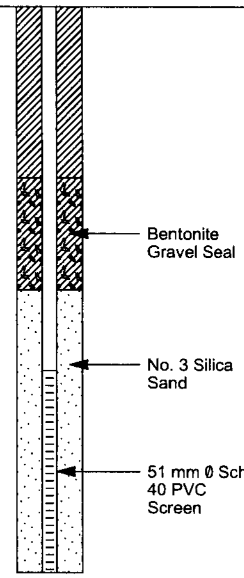
STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW6B-08
DATE COMPLETED: May 21, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
17.5		301.83				
18.0–18.5	DOLOSTONE (GUELPH FORMATION) - highly fractured, moderately weathered, occasional thin stylolites, microcrystalline - subhorizontal fracture @ 45° @ 17.73, 17.86 at 17.81m BGS - subhorizontal fracture @ 70° at 17.88m BGS - horizontal fracture with sand infilling at 17.96m BGS - horizontal fracture with fine gravel infilling at 18.06m BGS - horizontal fracture at 18.42m BGS - horizontal fracture at 18.64m BGS - moderately weathered, moderately fractured, occasional thin stylolites, microcrystalline at 18.77m BGS - horizontal fracture with sand infilling at 19.58m BGS - horizontal fracture with calcite infilling at 19.71m BGS - horizontal fracture with calcite infilling at 19.94m BGS - horizontal fracture @ 20.07, 20.20 at 20.04m BGS - moderately weathered, moderately fractured, frequent thin stylolites, microcrystalline at 20.29m BGS - horizontal fracture with sand infilling and oxidation at 20.57m BGS - horizontal fracture at 20.80m BGS - horizontal fracture at 21.06m BGS - horizontal fracture at 21.11m BGS - slightly vuggy at 21.25m BGS			1	100	51
19.0–20.0				2	100	93
20.5–21.0		297.94		3	100	92
21.5	END OF BOREHOLE @ 21.26m BGS					

Depth scale: 17.5, 18.0, 18.5, 19.0, 19.5, 20.0, 20.5, 21.0, 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 25.5, 26.0, 26.5



WELL DETAILS
Screened interval:
299.47 to 297.94m AMSL
19.74 to 21.26m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 10
Material: Schedule 40 PVC
Seal:
300.91 to 300.08m AMSL
18.29 to 19.13m BGS
Material: Bentonite Gravel
Sand Pack:
300.08 to 297.94m AMSL
19.13 to 21.26m BGS
Material: No. 3 Silica Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW7A-08
DATE COMPLETED: May 28, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL
	TOP OF RISER	317.42
	GROUND SURFACE	316.59
	PT PEAT - trace sand, trace silt, low plasticity, dark brown, moist, fibrous	316.49
0.5	SM SAND - some silt, trace clay, fine grained, poorly graded, light brown, moist, oxidized	
1.0	SM/GP SAND AND GRAVEL - trace silt, medium to coarse grained, well graded, grey, wet	315.78
1.5	- dense, wet at 1.52m BGS	
3.0	- little clay at 2.84m BGS	
3.5	SM SAND - with silt, trace clay, fine grained, poorly graded, brown, moist	312.98
4.5	- moist to wet, oxidized at 4.40m BGS	
4.5	- moist to wet at 4.57m BGS	
5.5	- with oxidation, compact at 5.54m BGS	
6.5	- with clay, compact at 6.43m BGS	
7.0	ML SILTY SAND (TILL) - trace gravel, trace clay, low to medium plasticity, grey, moist to wet, dense	309.73
7.5	- low plasticity, brown, moist at 7.62m BGS	
8.5	SM SAND - with silt, fine grained, poorly graded, brown, moist	308.21
9.0	- little clay, moist, dense at 9.14m BGS	
	- trace gravel, moist to wet, compact at 9.91m	

Monitoring Well:
- 254 mm Ø Borehole
- Cement Bentonite Grout
- 51 mm Ø Sch 40 PVC Riser

SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
1		50	8
2		50	23
3		50	48
4		66	67
5		91	32
6		66	21
7		83	21
8		58	19
9		66	27
10		100	39
11		96	30
12		50	46
13		75	31

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW7A-08
DATE COMPLETED: May 28, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	BGS		254 mm Ø Borehole	14		66	12
10.5	SM/GP SAND AND GRAVEL - trace silt, trace clay, medium to coarse grained, poorly graded, light brown, moist	305.92		15		66	21
11.0	- moist to wet, loose at 11.43m BGS		51 mm Ø Sch 40 PVC Riser	16		33	5
12.0	SM SAND - with gravel, little silt, trace clay, fine grained, poorly graded, brown, wet, loose	304.40		17		58	2
12.5	END OF OVERBURDEN HOLE @ 12.55m BGS						

Depth scale: 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW7A-08
DATE COMPLETED: May 28, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
		304.40				
12.5	SM SAND - with gravel, little silt, trace clay, fine grained, poorly graded, brown, wet, loose	304.04				
13.0–14.0	DOLOSTONE (GUELPH FORMATION) - moderately weathered, moderately fractured, microcrystalline, occasional thin styolite, vuggy - horizontal fracture with calcite infilling at 12.67m BGS - horizontal fracture at 12.78m BGS - vuggy at 12.90m BGS - horizontal fracture with sand infilling @ 45° at 13.03m BGS - horizontal fracture at 13.05m BGS - vuggy at 13.11m BGS - horizontal fracture with sand infilling at 13.23m BGS - vuggy at 13.28m BGS - horizontal fracture with silt infilling at 13.61m BGS - vuggy at 13.94m BGS - horizontal fracture at 14.10m BGS - horizontal fracture at 14.15m BGS - vuggy at 14.22m BGS - horizontal fracture at 14.33m BGS - vuggy from 14.48 to 14.58m BGS - horizontal fracture with silt infilling at 14.78m BGS - vuggy from 14.86 to 14.96m BGS - horizontal fracture at 15.09m BGS - subhorizontal fracture @ 45° at 15.24m BGS - moderately weathered, moderately fractured, occasional vug, microcrystalline, shaley at 15.32m BGS - large vug at 15.38m BGS - horizontal fracture at 15.47m BGS - large vug at 15.57m BGS - horizontal fracture at 15.65m BGS - small vug at 15.72m BGS - horizontal fracture at 15.87m BGS - small vug at 15.99m BGS			1	87	70
14.5			51 mm Ø Sch 40 PVC Riser	2	100	88
16.0		300.59	Cement Bentonite Grout	3	100	94
17.5				4	100	90
19.0	SHALEY LIMESTONE (ERAMOSA FORMATION) - moderately weathered, moderately fractured, thinly bedded, microcrystalline, bitumous odour - horizontal fracture at 16.15m BGS - large vug with sand infilling at 16.21m BGS - small vug at 16.23m BGS - horizontal fracture at 16.36m BGS - vuggy from 16.37 to 16.59m BGS - subhorizontal fracture @ 45° at 16.66m BGS - vuggy from 16.68 to 16.86m BGS - moderately weathered, moderately fractured, vuggy, microcrystalline, bitumous odour at 16.86m BGS - horizontal fracture at 16.97m BGS			5	100	85
20.0			98 mm Ø Corehole			
20.5				6	100	81

Depth scale: 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20.0, 20.5, 21.0, 21.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW7A-08
DATE COMPLETED: May 28, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

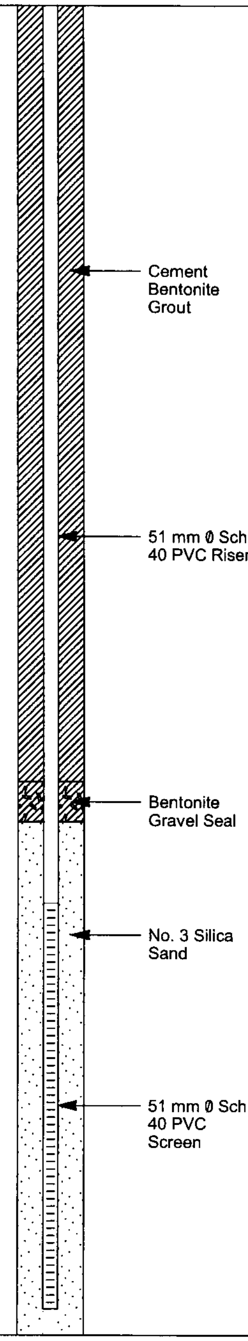
DEPTH m BGS: 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 25.5, 26.0, 26.5, 27.0, 27.5, 28.0, 28.5, 29.0, 29.5, 30.0, 30.5, 31.0, 31.5

ELEV. m AMSL: 290.07 (at 26.5 m BGS)

STRATIGRAPHIC DESCRIPTION & REMARKS

- extremely vuggy from 16.97 to 17.15m BGS
- horizontal fracture with sand and silt infilling at 17.15m BGS
- small vug at 17.20m BGS
- subhorizontal fracture @ 45° at 17.25m BGS
- horizontal fracture at 17.30m BGS
- vuggy from 17.40 to 17.47m BGS
- horizontal fracture at 17.73m BGS
- vuggy from 17.73 to 17.91m BGS
- horizontal fracture at 18.01m BGS
- vuggy from 18.04 to 18.16m BGS
- large vug at 18.11m BGS
- horizontal fracture at 18.24m BGS
- moderately weathered, moderately fractured, occasional vug, occasional fossil, microcrystalline, shaley, bitumous odour at 18.42m BGS
- vug with quartz interior and oxidation at 18.46m BGS
- small vug at 18.75m BGS
- horizontal fracture at 18.95m BGS
- small vugs at 19.07m BGS
- horizontal fracture at 19.10m BGS
- verticle mechanical fracture at 19.13m BGS
- horizontal fracture at 19.20m BGS
- vuggy from 19.23 to 19.33m BGS
- verticle mechanical fracture at 19.30m BGS
- small fossil at 19.46m BGS
- horizontal fracture at 19.58m BGS
- horizontal fracture at 19.64m BGS
- vuggy from 19.67 to 19.89m BGS
- horizontal fracture at 19.69m BGS
- moderately weathered, moderately fractured, microcrystalline, occasional thin styolite, bitumous odour at 19.91m BGS
- thin black styolite at 19.94m BGS
- horizontal fracture at 20.09m BGS
- horizontal fracture at 20.26m BGS
- horizontal fracture at 20.27m BGS
- verticle mechanical fracture from 20.52 to 20.65m BGS
- subhorizontal fracture @ 45° at 20.80m BGS
- horizontal fracture at 20.96m BGS
- verticle mechanical fracture at 21.01m BGS
- horizontal fracture at 21.06m BGS
- verticle mechanical fracture at 21.08m BGS
- horizontal fracture at 21.18m BGS
- horizontal fracture at 21.31m BGS
- moderately weathered, moderately fractured, frequent thin styolites, shaley, microcrystalline at 21.36m BGS
- verticle mechanical fracture at 21.39m BGS
- horizontal fracture at 21.92m BGS
- horizontal fracture at 22.05m BGS
- horizontal fracture at 22.12m BGS

Monitoring Well



RUN NUMBER	CORE RECOVERY %	RQD %
7	100	94
8	100	84
9	100	88
10	96	100
11	100	100
12	92	96
13	100	100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW7A-08
DATE COMPLETED: May 28, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
32.5	- porous from 22.13 to 22.27m BGS - horizontal fracture at 22.40m BGS - moderately weathered, moderately fractured, frequent thin stylolites, microcrystalline at 22.88m BGS		Bentonite Gravel Seal		100	100
33.0	- horizontal fracture at 23.11m BGS - horizontal fracture at 23.24m BGS - horizontal fracture at 23.39m BGS	283.27				
33.5	- horizontal fracture at 23.46m BGS - frequent thin stylolites from 23.47 to 23.83m BGS		WELL DETAILS Screened interval: 287.84 to 284.79m AMSL 28.75 to 31.80m BGS Length: 3.05m Diameter: 51mm Slot Size: 10 Material: Schedule 40 PVC Seal: 288.75 to 288.45m AMSL 27.84 to 28.14m BGS Material: Bentonite Gravel Sand Pack: 288.45 to 284.79m AMSL 28.14 to 31.80m BGS Material: No. 3 Silica Sand			
34.0	- horizontal fracture at 23.85m BGS - horizontal fracture at 24.00m BGS					
34.5	- horizontal fracture at 24.08m BGS - horizontal fracture, very close at 24.16m BGS - horizontal fracture at 24.18m BGS					
35.0	- moderately weathered, moderately fractured, frequent thin stylolites, microcrystalline, shaley at 24.41m BGS					
35.5	- horizontal fracture at 24.51m BGS - thinly bedded stylolite at 24.77m BGS - horizontal fracture at 25.02m BGS					
36.0	- thinly bedded stylolite at 25.08m BGS - horizontal fracture at 25.09m BGS					
36.5	- frequent thin stylolites from 25.10 to 25.43m BGS - horizontal fracture at 25.45m BGS					
37.0	- horizontal fracture at 25.63m BGS - horizontal fracture at 25.66m BGS					
37.5	- moderately weathered, moderately fractured, frequent thin stylolites, microcrystalline, shaley at 25.91m BGS					
38.0	- horizontal fracture at 25.92m BGS - horizontal fracture at 26.06m BGS - thin stylolite at 26.08m BGS					
38.5	- horizontal fracture at 26.21m BGS - subhorizontal fracture @ 35° at 26.51m BGS					
39.0	DOLOMITIC LIMESTONE (AMABEL FORMATION) - moderately weathered, moderately fractured, microcrystalline, thinly bedded					
39.5	- moderately weathered, slightly fractured, thinly bedded, microcrystalline, frequent thin stylolites, occasional fossil at 27.43m BGS					
40.0	- subhorizontal fracture @ 45° at 27.50m BGS - horizontal fracture at 27.66m BGS - horizontal fracture at 28.22m BGS					
40.5	- moderately weathered, slightly fractured, massive, thinly bedded, frequent thin stylolites at 28.93m BGS					
41.0	- horizontal fracture at 29.85m BGS - subhorizontal fracture at 30.18m BGS					
41.5	- moderately weathered, slightly fractured, massive, thinly bedded, microcrystalline at 30.30m BGS - horizontal fracture at 30.66m BGS					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW7A-08
DATE COMPLETED: May 28, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
42.5	- horizontal fracture at 31.19m BGS - horizontal fracture at 31.49m BGS - horizontal fracture at 31.72m BGS					
43.0	- moderately weathered, moderately fractured, massive, thinly bedded, slightly vuggy, occasional fossil, at 31.90m BGS - vuggy at 32.31m BGS - small fossil at 32.33m BGS					
43.5	- small vugs from 32.34 to 33.32m BGS END OF BOREHOLE @ 33.32m BGS					
44.0						
44.5						
45.0						
45.5						
46.0						
46.5						
47.0						
47.5						
48.0						
48.5						
49.0						
49.5						
50.0						
50.5						
51.0						
51.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW7B-08
DATE COMPLETED: June 2, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	TOP OF RISER	317.59					
	GROUND SURFACE	316.76					
	PT PEAT - trace sand, trace silt, low plasticity, dark brown, moist, fibrous	316.66					
0.5	SM SAND - some silt, trace clay, fine grained, poorly graded, light brown, moist, oxidized						
1.0	SM/GP SAND AND GRAVEL - trace silt, medium to coarse grained, well graded, grey, wet	315.95					
1.5	- dense, wet at 1.52m BGS						
2.0							
2.5							
3.0	- little clay at 2.84m BGS		254 mm Ø Borehole				
3.5							
4.0	SM SAND - with silt, trace clay, fine grained, poorly graded, brown, moist	313.15					
4.5	- moist to wet, oxidized at 4.40m BGS - moist to wet at 4.57m BGS						
5.0			Cement Bentonite Grout				
5.5	- with oxidation, compact at 5.54m BGS						
6.0							
6.5	- with clay, compact at 6.43m BGS						
7.0	ML SILTY SAND (TILL) - trace gravel, trace clay, low to medium plasticity, grey, moist to wet, dense	309.90					
7.5	- low plasticity, brown, moist at 7.62m BGS		51 mm Ø Sch 40 PVC Riser				
8.0							
8.5	SM SAND - with silt, fine grained, poorly graded, brown, moist	308.38					
9.0	- little clay, moist, dense at 9.14m BGS						
9.5							
	- trace gravel, moist to wet, compact at 9.91m						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.	HOLE DESIGNATION: MW7B-08
PROJECT NUMBER: 653-25	DATE COMPLETED: June 2, 2008
CLIENT: NESTLE WATERS CANADA	DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO	FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	BGS						
10.5–12.2	SM/GP SAND AND GRAVEL - trace silt, trace clay, medium to coarse grained, poorly graded, light brown, moist - moist to wet, loose at 11.43m BGS	306.09	Cement Bentonite Grout				
12.2–13.51	SM SAND - with gravel, little silt, trace clay, fine grained, poorly graded, brown, wet, loose	304.57	51 mm Ø Sch 40 PVC Riser 254 mm Ø Borehole				
13.51	END OF OVERBURDEN HOLE @ 13.51m BGS						

Depth scale (m BGS): 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

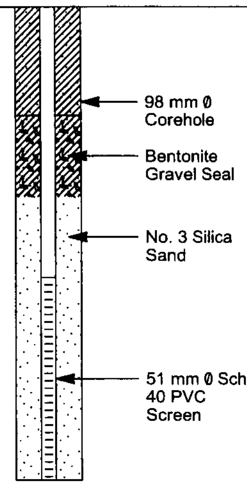
PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW7B-08
DATE COMPLETED: June 2, 2008
DRILLING METHOD: 159 mm ID HSA / HQ Wet Coring
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL
13.5 – 16.56	DOLOSTONE (GUELPH FORMATION) - moderately weathered, moderately fractured, microcrystalline, vuggy - large vug with crystalline interior at 13.61m BGS - horizontal fracture at 13.72m BGS - subhorizontal fracture @ 45° at 13.79m BGS - horizontal fracture at 13.92m BGS - slightly vuggy from 13.92 to 14.12m BGS - horizontal fracture at 14.15m BGS - moderately weathered, moderately fractured, slightly vuggy, microcrystalline at 14.25m BGS - small vug at 14.35m BGS - horizontal fracture at 14.40m BGS - horizontal fracture at 14.83m BGS - small vug at 14.99m BGS - horizontal fracture at 15.14m BGS - horizontal fracture at 15.37m BGS - horizontal fracture at 15.42m BGS - small vug at 15.44m BGS - horizontal fracture at 15.67m BGS - moderately weathered, moderately fractured, occasional vug, microcrystalline at 15.75m BGS - horizontal fracture at 15.98m BGS - small vug at 16.05m BGS - horizontal fracture at 16.10m BGS - horizontal fracture at 16.25m BGS - small vug at 16.33m BGS	303.25
	END OF BOREHOLE @ 16.56m BGS	300.20

Depth scale (m BGS): 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20.0, 20.5, 21.0, 21.5, 22.0, 22.5

Monitoring Well



WELL DETAILS
Screened interval:
301.72 to 300.20m AMSL
15.04 to 16.56m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 10
Material: Schedule 40 PVC
Seal:
302.94 to 302.33m AMSL
13.82 to 14.43m BGS
Material: Bentonite Gravel
Sand Pack:
303.86 to 300.20m AMSL
12.90 to 16.56m BGS
Material: No. 3 Silica Sand

RUN NUMBER	CORE RECOVERY %	RQD %
1	100	95
2	100	92
3	100	100

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW8A-08
DATE COMPLETED: June 11, 2008
DRILLING METHOD: 159 mm ID HSA / Tri-Cone
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL
	TOP OF RISER	318.38
	GROUND SURFACE	317.65
	SM SAND (TOPSOIL) - trace silt, trace clay, fine to medium grained, poorly graded, dark brown, moist, trace rootlets	317.55
0.5	SM SAND - trace silt, trace gravel, trace clay, fine grained, poorly graded, light brown, moist, oxidized, little red staining	
1.0	SM GRAVELLY SAND - trace silt, medium grained, poorly graded, grey, moist to wet, compact	316.74
1.5	- trace cobble, moist to wet at 1.52m BGS	
2.0		
2.5	SM SAND - some silt, trace gravel, fine grained, poorly graded, grey, moist, dense	315.36
3.0	ML SANDY SILT - trace gravel, trace clay, slightly cohesive, grey, moist, dense	314.60
3.5		
4.0	SM SAND - with silt, trace gravel, fine grained, poorly graded, light brown, moist, little oxidation	313.84
4.5	- with gravel, moist to wet at 4.57m BGS	
5.0		
5.5	- very dense at 5.33m BGS	
6.0	- dense at 6.10m BGS	
6.5		
7.0	ML SANDY SILT (TILL) - some clay, trace gravel, low plasticity, brown, moist, very dense	310.64
7.5	- very dense at 7.62m BGS	
8.0		
8.5	- oxidation, very dense at 8.38m BGS	
9.0	- dense at 9.14m BGS	
9.5	- loose at 9.91m BGS	

Monitoring Well:
- 254 mm Ø Borehole
- Cement Bentonite Grout
- 51 mm Ø Sch 40 PVC Riser

SAMPLE

NUMBER	INTERVAL	REC (%)	'N' VALUE
1		25	7
2		53	16
3		71	77
4		25	50
5		58	45
6		58	34
7		50	25
8		75	84
9		83	40
10		50	50
11		33	62
12		71	69
13		100	42

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW8A-08
DATE COMPLETED: June 11, 2008
DRILLING METHOD: 159 mm ID HSA / Tri-Cone
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL
10.67	- no sample recovered at 10.67m BGS	
11.43	- some gravel, dense at 11.43m BGS	
12.19	- very dense at 12.19m BGS	
12.95	ML SILT (TILL) - some clay, trace gravel, trace fine sand, low plasticity, brown, moist, very dense	304.70
13.72	- very dense at 13.72m BGS	
14.48	- some gravel, very dense at 14.48m BGS	
15.24	- trace cobble at 15.24m BGS	
16.92	SM/GP SAND AND GRAVEL - trace clay, trace silt, medium grained, poorly graded, brown, moist	300.73
17.12	DOLOSTONE (GUELPH FORMATION) END OF OVERBURDEN HOLE @ 17.12m BGS	300.53

Monitoring Well:
- 51 mm Ø Sch 40 PVC Riser
- 254 mm Ø Borehole
- Cement Bentonite Grout

SAMPLE

NUMBER	INTERVAL	REC (%)	'N' VALUE
14	X	25	6
15	X	0	50
16	X	42	39
17	X	33	87
18	X	33	95
19	X	66	100
20	X	66	100
21	X	50	100
22	X	66	28

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW8A-08
DATE COMPLETED: June 11, 2008
DRILLING METHOD: 159 mm ID HSA / Tri-Cone
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
17.0	SM/GP SAND AND GRAVEL - trace clay, trace silt, medium grained, poorly graded, brown, moist	300.73				
	DOLOSTONE (GUELPH FORMATION)	300.53				
17.5						
18.0						
18.5			51 mm Ø Sch 40 PVC Riser			
19.0						
19.5						
20.0			98 mm Ø Corehole			
20.5						
21.0						
21.5						
	SHALEY LIMESTONE (ERAMOSA FORMATION)	295.91				
22.0						
22.5						
23.0			Cement Bentonite Grout			
23.5						
24.0						
24.5						
25.0						
25.5						
26.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW8A-08
DATE COMPLETED: June 11, 2008
DRILLING METHOD: 159 mm ID HSA / Tri-Cone
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
27.0						
27.5						
28.0			Cement Bentonite Grout			
28.5						
29.0						
29.5						
30.0						
30.5			51 mm Ø Sch 40 PVC Riser			
31.0						
31.5	DOLOMITIC LIMESTONE (AMABEL FORMATION)	286.06				
32.0						
32.5			Bentonite Gravel Seal			
33.0						
33.5			No. 3 Silica Sand			
34.0						
34.5						
35.0			51 mm Ø Sch 40 PVC Screen			
35.5						
36.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW8A-08
DATE COMPLETED: June 11, 2008
DRILLING METHOD: 159 mm ID HSA / Tri-Cone
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
37.0			No. 3 Silica Sand			
37.5						
38.0			Bentonite Gravel Seal			
38.5						
	END OF BOREHOLE @ 38.69m BGS	278.97				
39.0						
39.5						
40.0						
40.5						
41.0						
41.5						
42.0						
42.5						
43.0						
43.5						
44.0						
44.5						
45.0						
45.5						
46.0						

WELL DETAILS
Screened interval:
284.12 to 281.07m AMSL
33.53 to 36.58m BGS
Length: 3.05m
Diameter: 51mm
Slot Size: 10
Material: Schedule 40 PVC
Seal:
285.04 to 284.73m AMSL
32.61 to 32.92m BGS
Material: Bentonite Gravel
Sand Pack:
284.73 to 280.46m AMSL
32.92 to 37.19m BGS
Material: No. 3 Silica Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

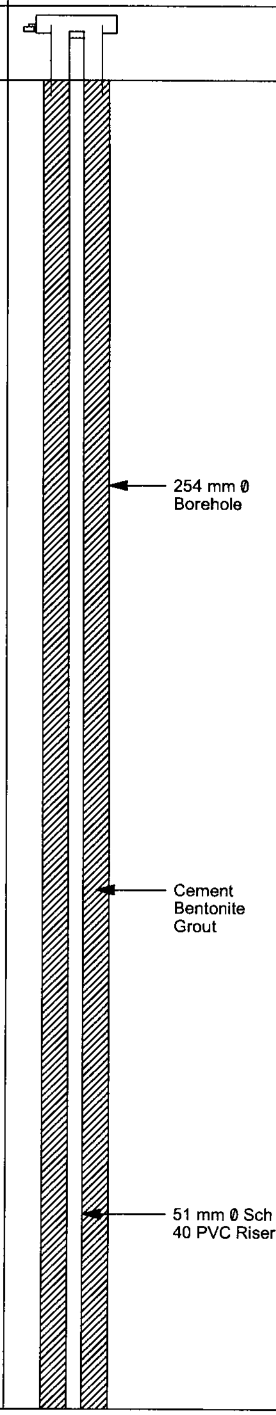
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW8B-08
DATE COMPLETED: June 13, 2008
DRILLING METHOD: 159 mm ID HSA / Tri-Cone
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL
	TOP OF RISER	318.47
	GROUND SURFACE	317.72
	SM SAND (TOPSOIL) - trace silt, trace clay, fine to medium grained, poorly graded, dark brown, moist, trace rootlets	317.62
0.5	SM SAND - trace silt, trace gravel, trace clay, fine grained, poorly graded, light brown, moist, oxidized, little red staining	
1.0	SM GRAVELLY SAND - trace silt, medium grained, poorly graded, grey, moist to wet, compact - trace cobble, moist to wet at 1.52m BGS	316.81
1.5		
2.0		
2.5	SM SAND - some silt, trace gravel, fine grained, poorly graded, grey, moist, dense	315.44
3.0	ML SANDY SILT - trace gravel, trace clay, slightly cohesive, grey, moist, dense	314.68
3.5		
4.0	SM SAND - with silt, trace gravel, fine grained, poorly graded, light brown, moist, little oxidation	313.91
4.5	- with gravel, moist to wet at 4.57m BGS	
5.0		
5.5	- very dense at 5.33m BGS	
6.0	- dense at 6.10m BGS	
6.5		
7.0	ML SANDY SILT (TILL) - some clay, trace gravel, low plasticity, brown, moist, very dense	310.71
7.5	- very dense at 7.62m BGS	
8.0		
8.5	- oxidation, very dense at 8.38m BGS	
9.0	- dense at 9.14m BGS	
9.5	- loose at 9.91m BGS	

Monitoring Well



SAMPLE			
NUMBER	INTERVAL	REC (%)	'N' VALUE

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW8B-08
DATE COMPLETED: June 13, 2008
DRILLING METHOD: 159 mm ID HSA / Tri-Cone
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
10.5	- no sample recovered at 10.67m BGS						
11.0			Cement Bentonite Grout				
11.5	- some gravel, dense at 11.43m BGS						
12.0	- very dense at 12.19m BGS						
12.5							
13.0	ML SILT (TILL) - some clay, trace gravel, trace fine sand, low plasticity, brown, moist, very dense	304.77					
13.5	- very dense at 13.72m BGS		51 mm Ø Sch 40 PVC Riser				
14.0							
14.5	- some gravel, very dense at 14.48m BGS						
15.0	- trace cobble at 15.24m BGS						
15.5			254 mm Ø Borehole				
16.0							
16.5							
17.0	SM/GP SAND AND GRAVEL - trace clay, trace silt, medium grained, poorly graded, brown, moist	300.81	Cement Bentonite Grout				
17.5	END OF OVERBURDEN HOLE @ 17.12m BGS						
18.0							
18.5							
19.0							
19.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

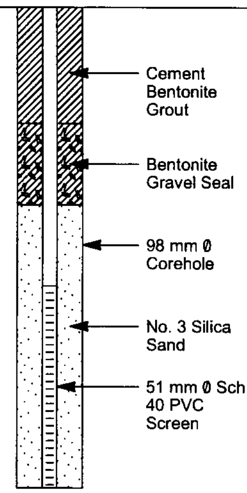
STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: SUPPLEMENTAL HYDROGEOLOGIC INV.
PROJECT NUMBER: 653-25
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK ROAD, GUELPH, ONTARIO

HOLE DESIGNATION: MW8B-08
DATE COMPLETED: June 13, 2008
DRILLING METHOD: 159 mm ID HSA / Tri-Cone
FIELD PERSONNEL: N. Hinsperger

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Monitoring Well	RUN NUMBER	CORE RECOVERY %	RQD %
17.0	SM/GP SAND AND GRAVEL - trace clay, trace silt, medium grained, poorly graded, brown, moist	300.81				
	DOLOSTONE (GUELPH FORMATION)	300.60				
20.0	END OF BOREHOLE @ 20.12m BGS	297.61				

Depth scale (m BGS): 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20.0, 20.5, 21.0, 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 25.5, 26.0



WELL DETAILS
Screened interval:
299.13 to 297.61m AMSL
18.59 to 20.12m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 10
Material: Schedule 40 PVC
Seal:
300.35 to 299.74m AMSL
17.37 to 17.98m BGS
Material: Bentonite Gravel
Sand Pack:
299.74 to 297.61m AMSL
17.98 to 20.12m BGS
Material: No. 3 Silica Sand

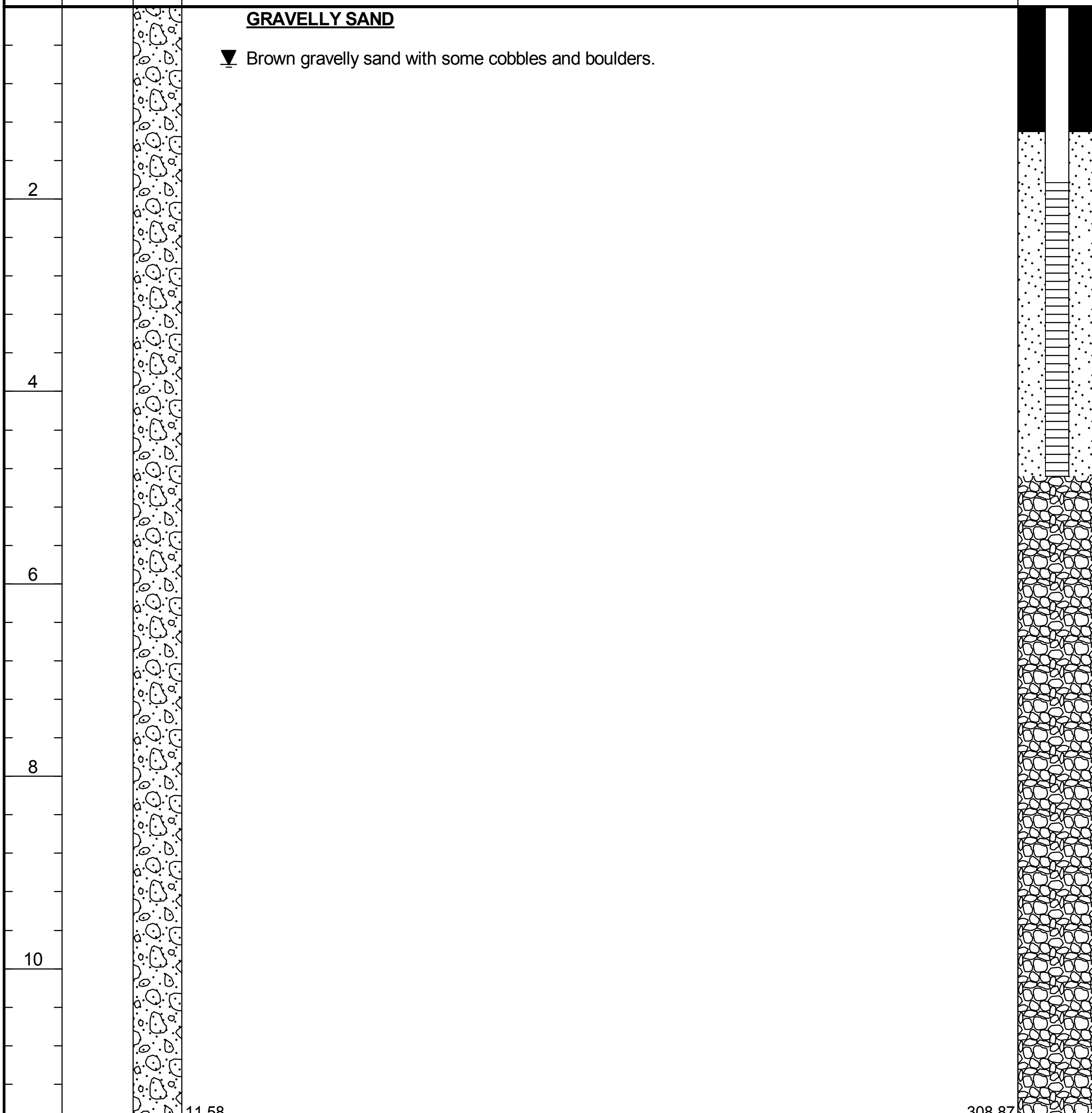
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

WELL NUMBER MW10A

AES International Environmental Consultants
3-88 Woodlawn Road E
Guelph, Ontario

CLIENT Nestle Waters Canada
PROJECT NAME Groundwater Supply Investigation
PROJECT NUMBER J00017
PROJECT LOCATION Aberfoyle, ON
DATE STARTED 6/18/09 **COMPLETED** 6/19/09
GROUND ELEVATION 320.45 m **HOLE SIZE** 254 mm
DRILLING CONTRACTOR All-Terrain Drilling Limited
GROUND WATER LEVELS:
DRILLING METHOD HS Auger
AT TIME OF DRILLING ---
LOGGED BY AIZ **CHECKED BY** PJAM
AT END OF DRILLING 0.60 m / Elev 319.85 m
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0–11.58			**GRAVELLY SAND** Brown gravelly sand with some cobbles and boulders.	Monitor constructed of 51 mm Schedule 40 PVC screen and riser. Seal: bentonite grout and/or bentonite chips Sand pack: No. 1 silica sand Slough
11.58				308.87



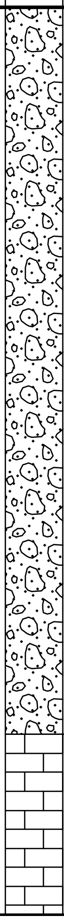
Bottom of borehole at 11.58 meters.

WELL NUMBER MW10B

AES International Environmental Consultants
3-88 Woodlawn Road E
Guelph, Ontario

CLIENT Nestle Waters Canada
PROJECT NAME Groundwater Supply Investigation
PROJECT NUMBER J00017
PROJECT LOCATION Aberfoyle, ON
DATE STARTED 6/30/09 **COMPLETED** 7/2/09
GROUND ELEVATION 322.2 m **HOLE SIZE** 222 mm to 16 m, 149 mm to BOH
DRILLING CONTRACTOR Durl Hopper Ltd.
GROUND WATER LEVELS:
DRILLING METHOD Mud Rotary
AT TIME OF DRILLING ---
LOGGED BY AIZ **CHECKED BY** PJAM
AT END OF DRILLING 2.65 m / Elev 319.55 m
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0 – 16.15			**GRAVELLY SAND** Brown gravelly sand with some cobbles and boulders.	Monitor constructed of 51 mm Schedule 40 PVC screen and riser. Seal: bentonite grout and/or bentonite chips.
16.15				306.05
16.15 – 20.16			**GUELPH FORMATION** Dolostone: Light brown to greyish-brown; fresh.	Sand pack: No. 1 silica sand.
20.16				302.04



Depth scale: 5, 10, 15, 20

Bottom of borehole at 20.16 meters.

AES International Environmental Consultants
3-88 Woodlawn Road E
Guelph, Ontario

WELL NUMBER MW10C/D

CLIENT Nestle Waters Canada
PROJECT NAME Groundwater Supply Investigation
PROJECT NUMBER J00026
PROJECT LOCATION Aberfoyle, Ontario
DATE STARTED 11/25/09 **COMPLETED** 11/27/09
GROUND ELEVATION 322.22 m **HOLE SIZE** 222 mm to 16.92 m, 152 mm to BOH
DRILLING CONTRACTOR Durl Hopper Ltd.
GROUND WATER LEVELS:
DRILLING METHOD Mud Rotary/Rotary Air Hammer
AT TIME OF DRILLING ---
LOGGED BY DD/AIZ **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0		Overburden drilled using mud rotary. Overburden lithology inferred from drill performance and cuttings returns. 152 mm steel casing set at ~16.9 m depth.		**GRAVELLY SAND** Brown gravelly sand with some cobbles and boulders.	Monitors constructed of 51 mm Schedule 40 PVC screen and riser. Seal: bentonite chips.
16.23 (305.99)				**GUELPH FORMATION** Dolostone: medium brown; coarse crystalline with sucrosic texture; hard.	
20.72 (301.50)		All formation contacts are approximate due to lag time for cutting returns and estimation of drilling depth.		**ERAMOSA FORMATION (REFORMATORY QUARRY MEMBER)** Dolostone: brownish grey; matte texture; hard.	

Depth scale: 5, 10, 15, 20, 25

AES International Environmental Consultants
3-88 Woodlawn Road E
Guelph, Ontario

CLIENT Nestle Waters Canada

PROJECT NAME Groundwater Supply Investigation

PROJECT NUMBER J00026

PROJECT LOCATION Aberfoyle, Ontario

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION			WELL DIAGRAM
					- fracture noted during drilling at ~25.3 m depth.		
				26.51	- fracture noted during drilling at ~25.9 m depth.	295.71	
					ERAMOSA FORMATION (VINEMOUNT MEMBER) Argillaceous Dolostone: dark greyish-brown to very dark brown; common shale cutttings; hard; petroliferous odour.		
30							
				34.13		288.09	
35					**GOAT ISLAND FORMATION** Dolostone: light to dark grey. - numerous fractured noted during drilling between ~34.1 and 35.7 m depth.		
40							
					- fracture noted during drilling at ~41.2 m depth.		
				44.19		278.03	
45					**GASPORT FORMATION** Dolostone: light to medium grey, bluish-grey; hard.		
					- fracture noted during drilling at ~47.2 m depth.		
					- fracture noted during drilling at ~49.4 m depth.		
50					- fracture noted during drilling at ~50.0 m depth.		

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Guelph, Ontario

WELL NUMBER MW10C/D

CLIENT Nestle Waters Canada

PROJECT NAME Groundwater Supply Investigation

PROJECT NUMBER J00026

PROJECT LOCATION Aberfoyle, Ontario

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
55				- fracture noted during drilling at ~54.0 m depth.	
				- fracture noted during drilling at ~55.8 m depth.	
				- fracture noted during drilling at ~57.0 m depth.	
60				- 60 cm thick fracture/void encountered during drilling at ~59.7 m depth.	Sand pack: No. 3 silica sand.
65				- fracture noted during drilling at ~64.3 m depth.	Seal: bentonite chips.
70				- fracture noted during drilling at ~71.3 m depth.	
75				- 30 cm thick fracture/void encountered during drilling at ~74.7 m depth.	Sand pack: No. 3 silica sand.
80				80.00 / 242.22	Seal: bentonite chips.
				IRONDEQUOIT FORMATION Dolostone: light to dark grey; hard.	

GENERAL BH / TP / WELL J00026.GPJ GINT STD CANADA LAB.GDT 2/2/10

AES International Environmental Consultants
3-88 Woodlawn Road E
Guelph, Ontario

WELL NUMBER MW10C/D

CLIENT Nestle Waters Canada
PROJECT NUMBER J00026
PROJECT NAME Groundwater Supply Investigation
PROJECT LOCATION Aberfoyle, Ontario

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION			WELL DIAGRAM
				84.43		237.79	
85				85.04	**ROCKWAY FORMATION**	237.18	
					Argillaceous Dolostone: dark grey to greenish grey; hard.		
				85.83	**MERRITTON FORMATION**	236.39	
					Dolostone: brown; hard.		
				86.41	**CABOT HEAD FORMATION**	235.81	
					Shale: greyish-green; moderately soft.		

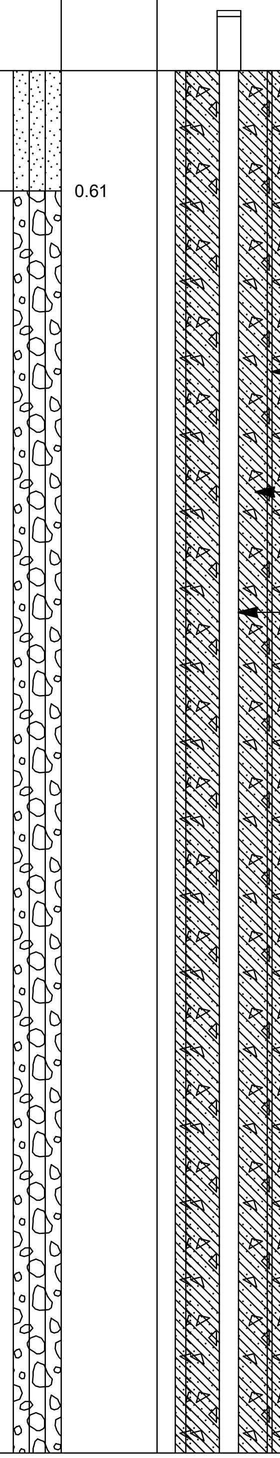
Bottom of borehole at 86.41 meters.

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14A-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	SM-GRAVELLY SANDY SILT, compact, brown						
0.5							
	GM-SILTY SANDY GRAVEL, compact, brown	0.61	254mm Ø BOREHOLE				
1.0							
1.5			210mm ID STEEL CASING				
2.0	- sand and gravel, with silt at 2.13m BGS		CEMENT GROUT				
2.5	- 0.3m section with cobbles at 2.44m BGS		50.8mm Ø STEEL RISER				
3.0							
3.5	- 0.2m section with cobbles at 3.51m BGS						
4.0	- increased silt content at 3.96m BGS						
	- 0.15m section with cobbles at 4.27m BGS						
4.5	- increased silt, decreased gravel content at 4.57m BGS						
5.0							
5.5	- 0.15m section with cobbles at 5.79m BGS						
6.0							
6.5	- sand and gravel, with silt, few cobbles at						



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14A-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	6.86m BGS						
7.5			254mm Ø BOREHOLE				
8.0			210mm ID STEEL CASING				
8.5							
9.0			CEMENT GROUT				
9.5			50.8mm Ø STEEL RISER				
	- increase sand and silt content at 9.75m BGS						
10.0							
10.5							
11.0	- decreased silt content, occasional cobbles at 10.97m BGS						
11.5							
12.0							
	- decreased gravel content at 12.19m BGS						
12.5							
13.0							
13.5							
	ML-GRAVELLY SILT, trace sand	13.87					

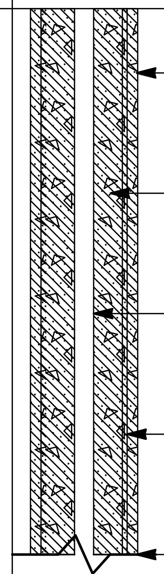
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14A-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
14.5	GM-SAND AND GRAVEL, with silt	14.33					
15.0							
15.5	ML-SANDY SILT, with limestone fragments	15.54					
16.0	DOLOSTONE, weathered, highly fractured	16.15					
16.5							
17.0	END OF OVERBURDEN HOLE @ 16.76m BGS						
17.5							
18.0							
18.5							
19.0							
19.5							
20.0							
20.5							



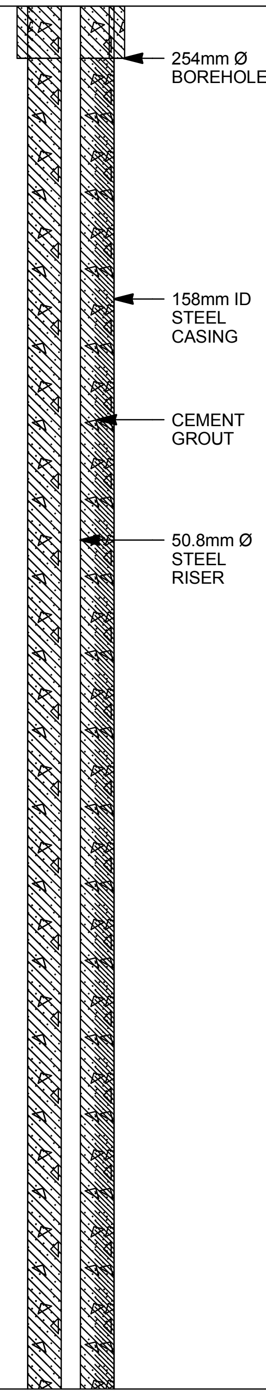
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14A-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
17.0	DOLOSTONE (Guelph Formation-proposed) (Guelph Formation-current), buff to tan, weathered, fractured, coarse crystalline, hard - fracture at 17.07m BGS - fracture at 17.22m BGS	16.76				
17.5						
18.0	- fracture at 17.83m BGS					
18.5	- fracture at 18.44m BGS					
19.0						
19.5	DOLOSTONE (Eramosa Formation, Reformatory Quarry Member-proposed) (Guelph Formation-current), greyish brown, fine crystalline, hard	19.35				
20.0						
20.5	- fracture at 20.42m BGS					
21.0						
21.5						
22.0						
22.5	- fracture at 22.25m BGS - fracture at 22.56m BGS					
23.0						



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14A-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
24.0						
24.5	- fracture at 24.38m BGS		158mm ID STEEL CASING			
25.0	- dark brown at 24.99m BGS		CEMENT GROUT			
25.5	- greyish brown at 25.60m BGS		50.8mm Ø STEEL RISER			
26.0						
26.5	DOLOSTONE (Eramosa Formation, Vinemount Member-proposed) (Amabel Formation, Eramosa Member-current), dark brown to dark grey, petroliferous odour, hard, minor occurence pyrite and sphalterite	26.52				
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0						

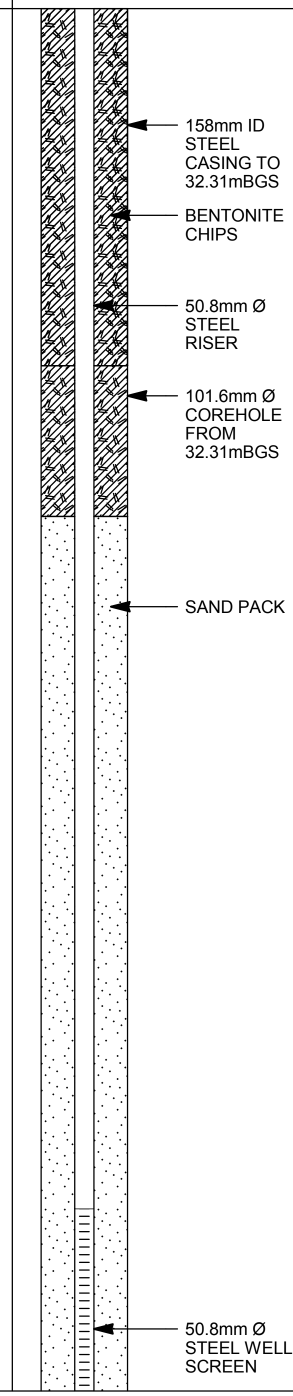
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14A-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
31.0						
31.5						
32.0	DOLOSTONE (Goat Island Formation-proposed) (Amabel Formation, Unsubdivided Member-current), light to medium brown, fine crystalline, pin-striped appearance	32.00				
32.5						
33.0						
33.5						
34.0	- 0.3m section softer at 34.14m BGS					
34.5						
35.0						
35.5	DOLOSTONE (Gasport Formation-proposed (Amabel Formation, Unsubdivided Member-current), bluish grey to white to grey, fine crystalline, fossiliferous, minor occurence of pyrite	35.36				
36.0						
36.5						
37.0						



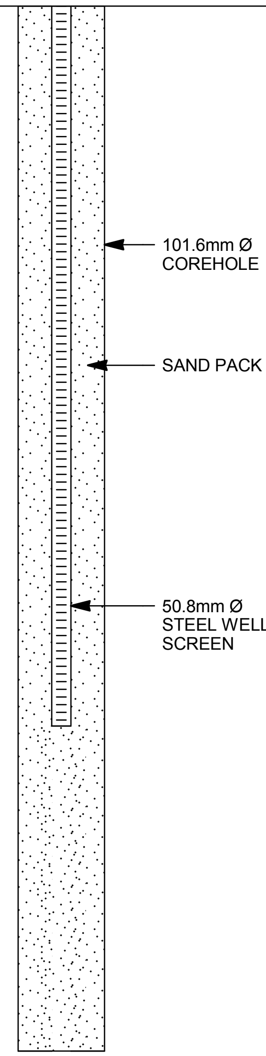
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14A-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
38.0						
38.5						
39.0						
39.5	- change in drilling, occasional small fractures at 39.62m BGS					
40.0						
40.5						
41.0						
41.5						
42.0						
42.5						
43.0	END OF BOREHOLE @ 42.82m BGS	42.82				
43.5	NOTE: BEDROCK LOGGED UTILIZING PROPOSED NOMENCLATURE (PER BRUNTON 2008, 2009). "CURRENT" - CURRENTLY ACCEPTED NOMENCLATURE					
44.0						



WELL DETAILS
Screened interval:
36.58 to 41.15m BGS
Length: 4.57m
Diameter: 51mm
Slot Size: 0.010
Material: STAINLESS STEEL
Seal:
30.36 to 33.07m BGS
Material: BENTONITE CHIPS
Sand Pack:
33.07 to 42.79m BGS
Material: NO. 1 SAND

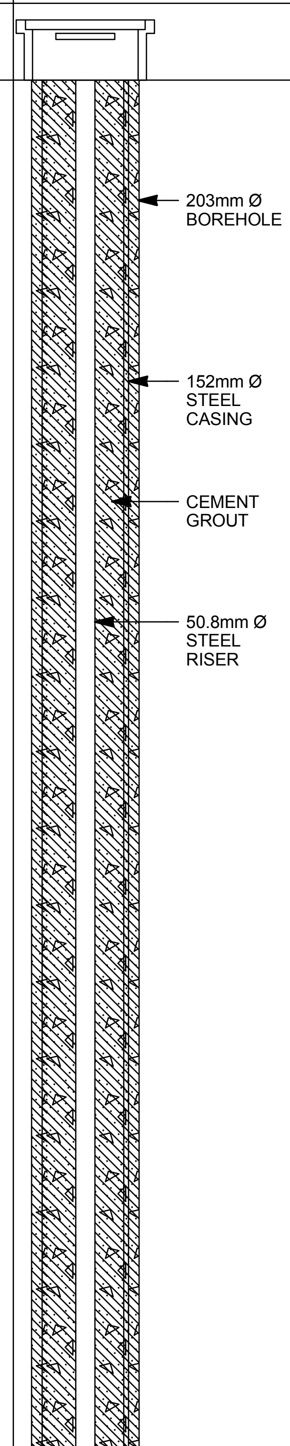
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14B-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	SM-GRAVELLY SANDY SILT, compact, brown						
0.5							
	GM-SILTY SANDY GRAVEL, compact, brown	0.61					
1.0							
1.5							
2.0	- sand and gravel, with silt at 2.13m BGS						
2.5	- 0.3m section with cobbles at 2.44m BGS						
3.0							
3.5	- 0.2m section with cobbles at 3.51m BGS						
4.0	- increased silt content at 3.96m BGS						
	- 0.15m section with cobbles at 4.27m BGS						
4.5	- increased silt, decreased gravel content at 4.57m BGS						
5.0							
5.5	- 0.15m section with cobbles at 5.79m BGS						
6.0							
6.5							
	- sand and gravel, with silt, few cobbles at						



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14B-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	6.86m BGS						
7.5			203mm Ø BOREHOLE				
8.0			152mm Ø STEEL CASING				
8.5							
9.0			CEMENT GROUT				
9.5			50.8mm Ø STEEL RISER				
	- increase sand and silt content at 9.75m BGS						
10.0							
10.5							
11.0	- decreased silt content, occasional cobbles at 10.97m BGS						
11.5							
12.0							
	- decreased gravel content at 12.19m BGS						
12.5							
13.0							
13.5							
	ML-GRAVELLY SILT, trace sand	13.87					

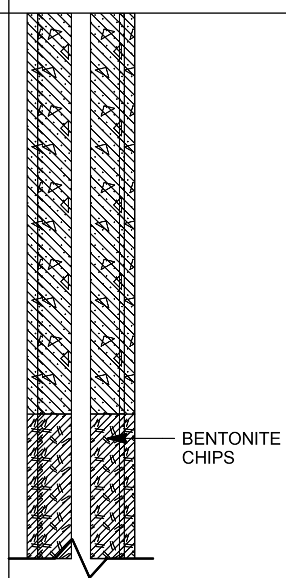
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14B-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
14.5	GM-SAND AND GRAVEL, with silt	14.33					
15.0							
15.5	ML-SANDY SILT, with limestone fragments	15.54					
16.0	DOLOSTONE, weathered, highly fractured	16.15	BENTONITE CHIPS				
16.5							
17.0	END OF OVERBURDEN HOLE @ 16.76m BGS						
17.5							
18.0							
18.5							
19.0							
19.5							
20.0							
20.5							



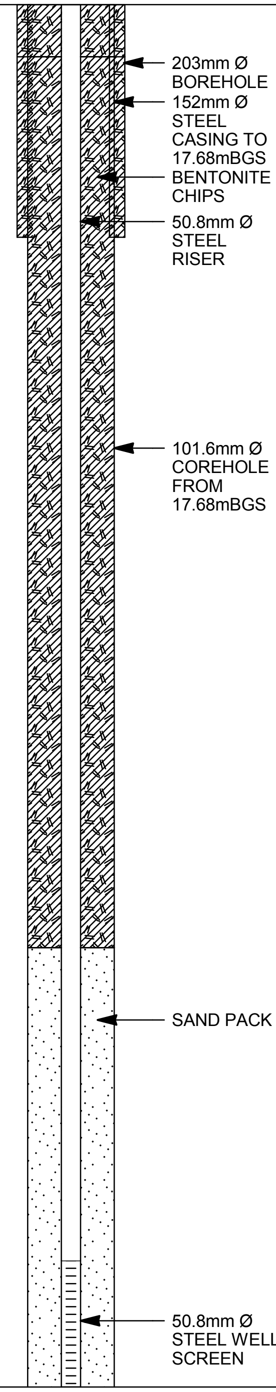
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14B-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
17.0	DOLOSTONE (Guelph Formation-proposed) (Guelph Formation-current), buff to tan, weathered, fractured, coarse crystalline, hard - fracture at 17.07m BGS - fracture at 17.22m BGS	16.76				
17.5						
18.0	- fracture at 17.83m BGS					
18.5	- fracture at 18.44m BGS					
19.0						
19.5	DOLOSTONE (Eramosa Formation, Reformatory Quarry Member-proposed) (Guelph Formation-current), greyish brown, fine crystalline, hard	19.35				
20.0						
20.5						
21.0						
21.5						
22.0						
22.5						
23.0						



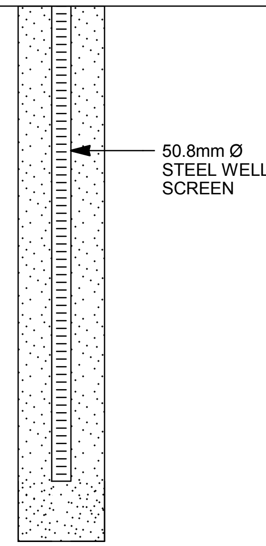
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14B-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %	
24.0							
24.5							
25.0							
25.5							
26.0							
	END OF BOREHOLE @ 26.21m BGS	26.21					
26.5	NOTE: BEDROCK LOGGED UTILIZING PROPOSED NOMENCLATURE (PER BRUNTON 2008, 2009). "CURRENT" - CURRENTLY ACCEPTED NOMENCLATURE						
27.0							
27.5							
28.0							
28.5							
29.0							
29.5							
30.0							



WELL DETAILS
Screened interval:
22.86 to 25.91m BGS
Length: 3.05m
Diameter: 51mm
Slot Size: 0.010
Material: STAINLESS STEEL
Seal:
16.03 to 21.28m BGS
Material: BENTONITE CHIPS
Sand Pack:
21.28 to 26.21m BGS
Material: NO. 1 SAND

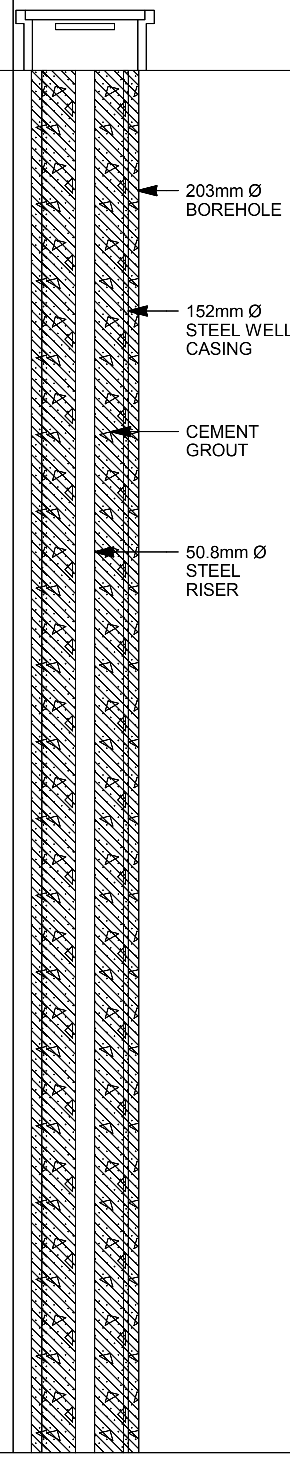
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14C-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	SM-GRAVELLY SANDY SILT, compact, brown						
0.5							
	GM-SILTY SANDY GRAVEL, compact, brown	0.61					
1.0							
1.5							
2.0							
	- sand and gravel, with silt at 2.13m BGS						
	- 0.3m section with cobbles at 2.44m BGS						
2.5							
3.0							
3.5	- 0.2m section with cobbles at 3.51m BGS						
	- increased silt content at 3.96m BGS						
4.0							
	- 0.15m section with cobbles at 4.27m BGS						
4.5	- increased silt, decreased gravel content at 4.57m BGS						
5.0							
5.5							
	- 0.15m section with cobbles at 5.79m BGS						
6.0							
6.5							
	- sand and gravel, with silt, few cobbles at						



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14C-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	6.86m BGS						
7.5			203mm Ø BOREHOLE				
8.0			152mm Ø STEEL WELL CASING				
8.5			CEMENT GROUT				
9.0							
9.5			50.8mm Ø STEEL RISER				
	- increase sand and silt content at 9.75m BGS						
10.0							
10.5							
11.0	- decreased silt content, occasional cobbles at 10.97m BGS						
11.5							
12.0							
	- decreased gravel content at 12.19m BGS						
12.5							
13.0							
13.5							
	ML-GRAVELLY SILT, trace sand	13.87					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

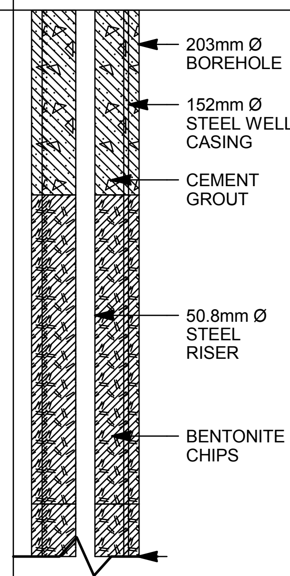
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14C-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS
	GM-SAND AND GRAVEL, with silt	14.33
14.5		
15.0		
15.5	ML-SANDY SILT, with limestone fragments	15.54
16.0	DOLOSTONE, weathered, highly fractured	16.15
16.5		
	END OF OVERBURDEN HOLE @ 16.76m BGS	
17.0		
17.5		
18.0		
18.5		
19.0		
19.5		
20.0		
20.5		

MONITORING WELL



SAMPLE			
NUMBER	INTERVAL	REC (%)	'N' VALUE

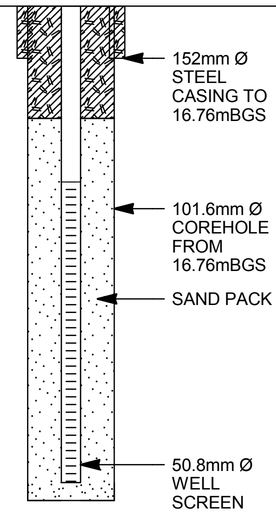
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS
PROJECT NUMBER: 000653-34
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW14C-11
DATE COMPLETED: September 14, 2011
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
	DOLOSTONE (Guelph Formation-proposed) (Guelph Formation-current), buff to tan, weathered, fractured, coarse crystalline, hard	16.76				
17.0	- fracture at 17.07m BGS - fracture at 17.22m BGS					
17.5						
	- fracture at 17.83m BGS					
18.0						
18.5	- fracture at 18.44m BGS					
19.0	END OF BOREHOLE @ 19.00m BGS	19.00				
	NOTE: BEDROCK LOGGED UTILIZING PROPOSED NOMENCLATURE (PER BRUNTON 2008, 2009). "CURRENT" - CURRENTLY ACCEPTED NOMENCLATURE					
19.5						
20.0						
20.5						
21.0						
21.5						
22.0						
22.5						
23.0						



WELL DETAILS
Screened interval:
17.39 to 18.91m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 0.010
Material: STAINLESS STEEL
Seal:
14.94 to 17.07m BGS
Material: BENTONITE CHIPS
Sand Pack:
17.07 to 19.00m BGS
Material: NO. 1 SAND

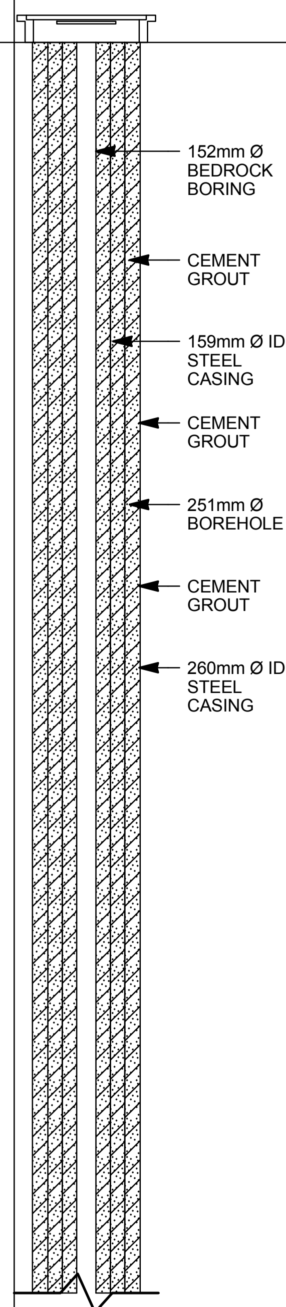
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
HOLE DESIGNATION: MW15A-12
PROJECT NUMBER: 000653
DATE COMPLETED: July 17, 2012
CLIENT: NESTLE WATERS CANADA
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
LOCATION: 101 BROCK RD, GUELPH, ON
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	SM/GM-SILTY SANDY GRAVEL, compact, fine and coarse grained gravel, brown						
	ML-GRAVELLY SILT, compact, brown	4.27					
	GM-SILTY SANDY GRAVEL, compact, brown	5.49					
	SW/GW-SAND AND GRAVEL, compact, up to cobble size gravel - increase in density at 10.36m BGS - decrease in density at 10.97m BGS - trace clay at 11.58m BGS - increase in density at 11.89m BGS	7.92					
	END OF OVERBURDEN HOLE @ 14.02m BGS						

Depth scale (m BGS): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

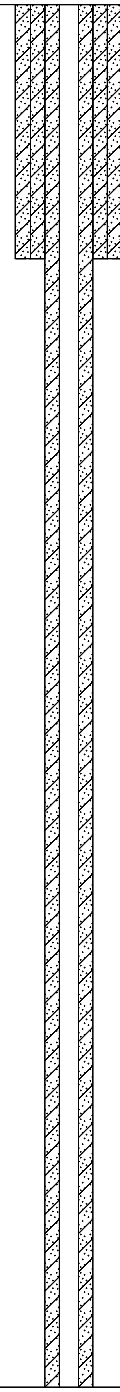


NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW15A-12
DATE COMPLETED: July 17, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
14	DOLOSTONE (Guelph Formation-proposed) (Guelph Formation-current), buff to tan, weathered, fractured, coarse, crystalline, hard - fracture at 14.48m BGS - fracture at 15.30m BGS	14.02				
15						
16						
17						
18						
19						
20	DOLOSTONE (Eramosa Formation, Reformatory Quarry Member-proposed) (Guelph Formation-current), greyish brown, fine crystalline, hard	19.81				
21						
22						
23						
24						
25						
26						
27	DOLOSTONE (Eramosa Formation-Vinemount Member-proposed) (Amabel Formation, Eramosa Member-current), dark brown to dark grey, petroliferous odor, hard, minor occurence pyrite and sphalerite	26.52				
28						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW15A-12
DATE COMPLETED: July 17, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
29–32						
32.31–37.80	DOLOSTONE (Goat Island Formation-proposed) (Amabel Formation, Unsubdivided Member-current), light to medium brown, fine crystalline, pin-striped appearance - fracture at 35.66m BGS - fracture at 36.88m BGS	32.31	OPEN HOLE			
37.80–43	DOLOSTONE (Gasport Formation-proposed) (Amabel Formation, Unsubdivided Member-current), bluish grey to white to grey, fine crystalline, fossiliferous, minor occurence of pyrite - fracture at 41.15m BGS - fracture at 43.28m BGS	37.80				

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW15A-12
DATE COMPLETED: July 17, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
45						
46						
47	- soft section at 46.94m BGS					
48	- soft section at 48.16m BGS					
	- soft section at 48.77m BGS					
49						
50						
51	- fracture at 50.90m BGS					
52	- fracture at 52.43m BGS					
53	- fracture at 53.64m BGS					
54						
55	- fracture at 55.17m BGS					
56	- fracture at 55.78m BGS - soft section at 56.08m BGS					
57						
58						
59	- soft section at 58.83m BGS					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
HOLE DESIGNATION: MW15A-12
PROJECT NUMBER: 000653
DATE COMPLETED: July 17, 2012
CLIENT: NESTLE WATERS CANADA
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
LOCATION: 101 BROCK RD, GUELPH, ON
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
60						
61						
62	- soft section at 61.87m BGS - soft section at 62.18m BGS					
63						
64	- 0.61m soft section at 64.31m BGS					
65	- 0.3m void at 65.07m BGS					
66						
67	END OF BOREHOLE @ 67.06m BGS	67.06				
68	NOTE: *260mm ID STEEL CASING SET INSIDE 343mm BOREHOLE WITH CEMENT GROUT					
69	OPEN HOLE: 34.75-67.06m BGS (114-220ft BGS)					
70						
71						
72						
73						
74						

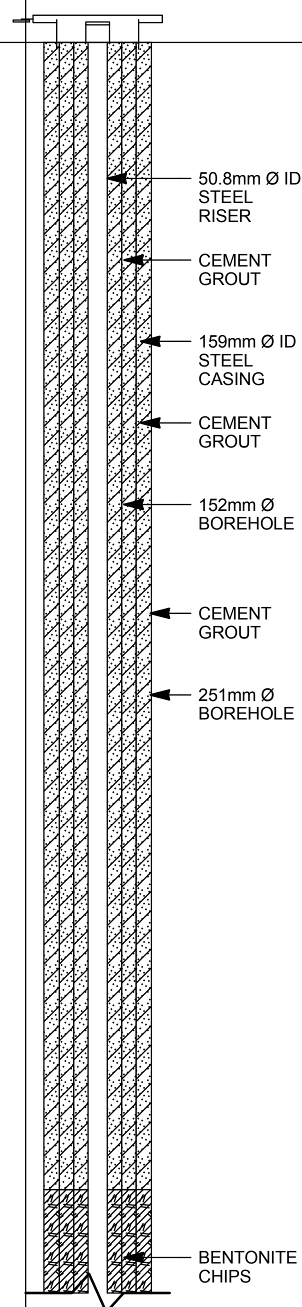
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW15B-12
DATE COMPLETED: July 17, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
0–4.27	SM/GM-SILTY SANDY GRAVEL, compact, fine and coarse grained gravel, brown	4.27					
4.27–5.49	ML-GRAVELLY SILT, compact, brown	5.49					
5.49–7.92	GM-SILTY SANDY GRAVEL, compact, brown	7.92					
7.92–14.02	SW/GW-SAND AND GRAVEL, compact, up to cobble size gravel - increase in density at 10.36m BGS - decrease in density at 10.97m BGS - trace clay at 11.58m BGS - increase in density at 11.89m BGS						
14.02	END OF OVERBURDEN HOLE @ 14.02m BGS						

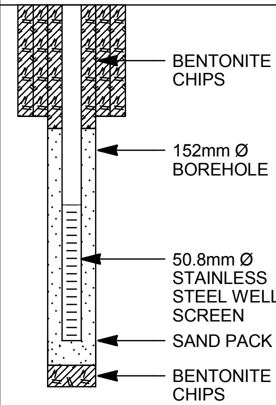


NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
HOLE DESIGNATION: MW15B-12
PROJECT NUMBER: 000653
DATE COMPLETED: July 17, 2012
CLIENT: NESTLE WATERS CANADA
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
LOCATION: 101 BROCK RD, GUELPH, ON
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
14	DOLOSTONE (Guelph Formation-proposed) (Guelph Formation-current), buff to tan, weathered, fractured, coarse, crystalline, hard - fracture at 14.48m BGS - fracture at 15.30m BGS	14.02				
15						
16						
17	END OF BOREHOLE @ 17.28m BGS	17.28				
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						



WELL DETAILS
Screened interval:
15.24 to 16.76m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 0.010
Material: STAINLESS STEEL
Seal:
12.86 to 14.39m BGS
Material: BENTONITE CHIPS
Sand Pack:
14.39 to 17.04m BGS
Material: SAND

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

BEDROCK LOG 000653WIN.GPJ CRA_CORP.GDT 12/5/12

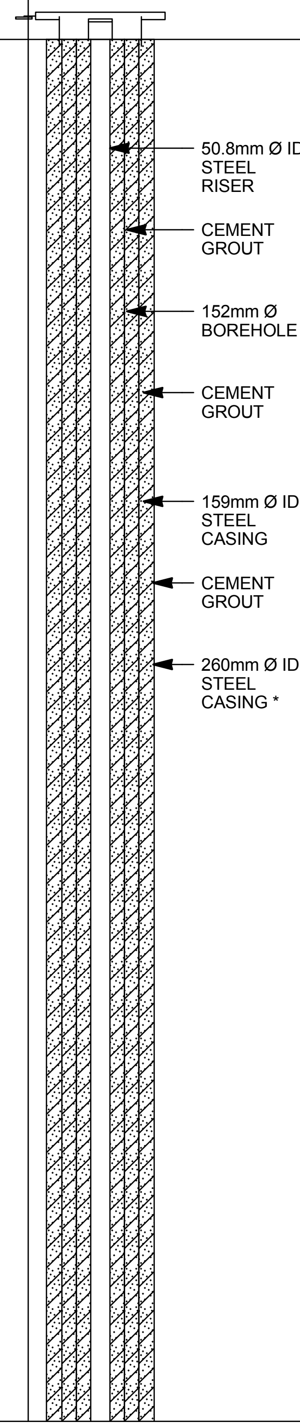
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW16A-12
DATE COMPLETED: July 26, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-GRAVELLY SILT, gravel up to cobble size, brown						
	GM-SILTY GRAVEL, compact, silty sandy gravel	1.22					
	SP/GP-SAND AND GRAVEL, compact, up to coarse grained gravel	4.57					
	- loose at 12.80m BGS						

Depth scale (m BGS): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15



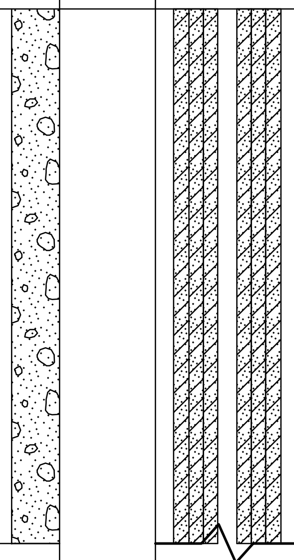
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW16A-12
DATE COMPLETED: July 26, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
16							
17							
18							
19							
20							
21							
22	END OF OVERBURDEN HOLE @ 21.49m BGS						
23							
24							
25							
26							
27							
28							
29							
30							



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW16A-12
DATE COMPLETED: July 26, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
21						
22	DOLOSTONE (Guelph Formation-proposed) (Guelph Formation-current), buff to tan, very soft, highly fractured, weathered, coarse crystalline	21.49				
23						
24	- hard, becoming competent at 23.62m BGS					
25	DOLOSTONE (Eramosa Formation, Reformatory Quarry Member-proposed) (Guelph Formation-current), greyish brown, fine crystalline, hard)	24.54				
26						
27						
28						
29						
30						
31	DOLOSTONE (Eramosa Formation-Vinemount Member-proposed) (Amabel Formation, Eramosa Member-current), dark brown to dark grey, petroliferous odor, hard, minor occurence pyrite and sphalerite	30.18				
32						
33						
34						
35						

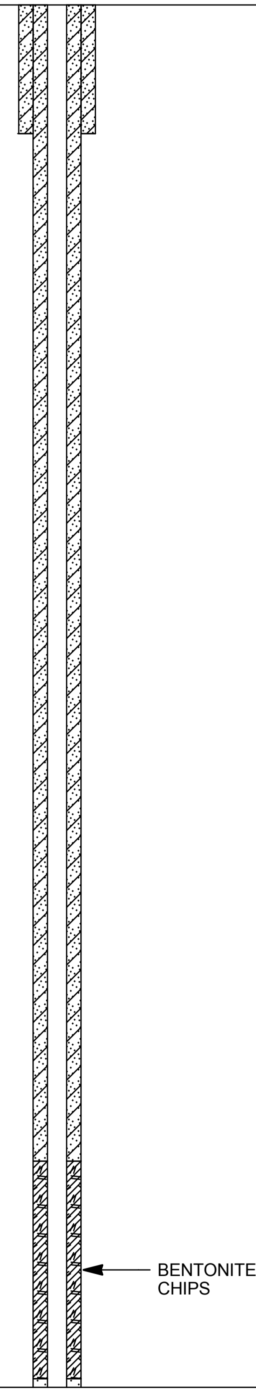
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW16A-12
DATE COMPLETED: July 26, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
36						
37	DOLOSTONE (Goat Island Formation-proposed) (Amabel Formation, Unsubdivided Member-current), light to medium brown, fine crystalline, pin-striped appearance	36.42				
38						
39	DOLOSTONE (Gasport Formation-proposed) (Amabel Formation, Unsubdivided Member-current), bluish grey to white to grey, fine crystalline, fossiliferous, minor occurence of pyrite	38.71				
40	- fracture at 39.62m BGS					
41						
42						
43	- fracture at 43.59m BGS					
44	- soft section at 44.50m BGS					
45	- soft section at 45.11m BGS					
	- fracture at 45.57m BGS					
46						
47	- fracture at 47.24m BGS					
48						
49	- fracture at 49.07m BGS					
50	- soft section at 49.99m BGS					



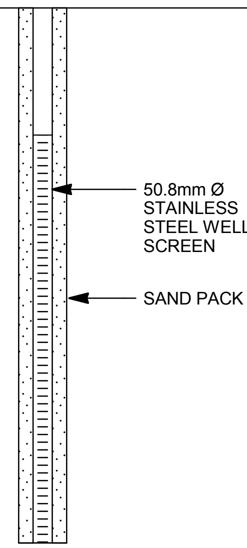
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW16A-12
DATE COMPLETED: July 26, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
52	- fracture at 52.12m BGS					
53	- soft section at 53.19m BGS					
54	- fracture at 53.95m BGS - fracture at 54.25m BGS					
55						
56						
57	END OF BOREHOLE @ 57.00m BGS NOTES: *260mm ID STEEL CASING SET INSIDE 343mm BOREHOLE WITH CEMENT GROUT	57.00	WELL DETAILS Screened interval: 52.43 to 57.00m BGS Length: 4.57m Diameter: 51mm Slot Size: 0.010 Material: STAINLESS STEEL Seal: 48.46 to 50.90m BGS Material: BENTONITE CHIPS Sand Pack: 50.90 to 57.00m BGS Material: SAND			
58						
59						
60						
61						
62						
63						
64						
65						
66						



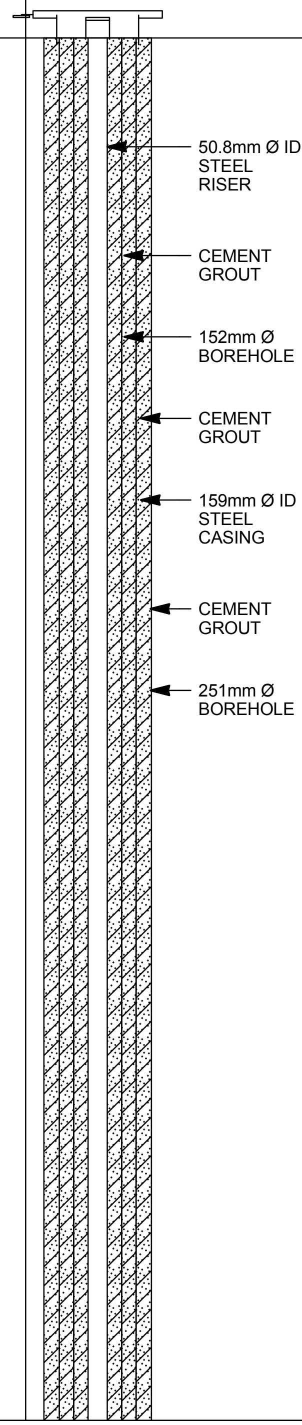
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW16B-12
DATE COMPLETED: July 26, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-GRAVELLY SILT, gravel up to cobble size, brown						
1.22	GM-SILTY GRAVEL, compact, silty sandy gravel	1.22					
4.57	SP/GP-SAND AND GRAVEL, compact, up to coarse grained gravel	4.57					
12.80	- loose at 12.80m BGS						

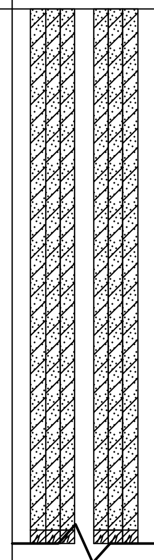


NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
HOLE DESIGNATION: MW16B-12
PROJECT NUMBER: 000653
DATE COMPLETED: July 26, 2012
CLIENT: NESTLE WATERS CANADA
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
LOCATION: 101 BROCK RD, GUELPH, ON
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
16							
17							
18							
19							
20							
21							
	END OF OVERBURDEN HOLE @ 21.49m BGS						
22							
23							
24							
25							
26							
27							
28							
29							
30							



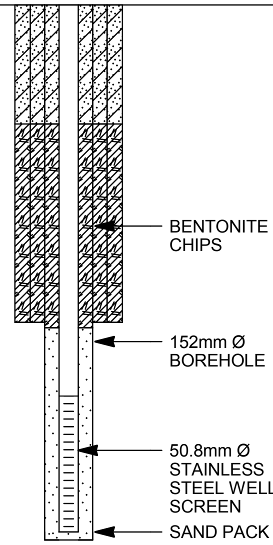
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW16B-12
DATE COMPLETED: July 26, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
21.49	DOLOSTONE (Guelph Formation-proposed) (Guelph Formation-current), buff to tan, very soft, highly fractured, weathered, coarse crystalline - hard, becoming competent at 23.62m BGS	21.49				
24.54	DOLOSTONE (Eramosa Formation, Reformatory Quarry Member-proposed) (Guelph Formation-current), greyish brown, fine crystalline, hard)	24.54				
26.00	END OF BOREHOLE @ 26.00m BGS	26.00				



WELL DETAILS
Screened interval:
24.38 to 25.91m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 0.010
Material: STAINLESS STEEL
Seal:
21.34 to 23.62m BGS
Material: BENTONITE CHIPS
Sand Pack:
23.62 to 26.00m BGS
Material: SAND

Depth scale (m BGS): 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35

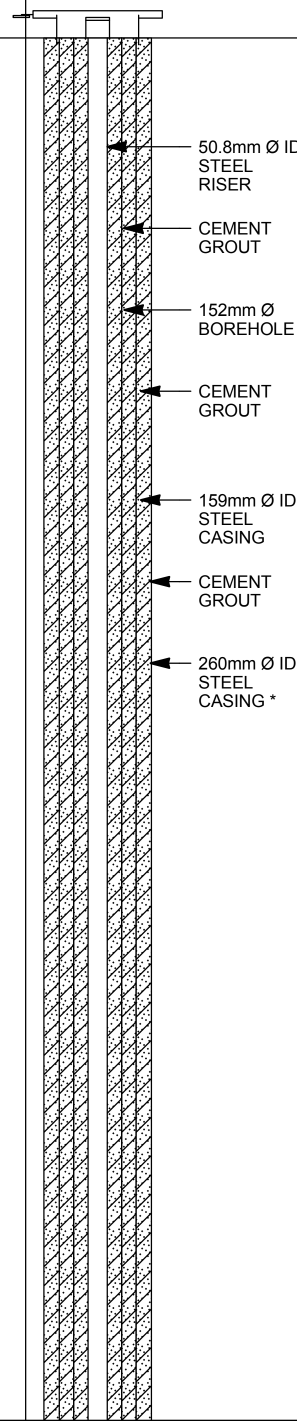
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
HOLE DESIGNATION: MW17A-12
PROJECT NUMBER: 000653
DATE COMPLETED: August 3, 2012
CLIENT: NESTLE WATERS CANADA
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
LOCATION: 101 BROCK RD, GUELPH, ON
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
0–1.83	SM/GM-SILT AND GRAVEL, compact, fine to medium grained sand, fine to coarse grained gravel, brown, moist - cobbles at 1.52m BGS						
1.83–3.96	SW/GW-SAND AND GRAVEL, compact, fine to medium grained sand, fine to coarse grained gravel up to cobble size, brown	1.83					
3.96–4.27	ML-GRAVELLY SILT, compact, brown	3.96					
4.27–	SW/GW-SAND AND GRAVEL, compact, gravel up to cobble size, brown	4.27					

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW17A-12
DATE COMPLETED: August 3, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	- very loose at 15.54m BGS						
16							
17							
18							
19	SM/GM-SILTY SAND AND GRAVEL, compact, brown	19.20					
20	ML-GRAVELLY SANDY SILT, hard, greyish white, moist	19.81					
	END OF OVERBURDEN HOLE @ 20.12m BGS						
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW17A-12
DATE COMPLETED: August 3, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
	SM/GM-SILTY SAND AND GRAVEL, compact, brown	19.20				
20	ML-GRAVELLY SANDY SILT, hard, greyish white, moist	19.81				
21	DOLOSTONE (Guelph Formation-proposed) (Guelph Formation-current), buff to tan, weathered, fractured, coarse crystalline, soft - becoming competent at 21.49m BGS	20.12				
22						
23			BENTONITE CHIPS			
24	- fracture at 24.38m BGS		BENTONITE GROUT			
25						
26	- fracture at 25.91m BGS					
27	DOLOSTONE (Eramosa Formation, Reformatory Quarry Member-proposed) (Guelph Formation-current), greyish brown, fine crystalline, hard - fracture at 26.67m BGS	26.52				
28						
29						
30	DOLOSTONE (Eramosa Formation, Vinemount Member-proposed) (Amabel Formation, Eramosa Member-current), dark brown to dark grey, petroliferous odor, hard, minor occurence pyrite and sphalerite	29.57				
31						
32						
33						
34	- fracture at 33.53m BGS					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW17A-12
DATE COMPLETED: August 3, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
35						
36						
37						
	DOLOSTONE (Goat Island Formation-proposed) (Amabel Formation, Unsubdivided Member-current), light to medium brown, fine crystalline, pin-striped appearance	37.19				
38						
39						
	- fracture at 39.78m BGS					
40	- fracture at 40.23m BGS					
41	- fracture at 40.84m BGS					
	DOLOSTONE (Gasport Formation-proposed) (Amabel Formation, Unsubdivided Member-current), bluish grey to white to grey, fine crystalline, fossiliferous, minor occurence of pyrite	41.76				
42						
43	- fracture at 43.28m BGS					
44	- soft section at 44.50m BGS					
45			BENTONITE CHIPS			
46	- soft section at 46.33m BGS					
	- fracture at 46.63m BGS					
47						
48						
49	- soft section at 49.53m BGS					

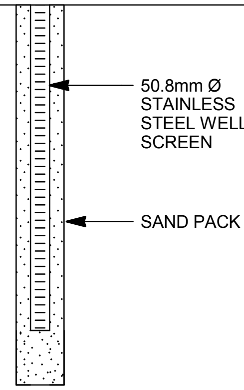
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW17A-12
DATE COMPLETED: August 3, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
51	- soft section at 50.90m BGS					
52	- fracture at 52.12m BGS					
53						
54	END OF BOREHOLE @ 53.95m BGS	53.95				
55	NOTE: *260mm ID STEEL CASING SET INSIDE 343mm BOREHOLE WITH CEMENT GROUT					
56						
57						
58						
59						
60						
61						
62						
63						
64						
65						



WELL DETAILS
Screened interval:
49.07 to 53.64m BGS
Length: 4.57m
Diameter: 51mm
Slot Size: 0.010
Material: STAINLESS STEEL
Seal:
44.20 to 46.02m BGS
Material: BENTONITE CHIPS
Sand Pack:
46.02 to 54.25m BGS
Material: SAND

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

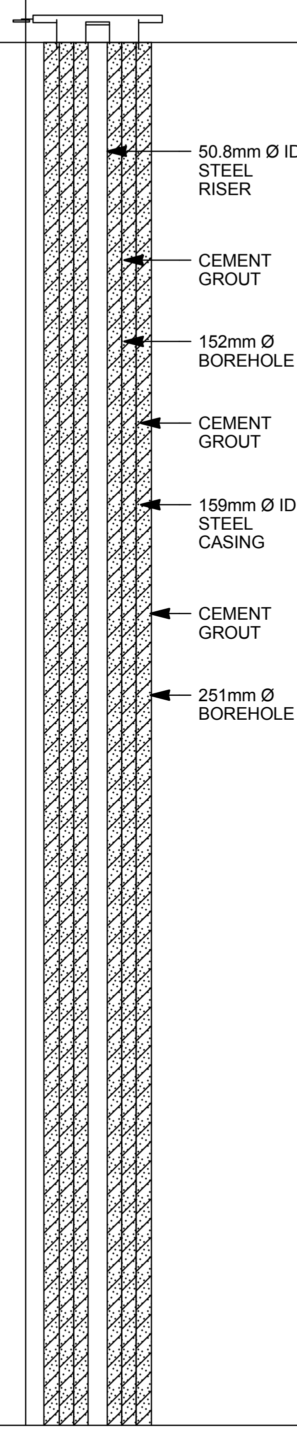
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW17B-12
DATE COMPLETED: August 3, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	SM/GM-SILT AND GRAVEL, compact, fine to medium grained sand, fine to coarse grained gravel, brown, moist						
1	- cobbles at 1.52m BGS						
2	SW/GW-SAND AND GRAVEL, compact, fine to medium grained sand, fine to coarse grained gravel up to cobble size, brown	1.83					
4	ML-GRAVELLY SILT, compact, brown	3.96					
	SW/GW-SAND AND GRAVEL, compact, gravel up to cobble size, brown	4.27					

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW17B-12
DATE COMPLETED: August 3, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	- very loose at 15.54m BGS						
16							
17							
18							
19							
	SM/GM-SILTY SAND AND GRAVEL, compact, brown	19.20					
20	ML-GRAVELLY SANDY SILT, hard, greyish white, moist	19.81					
	END OF OVERBURDEN HOLE @ 20.12m BGS						
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

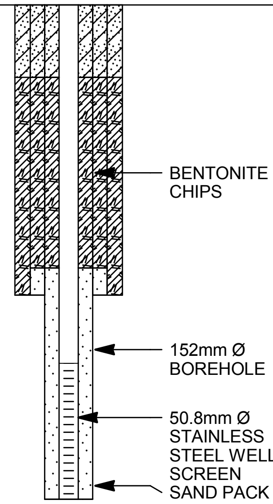
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW17B-12
DATE COMPLETED: August 3, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
	SM/GM-SILTY SAND AND GRAVEL, compact, brown	19.20				
20	ML-GRAVELLY SANDY SILT, hard, greyish white, moist	19.81				
	DOLOSTONE (Guelph Formation-proposed) (Guelph Formation-current), buff to tan, weathered, fractured, coarse crystalline, soft	20.12				
21	- becoming competent at 21.49m BGS					
22						
23						
24	- fracture at 24.38m BGS					
	END OF BOREHOLE @ 24.54m BGS	24.54				
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						



WELL DETAILS
Screened interval:
23.01 to 24.54m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 0.010
Material: STAINLESS STEEL
Seal:
19.81 to 21.95m BGS
Material: BENTONITE CHIPS
Sand Pack:
21.95 to 24.54m BGS
Material: SAND

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

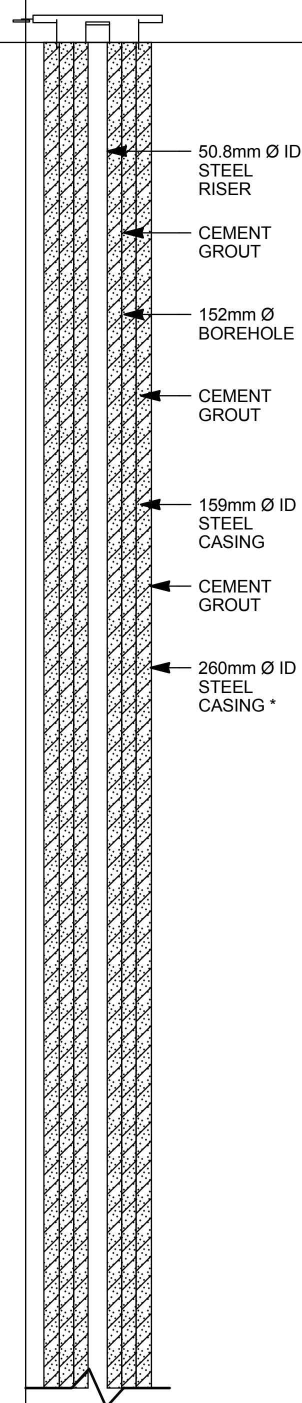
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW18A-12
DATE COMPLETED: August 15, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS
ML-SANDY SILT, trace gravel, compact, no plasticity, brown	0.30
GM-SILTY SANDY GRAVEL, compact, fine grained sand, fine to coarse grained gravel, brown	1.07
ML-SILT, few sand, few clay, compact, slight plasticity, brown	1.68
GM-SILTY SANDY GRAVEL, compact, fine grained sand, fine to coarse grained gravel, brown	3.66
SW/GW-SAND AND GRAVEL, trace to with silt, compact, fine to medium grained sand, fine and coarse grained gravel, brown	9.14
GM-SILTY SANDY GRAVEL, compact, fine and coarse grained gravel, brown	9.45
GM/ML-GRAVELLY SANDY SILT/SILTY SANDY GRAVEL, compact, fine to coarse grained gravel, brown - trace clay at 10.67m BGS	11.28
SW/GW-SAND AND GRAVEL, trace silt, compact, fine to coarse gravel, brown - rock pieces at 13.72m BGS	
END OF OVERBURDEN HOLE @ 15.09m BGS	

MONITORING WELL



SAMPLE			
NUMBER	INTERVAL	REC (%)	'N' VALUE

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

OVERBURDEN LOG 000653WIN.GPJ CRA_CORP.GDT 12/5/12

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
HOLE DESIGNATION: MW18A-12
PROJECT NUMBER: 000653
DATE COMPLETED: August 15, 2012
CLIENT: NESTLE WATERS CANADA
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
LOCATION: 101 BROCK RD, GUELPH, ON
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
15	BEDROCK (Guelph Formation), buff to light grey, soft, highly weathered, highly fractured	15.09				
16						
17	DOLOSTONE (Guelph Formation-proposed) (Guelph Formation-current), buff to tan, weathered, fractured, coarse crystalline, hard	16.61				
18	- fracture at 18.29m BGS					
19	- fracture at 18.90m BGS - soft drilling at 19.20m BGS - fracture (500 gpm, sulfur type odor) at 19.51m BGS					
20						
21						
22	- fracture at 21.95m BGS					
23						
24	- fracture at 23.77m BGS - fracture at 24.08m BGS					
25	- fracture at 25.30m BGS					
26	DOLOSTONE (Eramosa Formation, Reformatory Quarry Member-proposed) (Guelph Formation-current), greyish brown, fine crystalline, hard - fracture at 26.21m BGS	25.60				
27	- fracture at 26.97m BGS					
28						
29						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW18A-12
DATE COMPLETED: August 15, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
30.18–34.75	DOLOSTONE (Eramosa Formation, Vinemount Member-proposed) (Amabel Formation, Eramosa Member-current), dark brown to dark grey, petroliferous odor, hard, minor occurence pyrite and sphalerite - fracture at 30.94m BGS - fracture at 32.92m BGS - fracture at 33.83m BGS - fracture at 34.14m BGS	30.18				
34.75–40.23	DOLOSTONE (Goat Island Formation-proposed) (Amabel Formation, Unsubdivided Member-current), light to medium brown, fine crystalline, pin-striped appearance - fracture at 35.51m BGS - faster drilling at 36.27m BGS - fracture at 37.80m BGS - fracture at 38.40m BGS - fracture at 39.93m BGS	34.75				
40.23–	DOLOSTONE (Gasport Formation-proposed) (Amabel Formation, Unsubdivided Member-current), bluish grey to white to grey, fine crystalline, fossiliferous, minor occurence of pyrite - fracture at 40.84m BGS - fracture at 41.45m BGS - fracture at 42.37m BGS - soft section at 43.28m BGS	40.23				

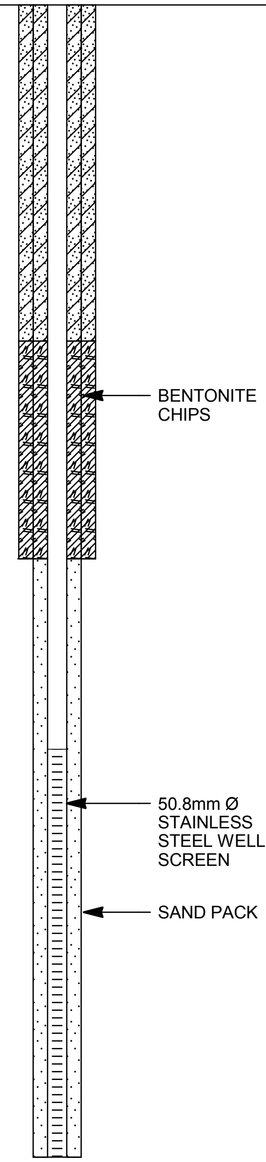
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW18A-12
DATE COMPLETED: August 15, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
	- fracture at 45.57m BGS					
46						
47	- fracture at 46.94m BGS					
48	- soft section at 47.85m BGS					
49	- fracture at 49.38m BGS					
50	- fracture at 49.99m BGS					
51	- soft section at 51.51m BGS					
52						
53						
54						
55						
56	- fracture at 56.08m BGS					
57						
58	END OF BOREHOLE @ 57.91m BGS	57.91				
59	NOTES:					
60	*260mm ID STEEL CASING SET INSIDE 343mm BOREHOLE WITH CEMENT GROUT					



WELL DETAILS
Screened interval:
53.34 to 57.91m BGS
Length: 4.57m
Diameter: 51mm
Slot Size: 0.010
Material: STAINLESS STEEL
Seal:
48.77 to 51.21m BGS

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH

PROJECT NUMBER: 000653

CLIENT: NESTLE WATERS CANADA

LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW18A-12

DATE COMPLETED: August 15, 2012

DRILLING METHOD: MUD ROTARY/ AIR ROTARY

FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
61			Material: BENTONITE CHIPS Sand Pack: 51.21 to 57.91m BGS Material: SAND			
62						
63						
64						
65						
66						
67						
68						
69						
70						
71						
72						
73						
74						
75						

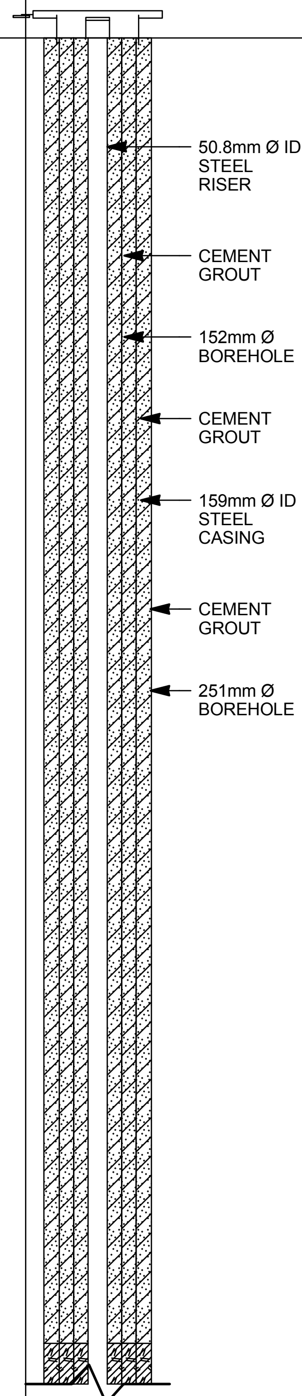
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
HOLE DESIGNATION: MW18B-12
PROJECT NUMBER: 000653
DATE COMPLETED: August 15, 2012
CLIENT: NESTLE WATERS CANADA
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
LOCATION: 101 BROCK RD, GUELPH, ON
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS
0.30	ML-SANDY SILT, trace gravel, compact, no plasticity, brown
1.07	GM-SILTY SANDY GRAVEL, compact, fine grained sand, fine to coarse grained gravel, brown
1.68	ML-SILT, few sand, few clay, compact, slight plasticity, brown
3.66	GM-SILTY SANDY GRAVEL, compact, fine grained sand, fine to coarse grained gravel, brown
9.14	SW/GW-SAND AND GRAVEL, trace to with silt, compact, fine to medium grained sand, fine and coarse grained gravel, brown
9.45	GM-SILTY SANDY GRAVEL, compact, fine and coarse grained gravel, brown
11.28	GM/ML-GRAVELLY SANDY SILT/SILTY SANDY GRAVEL, compact, fine to coarse grained gravel, brown - trace clay at 10.67m BGS
	SW/GW-SAND AND GRAVEL, trace silt, compact, fine to coarse gravel, brown - rock pieces at 13.72m BGS
	END OF OVERBURDEN HOLE @ 15.09m BGS

MONITORING WELL



SAMPLE			
NUMBER	INTERVAL	REC (%)	'N' VALUE

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CRA

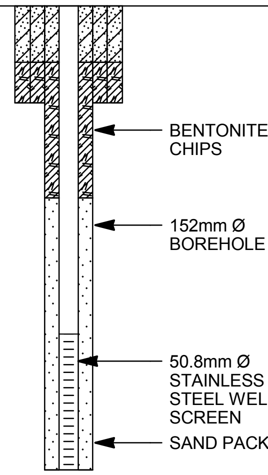
STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: NESTLE WATERS CANADA, GUELPH
PROJECT NUMBER: 000653
CLIENT: NESTLE WATERS CANADA
LOCATION: 101 BROCK RD, GUELPH, ON

HOLE DESIGNATION: MW18B-12
DATE COMPLETED: August 15, 2012
DRILLING METHOD: MUD ROTARY/ AIR ROTARY
FIELD PERSONNEL: D. DEITNER

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	MONITORING WELL	RUN NUMBER	CORE RECOVERY %	RQD %
15	BEDROCK (Guelph Formation), buff to light grey, soft, highly weathered, highly fractured	15.09				
16.61	DOLOSTONE (Guelph Formation-proposed) (Guelph Formation-current), buff to tan, weathered, fractured, coarse crystalline, hard - fracture at 18.29m BGS - fracture at 18.90m BGS - soft drilling at 19.20m BGS	16.61				
19.20	END OF BOREHOLE @ 19.20m BGS	19.20				

Depth scale: 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29



WELL DETAILS
Screened interval:
17.68 to 19.20m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 0.010
Material: STAINLESS STEEL
Seal:
14.63 to 16.15m BGS
Material: BENTONITE CHIPS
Sand Pack:
16.15 to 19.20m BGS
Material: SAND

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

MW21-18 (SWP BH1)

13-0221-00

Ontario — Ministry of the Environment and Climate Change

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Tag No. (Place Sticker and/or Print Below): Tag#:A 213542 BH1

Measurements recorded in: ☐ Metric ☑ Imperial

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Nestle Canada Inc.		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
25 Sheppard Ave W	North York	ON	M2N6S8	4165129000

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
55 Brock Rd S	Puslinch		

County/District/Municipality	City/Town/Village	Province	Postal Code
Wellington	Aberfoyle	Ontario	

UTM Coordinates Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83 17	564922	4821316		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
	Course, Sand, Gravel	Till clasts		0	30
	Dolostone		Guelph Formation	30	36.5
	Dolostone		Eramosa Formation	36.5	68.5
	Dolostone		Goat Island Formation	68.5	99
	Dolostone		Gasport Formation	99	223.5
	Dolostone		Irondequoit Formation	223.5	233
	Dolostone		Rockway Formation	233	242
	Dolostone		Cabot Head Formation	242	245

See attached for Metric Version

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	38	Portland	

Results of Well Yield Testing

After test of well yield, water was: ☐ Clear and sand free ☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping: hrs + min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min / GPM)

Well production (l/min / GPM)

Disinfected? ☐ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Method of Construction

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Boring ☐ Air percussion ☐ Other, specify ☑ Diamond ☐ Jetting ☐ Driving ☐ Digging

Well Use

☐ Public ☐ Domestic ☐ Livestock ☐ Irrigation ☐ Industrial ☐ Other, specify ☐ Commercial ☐ Municipal ☐ Test Hole ☐ Cooling & Air Conditioning ☐ Not used ☐ Dewatering ☐ Monitoring

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
6 5/8	steel	0.188	+1.5	38
6	open		38	245

Status of Well

☐ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well ☐ Dewatering Well ☑ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

Map of Well Location

Please provide a map below following instructions on the back.

Water Details

Water found at Depth: 2 (m/ft) Kind of Water: ☐ Fresh ☒ Untested ☐ Gas ☐ Other, specify

Water found at Depth: (m/ft) Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify

Water found at Depth: (m/ft) Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	25	14
25	38	8
38	245	6

Well Contractor and Well Technician Information

Business Name of Well Contractor: Aardvark Drilling Inc.

Well Contractor's Licence No.: 7 2 3 8

Business Address (Street Number/Name): 25-C Lewis Road

Municipality: Guelph

Province: ON Postal Code: N 1 H 1 E 9 Business E-mail Address: www.aardvarkdrillinginc.com

Bus. Telephone No. (inc. area code): 5 1 9 8 2 6 9 3 4 0

Name of Well Technician (Last Name, First Name): Grant, Dean

Well Technician's Licence No.: 3 1 3 1

Signature of Technician and/or Contractor

Date Submitted: 2016 08 26

Comments: See Attached Map

Well owner's information package delivered ☐ Yes ☐ No

Date Package Delivered: YYYY MM DD

Date Work Completed: 2016 08 10

Ministry Use Only — Audit No. Z303950 — Received

0506E (2014/11)

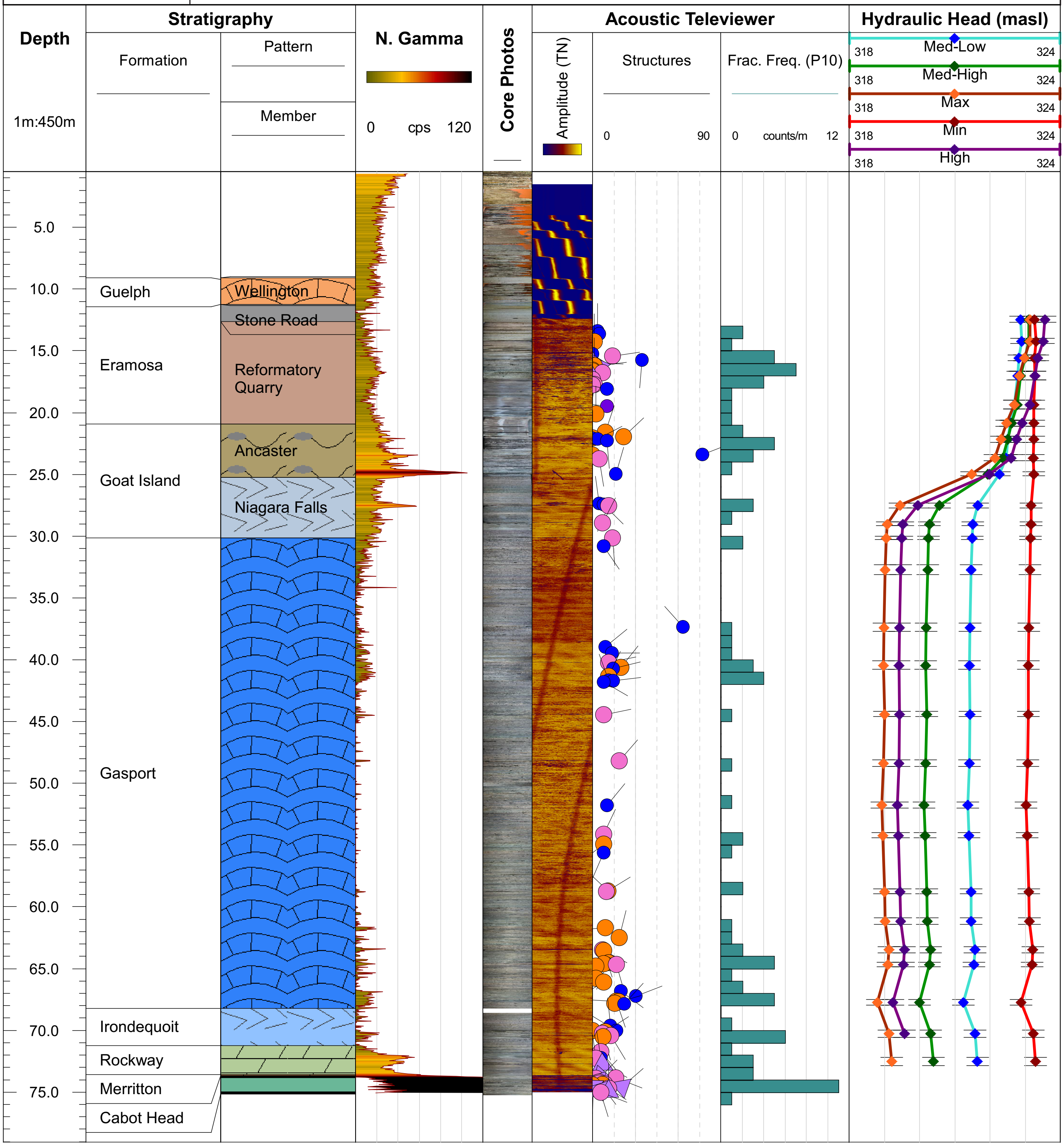
Well Owner's Copy

SWP BH01				
TopDepth		BottomDepth		Formation
(m)	(ft)	(m)	(ft)	(FT)
0	0.0	9.06	29.7	overburden, sand and gravel - very poor core retrieval
9.06	29.7	11.26	36.9	Guelph
11.26	36.9	20.9	68.6	Eramosa
20.9	68.6	30.13	98.9	Goat Island
30.13	98.9	68.22	223.8	Gasport
68.22	223.8	71.23	233.7	Irondequoit
71.23	233.7	73.57	241.4	Rockway
73.57	241.4	73.67	241.7	Merritton
73.67	241.7	74.73	245.2	Cabot Head

Project: South Wellington Puslinch
Borehole ID: **BH-01**

Preliminary Data Montage

Prepared by: G360 Institute for Groundwater Research
Prepared for: Nestle Waters Canada
Date: May 24, 2019



MW19-18 (SWP BH2)

18-gr0221-90

Ontario — Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. (Place Sticker and/or Print Below): A245306 BH 2

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Nestle Canada Inc.		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
25 Sheppard Ave W	North York	ON	M2N6S8	4165129000

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
7444 Wellington rd 34	Puslinch		

County/District/Municipality	City/Town/Village	Province	Postal Code
Wellington	Aberfoyle	Ontario	

UTM Coordinates Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83 17	561094	4811361 08		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
			Please see attached		

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m^3/ft^3)
0	60	Portland / Bentonite	

Results of Well Yield Testing

After test of well yield, water was: ☐ Clear and sand free ☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping: hrs + min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min / GPM)

Well production (l/min / GPM)

Disinfected? ☐ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Method of Construction

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Boring ☐ Air percussion ☐ Other, specify ☒ Diamond ☐ Jetting ☐ Driving ☐ Digging

Well Use

☐ Public ☐ Domestic ☐ Livestock ☐ Irrigation ☐ Industrial ☐ Other, specify ☐ Commercial ☐ Municipal ☐ Test Hole ☐ Cooling & Air Conditioning ☐ Not used ☐ Dewatering ☐ Monitoring

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
6	steel		+1.5	60
6	open		60	255

Status of Well

☐ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well ☐ Dewatering Well ☒ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

Map of Well Location

Please provide a map below following instructions on the back.

Water Details

Water found at Depth 6 (m/ft) Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify

Water found at Depth (m/ft) Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify

Water found at Depth (m/ft) Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	60	12
60	255	6

Well Contractor and Well Technician Information

Business Name of Well Contractor: Aardvark Drilling Inc.

Well Contractor's Licence No.: 7238

Business Address (Street Number/Name): 25-C Lewis Road

Municipality: Guelph

Province: ON Postal Code: N1H 1E9 Business E-mail Address: www.aardvarkdrillinginc.com

Bus. Telephone No. (inc. area code): 5198269140 Name of Well Technician (Last Name, First Name): Richards, Adrian

Well Technician's Licence No.: 2151 5 Signature of Technician and/or Contractor Date Submitted: 2019 09 10

Comments: See Attached Map

Well owner's information package delivered: ☐ Yes ☐ No

Date Package Delivered: YYYY MM DD

Date Work Completed: 2019 08 05

Ministry Use Only — Audit No. Z303899 Received

0506E (2014/11)

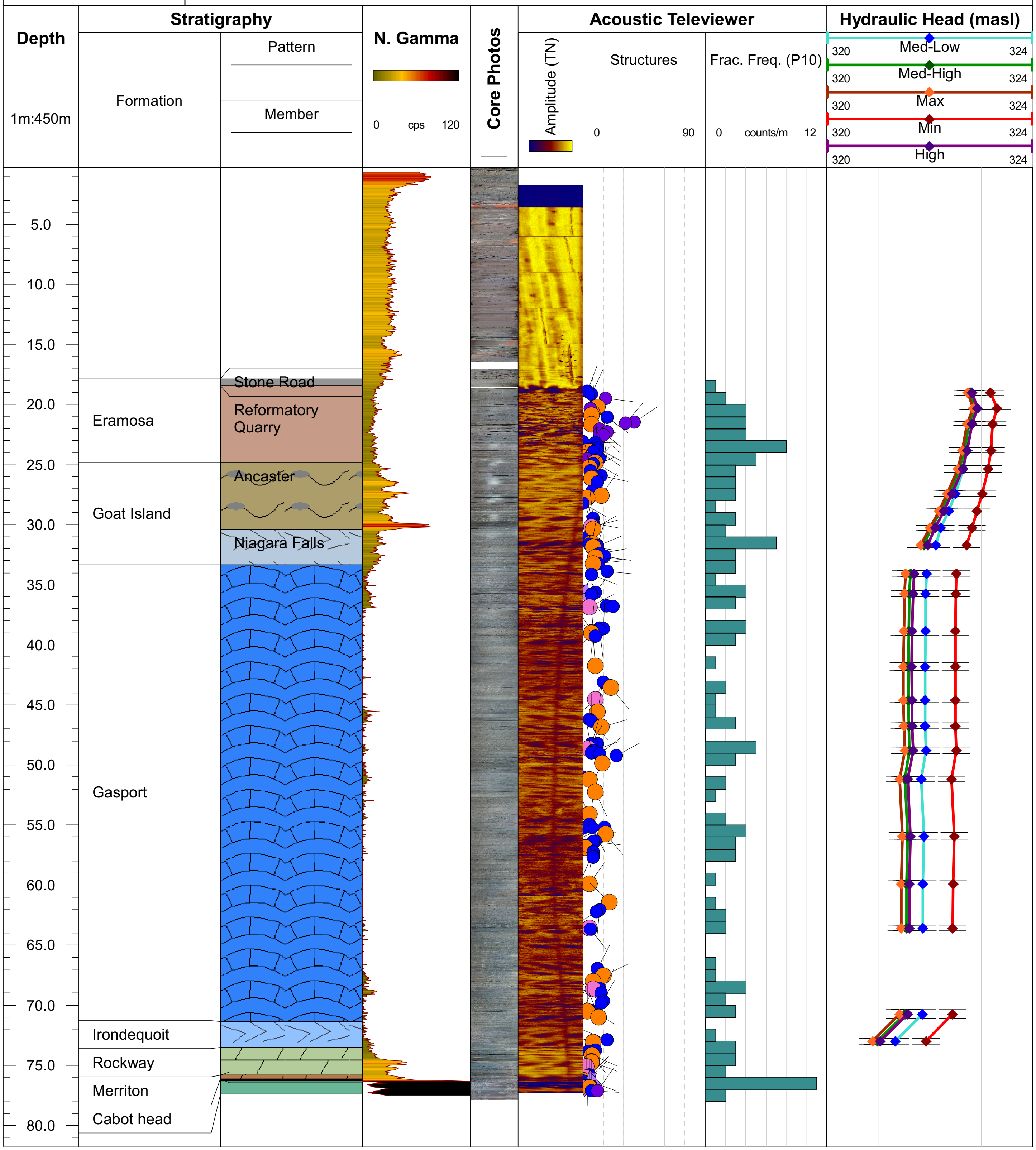
Well Owner's Copy

SWP BH02				
TopDepth		BottomDepth		Formation
(m)	(ft)	(m)	(ft)	(FT)
0		6.5		sand
6.5		8		silt and sand layers
8		14		silt and clay
14		17.9		diamict: sand some gravel and mud
17.86	58.6	24.8	81.4	Eramosa
24.8	81.4	33.34	109.4	Goat Island
33.34	109.4	71.35	234.1	Gasport
71.35	234.1	73.52	241.2	Irondequoit
73.52	241.2	75.82	248.8	Rockway
75.82	248.8	76.12	249.7	Merritton
76.12	249.7	77.87	255.5	Cabot Head

Project: South Wellington Puslinch
Borehole ID: **BH-02**

Preliminary Data Montage

Prepared by: G360 Institute for Groundwater Research
Prepared for: Nestle Waters Canada
Date: May 24, 2019



MW20-19 (SWP BH3)

18-0221-00

Ontario — Ministry of the Environment and Climate Change

Well Record

Regulation 903 Ontario Water Resources Act

Well Tag No. (Place Sticker and/or Print Below): A262202 BH3

Measurements recorded in: ☐ Metric ☑ Imperial

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Nestle Canada Inc		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
25 Sheppard Ave W	North York	ON	M2N 6S8	416 512 9000

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
16 Old Brock Rd	Puslinch		

County/District/Municipality	City/Town/Village	Province	Postal Code
Wellington	Aberfoyle	Ontario	

UTM Coordinates Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83 17	562896	4811356		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
			See attached		
			BH3 attached		

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	70	Portland	

Method of Construction

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Boring ☐ Air percussion ☐ Other, specify ☑ Diamond ☐ Jetting ☐ Driving ☐ Digging

Well Use

☐ Public ☐ Domestic ☐ Livestock ☐ Irrigation ☐ Industrial ☐ Other, specify ☐ Commercial ☐ Municipal ☐ Test Hole ☐ Cooling & Air Conditioning ☐ Not used ☐ Dewatering ☐ Monitoring

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
6⅝	Steel	0.188	+1.5	70
6	open		70	265

Status of Well

☐ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well ☐ Dewatering Well ☐ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

Water Details

Water found at Depth 35 (m/ft) Kind of Water: ☐ Fresh ☑ Untested ☐ Gas ☐ Other, specify

Water found at Depth (m/ft) Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify

Water found at Depth (m/ft) Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	70	12"
70	265	6"

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Aardvark Drilling Inc.	7238

Business Address (Street Number/Name)	Municipality
2-5-C Lewis Road	Guelph

Province	Postal Code	Business E-mail Address
ON	N1H 1E9	www.aardvarkdrillinginc.com

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
519 826 0340	Richard Allan

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
21554	[signature]	2019 06 06

Results of Well Yield Testing

After test of well yield, water was: ☐ Clear and sand free ☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping hrs + min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min / GPM)

Well production (l/min / GPM)

Disinfected? ☐ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Map of Well Location

Please provide a map below following instructions on the back.

Comments: See Attached Map

Well owner's information package delivered ☐ Yes ☐ No

Date Package Delivered: YYYY MM DD

Date Work Completed: 2019 05 06

Ministry Use Only

Audit No. Z303941

Received

0506E (2014/11) Well Owner's Copy

SWP BH03				
TopDepth		BottomDepth		Formation
(m)	(ft)	(m)	(ft)	(FT)
0	0.0	21.72	71.3	overburden - mostly sand and gravel, some finer layers - poor core retrieval
21.72	71.3	27.95	91.7	Eramosa
27.95	91.7	44.87	147.2	Goat Island
44.87	147.2	72.89	239.1	Gasport
72.89	239.1	76.12	249.7	Irondequoit
76.12	249.7	78.18	256.5	Rockway
78.18	256.5	78.61	257.9	Merritton
78.61	257.9	80.9	265.4	Cabot Head

Project: South Wellington Puslinch
Borehole ID: **BH-03**

Preliminary Data Montage

Prepared by: G360 Institute for Groundwater Research
Prepared for: Nestle Waters Canada
Date: May 24, 2019

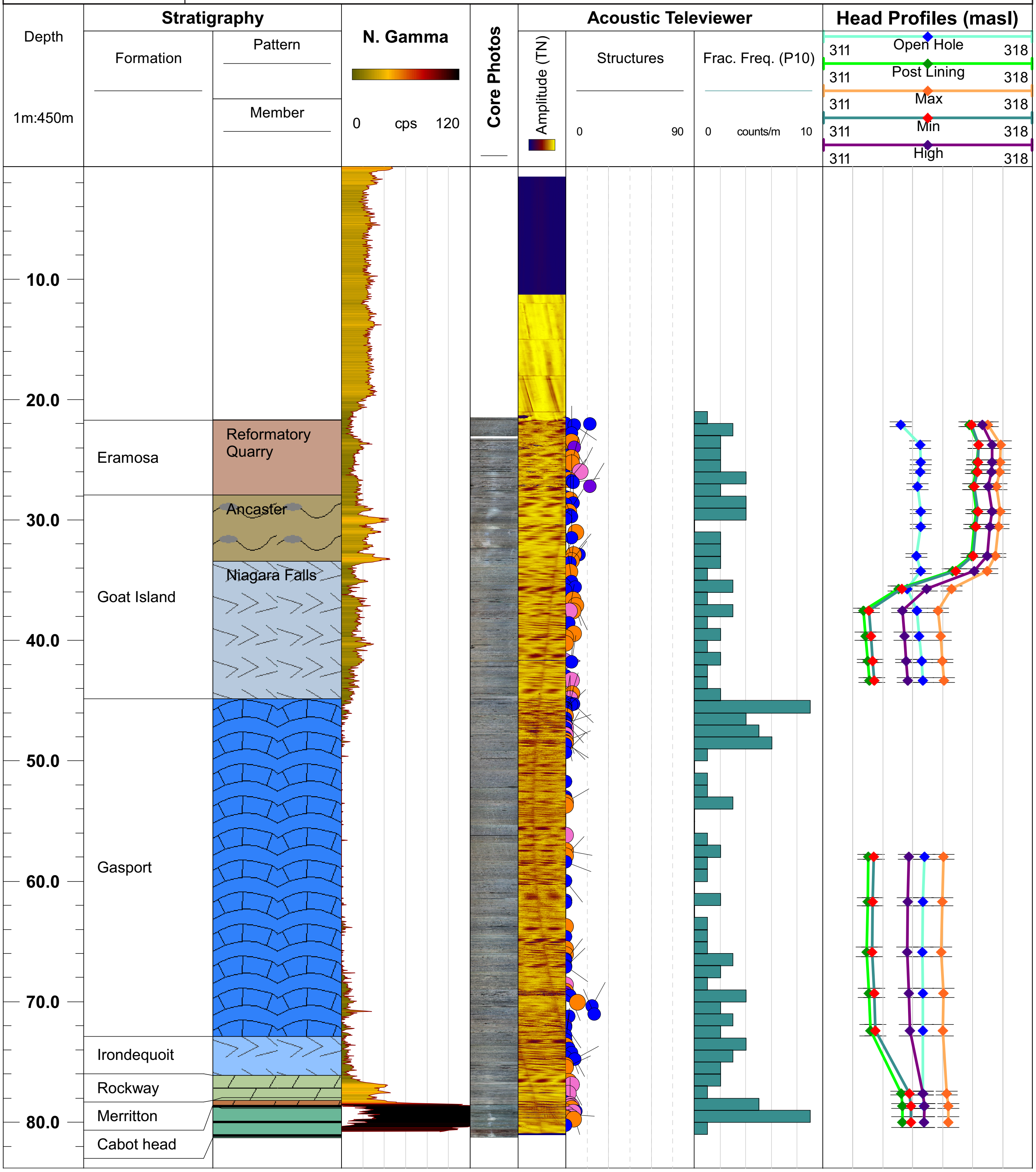


TABLE B1
MECP WATER WELL RECORDS
WITHIN 1.5 km OF TW3-80

Well ID	Date Completed	Depth (metres)	Well Status	Well Use
6702509	6/13/1961	18.3	Water Supply	Commerical
6702512	8/12/1959	14.6	Water Supply	Domestic
6702513	4/22/1955	36	Water Supply	Domestic
6702514	4/26/1958	20.4	Water Supply	Domestic
6702515	5/8/1959	30.5	Water Supply	Domestic
6702516	5/30/1959	19.5	Water Supply	Livestock
6702517	6/8/1962	28	Water Supply	Domestic
6702518	7/20/1967	18.3	Water Supply	Domestic
6702519	9/17/1959	15.8	Water Supply	Domestic
6702520	11/18/1961	18	Water Supply	Public
6702521	11/16/1959	19.8	Water Supply	Domestic
6702522	5/4/1961	18.3	Water Supply	Domestic
6702523	11/8/1963	14.6	Water Supply	Livestock
6702524	8/25/1965	12.8	Water Supply	Domestic
6702527	10/19/1966	20.7	Water Supply	Domestic
6702528	8/16/1966	30.5	Water Supply	Commerical
6702529	1/13/1959	24.4	Water Supply	Livestock
6702647	3/27/1962	18.9	Water Supply	Domestic
6702649	4/28/1958	13.1	Water Supply	Domestic
6702650	8/21/1959	27.4	Water Supply	Livestock
6702652	6/15/1961	10.4	Water Supply	Domestic
6702653	11/2/1966	11.3	Water Supply	Domestic
6703151	4/11/1968	20.4	Water Supply	Domestic
6703373	5/31/1969	6.1	Water Supply	Domestic
6703496	11/26/1969	25.9	Water Supply	Domestic
6703640	1/27/1970	45.7	Water Supply	Industrial
6703870	12/26/1970	44.8	Water Supply	Commerical
6703873	11/27/1970	16.8	Water Supply	Domestic
6704032	3/3/1971	24.7	Water Supply	Domestic
6704043	7/30/1971	20.7	Water Supply	Livestock
6704330	7/3/1972	18.9	Water Supply	Domestic
6704352	8/1/1972	43.6	Water Supply	Commerical
6704397	9/9/1972	14.3	Water Supply	Domestic
6704401	10/16/1972	19.2	Water Supply	Domestic
6704519	11/10/1972	19.2	Water Supply	Livestock
6704534	1/20/1973	24.4	Water Supply	Domestic
6704673	7/20/1973	11.3	Water Supply	Domestic
6704691	5/26/1973	24.4	Water Supply	Domestic
6704699	7/19/1973	36	Water Supply	Domestic
6704790	9/24/1973	20.1	Water Supply	Domestic
6704957	9/27/1973	11.9	Water Supply	Domestic
6704969	12/19/1973	48.8	Water Supply	Domestic

TABLE B1
MECP WATER WELL RECORDS
WITHIN 1.5 km OF TW3-80

Well ID	Date Completed	Depth (metres)	Well Status	Well Use
6705566	5/26/1975	39.9	Water Supply	Industrial
6705773	10/14/1975	30.8	Water Supply	Industrial
6705880	6/14/1975	25.9	Water Supply	Domestic
6706000	5/21/1976	40.5	Water Supply	Domestic
6706258	11/18/1976	20.1	Water Supply	Domestic
6706705	5/16/1978	42.7	Water Supply	Industrial
6707091	10/6/1979	22.3	Water Supply	Domestic
6707223	12/21/1979	32.9	Water Supply	Industrial
6707241	2/21/1980	25	Water Supply	Commerical
6707271	5/23/1980	36	Water Supply	Industrial
6707273	3/31/1980	55.8	Test Hole	Commerical
6707289	4/28/1980	44.2	Test Hole	Commerical
6707290	4/14/1980	42.4	Water Supply	Commerical
6707339	10/24/1980	23.2	Water Supply	Domestic
6707381	10/18/1980	19.8	Water Supply	Domestic
6707383	2/25/1980	35.7	Water Supply	Domestic
6707384	11/30/1980	36.6	Water Supply	Commerical
6707389	10/18/1980	25.9	Water Supply	Domestic
6707523	11/12/1981	18.3	Water Supply	Domestic
6707577	12/10/1981	45.1	Water Supply	Industrial
6707579	8/22/1981	18.3	Water Supply	Domestic
6707581	6/10/1981	42.7	Water Supply	Irrigation
6707585	3/26/1981	29	Water Supply	Livestock
6707586	2/13/1981	13.7	Water Supply	Domestic
6707587	2/13/1981	18.3	Water Supply	Domestic
6707589	10/15/1981	19.5	Water Supply	Municipal
6707590	1/19/1981	20.4	Water Supply	Domestic
6707591	1/19/1981	20.4	Water Supply	Domestic
6707592	1/20/1981	20.4	Water Supply	Domestic
6707593	1/21/1981	18.3	Water Supply	Domestic
6707742	2/5/1982	38.7	Water Supply	Public
6707797	4/27/1983	42.7	Water Supply	Commerical
6707935	12/17/1983	41.1	Water Supply	Domestic
6707985	10/26/1984	12.2	Water Supply	Domestic
6708075	11/11/1983	29	Water Supply	Domestic
6708076	11/30/1983	42.4	Water Supply	Domestic
6708205	5/14/1985	24.7	Water Supply	Domestic
6708234	12/14/1984	29.3	Water Supply	Domestic
6708266	8/18/1985	22.9	Water Supply	Domestic
6708315	7/9/1985	18	Water Supply	Domestic
6708317	6/7/1985	17.7	Water Supply	Domestic
6708407	1/10/1986	25.9	Water Supply	Domestic

TABLE B1
MECP WATER WELL RECORDS
WITHIN 1.5 km OF TW3-80

Well ID	Date Completed	Depth (metres)	Well Status	Well Use
6708456	5/1/1986	59.4	Water Supply	Domestic
6708457	4/25/1986	59.4	Water Supply	Domestic
6708472	6/20/1986	30.5	Water Supply	Domestic
6708493	5/6/1986	18	Water Supply	Domestic
6708577	10/16/1986	26.2	Water Supply	Domestic
6708578	10/17/1986	19.8	Water Supply	Domestic
6708590	11/21/1986	18.6	Water Supply	Domestic
6708740	12/26/1986	36.6	Water Supply	Domestic
6709476	11/10/1988	32.3	Water Supply	Domestic
6709669	10/25/1988	51.8	Water Supply	NULL
6709672	5/25/1988	7.3	Water Supply	Domestic
6710007	9/26/1989	54.9	Water Supply	Domestic
6710008	8/18/1989	56.4	Water Supply	Commerical
6710009	8/24/1989	62.5	Water Supply	Industrial
6710250	10/30/1989	22.3	Water Supply	Industrial
6710678	7/9/1991	19.5	Water Supply	Domestic
6711150	4/26/1993	13.7	Water Supply	Domestic
6711281	9/14/1993	18.3	Water Supply	Industrial
6711282	9/14/1993	30.5	Water Supply	Industrial
6711283	9/13/1993	13.1	Water Supply	Industrial
6711288	9/20/1993	32	Water Supply	Industrial
6711378	1/24/1994	32	Water Supply	Domestic
6711455	7/6/1994	49.7	Water Supply	Domestic
6711474	7/6/1994	51.8	Water Supply	Domestic
6711650	6/21/1994	13.4	Observation Wells	Not Used
6711692	7/26/1994	12.2	Water Supply	Domestic
6711713	4/11/1995	48.8	Water Supply	Industrial
6711723	6/15/1995	49.1	Water Supply	Industrial
6711747	6/23/1995	42.7	Water Supply	Domestic
6711762	6/29/1995	16.8	Test Hole	Commerical
6711801	7/13/1995	42.7	Water Supply	Industrial
6711821	9/22/1995	30.5	Water Supply	Commerical
6711872	10/17/1995	73.2	Water Supply	Industrial
6711873	11/7/1995	55.8	Abandoned-Quality	Industrial
6711874	11/8/1995	44.2	Abandoned-Quality	Industrial
6711875	11/8/1995	25	Abandoned-Quality	Industrial
6711936	5/15/1995	18.3	Test Hole	Not Used
6711997	5/8/1996	55.2	Water Supply	Municipal
6712145	12/10/1996	42.7	Water Supply	Domestic
6712159	7/29/1996	54.9	Water Supply	Domestic
6712209	4/2/1997	36.6	Water Supply	Domestic
6712223	4/24/1997	24.4	Water Supply	Domestic

TABLE B1
MECP WATER WELL RECORDS
WITHIN 1.5 km OF TW3-80

Well ID	Date Completed	Depth (metres)	Well Status	Well Use
6712247	5/9/1997	42.7	Abandoned-Other	Industrial
6712296	7/2/1997	61	Test Hole	Industrial
6712321	8/25/1997	62.8	Water Supply	Commerical
6712369	10/29/1997	36.6	Water Supply	Domestic
6712386	11/13/1997	0	Abandoned-Supply	NULL
6712462	8/11/1997	32	Water Supply	NULL
6712476	1/28/1998	12.2	Test Hole	Industrial
6712544	4/30/1998	50.9	Test Hole	Commerical
6712929	1/28/1999	15.2	Water Supply	Industrial
6712995	1/12/1999	61	Water Supply	Domestic
6713044	7/1/1999	56.4	Water Supply	Domestic
6713204	11/30/1999	54.9	Water Supply	Domestic
6713328	4/17/2000	0	Abandoned-Other	NULL
6713335	4/17/2000	55.5	Water Supply	Domestic
6713567	11/3/2000	0	Abandoned-Quality	Commerical
6713568	9/26/2000	79.2	Abandoned-Quality	Commerical
6713755	6/14/2001	36.6	Water Supply	Domestic
6713775	7/5/2001	18.3	Water Supply	Domestic
6713960	12/4/2001	30.5	Water Supply	Domestic
6713990	12/6/2001	61	NULL	Domestic
6713991	12/7/2001	61	NULL	Domestic
6713992	12/19/2001	61	Water Supply	Domestic
6713993	12/21/2001	61	Water Supply	Domestic
6714195	5/18/1998	50.9	Water Supply	Commerical
6714721	10/24/2003	0	Abandoned-Other	Commerical
6715098	9/27/2004	18.3	Water Supply	Commerical
6715246	12/30/2004	43	Water Supply	Domestic
6715326	5/2/2004	3.6	Observation Wells	NULL
6715444	5/6/2005	61	Water Supply	Domestic
6715638	1/6/2006	4.8	Observation Wells	NULL
6715714	4/26/2006	57.6	Water Supply	Commerical
6715718	4/7/2006	4.5	Observation Wells	NULL
6715851	6/16/2006	61	Water Supply	Domestic
6715867	8/3/2006	6.3	Observation Wells	NULL
6715873	8/5/2006	0	Abandoned-Other	NULL
6715921	9/29/2006	0	Abandoned-Other	Not Used
6715922	9/29/2006	0	Abandoned-Other	Not Used
6715923	9/29/2006	0	Abandoned-Other	Not Used
6716001	10/27/2006	43.3	Water Supply	Domestic
6716024	11/8/2006	12.2	Abandoned-Other	Not Used
7039424	12/15/2006	4.6	Observation Wells	NULL
7041703	1/9/2007	0	Abandoned-Other	NULL

TABLE B1
MECP WATER WELL RECORDS
WITHIN 1.5 km OF TW3-80

Well ID	Date Completed	Depth (metres)	Well Status	Well Use
7041704	1/6/2007	65.2	Water Supply	Industrial
7042838	2/12/2007	4.8	Observation Wells	Not Used
7104430	12/1/2007	38.5	Test Hole	Not Used
7104431	11/11/2007	38.5	Test Hole	Not Used
7104432	11/20/2007	38.5	Test Hole	Not Used
7104708	4/9/2008	19.5	Water Supply	Commerical
7105633	3/13/2008	0	Abandoned-Supply	NULL
7105633	3/13/2008	0	Abandoned-Supply	NULL
7105634	3/13/2008	0	Test Hole	Monitoring
7105634	3/13/2008	10.4	Test Hole	Monitoring
7106160	5/26/2008	0	Abandoned-Other	Not Used
7112542	8/13/2008	6	Test Hole	Monitoring
7112542	8/13/2008	0	Test Hole	Monitoring
7112542	8/13/2008	0	Test Hole	Monitoring
7112542	8/14/2008	0	Test Hole	Monitoring
7112542	8/14/2008	0	Test Hole	Monitoring
7112770	9/18/2008	36.6	Water Supply	Domestic
7121698	3/17/2009	44.2	Water Supply	Commerical
7122022	2/26/2009	83.2	Observation Wells	Test Hole
7122497	7/15/2008	0	Observation Wells	Monitoring
7122497	7/15/2008	7.6	Observation Wells	Monitoring
7122497	7/15/2008	0	Observation Wells	Monitoring
7122497	7/15/2008	0	Observation Wells	Monitoring
7122497	7/16/2008	0	Observation Wells	Monitoring
7122497	7/16/2008	0	Observation Wells	Monitoring
7122497	7/16/2008	0	Observation Wells	Monitoring
7125987	1/1/2009	0	Water Supply	Public
7125993	7/2/2009	20.2	Observation Wells	Monitoring
7125994	6/17/2009	24.8	Observation Wells	Monitoring
7139978	12/16/2009	10.7	Observation Wells	Monitoring
7140827	11/25/2009	87.5	Monitoring and Test Hole	Monitoring and Test Hole
7140828	11/19/2009	24.1	Observation Wells	Monitoring
7140829	11/27/2009	86.6	Observation Wells	Monitoring and Test Hole
7144014	4/5/2010	0	Test Hole	Monitoring and Test Hole
7144014	4/22/2010	6.7	Test Hole	Monitoring and Test Hole
7144014	4/5/2010	0	Test Hole	Monitoring and Test Hole
7144404	1/15/2010	32.3	Observation Wells	Monitoring
7146556	5/27/2010	6.7	Abandoned-Other	NULL
7150603	8/12/2010	38.1	Water Supply	Domestic
7153924	8/13/2010	60	Test Hole	Monitoring
7156639	8/20/2010	69.5	NULL	Commerical
7157856	10/31/2010	0	Water Supply	Commerical

TABLE B1
MECP WATER WELL RECORDS
WITHIN 1.5 km OF TW3-80

Well ID	Date Completed	Depth (metres)	Well Status	Well Use
7159236	NULL	85.7	Observation Wells	Monitoring
7159585	1/28/2011	8.8	Test Hole	Test Hole
7165430	5/24/2011	20.7	NULL	NULL
7165431	5/24/2011	7.8	Observation Wells	Commerical
7165432	5/24/2011	21	Observation Wells	Commerical
7165451	5/24/2011	7.8	Observation Wells	Monitoring
7167302	7/18/2011	61.3	Water Supply	Domestic
7167307	7/18/2011	0	Abandoned-Quality	NULL
7172966	9/26/2011	57.9	NULL	NULL
7182582	10/11/2011	0	Abandoned-Other	NULL
7182583	10/11/2011	0	Abandoned-Other	NULL
7182584	10/11/2011	0	Abandoned-Other	NULL
7182585	10/11/2011	0	Abandoned-Other	NULL
7189279	9/13/2012	54.9	Water Supply	Industrial
7189280	9/12/2012	54.9	Water Supply	Industrial
7193641	12/11/2012	0	NULL	NULL
7199708	4/17/2012	0	Abandoned-Other	NULL
7201847	4/19/2013	21.8	Abandoned-Other	Other
7202412	3/3/2013	10.9	Test Hole	Test Hole
7203788	10/16/2012	21.3	Observation Wells	NULL
7208512	9/19/2013	9.1	Abandoned-Other	Not Used
7208513	9/19/2013	18.3	Abandoned-Other	Not Used
7208514	9/19/2013	23.8	Abandoned-Other	Not Used
7210463	9/27/2013	0	Water Supply	Domestic
7211062	10/3/2013	37.5	Water Supply	Domestic
7211070	10/8/2013	0	Abandoned-Other	NULL
7212252	10/4/2013	0	NULL	NULL
7214719	12/19/2013	3.9	Observation Wells	Monitoring
7214720	12/19/2013	3.9	Observation Wells	NULL
7214721	12/19/2013	3.9	Observation Wells	Monitoring
7214722	12/19/2013	5.7	Observation Wells	Monitoring
7214832	8/8/2013	61	Water Supply	Domestic
7214833	7/30/2013	61.3	Water Supply	Domestic
7215604	1/9/2014	0	Abandoned-Other	NULL
7215605	1/9/2014	0	Abandoned-Other	NULL
7220822	5/3/2013	6.1	Observation Wells	Monitoring
7221470	5/12/2014	4.8	Abandoned-Other	NULL
7225752	6/19/2014	0	NULL	NULL
7229168	7/16/2014	37.2	Water Supply	Domestic
7230456	7/25/2014	6.1	Observation Wells	Monitoring
7230457	7/25/2014	9.2	Observation Wells	Monitoring
7230458	7/25/2014	6.1	Observation Wells	Monitoring

TABLE B1
MECP WATER WELL RECORDS
WITHIN 1.5 km OF TW3-80

Well ID	Date Completed	Depth (metres)	Well Status	Well Use
7230459	7/25/2014	10.7	Observation Wells	Monitoring
7230460	7/25/2014	9.2	Observation Wells	Monitoring
7253129	11/9/2015	0	Water Supply	Domestic

TABLE B2
PRIVATE WELL SURVEY

Well ID	Notes From First Visit On June 20, 2018	Notes From Second Visit On July 5, 2018	Completed Survey
7150603	Talked to person on site and left letter		yes
7189279	Talked to person on site and left letter		no
7189280	Talked to person on site and left letter		no
6716001	Talked to person on site and left letter		no
7041704	Talked to person on site and left letter		no
7214833	Talked to person on site and left letter		no
7214832	Talked to person on site and left letter		no
6715714	Talked to person on site and left letter		no
7121698	No entry allowed - did not leave letter		no
7104708	Talked to person on site and left letter		no
6715246	Left letter in dropbox		no
7253129	No one home - left letter	No one home at 6:30 pm	no
7112770	Gated - no mailbox - did not leave letter		no
7229168	No one home - left letter	Talked to owner and left second letter at 6:40 pm	no
7229167	No one home - left letter	No one home at 6:50 pm	no

June 20, 2018

RE: NOTICE OF PRIVATE WATER SUPPLY WELL SURVEY ABERFOYLE

Dear Homeowner,

Nestlé Waters Canada (Nestlé) has retained Golder Associates Ltd. (Golder) to conduct a hydrogeological assessment as part of the Permit To Take Water renewal process for the well located at 101 Brock Road South, Puslinch, Ontario. Nestlé produces bottled water from two sources; one in Aberfoyle and one in Erin. The water takings are governed by Ministry of the Environment and Climate Change (MOECC) Permits to Take Water. As part of the renewal process, a technical study is required to be submitted with the application. The technical study requires a well survey to identify existing water users in the study area. A survey of private wells was completed during previous testing at the site and the objective of this reconnaissance survey is to update previous work by identifying newly constructed wells in the study area. Water levels in some of the private wells are currently monitored as part of Nestlé's monitoring program.

As part of the investigation, Golder Associates Ltd. (on behalf of Nestlé) is conducting a survey of private wells in the area to obtain information on well details and water quality. The attached questionnaire requests basic information about your water well including details of the well construction, observations of water quality and quantity, and any issues or concerns you may have regarding your water supply. Unfortunately we missed you at the time of our door-to-door visits and would still like to offer you the opportunity to contribute. Please find attached to this letter a copy of the questionnaire.

The following options are available to return the completed form to us:

- By Person: Please contact Kurt Stamm of Golder at (647) 280-9463 to arrange a face-to-face meeting;
- By Mail: Please use the self-addressed envelope to mail in the completed form;
- By Phone: Please contact Greg Padusenko of Golder at (519) 620-8182 x6509 or Kurt Stamm at (519) 620-8182 x6524 to complete the questionnaire;
- By E-mail: Please scan your completed form and e-mail it to gpadusenko@golder.com; or
- By Fax: Please fax your completed form to (519) 620-9878, attention Greg Padusenko.

We ask that you return the completed form by July 6, 2018.

If available, please include a copy of your water well record with the questionnaire.

The information will be used as part of an assessment of water well use in the area and will be shared with Nestlé and the MOECC. We thank you for your participation in this exercise. If you have any questions on the questionnaire please feel free to contact Greg Padusenko or Kurt Stamm at the number above.

Should you have any further questions, comments or concerns, please do not hesitate to contact me at your earliest convenience by telephone at (519) 767-6422, Ext. 6422, or via email at andreanne.simard@waters.nestle.com.

Yours truly,

A Simard

Andreanne Simard, Ph.D.
Natural Resources Manager
Nestlé Waters Canada

Water Well Reconnaissance Survey

Owner of Well:

Name: ______________________ Telephone (Bus.): ______________

Address: ______________________ Telephone (Home): ______________

Person Interviewed: ______________________ Date: ______________

Interviewed By: ______________________ Time: ______________

Occupant of House Served by Well: (if other than owner)

Name: ______________________ Telephone (Bus.): ______________

Address: ______________________ Telephone (Home): ______________

Well Construction Details:

Date Constructed: ______________________ Use: ______________

Contractor: ______________________ Type (drilled or dug): ______________

Diameter: ______________________ Well Depth: ______________

Is well accessible for direct sampling? Or buried? ______________________

Screen: Yes / No   If yes, length: ___________m   Depth of top of screen: ___________m

Well Water Levels: (indicate whether measured from ground level or from top of casing)

Original water level depth: ______________m

Subsequent water level measurements (give depths in metres and dates): ______________________

____

Pumping Equipment:

Pump type: suction lift / positive submergence / other   Age: ______________

Depth of intake setting: ___________m   Pumping rate: ___________L/s

Storage tank type: ______________________   Capacity: ______________

Do you have a: Chlorinator: Yes / No   Water Softener: Yes / No   Water Filter: Yes / No

Water Use: Domestic: Yes / No   Number of people using water from well: ___________

Pool: Yes / No   Lawn watering: Yes / No

Other uses: ____

Private Waste and Water Disposal Type (septic, etc.): ______________________________

Distance to well: __________m Well is: uphill / downhill / same grade

Previous Problems:

How long have you owned, operated or lived on this property? ______________________

Have you ever experienced any <u>previous</u> problems with your well? _______________

If so, when? ____

What was the cause of the previous problem? Drought: __________ Pump Failure:

Increased Usage: __________ Interference: __________ Contamination:

If problem was contamination, what water quality changes were apparent? (note any differences in taste, odour, colour or clarity) ____

What action was taken to overcome the problem? ______________________________

____

What were the effects of this problem? ______________________________________

Did you ever have your well:	deepened	yes / no
	or cleaned	yes / no
	or a new well constructed	yes / no

If so, why? ____

Outline briefly any previous repairs or changes in pumping equipment and dates:

____

____

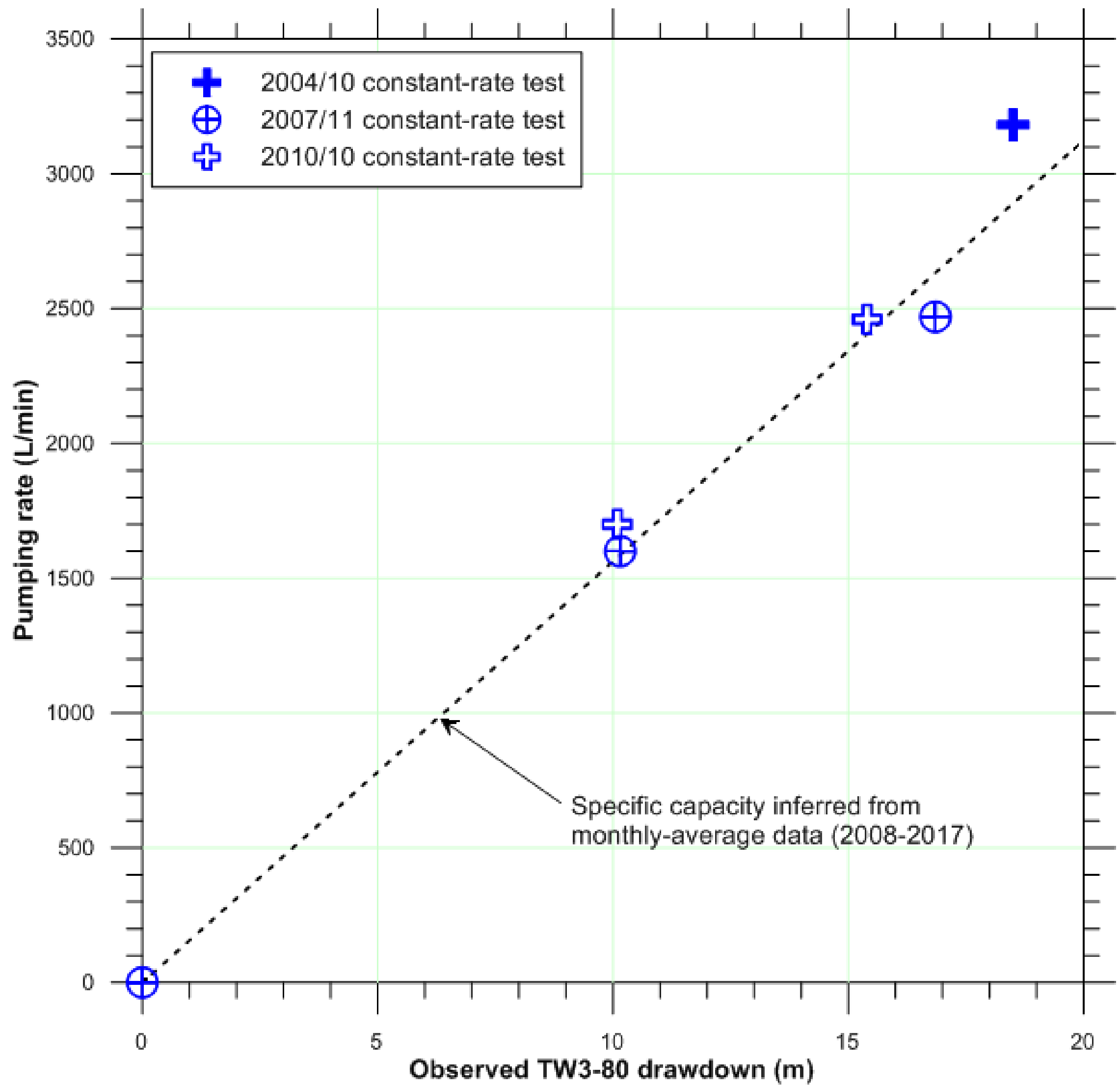
____

Location Sketch:

Notes:

APPENDIX C

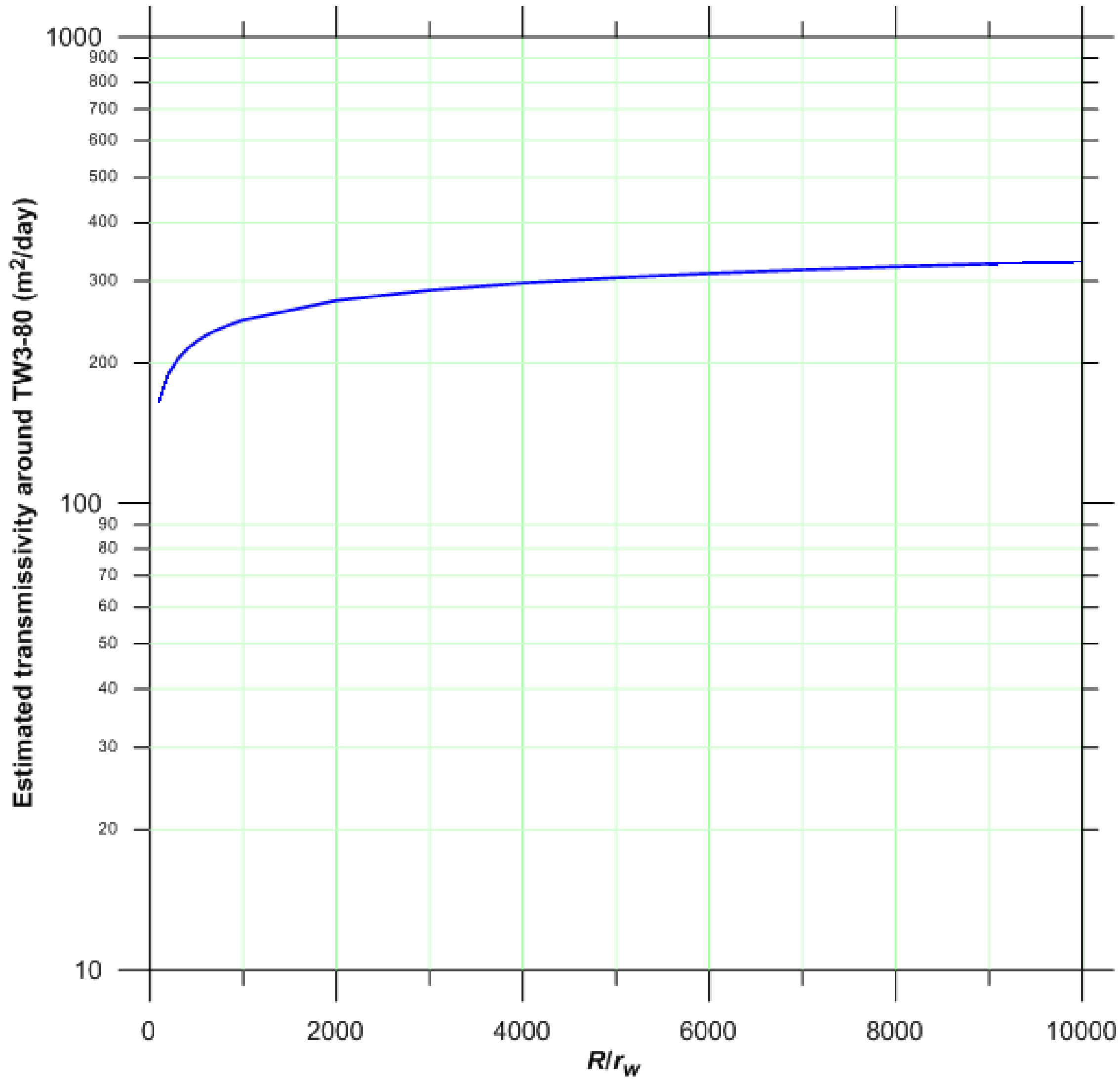
Technical Memoranda



GOLDER

Figure C1

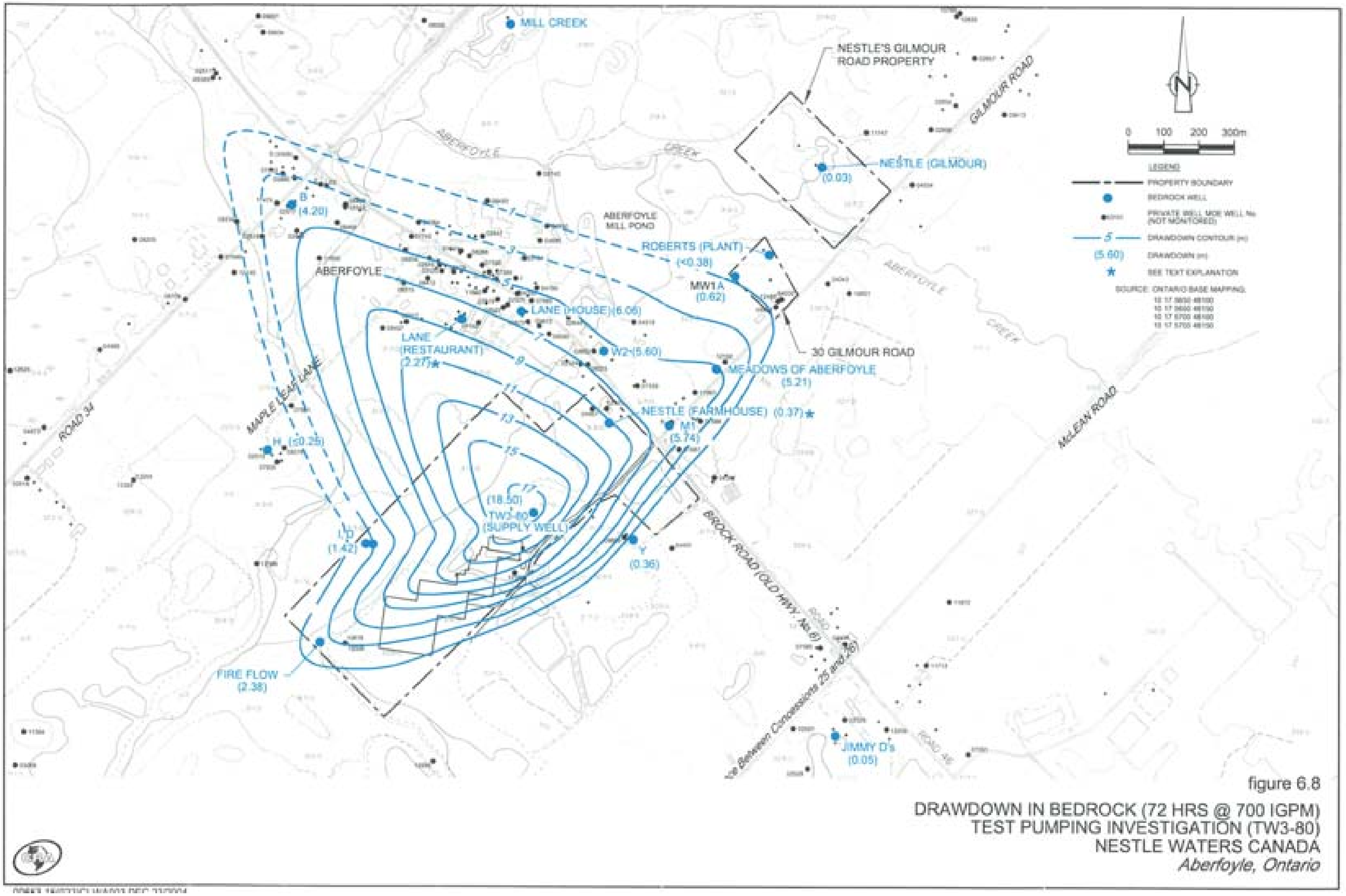
Consistency of specific capacity estimated from TW3-80 performance data and the stabilized conditions observed during extended constant rate pumping tests



GOLDER

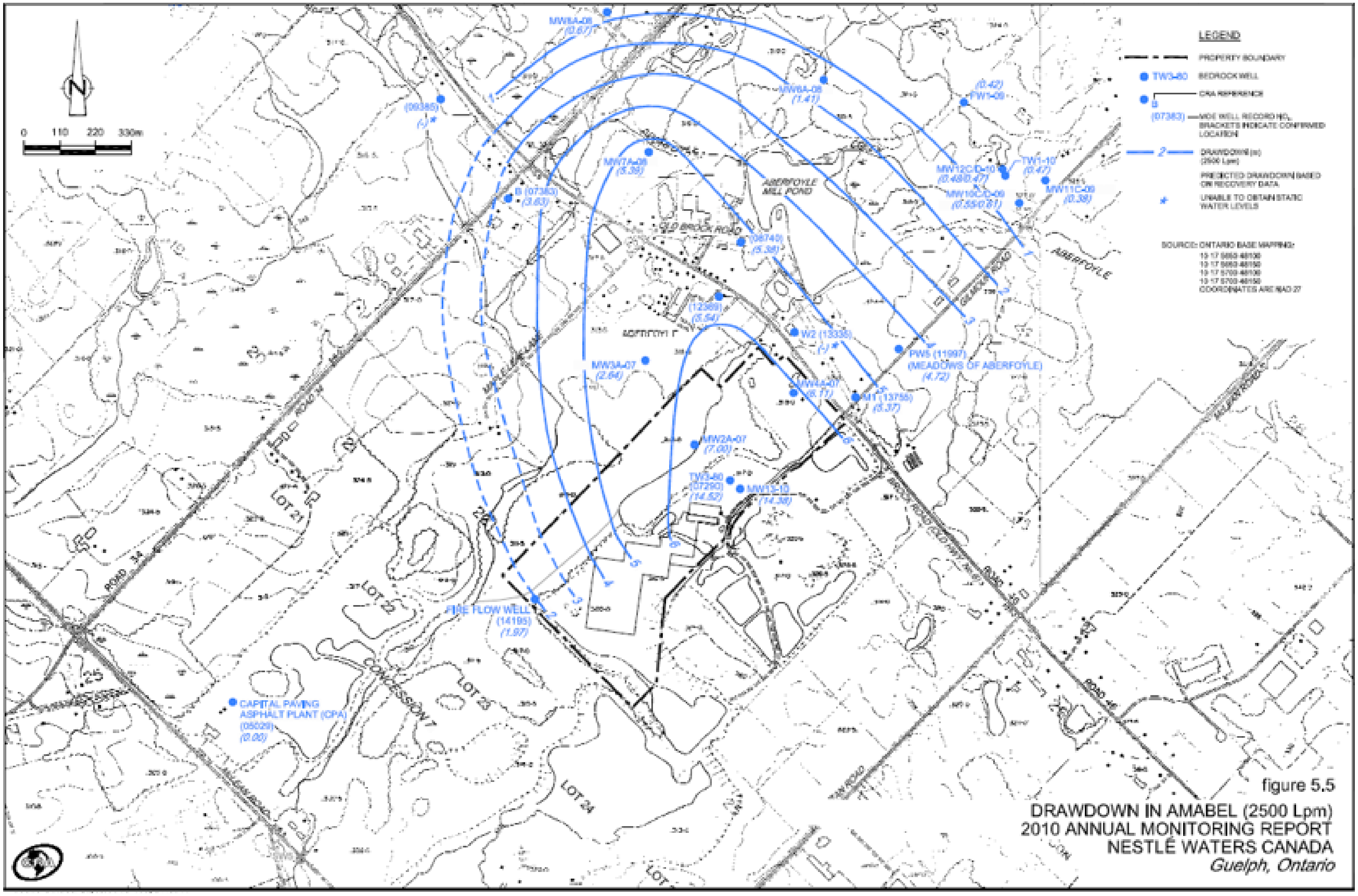
Figure C2

Estimation of transmissivity around TW3-80 with the Thiem solution



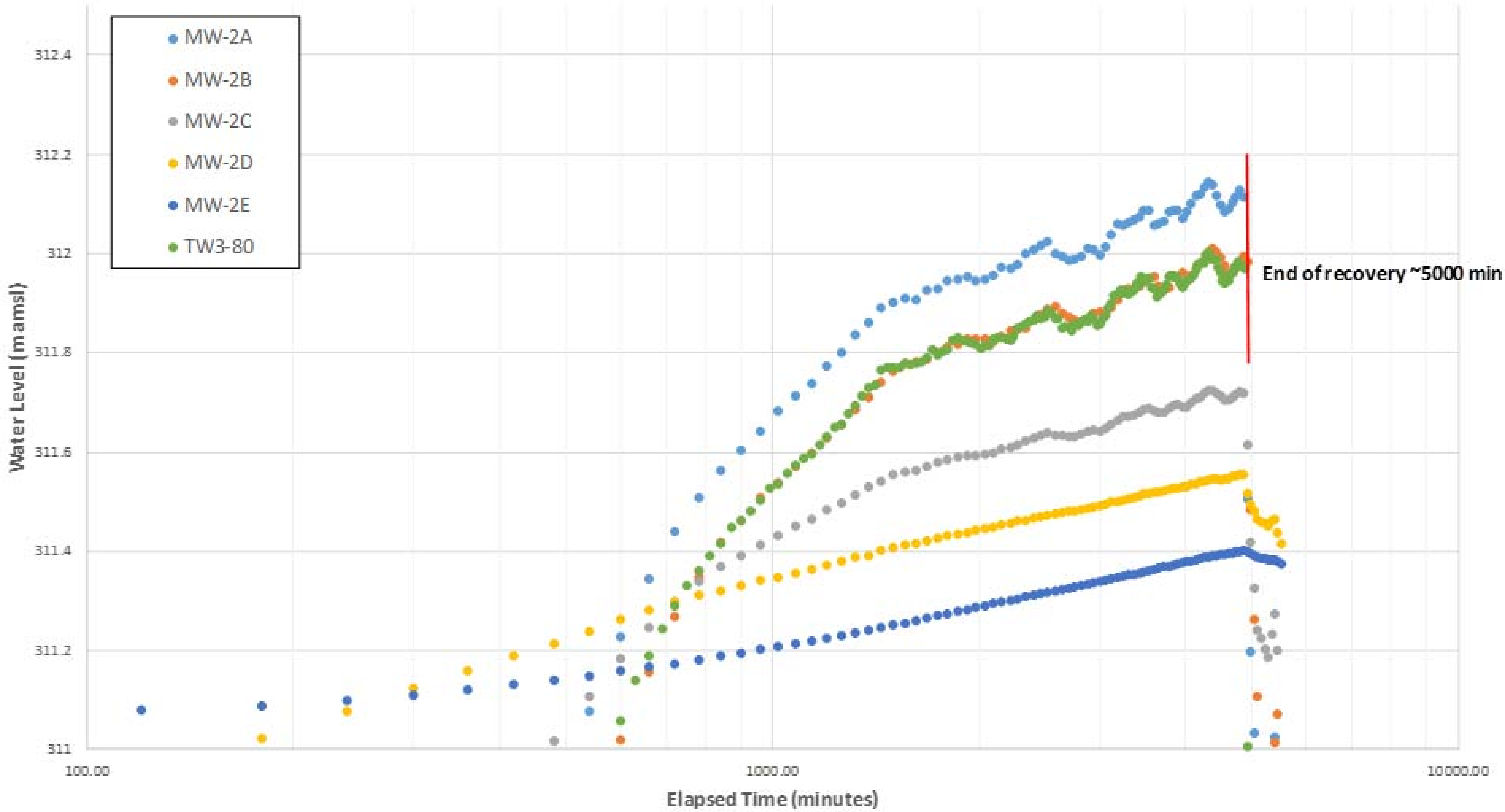
GOLDER

Figure C3
Lower bedrock aquifer response to pumping during TW3-80 October 2004 pumping test (CRA, 2004)



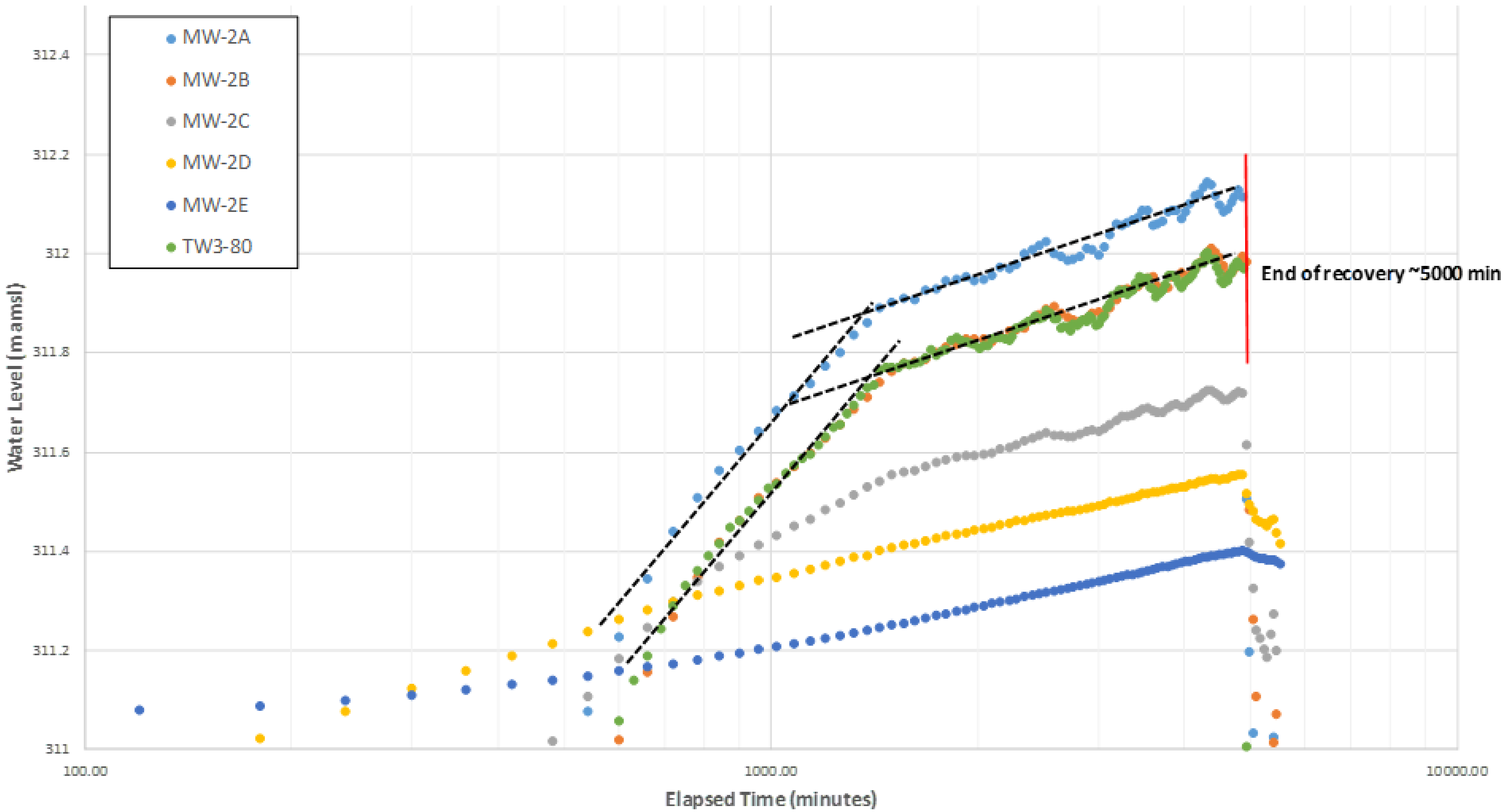
GOLDER

Figure C4
Lower bedrock aquifer response to pumping during TW3-80 August to October 2010 pumping test (CRA, 2011)



GOLDER

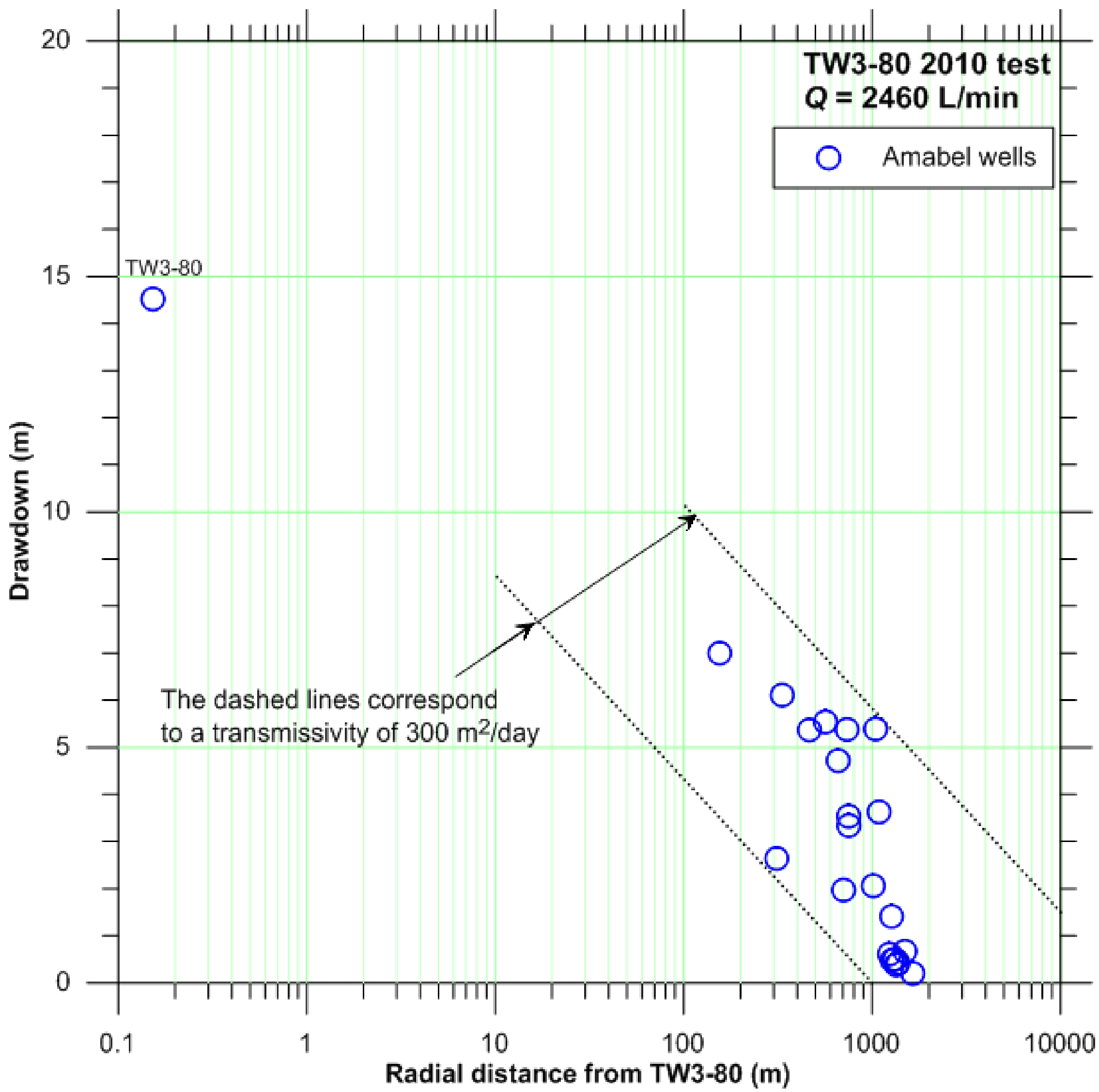
Figure C5
Recovery responses at the end of the 2010 pumping test



GOLDER

Figure C6

Straight lines superimposed on the semi-log plots of recovery responses at TW3-80 and MW2-07



GOLDER

Figure C7

Drawdowns in the lower bedrock aquifer at the end of recovery during the October 2010 test

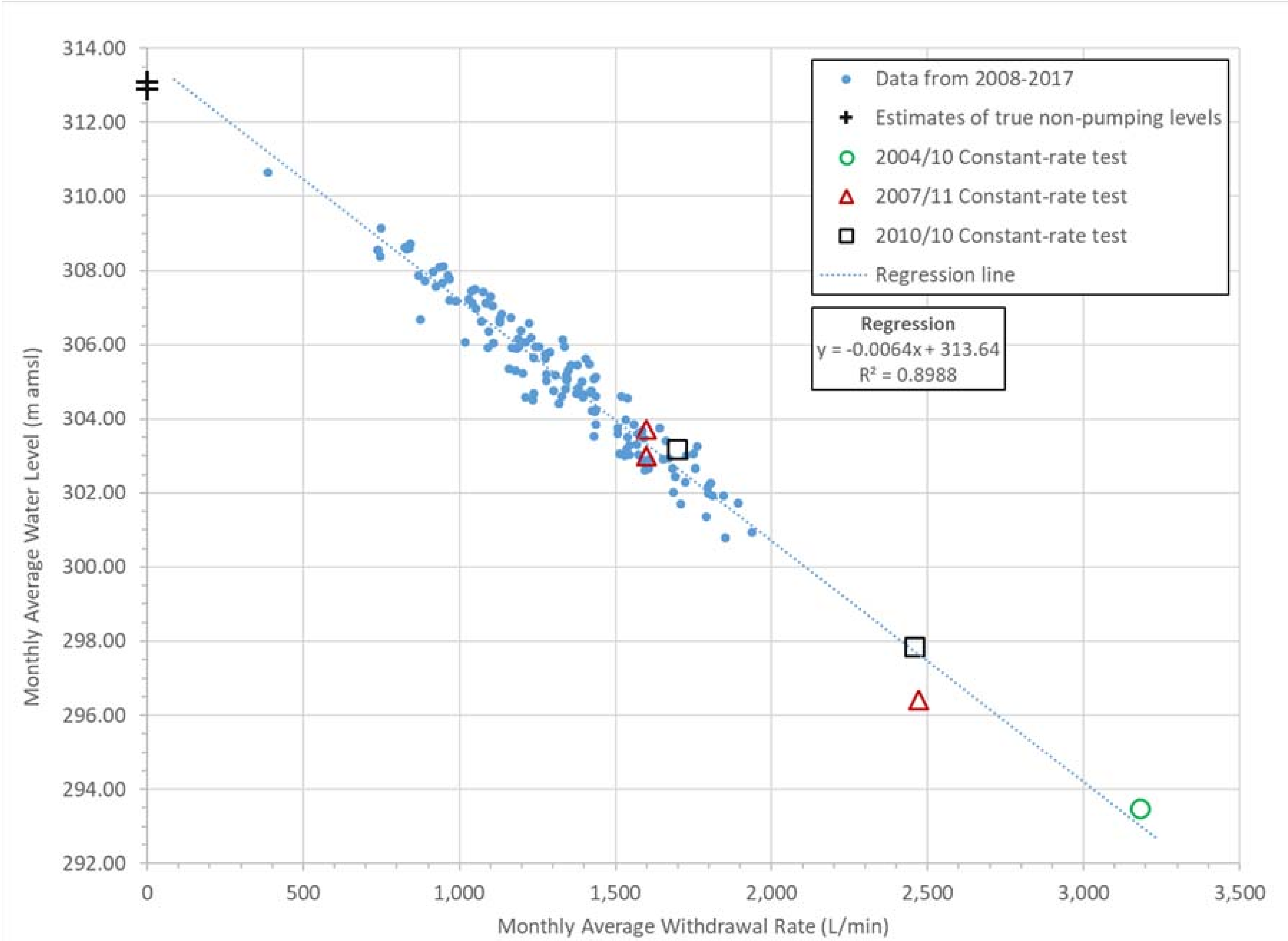


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Figure C8

TW3-80 Performance: Monthly Average Data Supplemented with Water Levels from Constant Rate Pumping Tests

GOLDER

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.

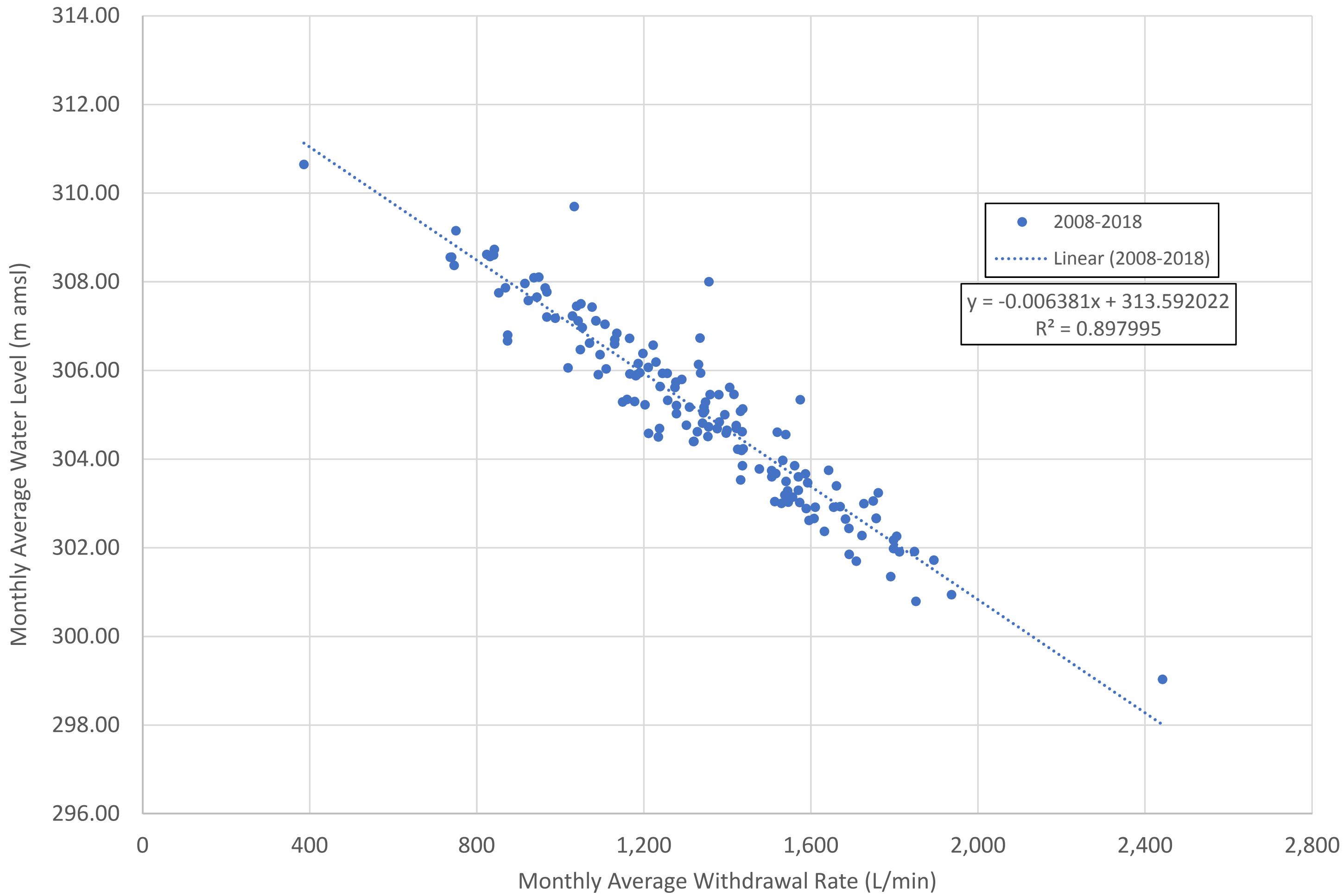
\\golder.gds\gal\mississauga\active\2013\1152\13-1152-0250 nestle waters ws s. ontario\aberfoyle\reports\2018 annual report\draft report\app i technical memo\13-1152-0250 (1000) tm 28jan2019 tw3-80 analysis.docx

ATTACHMENT

Figure 1

Figure 1

Relationship between TW3-80 Withdrawal Rate and Water Level



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.

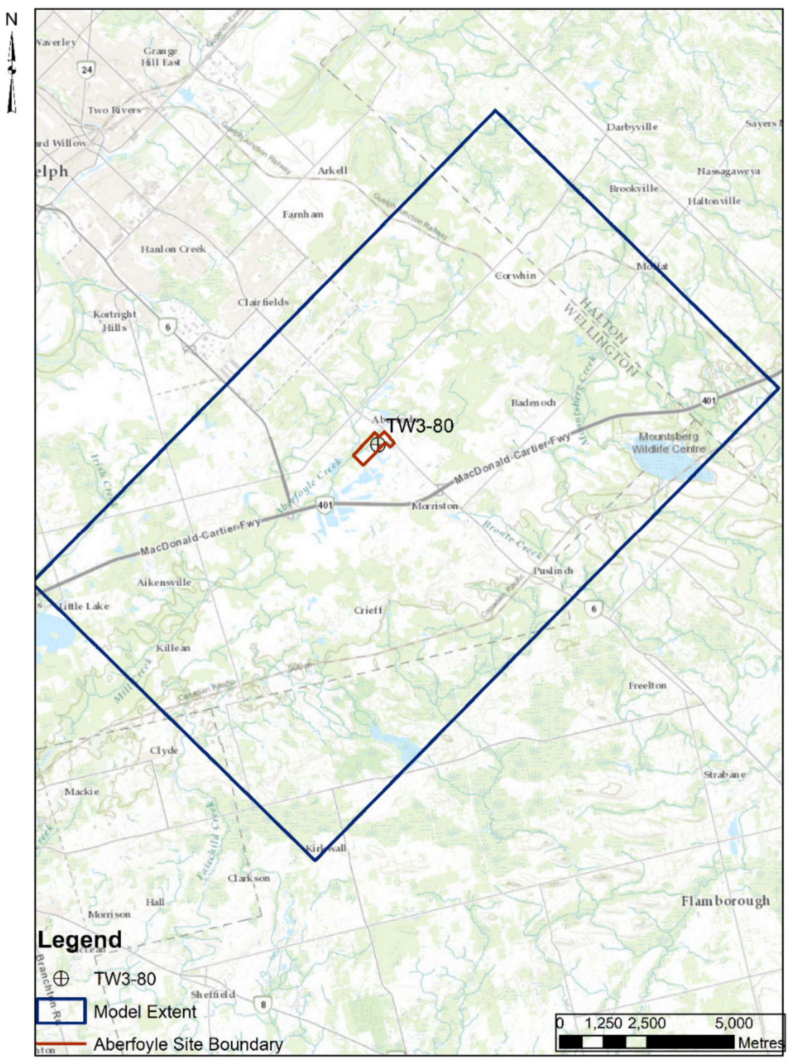


Figure 1. Model limits

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

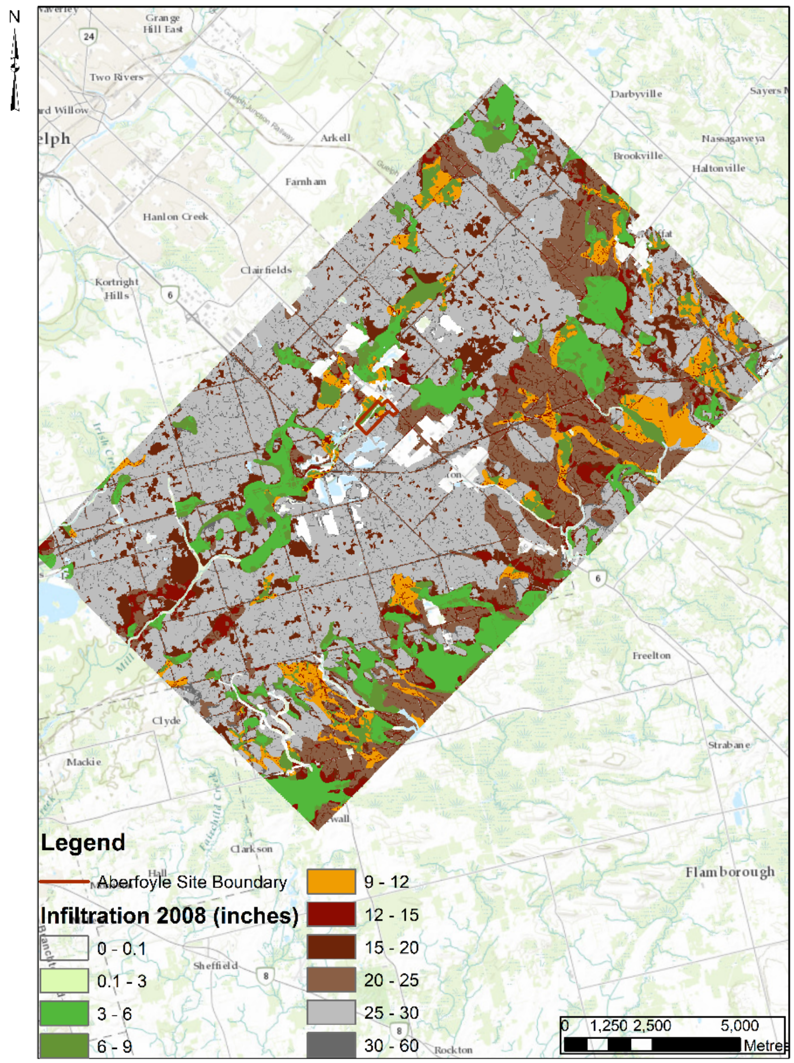


Figure 2. Calculated distribution of annual infiltration for 2008

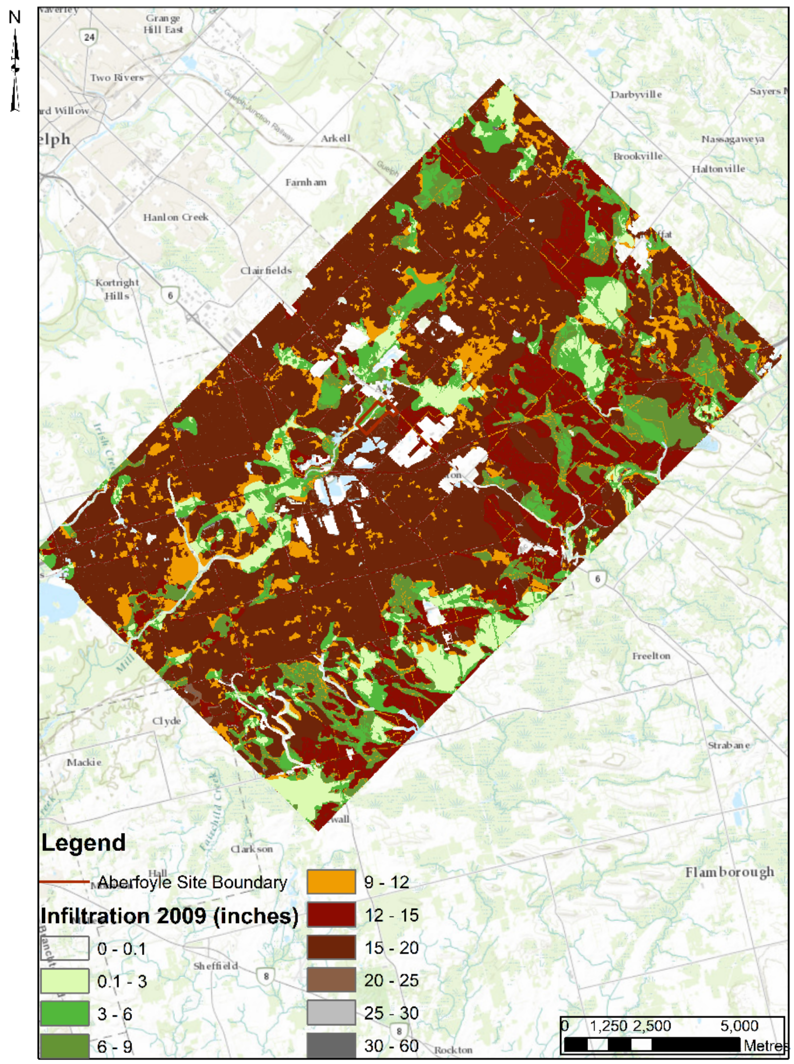


Figure 3. Calculated distribution of annual infiltration for 2009

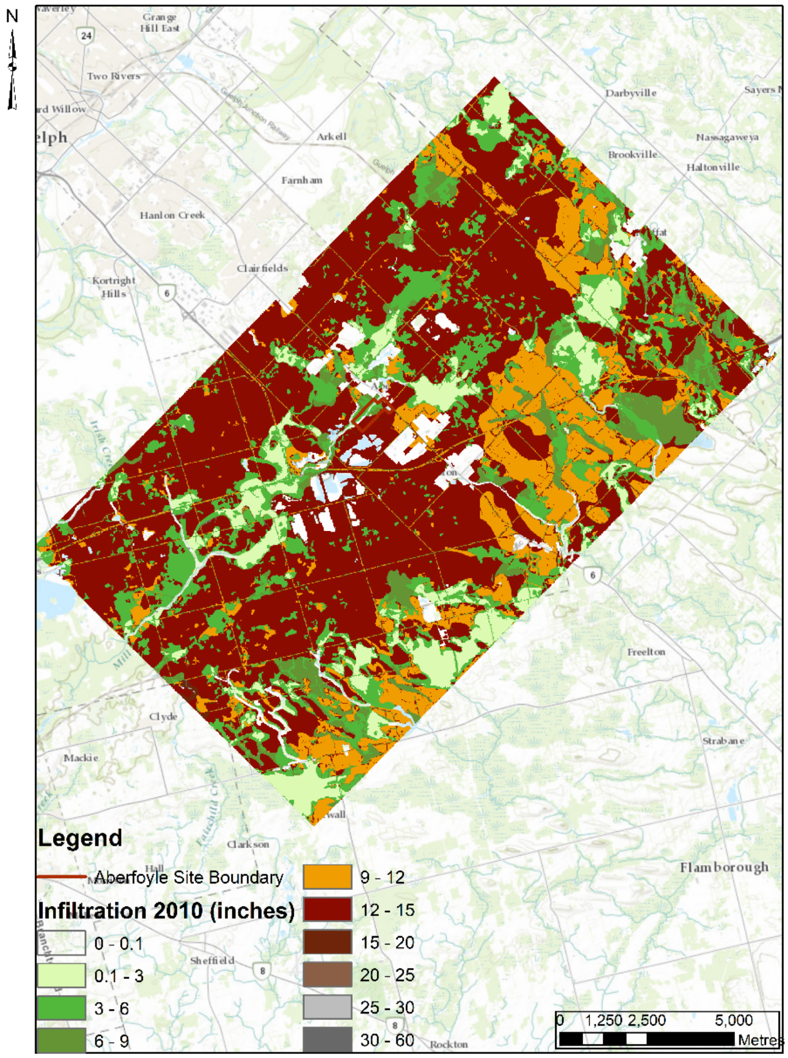


Figure 4. Calculated distribution of annual infiltration for 2010

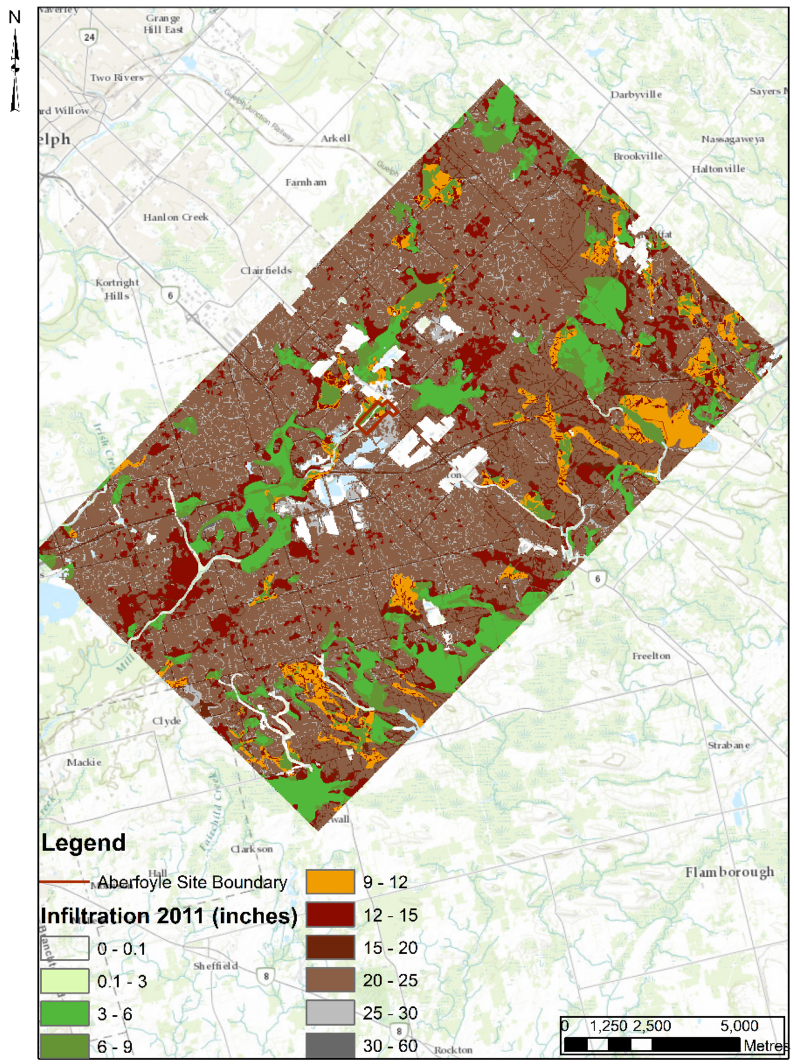


Figure 5. Calculated distribution of annual infiltration for 2011

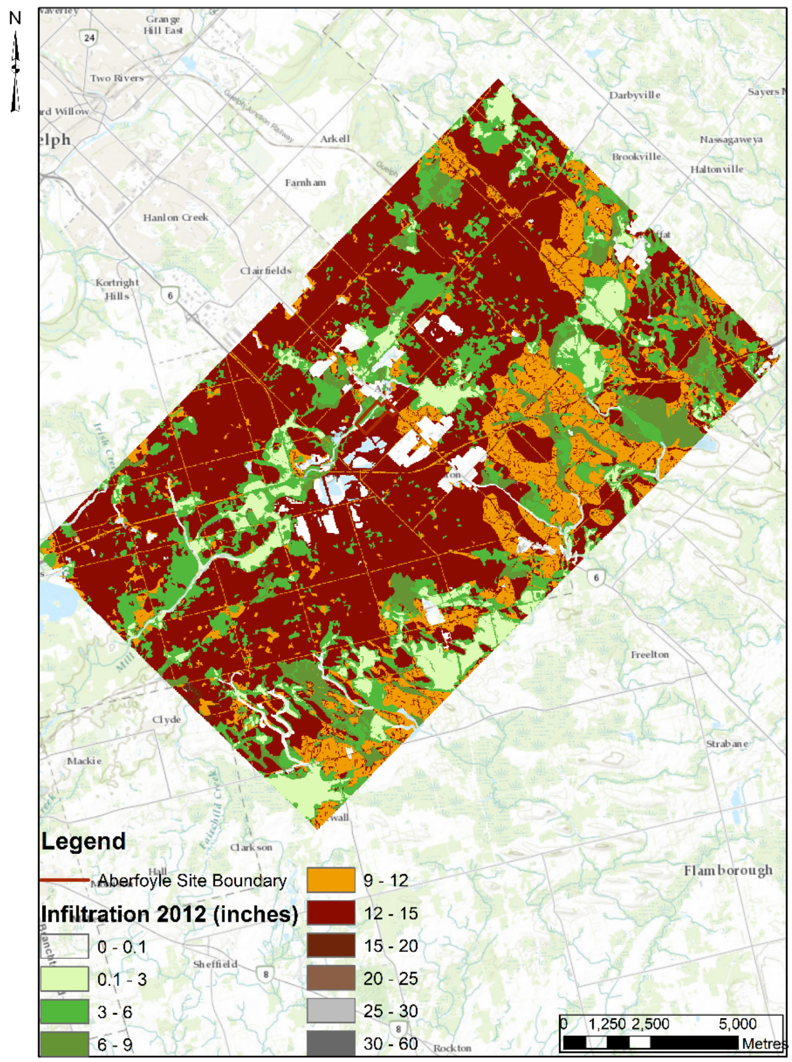


Figure 6. Calculated distribution of annual infiltration for 2012

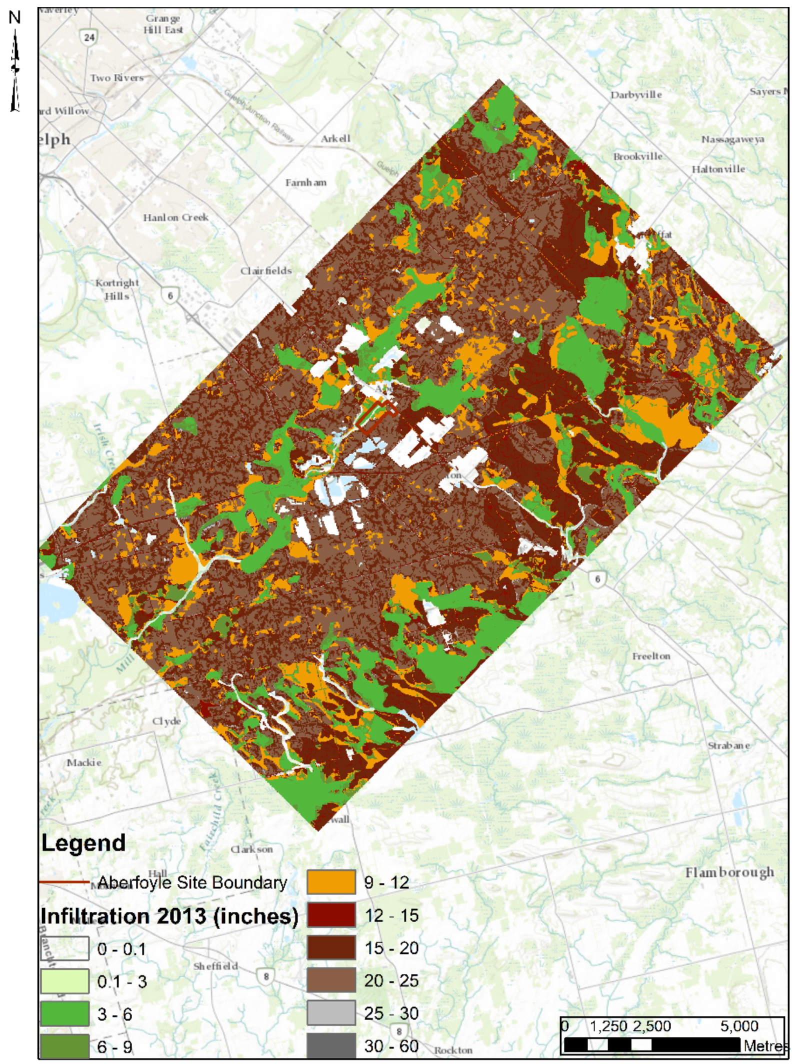


Figure 7. Calculated distribution of annual infiltration for 2013

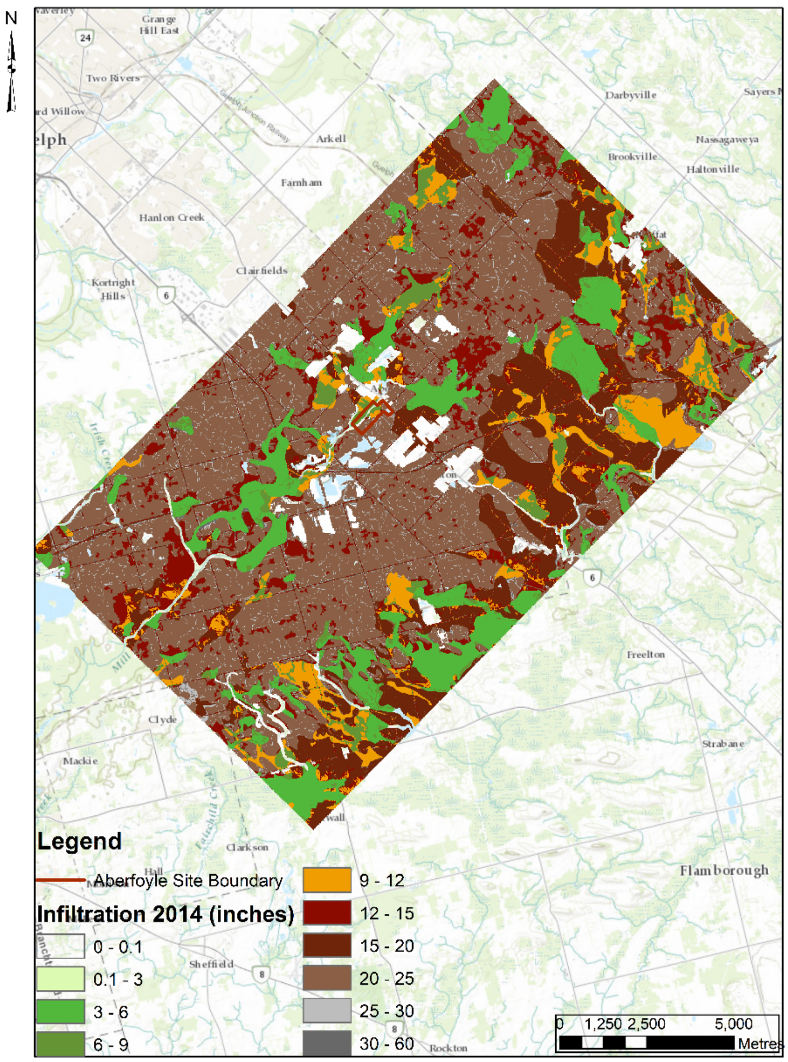


Figure 8. Calculated distribution of annual infiltration for 2014

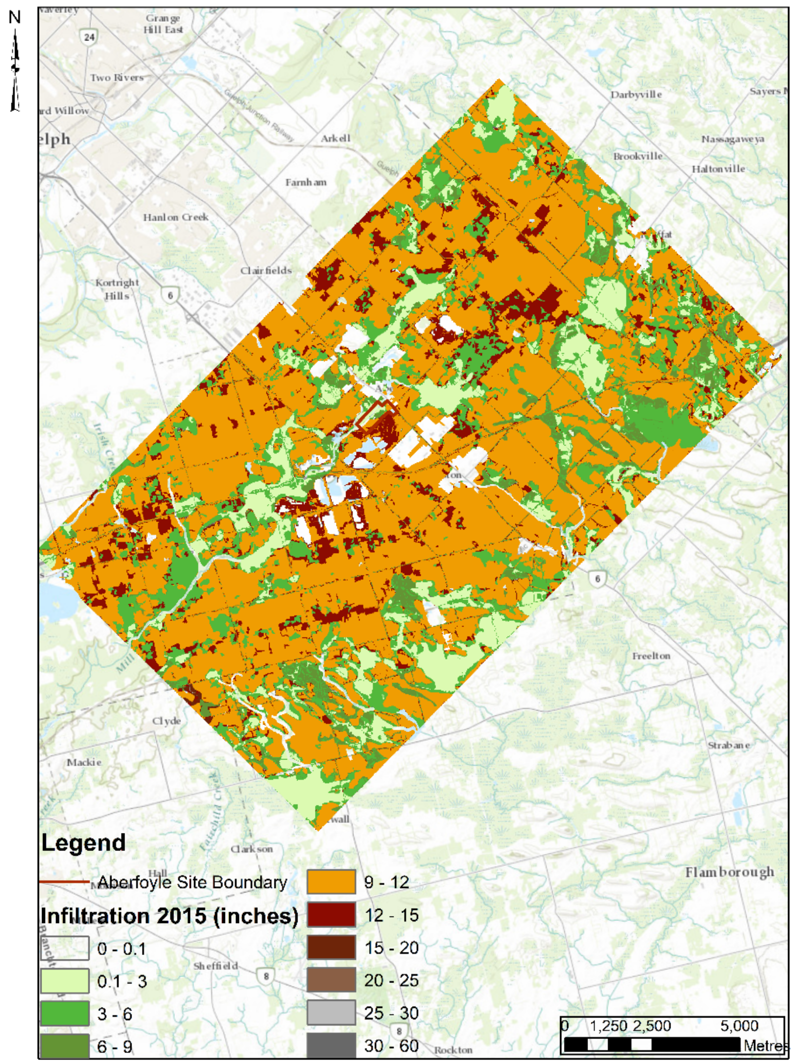


Figure 9. Calculated distribution of annual infiltration for 2015

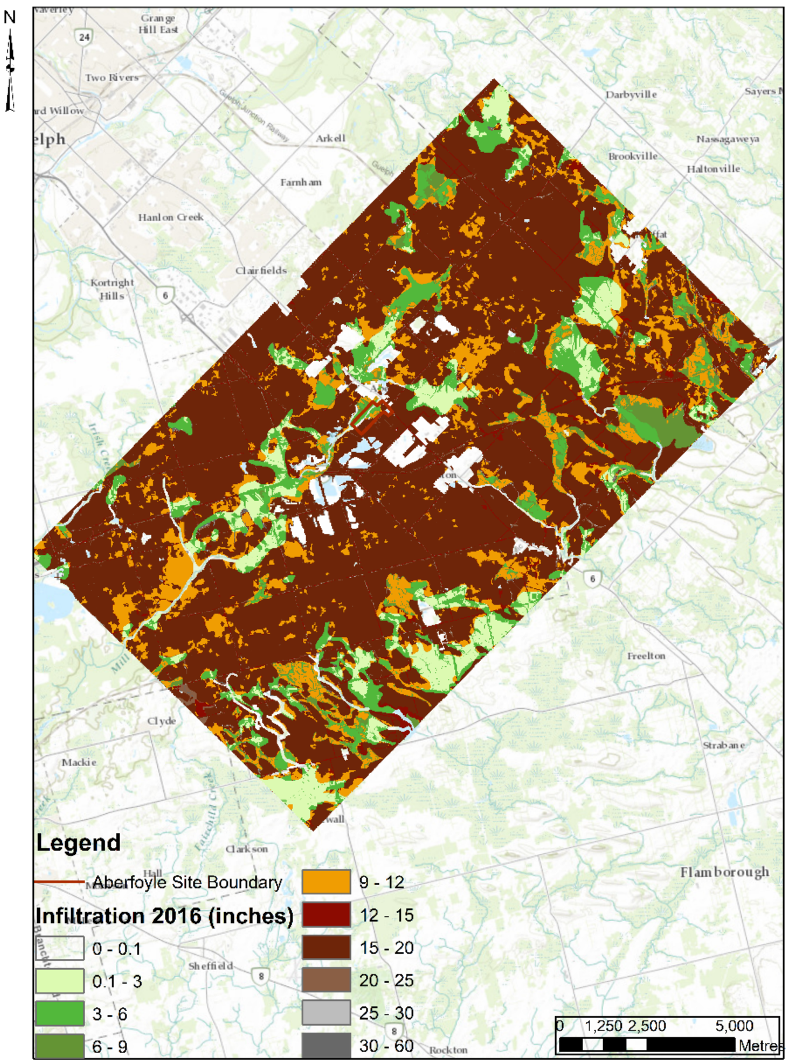


Figure 10. Calculated distribution of annual infiltration for 2016

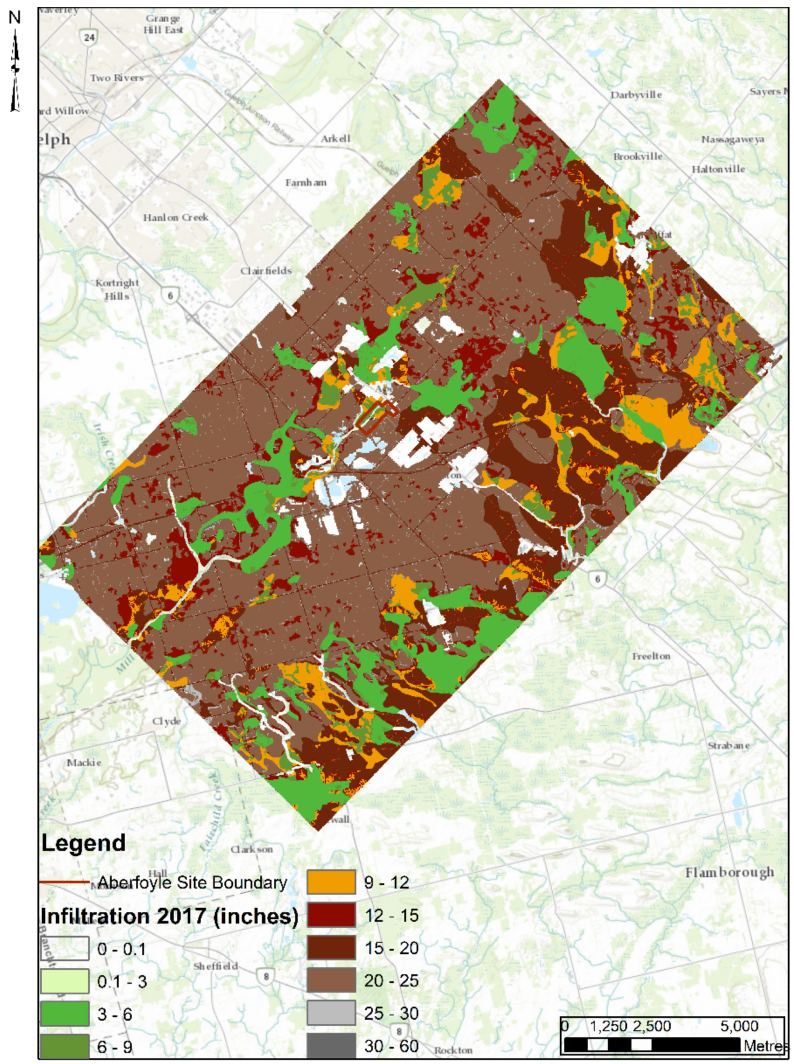


Figure 11. Calculated distribution of annual infiltration for 2017

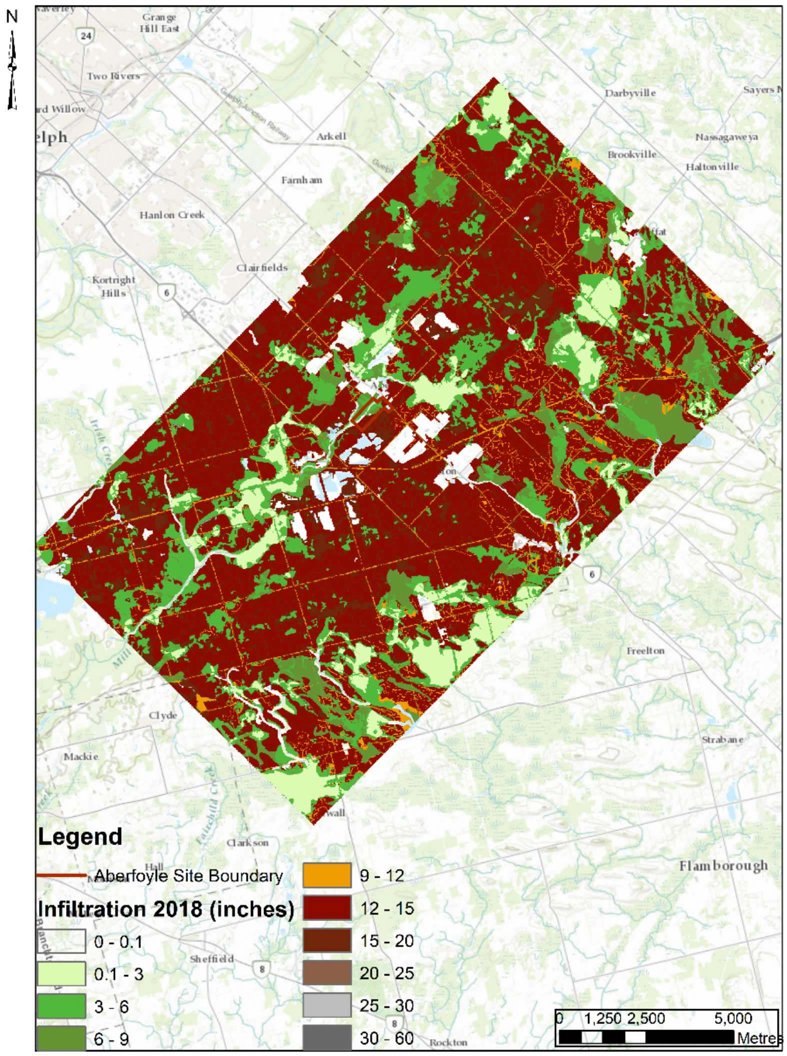


Figure 12. Calculated distribution of annual infiltration for 2018

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

The annual average infiltration distribution is shown in Figure 13.

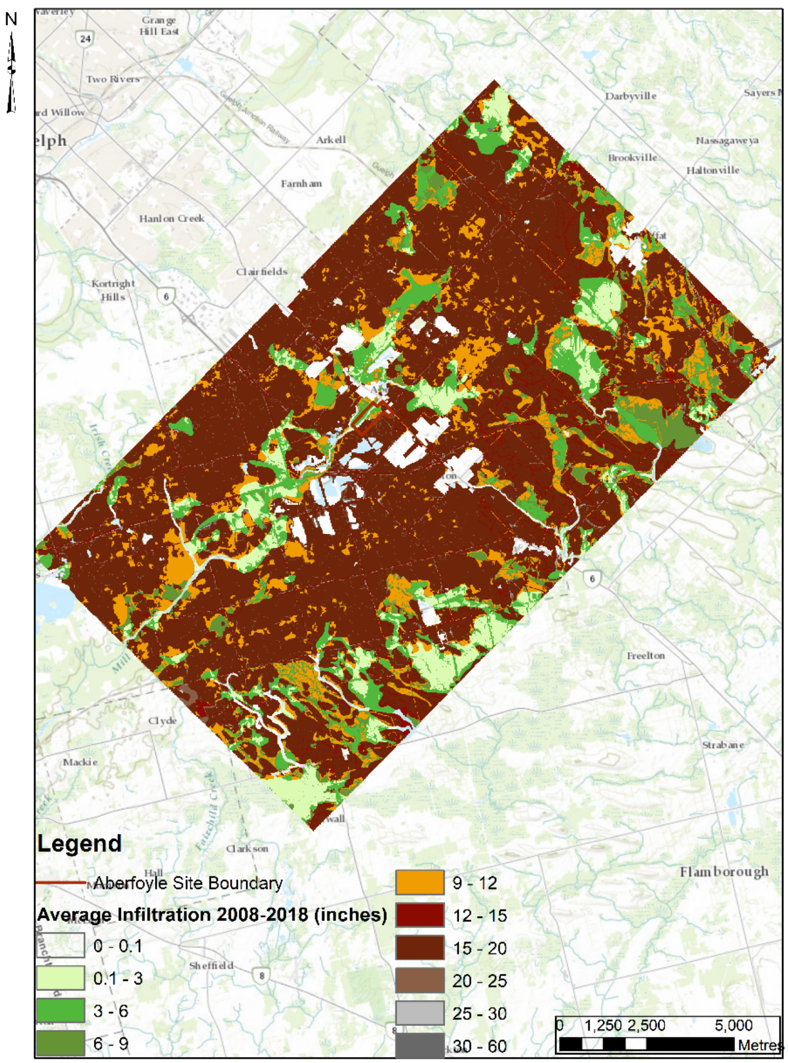


Figure 13. Calculated distribution of annual average infiltration from 2008 to 2018

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:

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

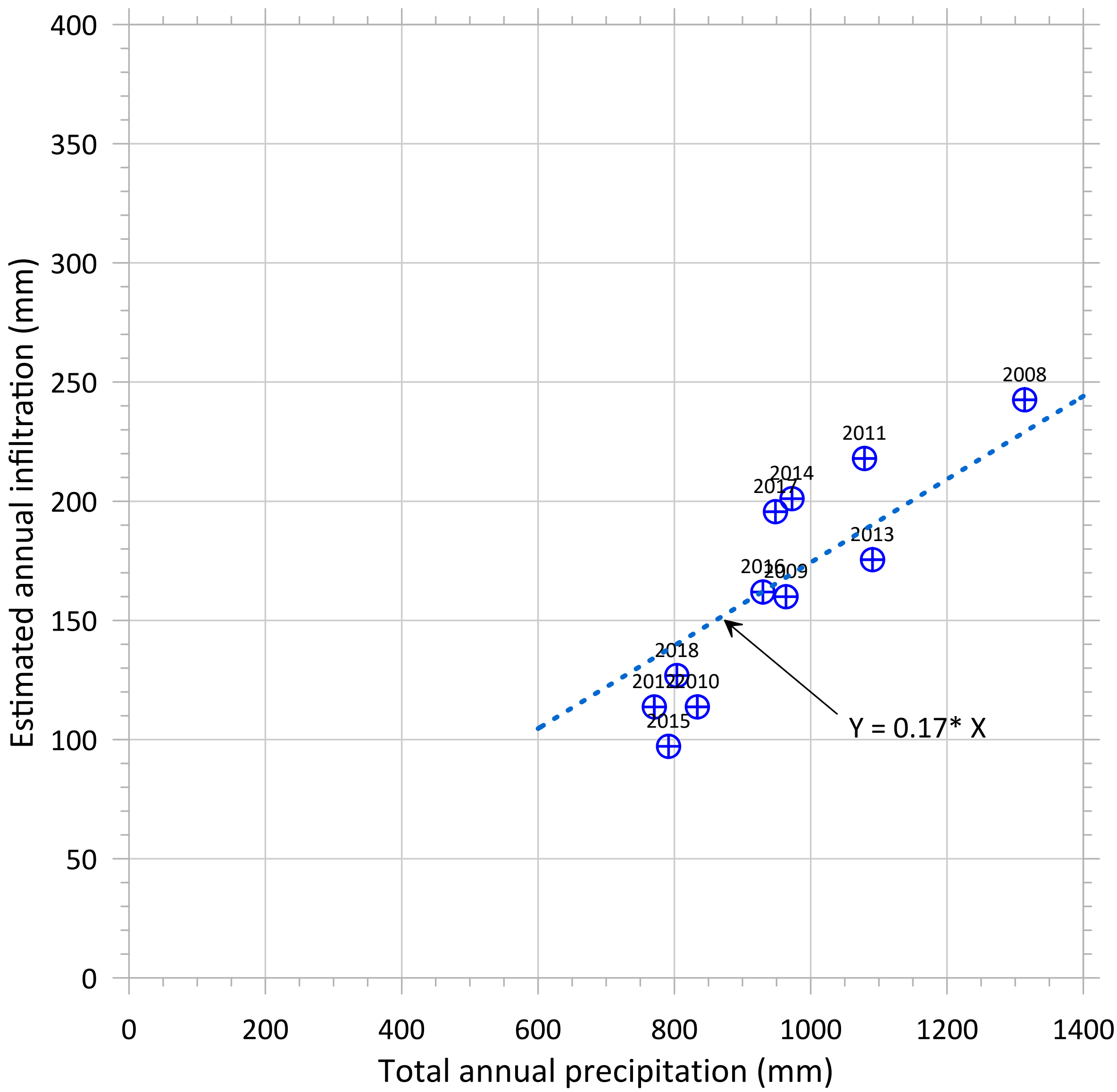


Figure 14. Relationship between infiltration and precipitation

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, Météroloqie 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%).

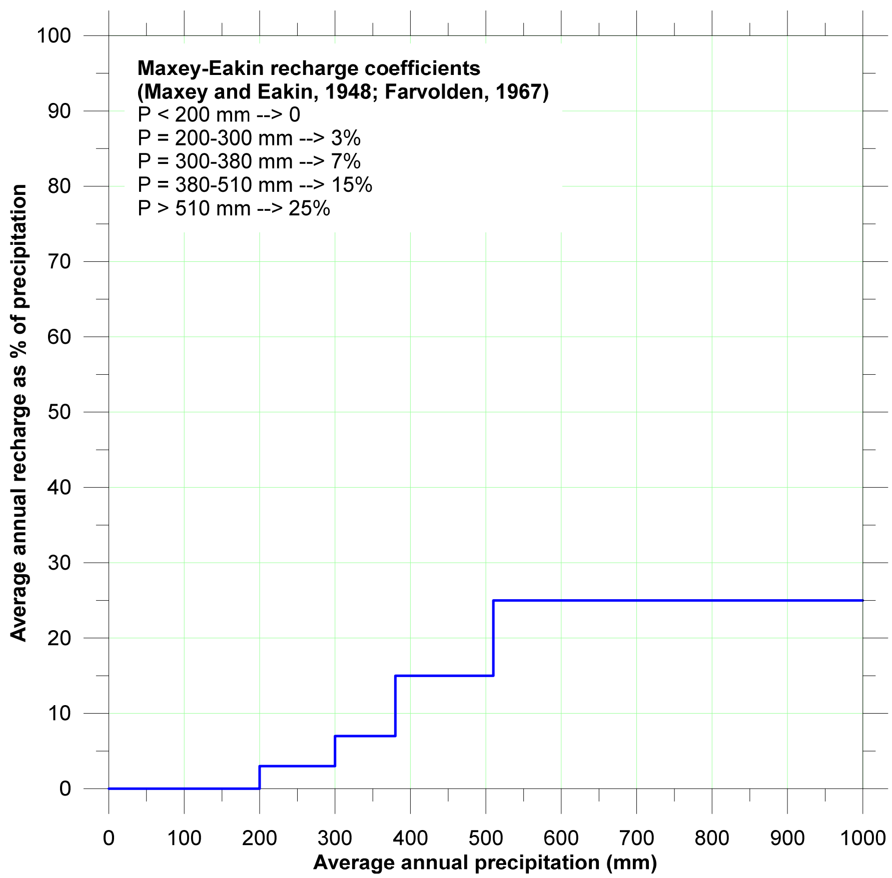


Figure 15. Correlations between recharge and annual precipitation presented in Maxey and Eakin (1949) and Farvolden (1967)

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

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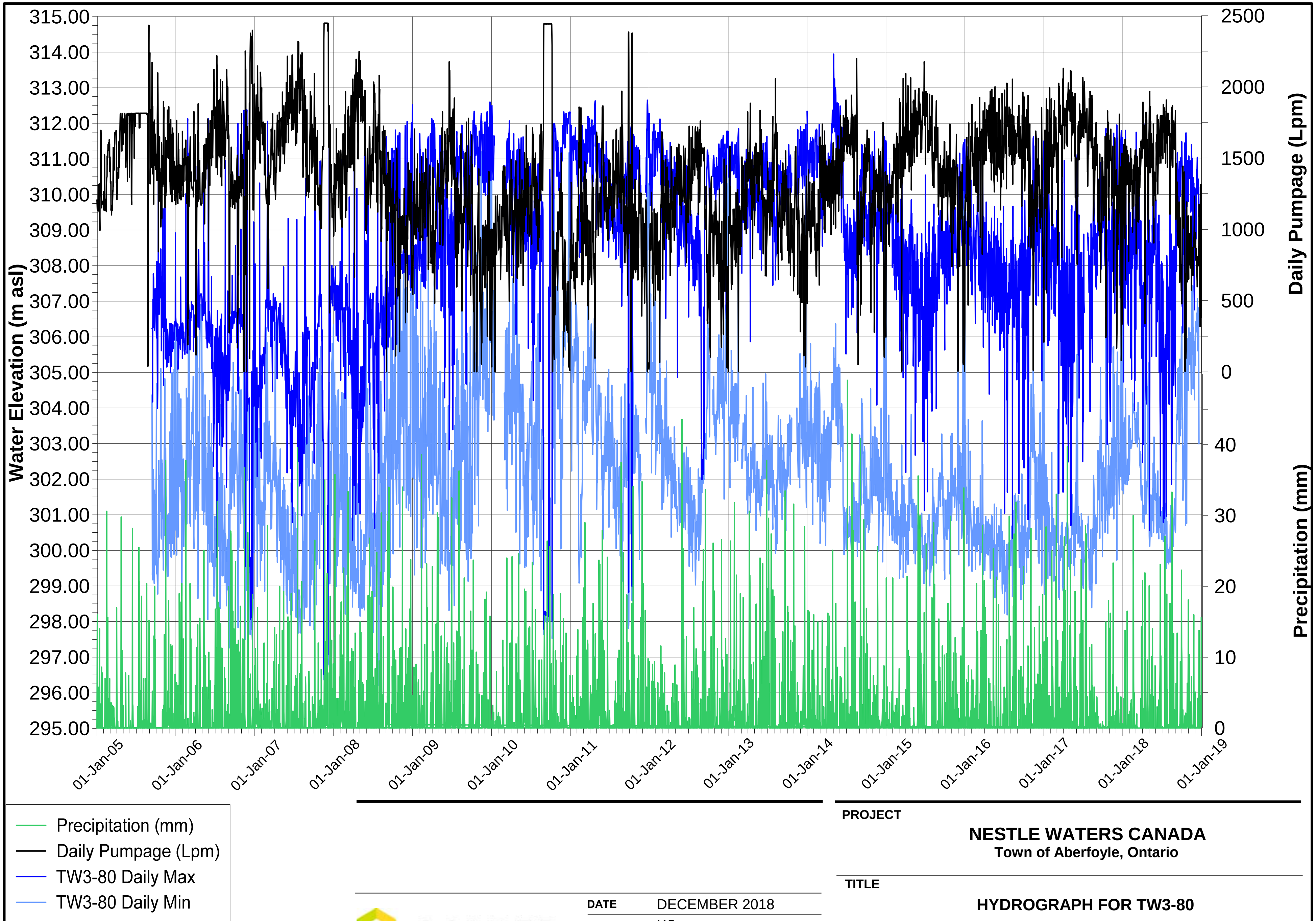
APPENDIX D

Groundwater Hydrographs



GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

HYDROGRAPH FOR TW3-80

PROJECT NO.	REV	FIGURE
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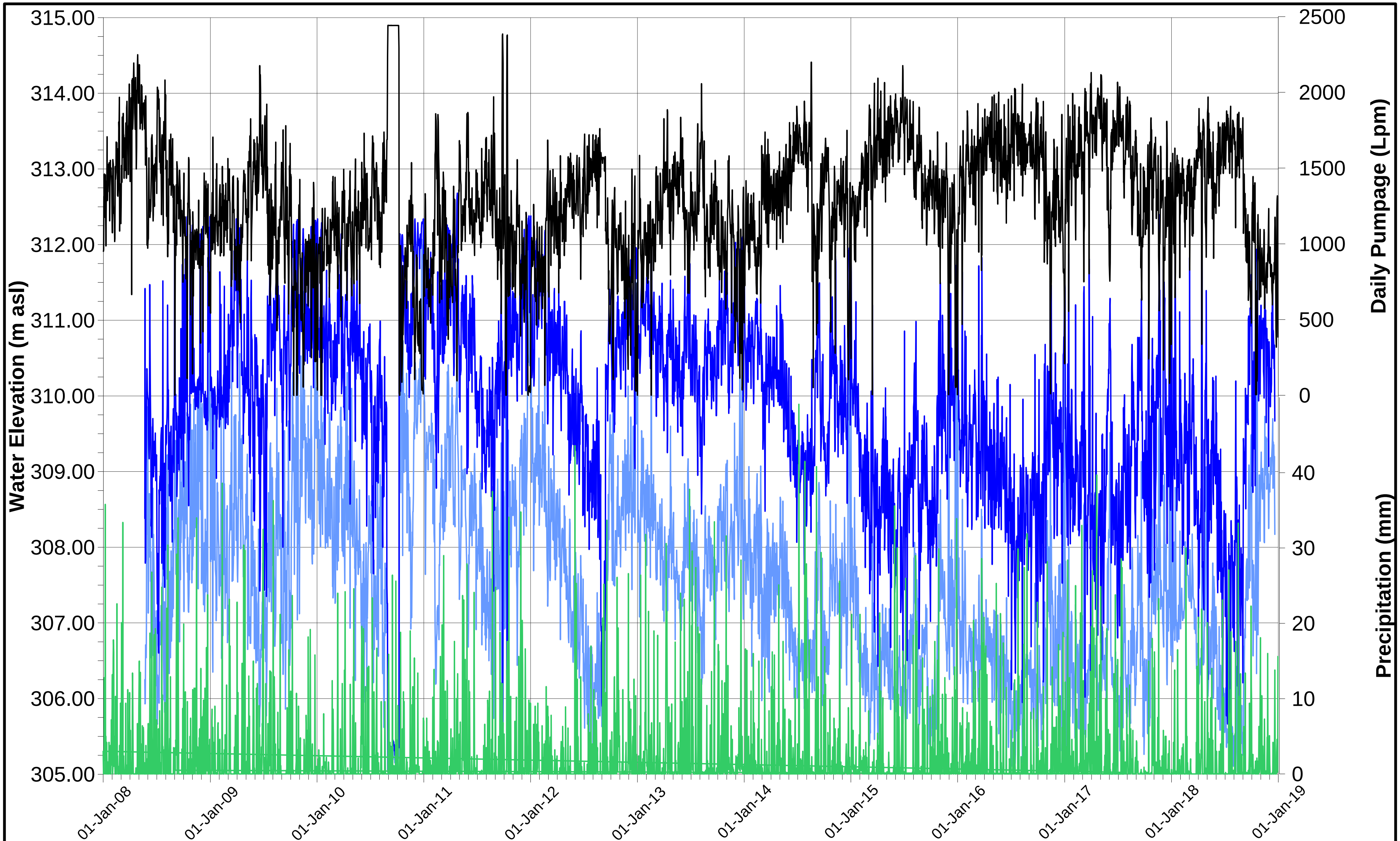

GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

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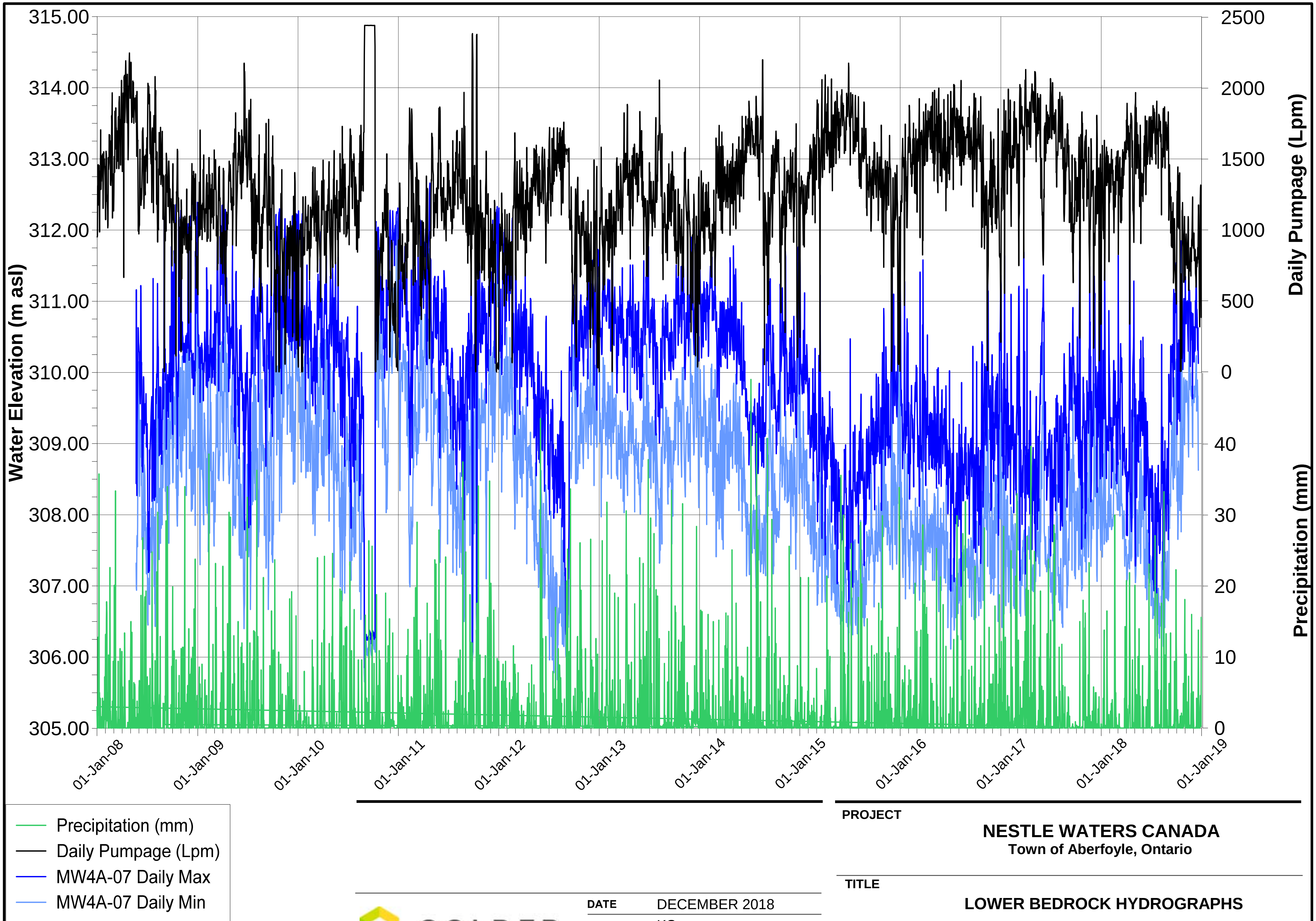

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DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

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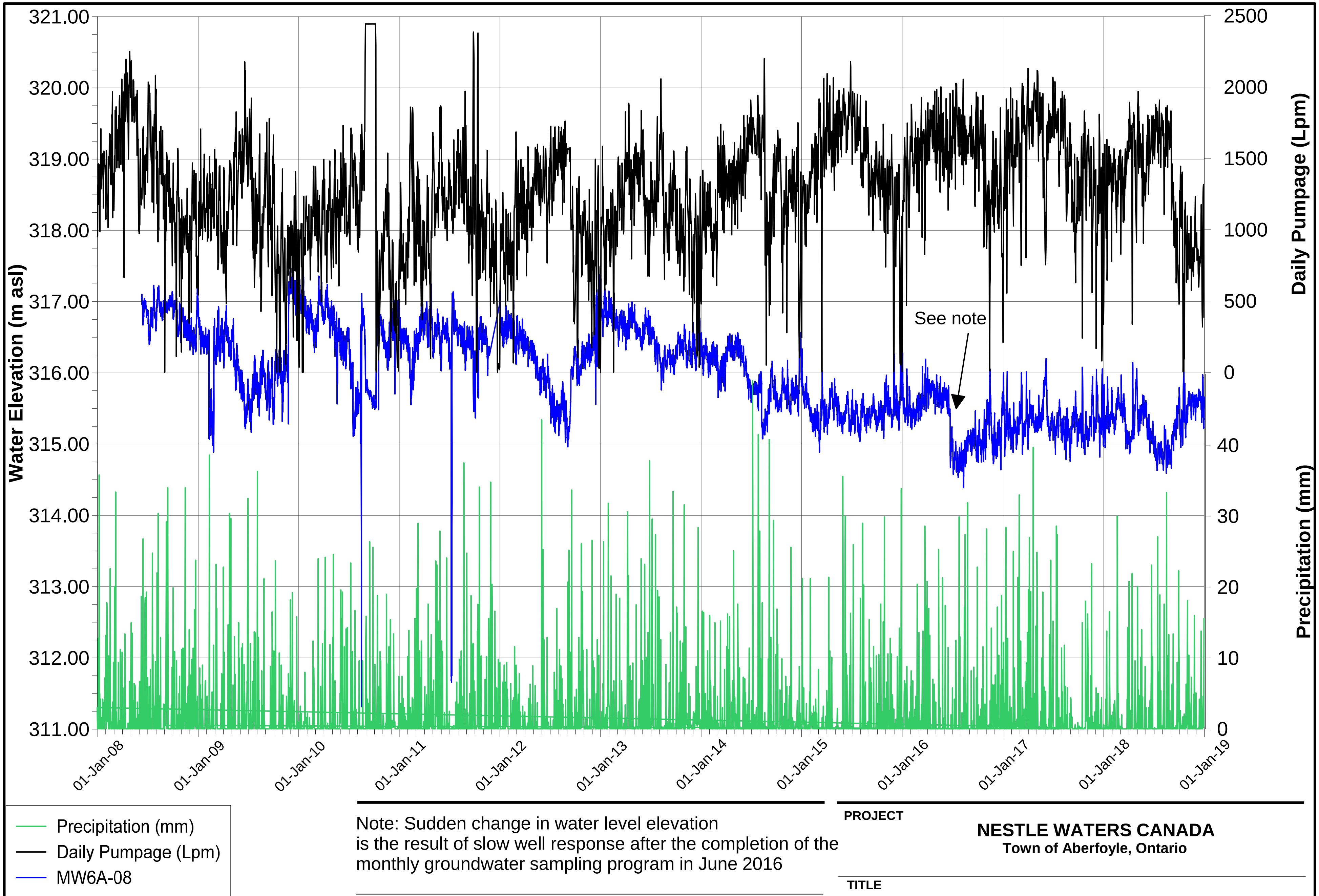

Note: Sudden change in water level elevation is the result of slow well response after the completion of the monthly groundwater sampling program in June 2016

GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

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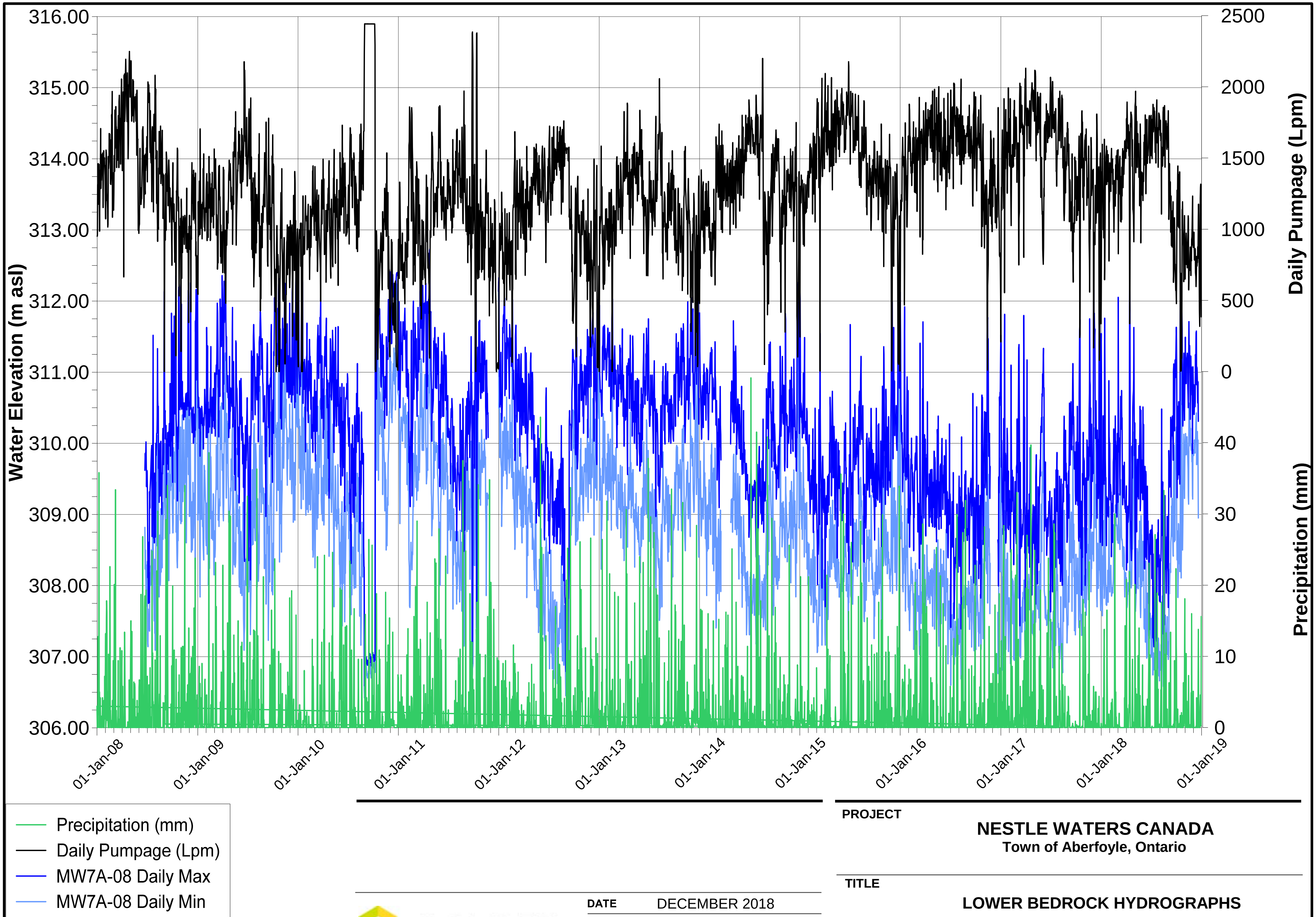

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DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

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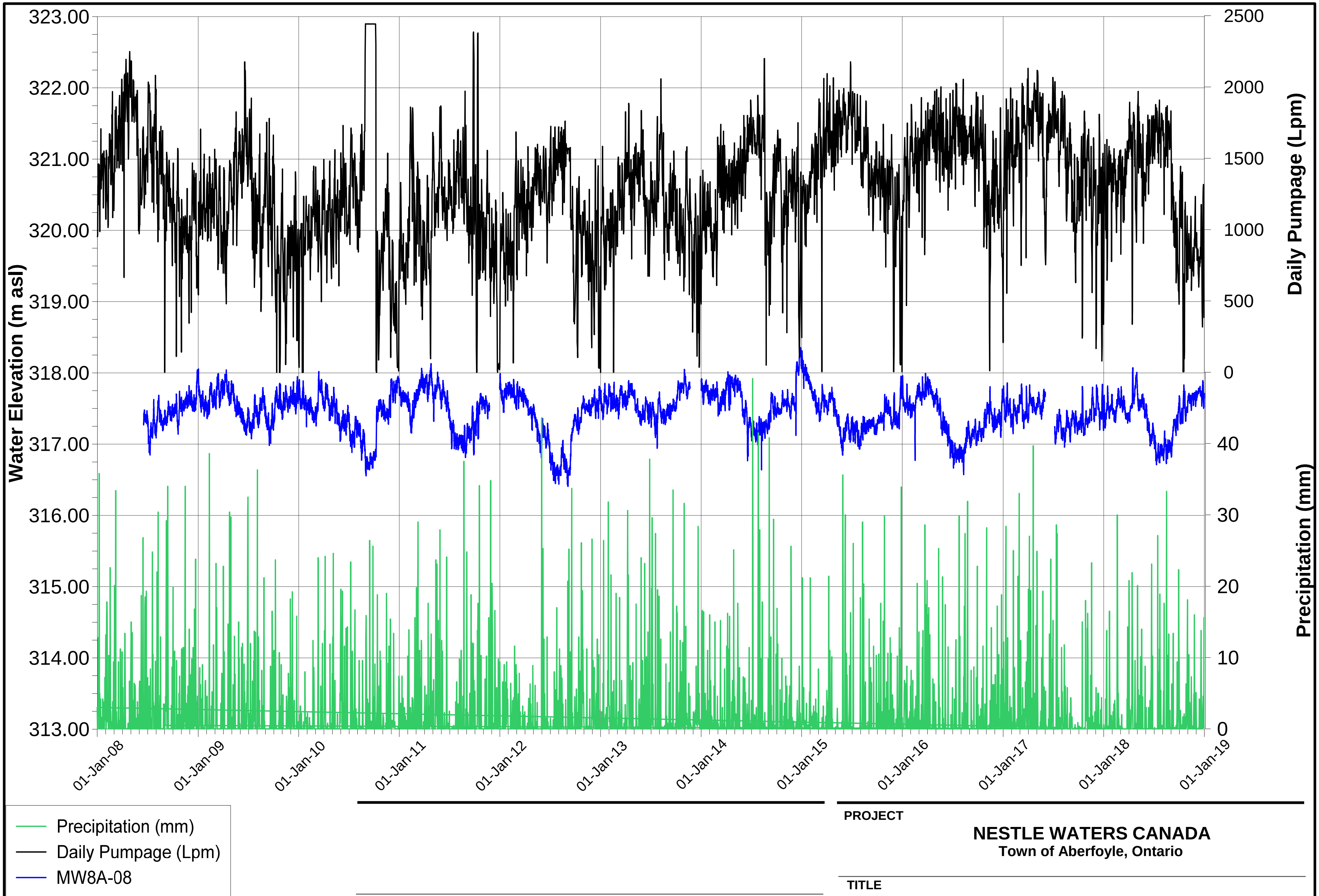

GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

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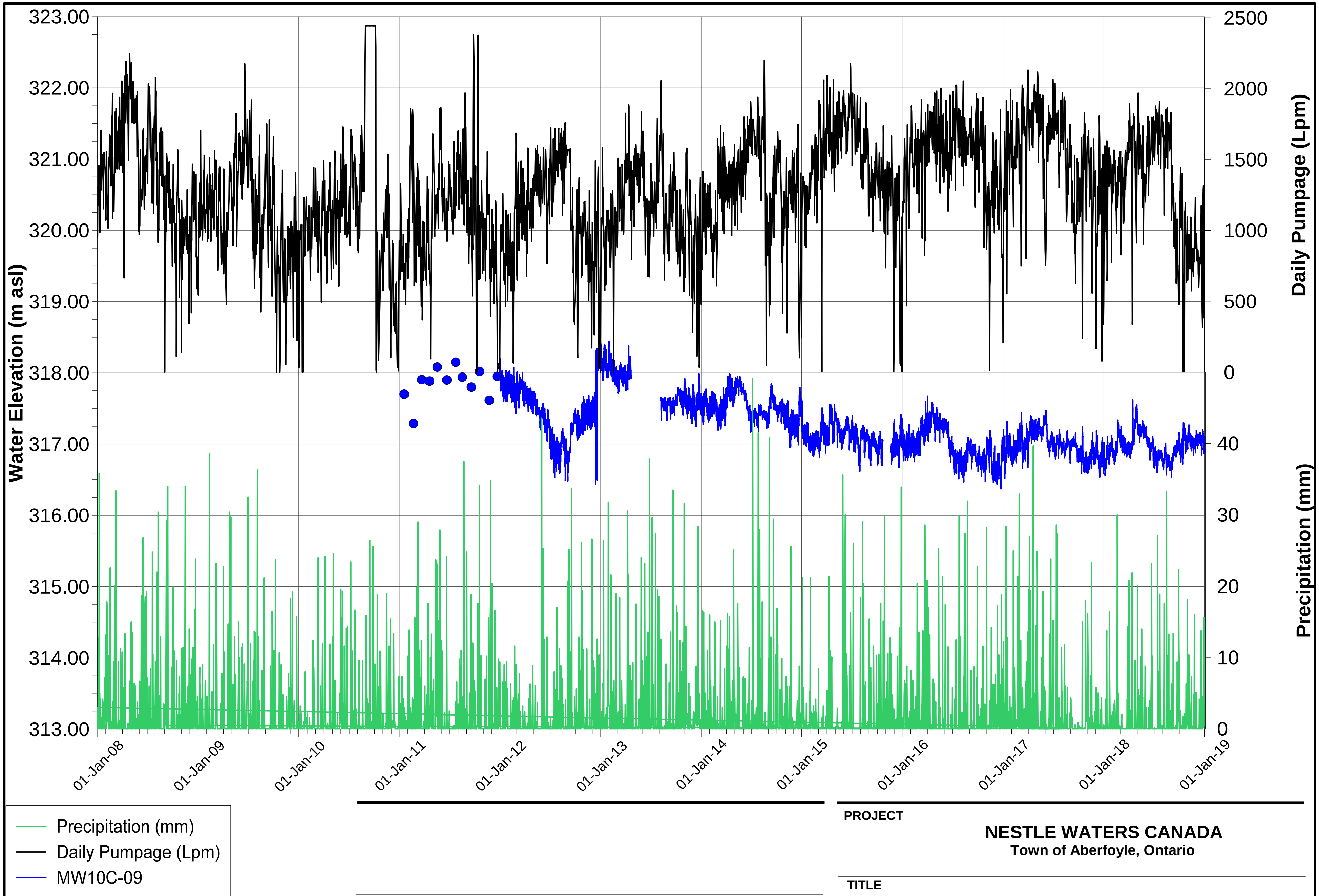

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DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

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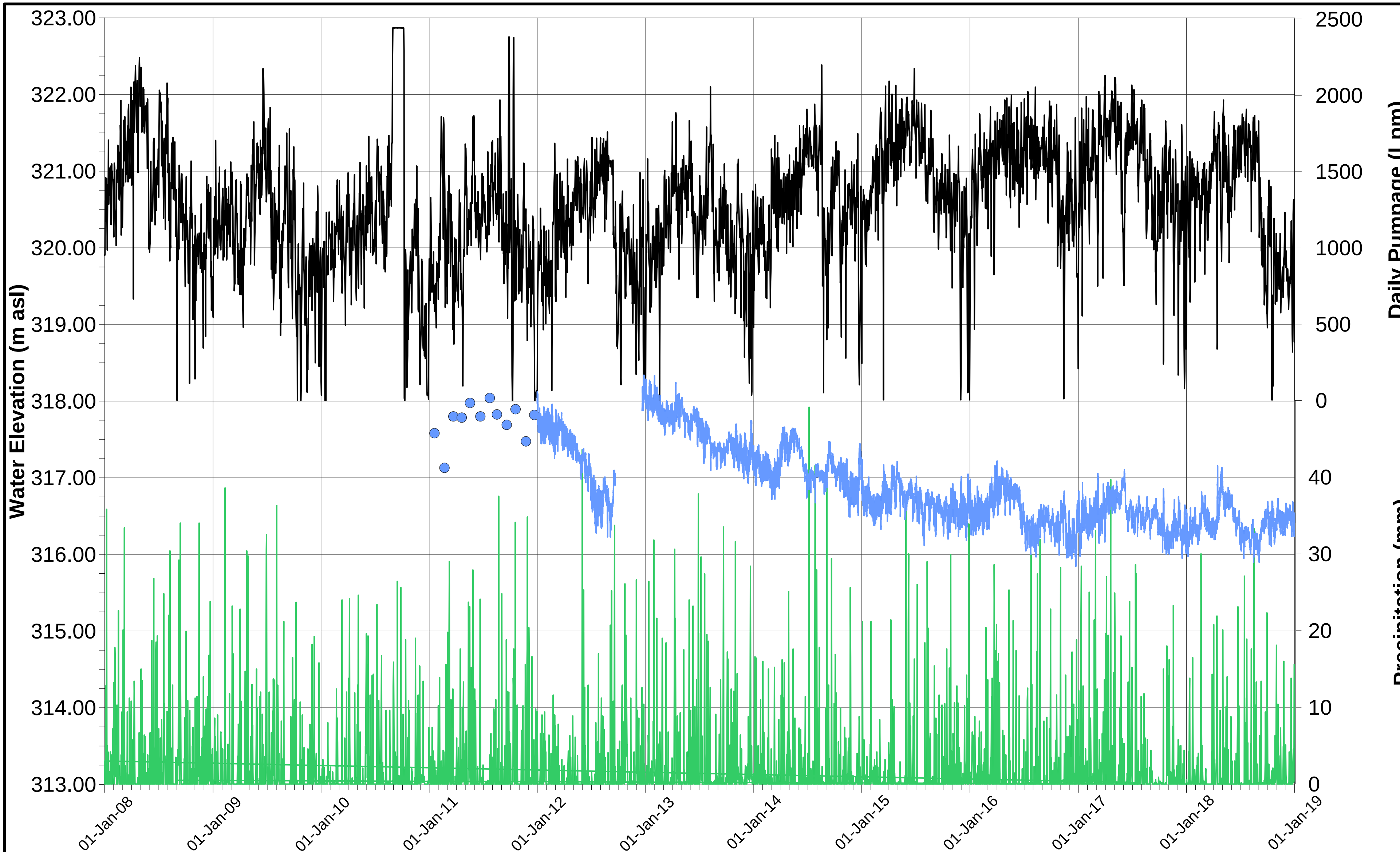

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DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
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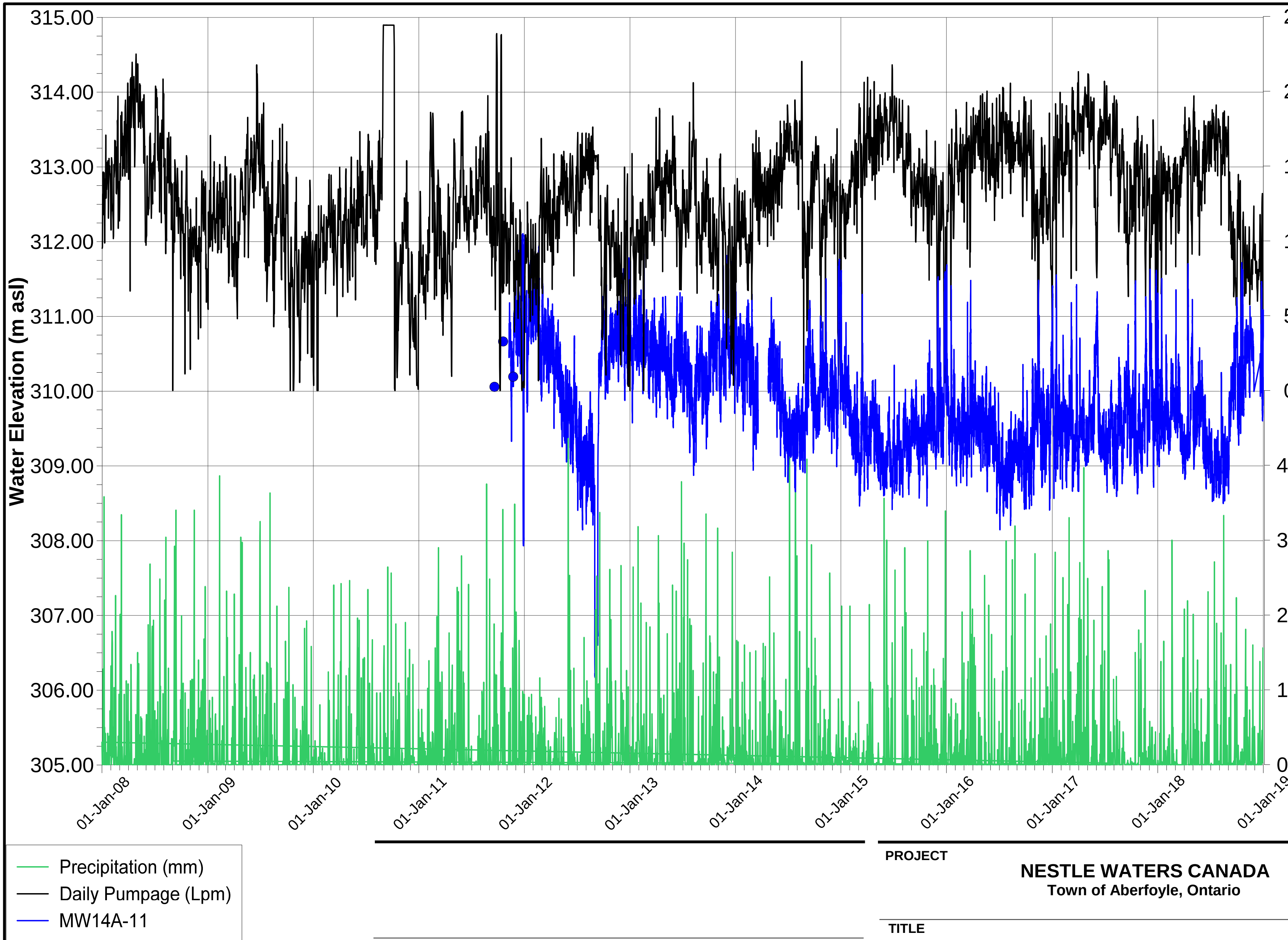

GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

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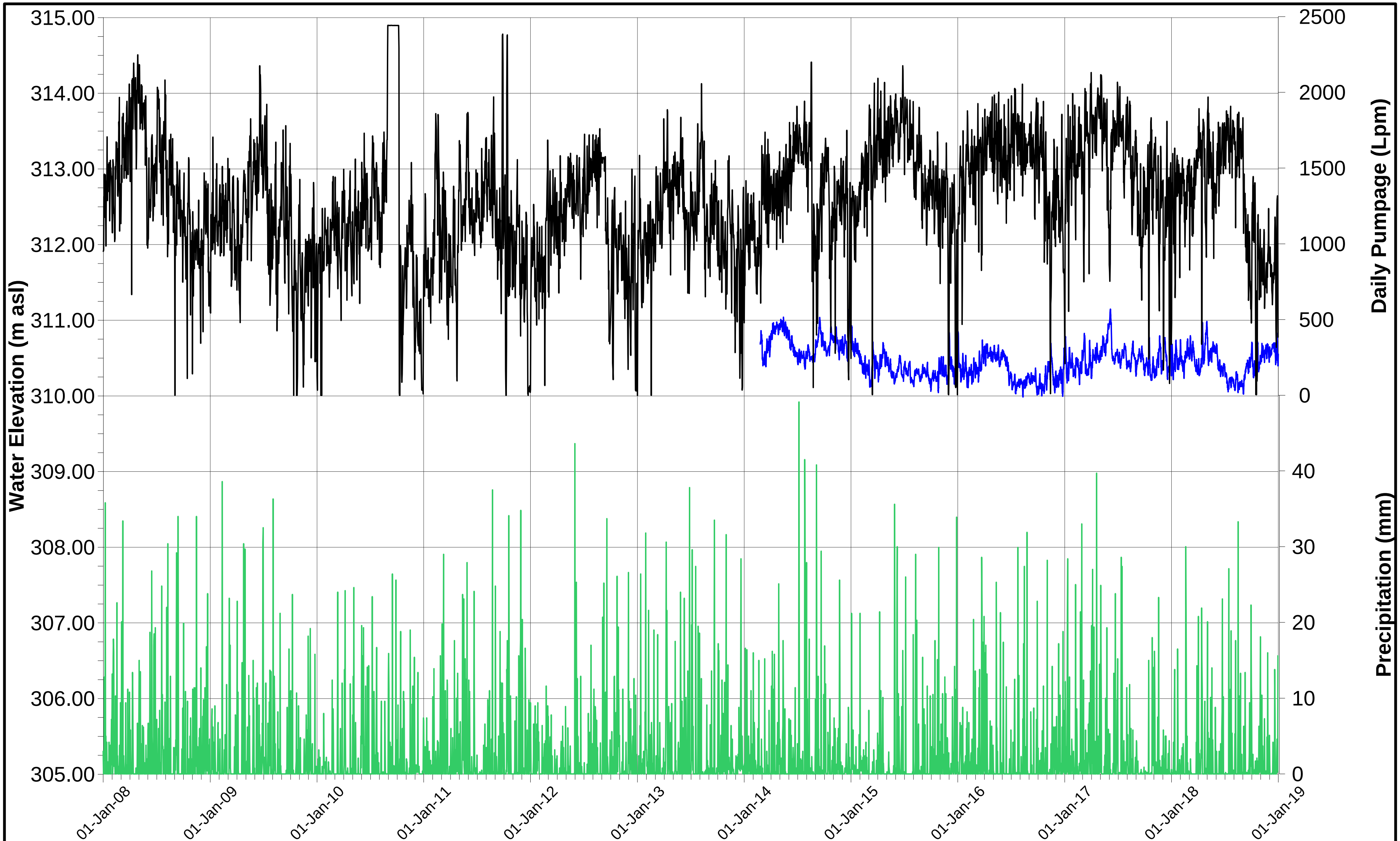

GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

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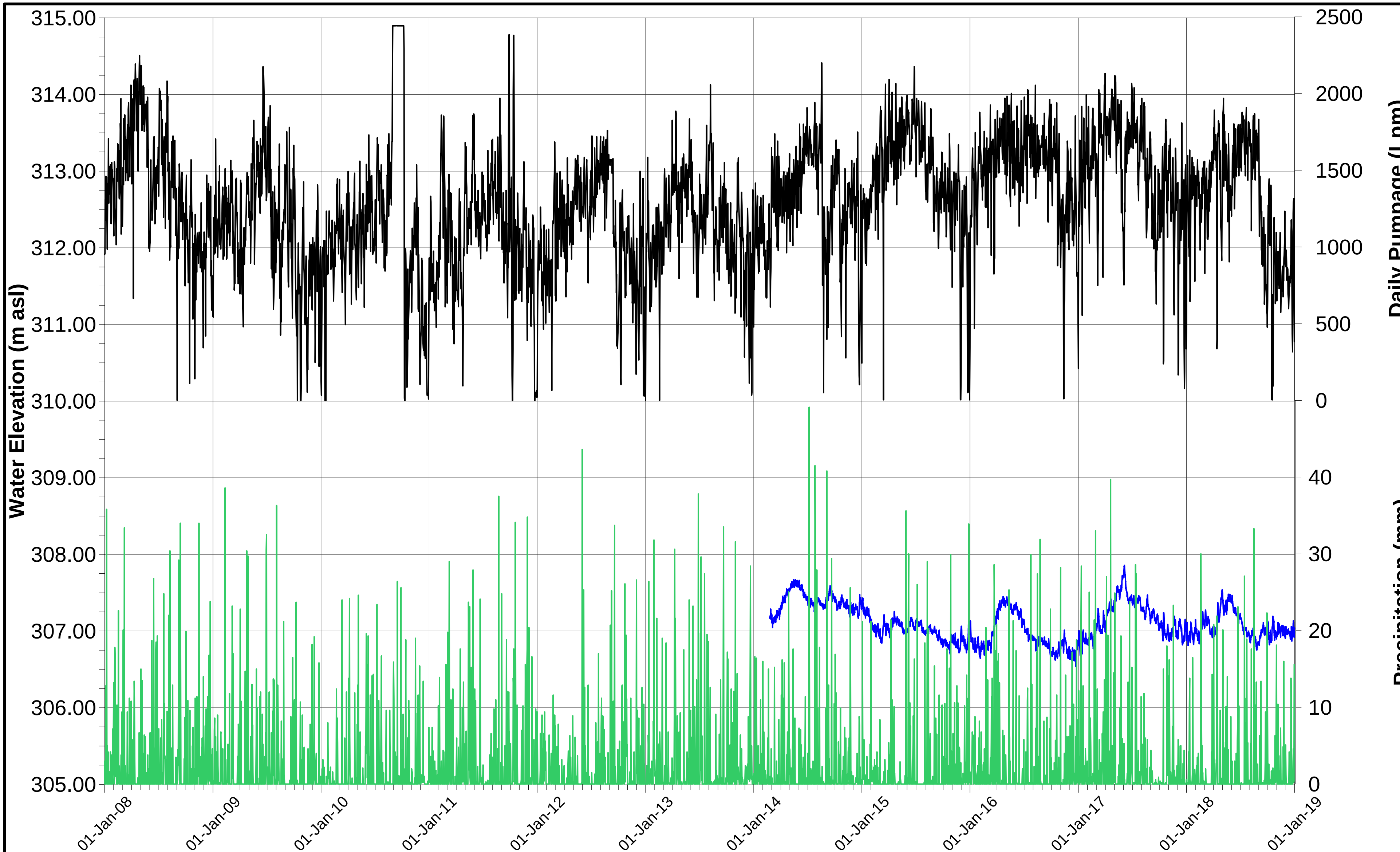

GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

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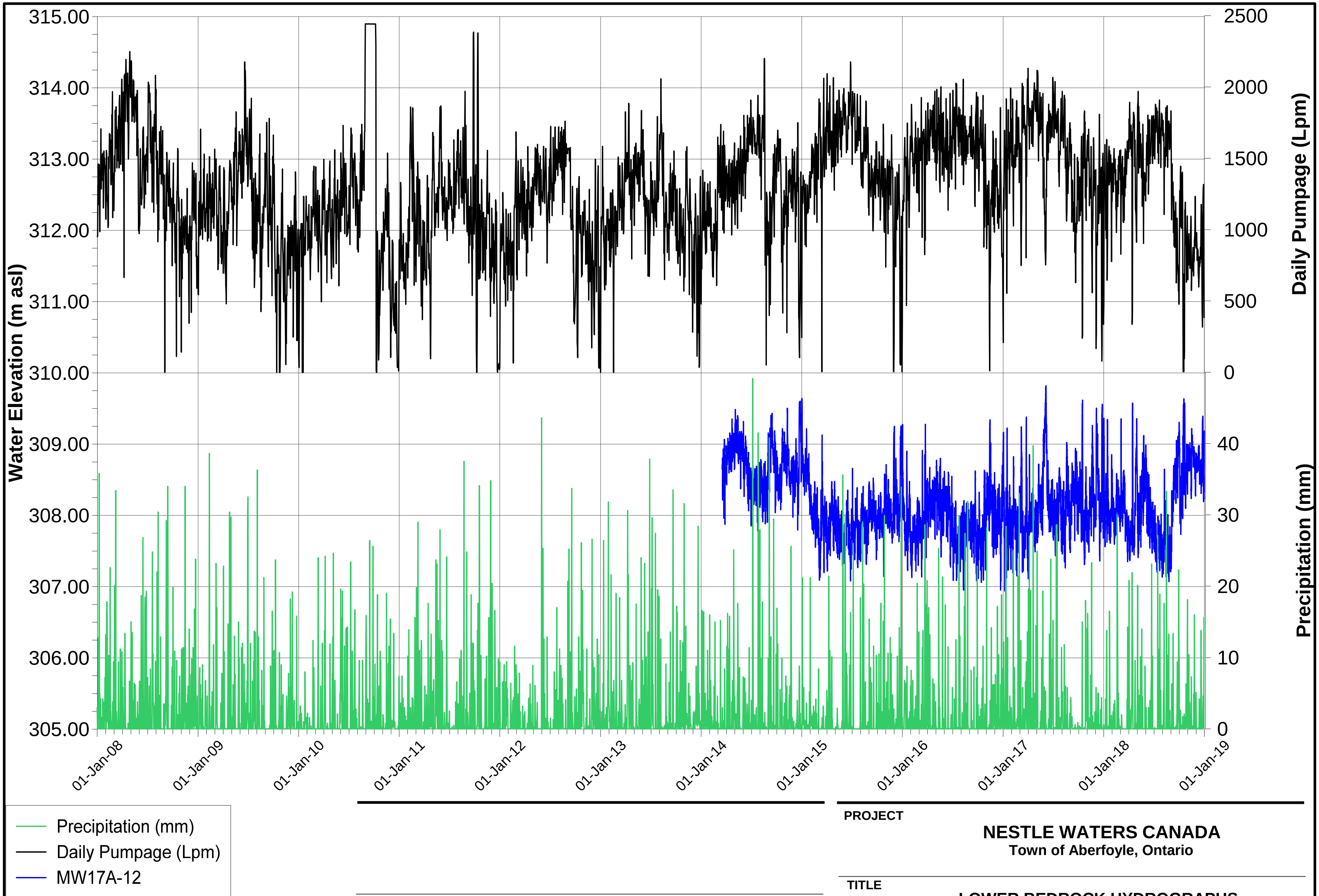

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

GOLDER

PROJECT

NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
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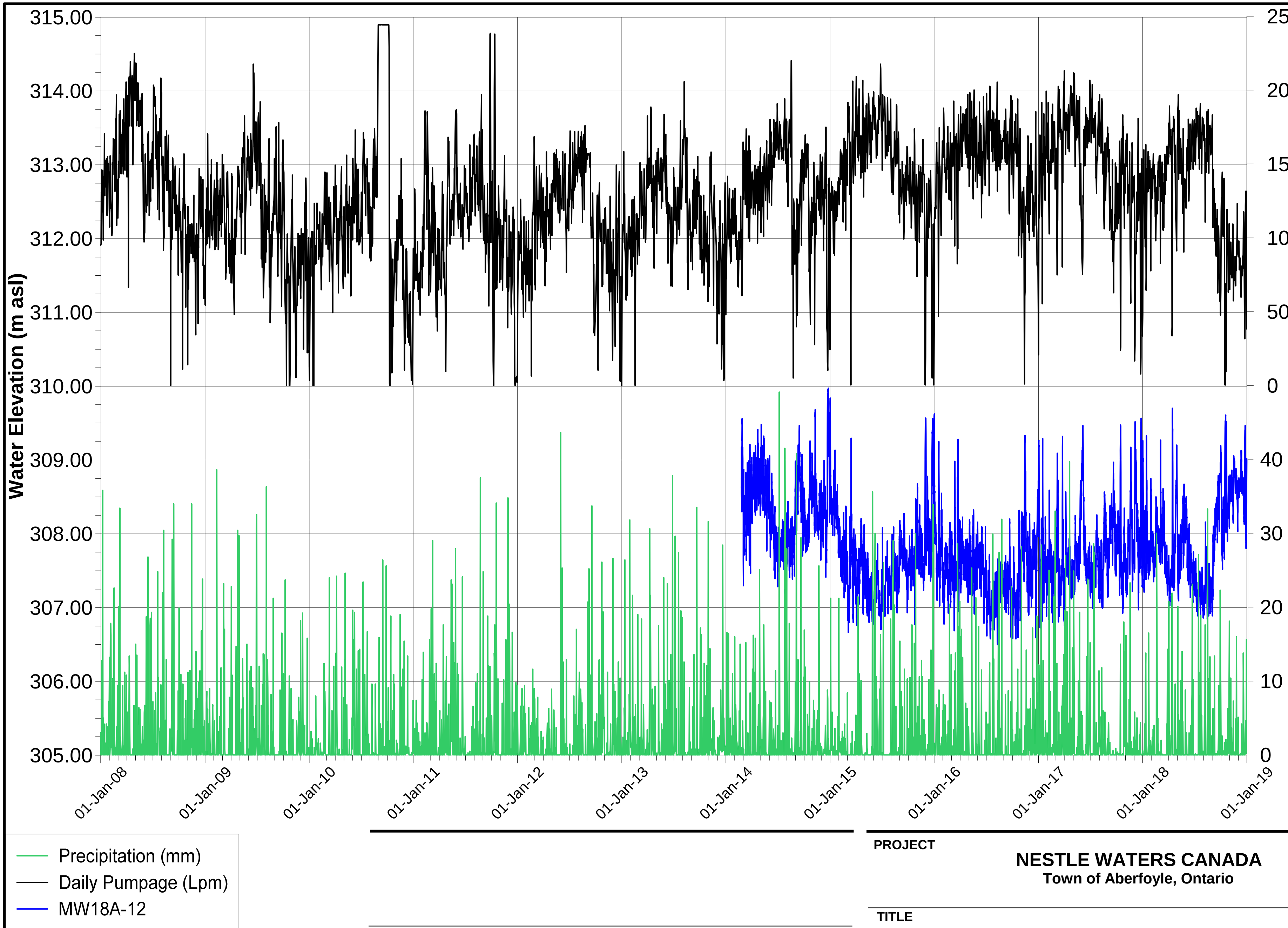


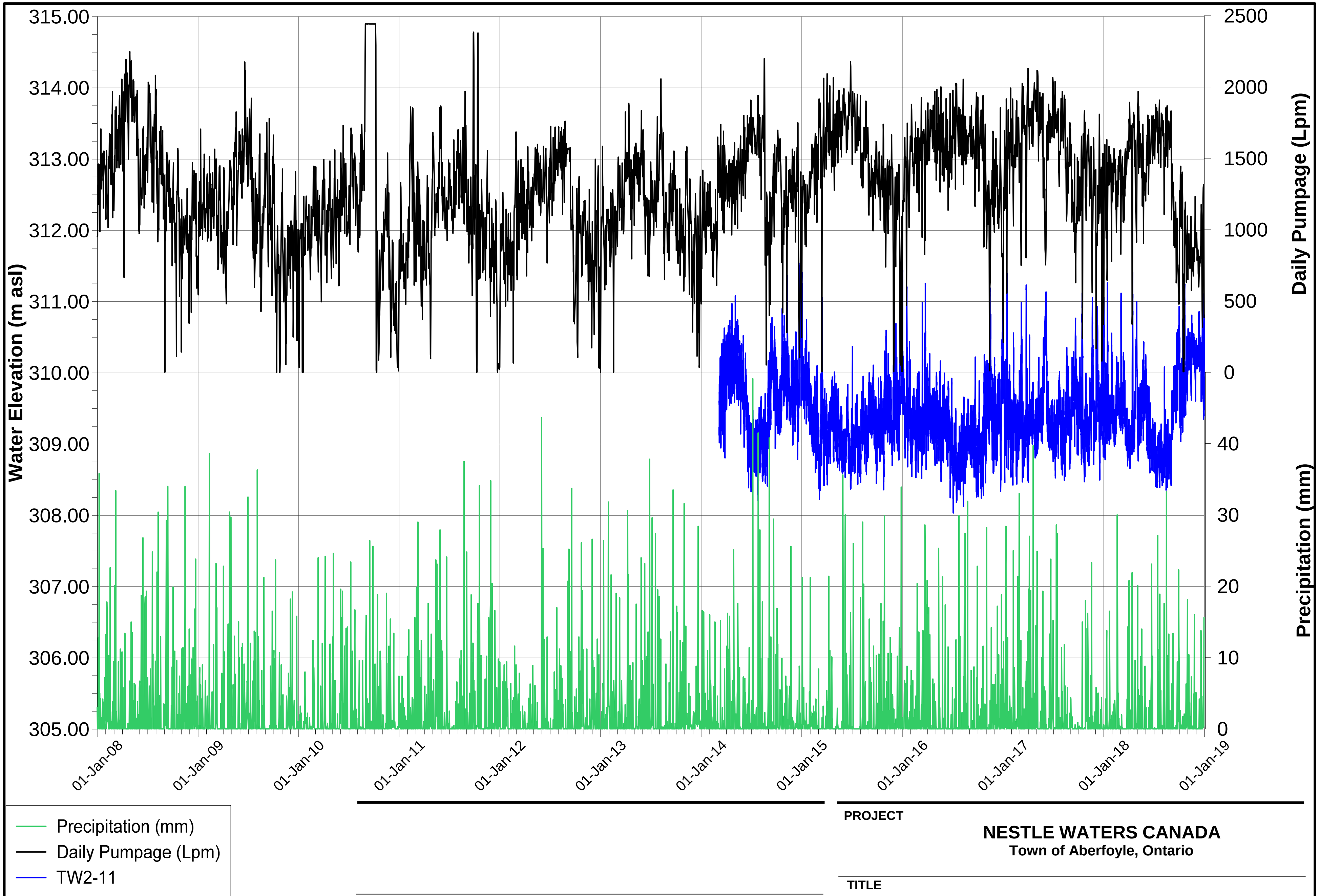
GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
LOWER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D13



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

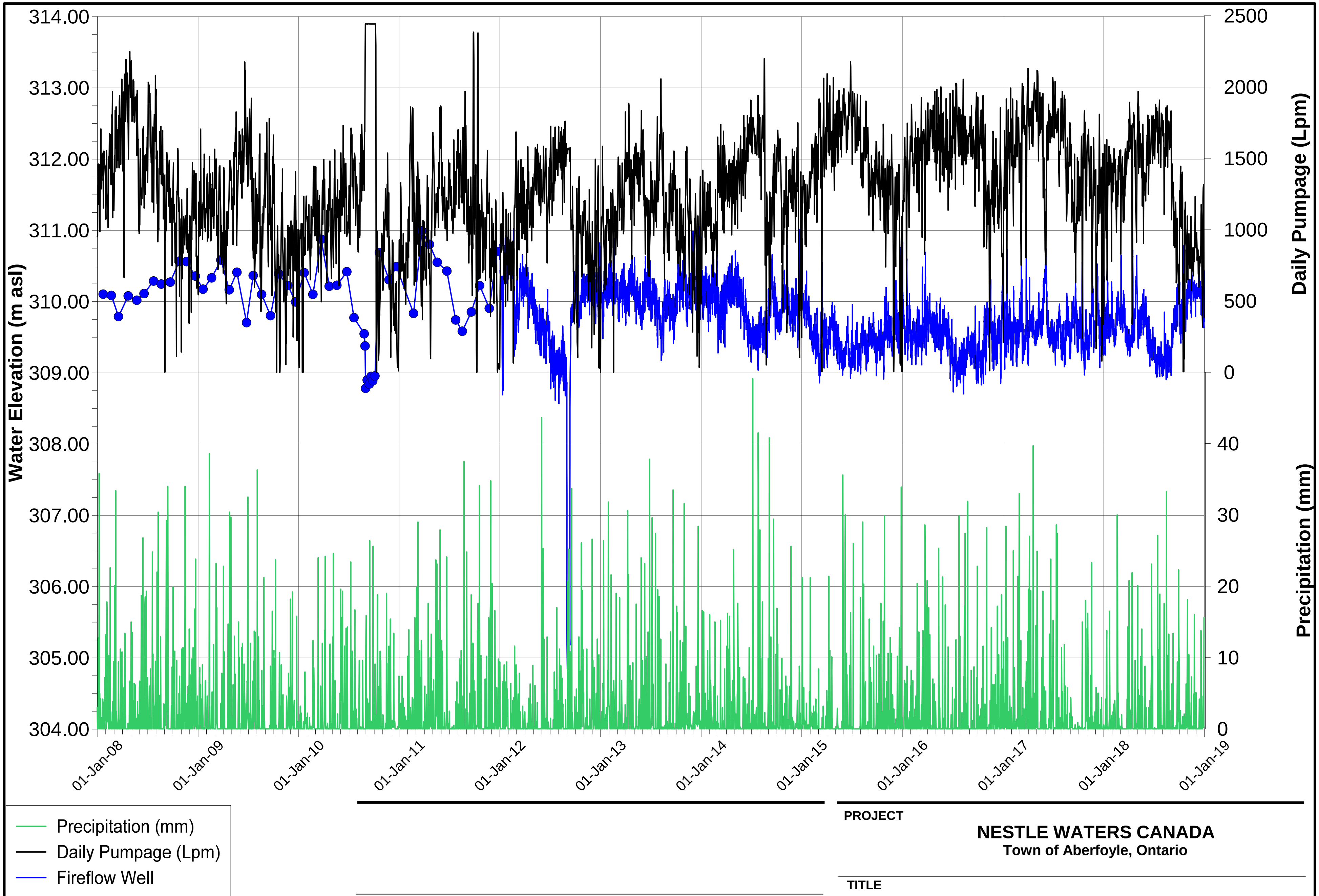
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D14



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

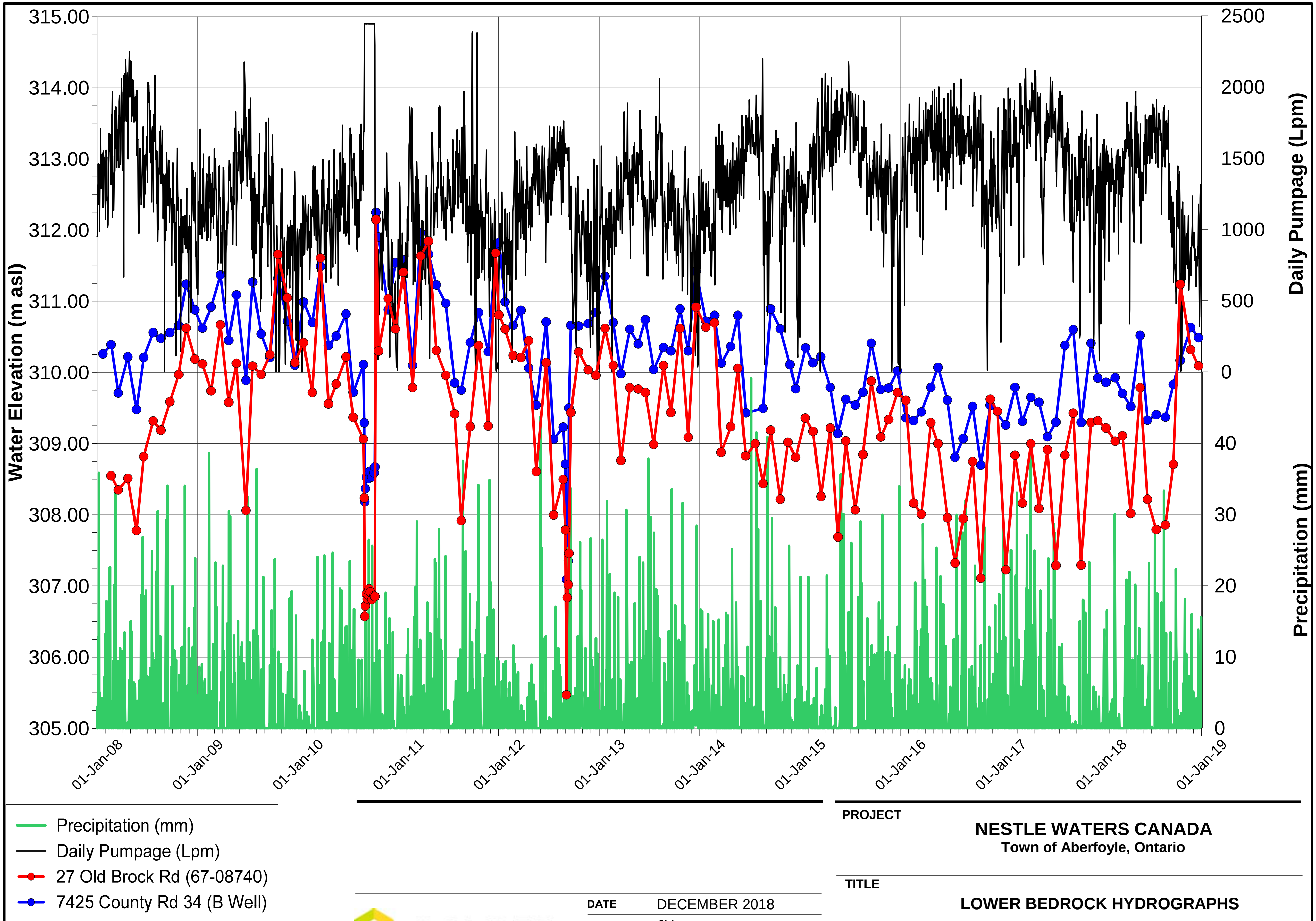
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D15



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

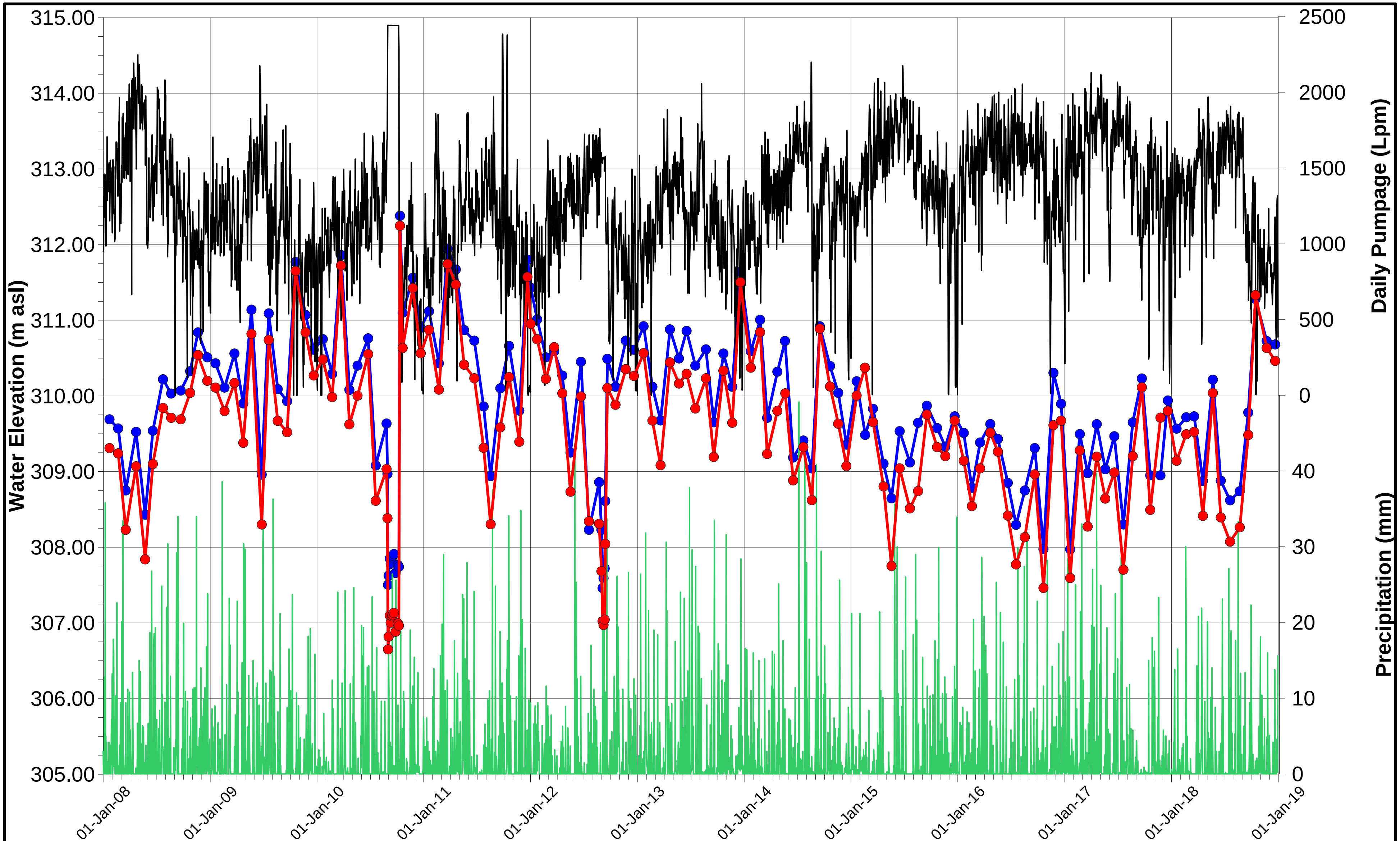
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D16



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

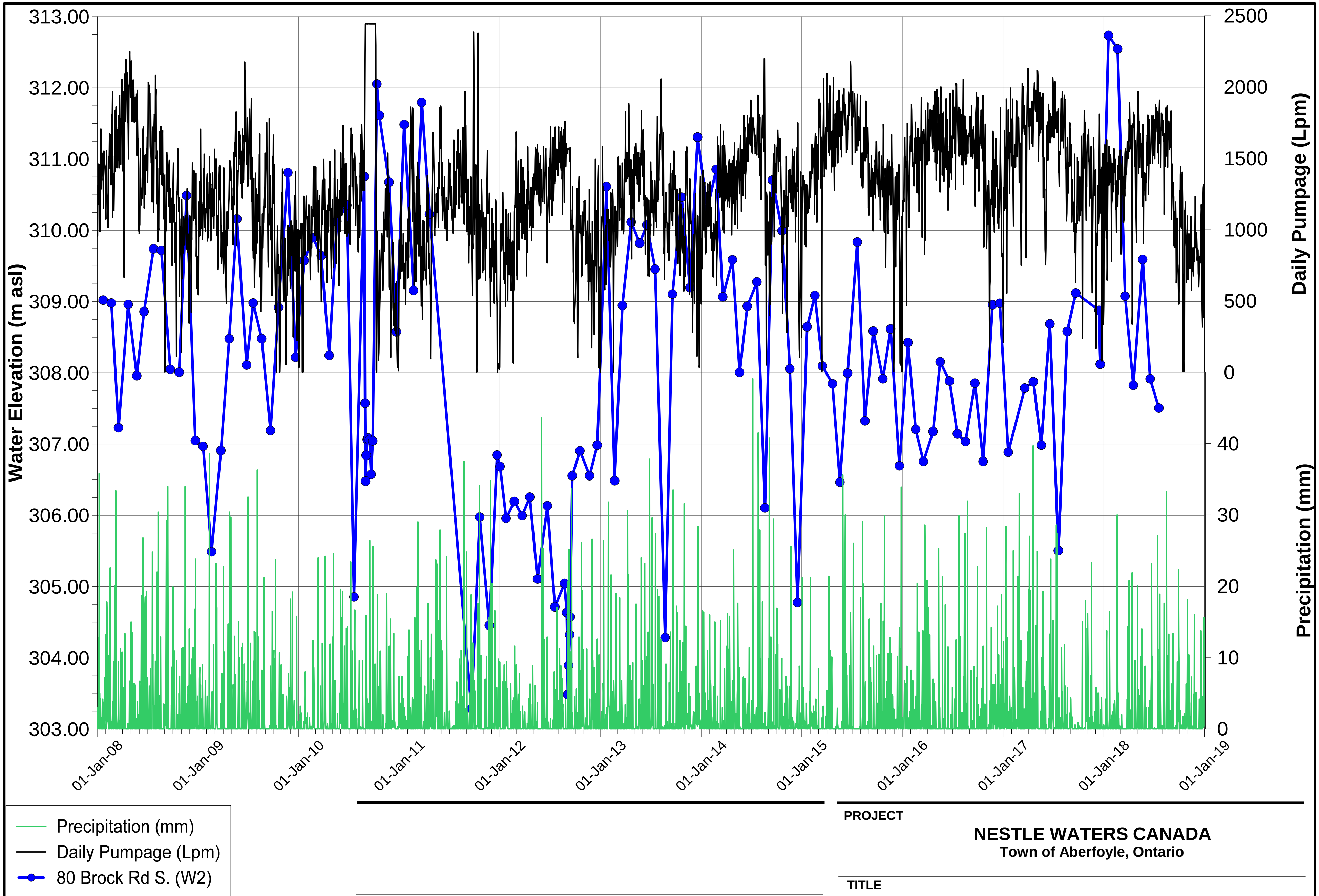
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D17



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

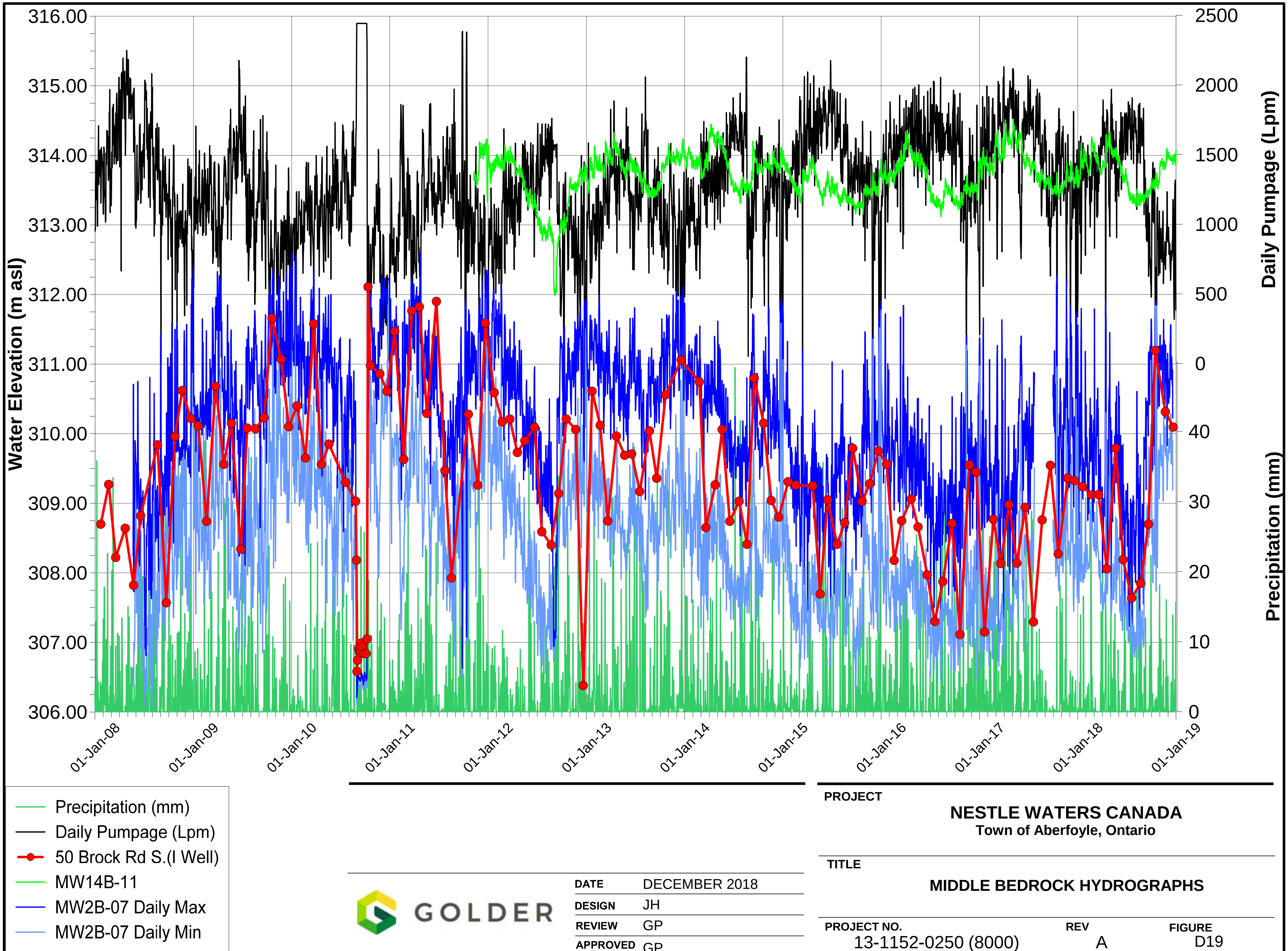
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D18



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

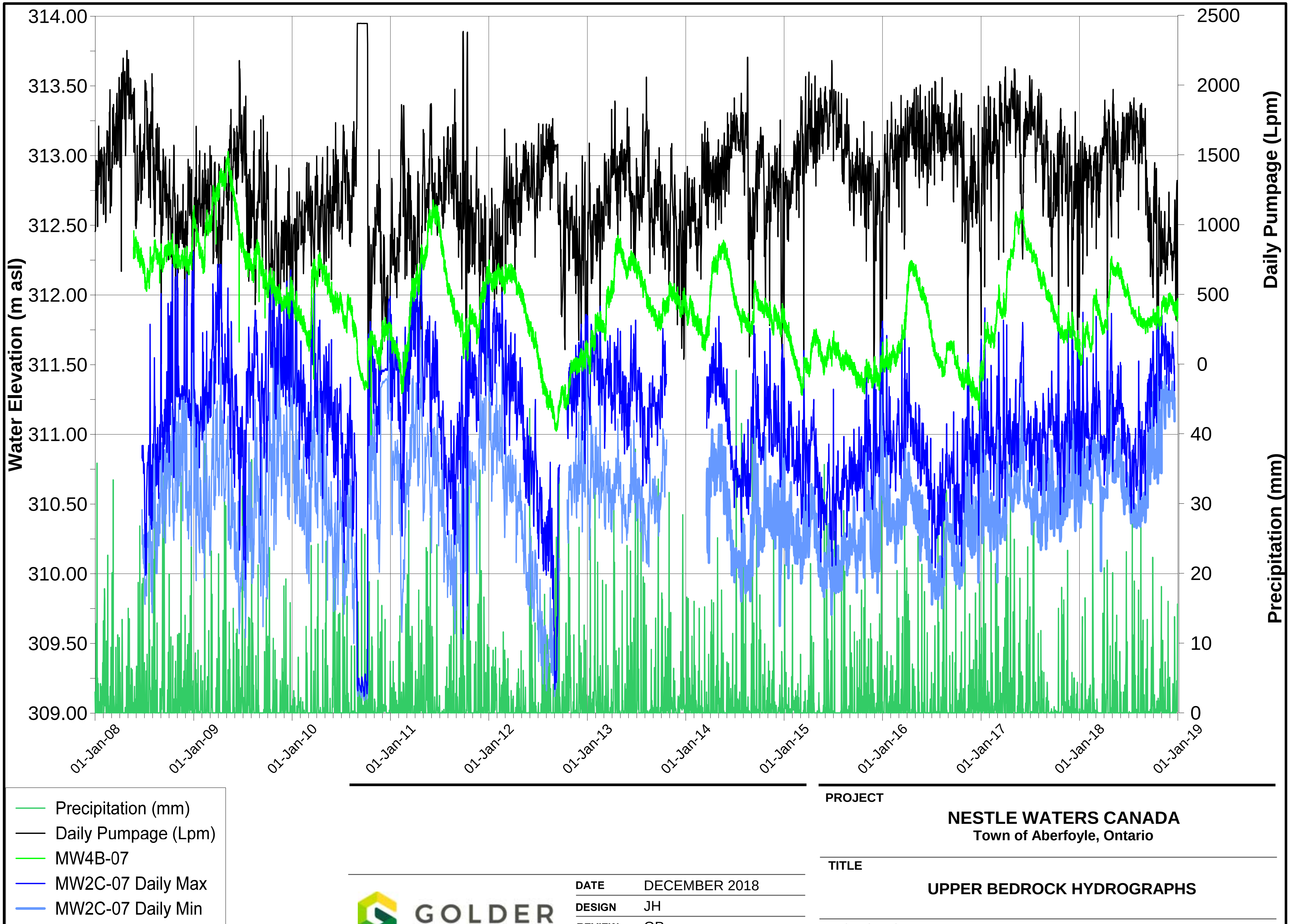
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MIDDLE BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D19



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

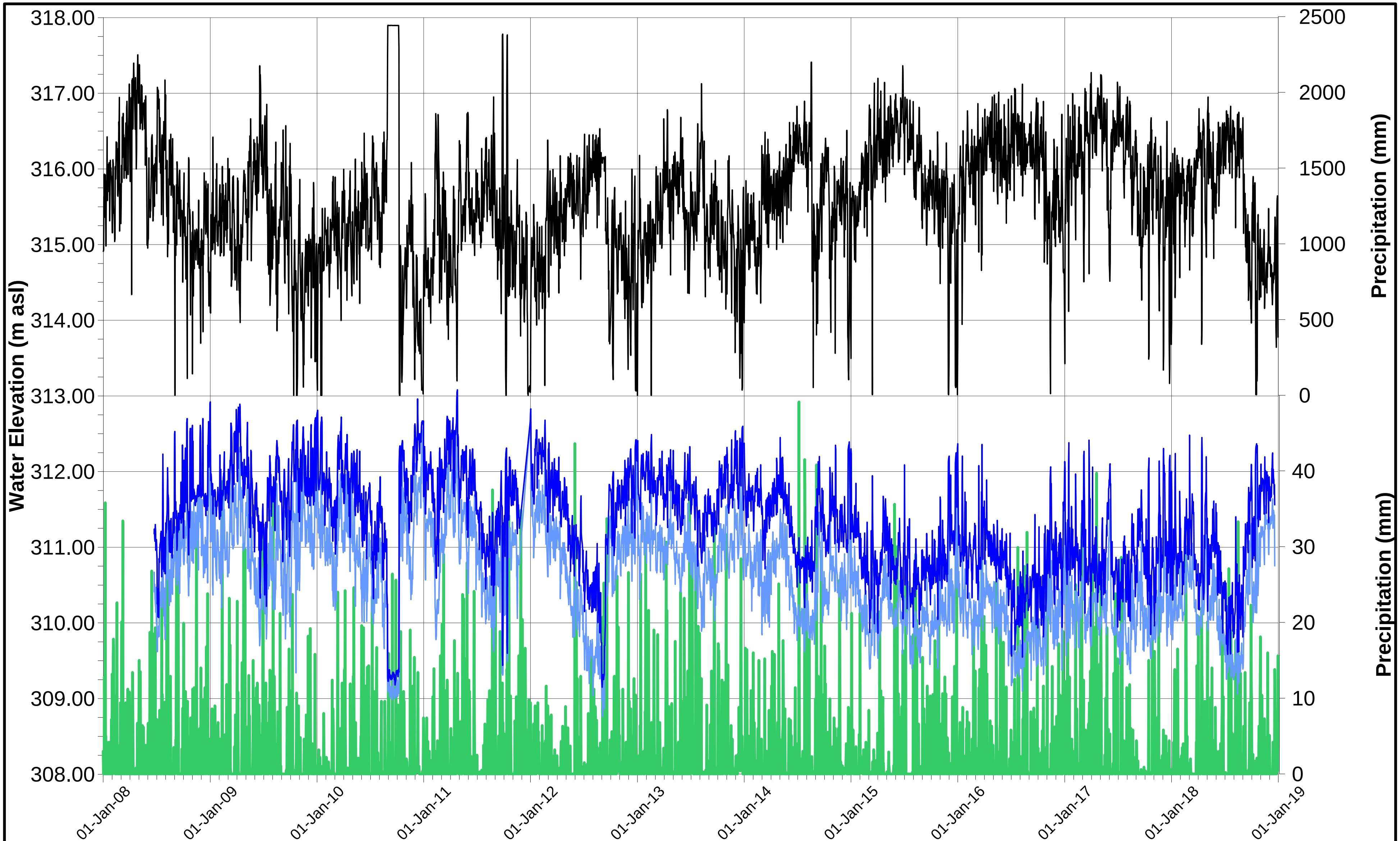
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D20



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

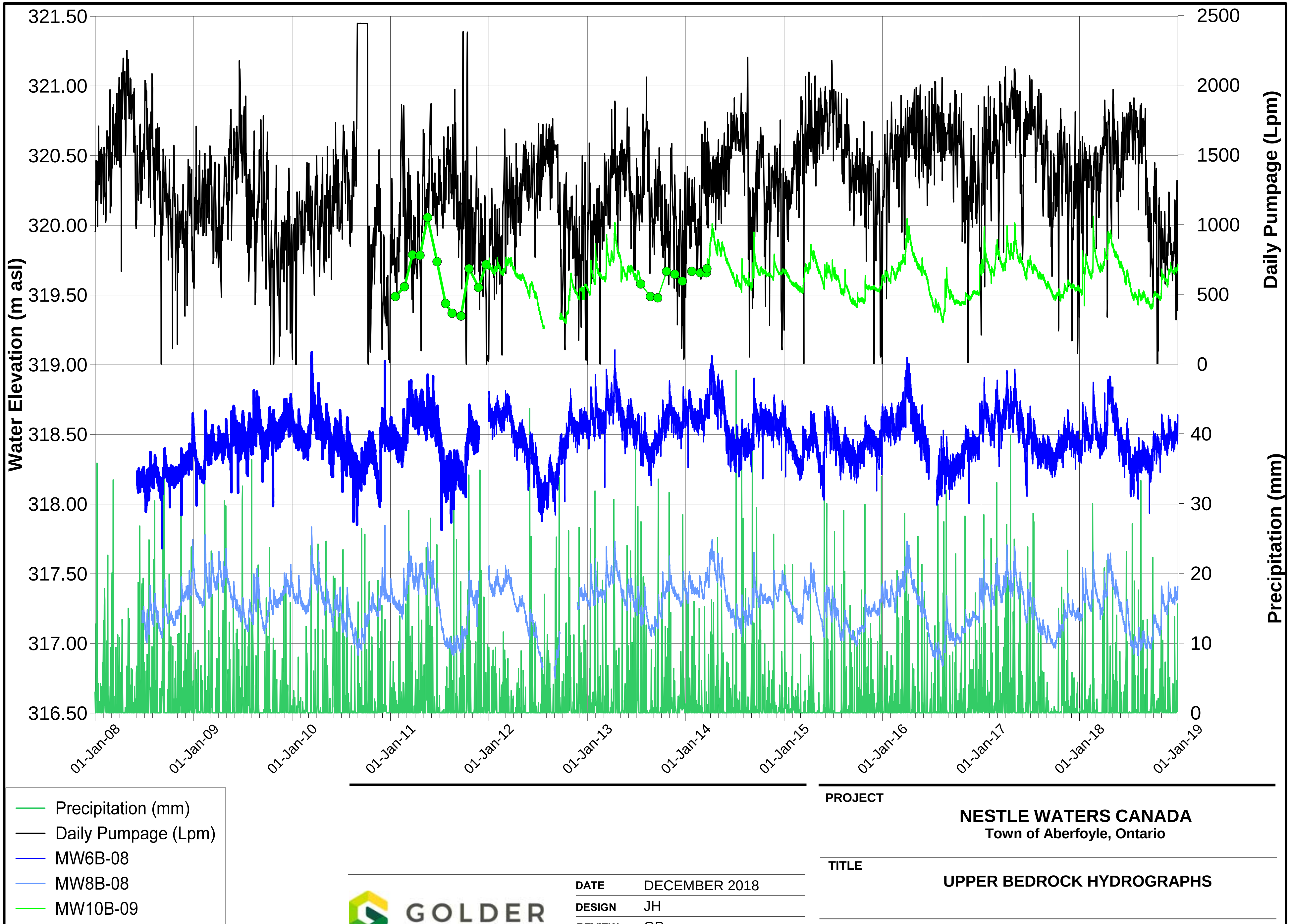
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D21



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

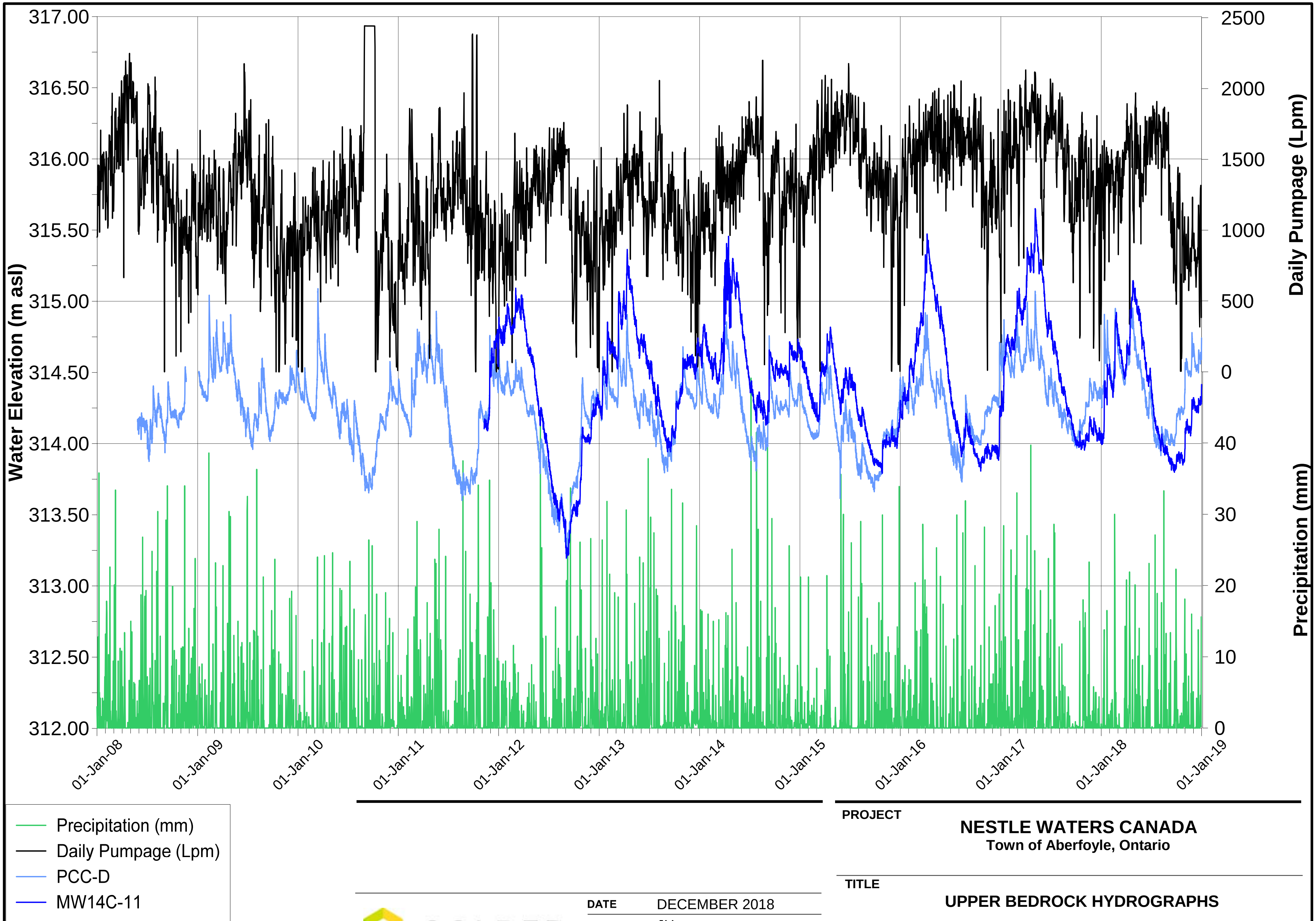
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D22



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

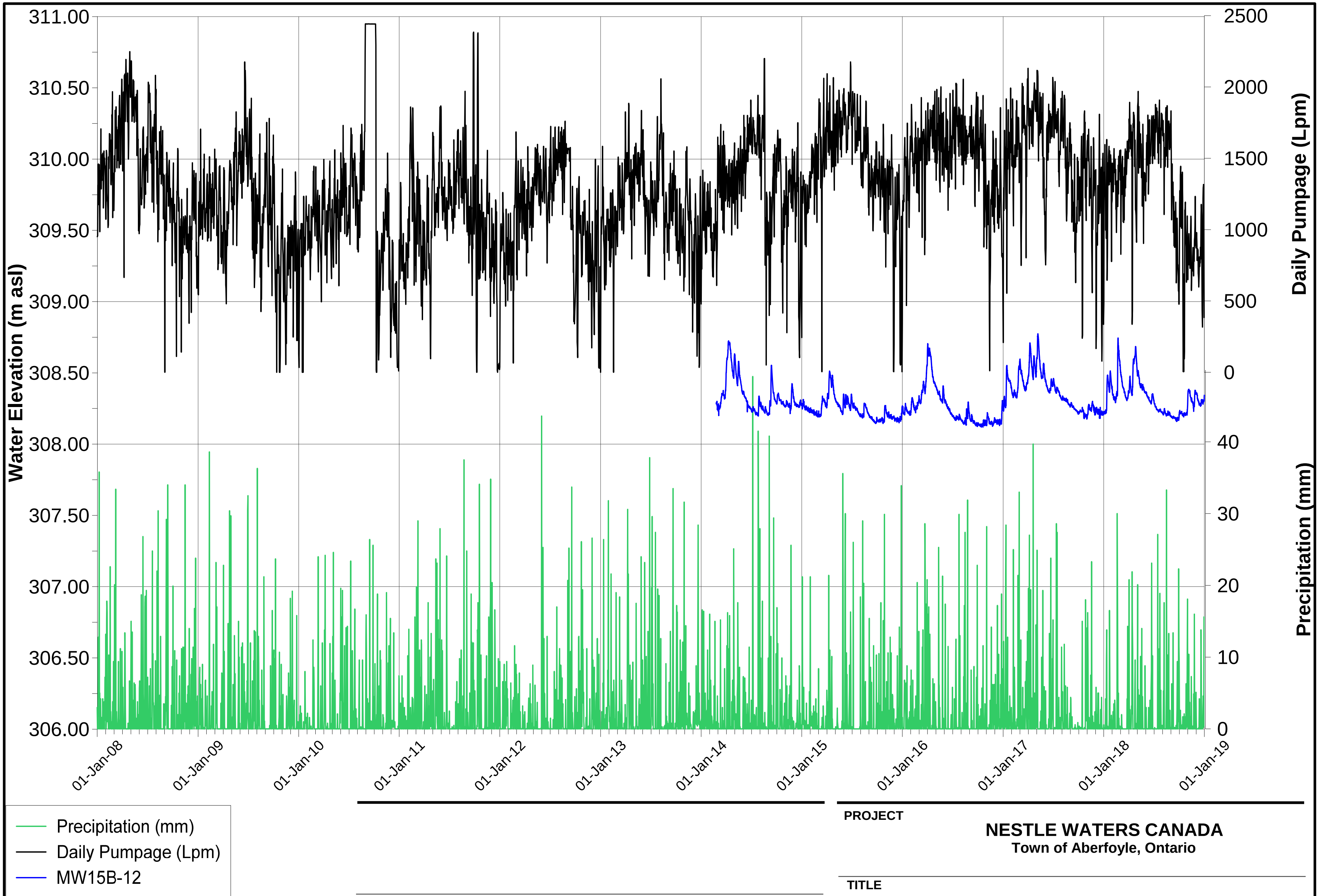
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D23



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

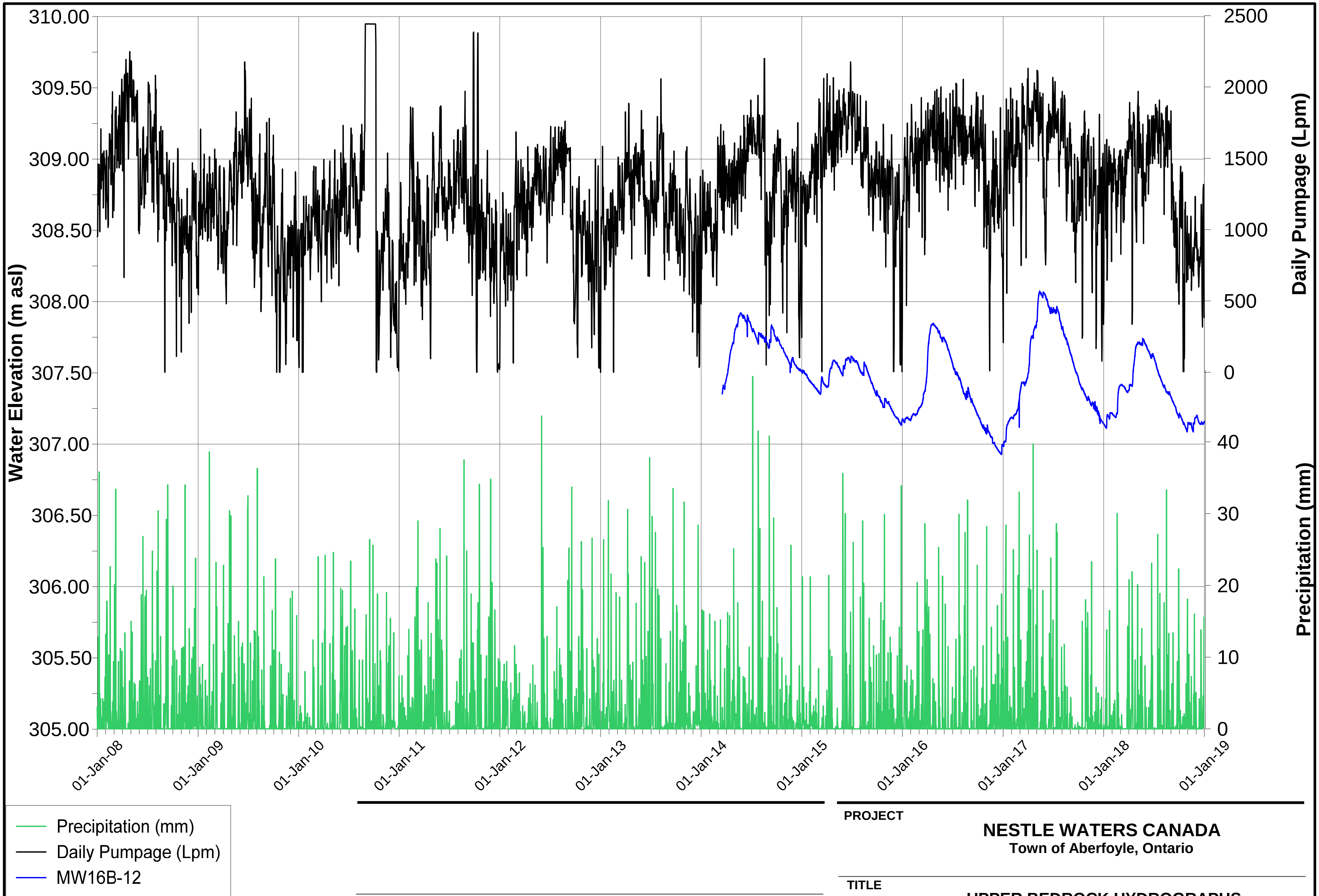
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D24



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

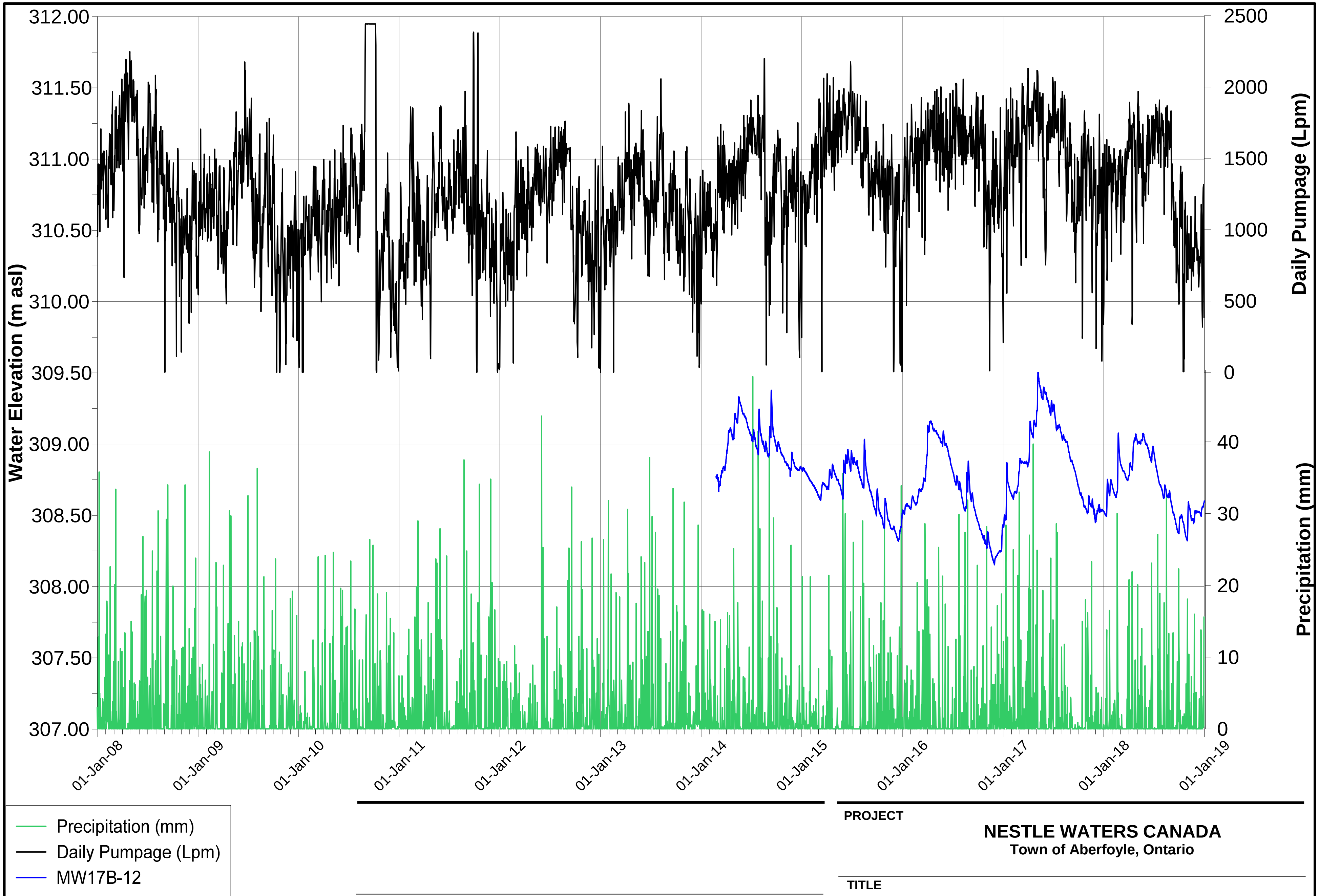
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D25



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

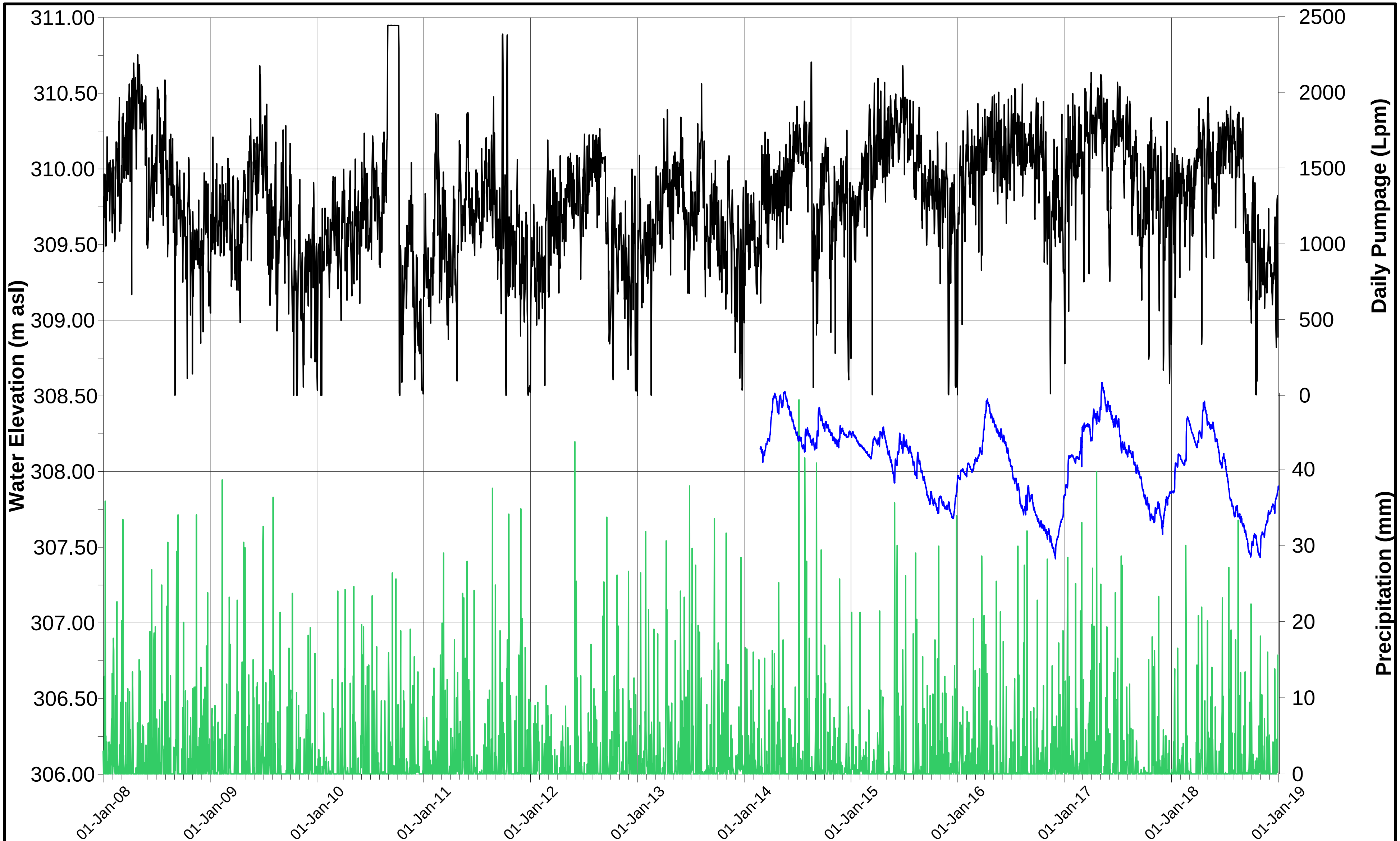
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D26



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

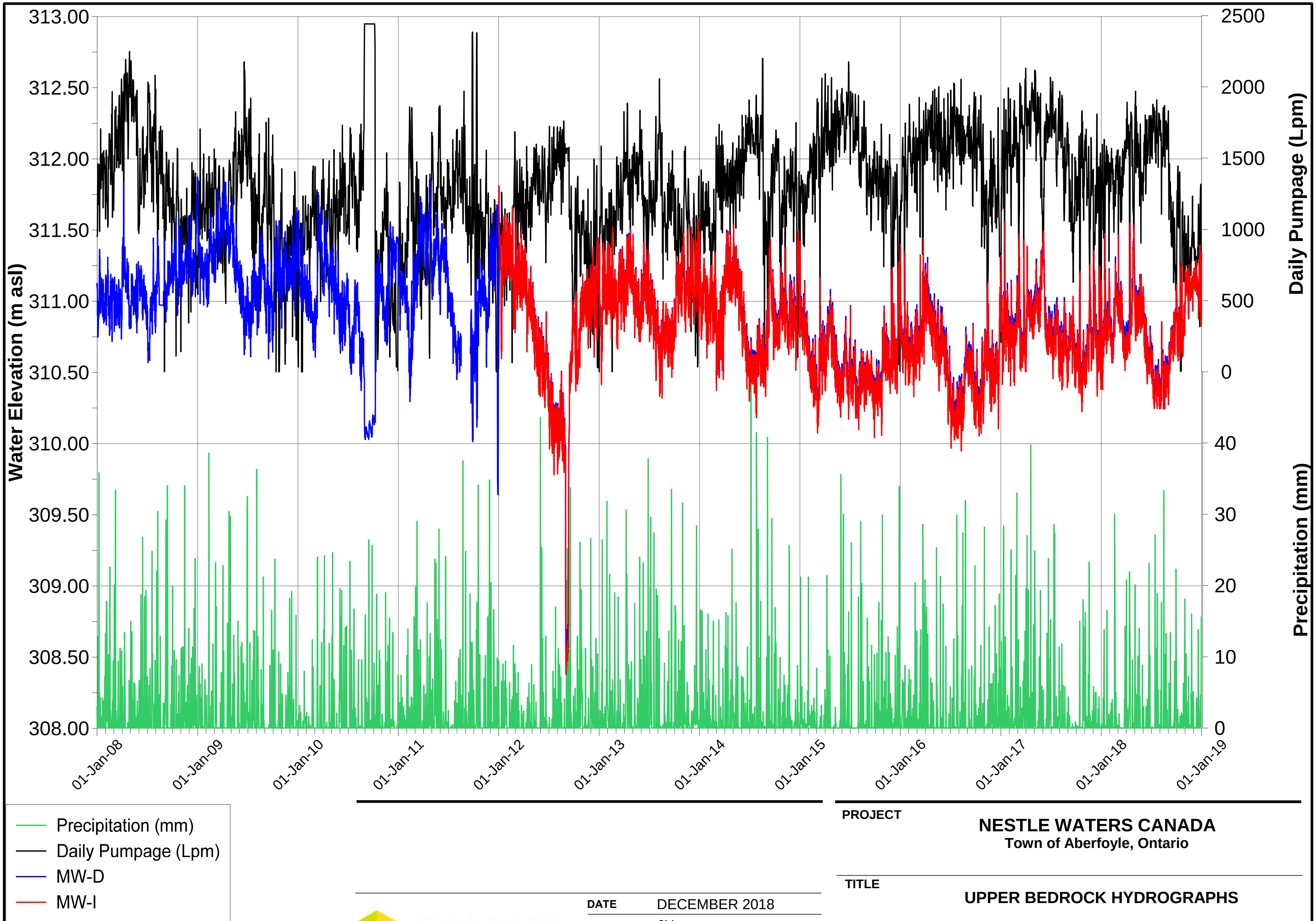
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D27



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

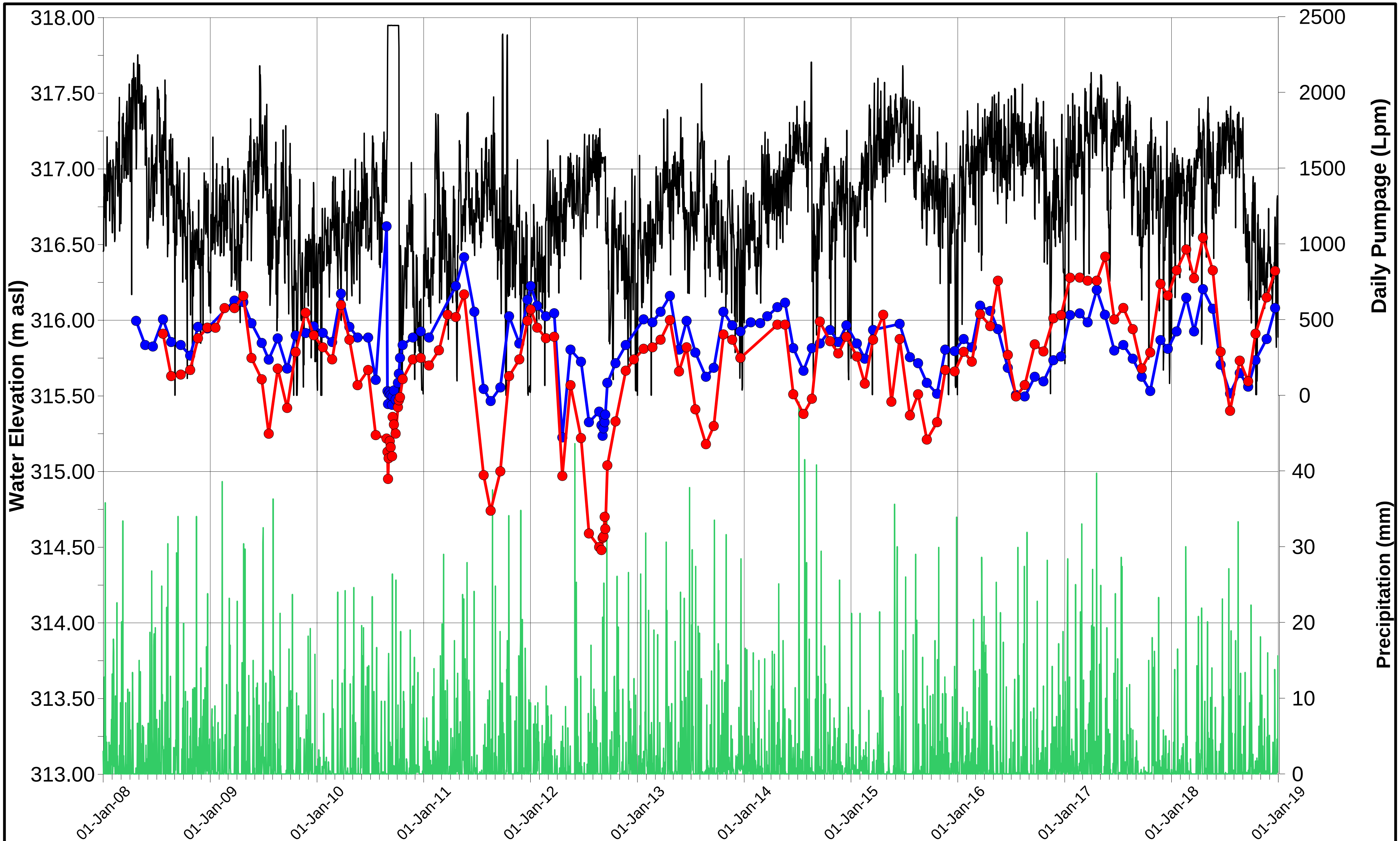
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D28



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

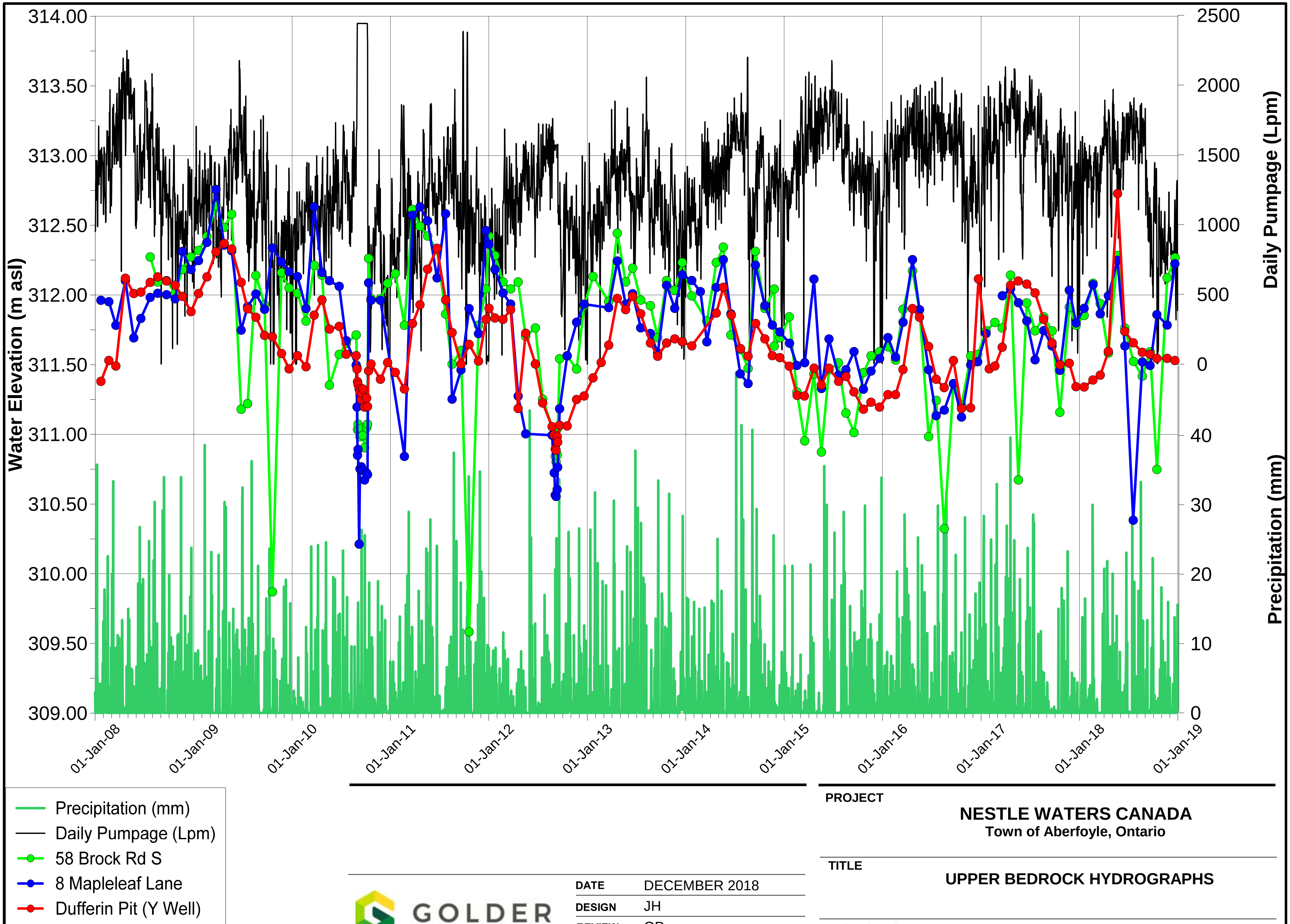
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D29



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

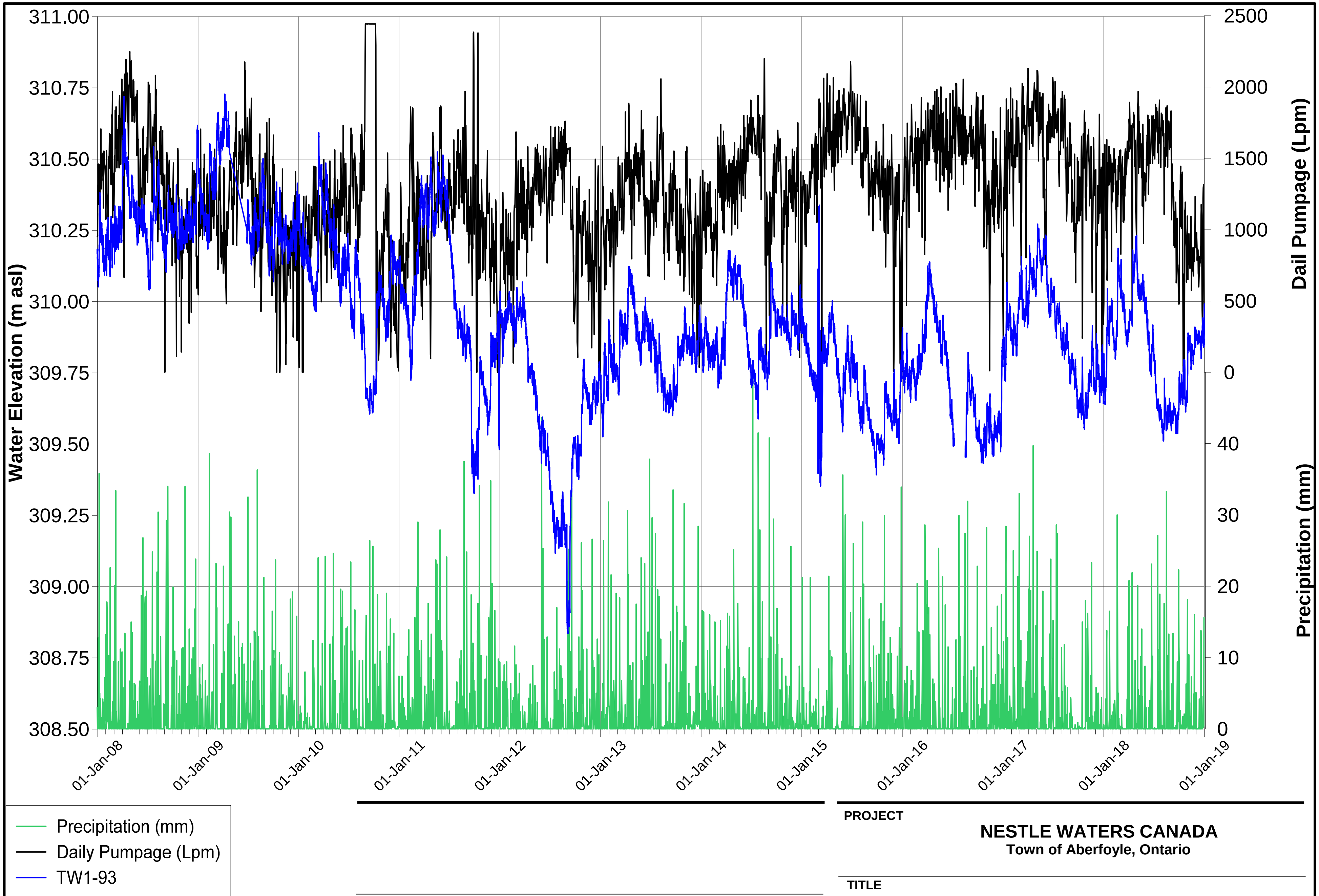
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D30



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

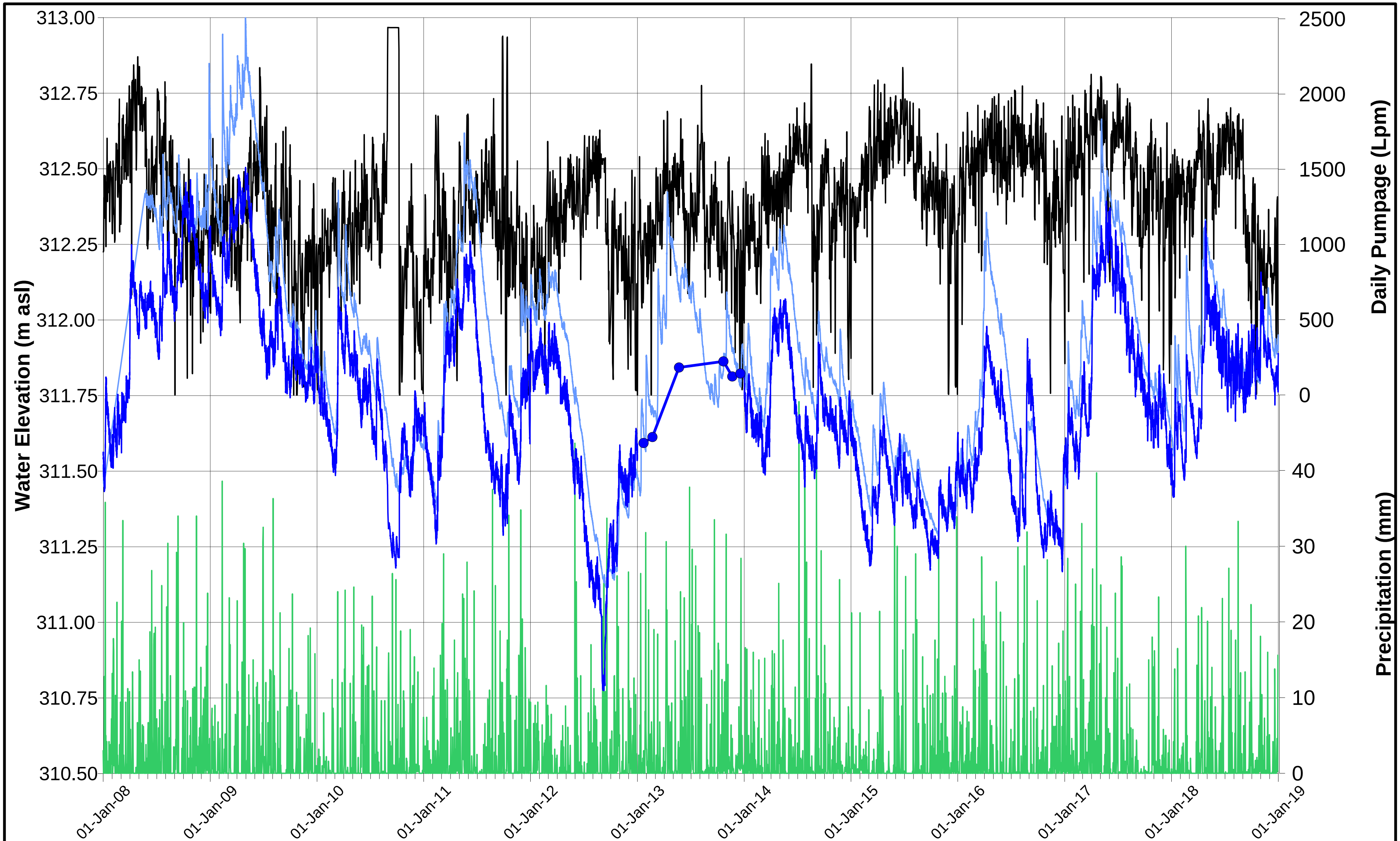
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D31



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

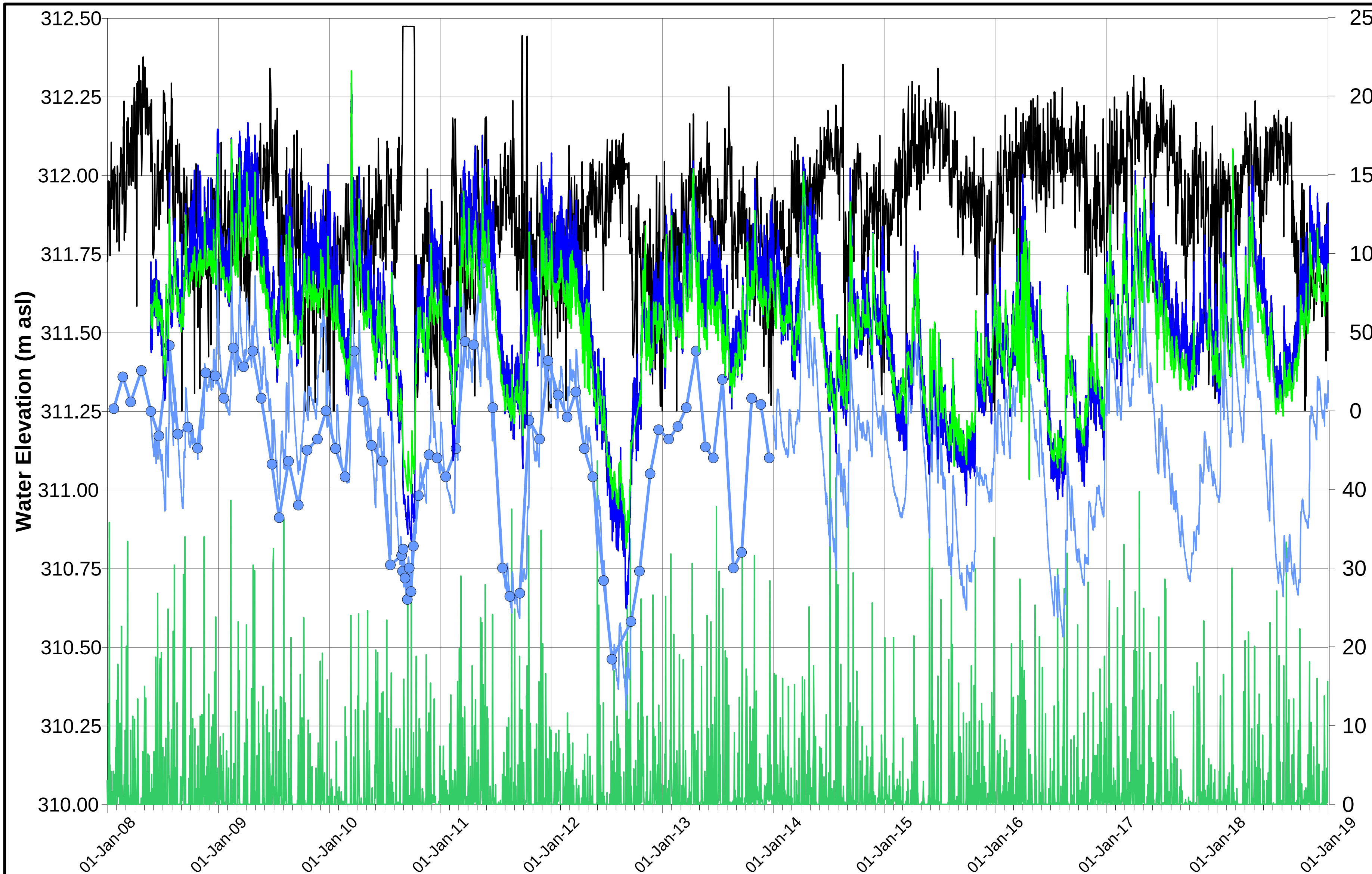
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D32



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

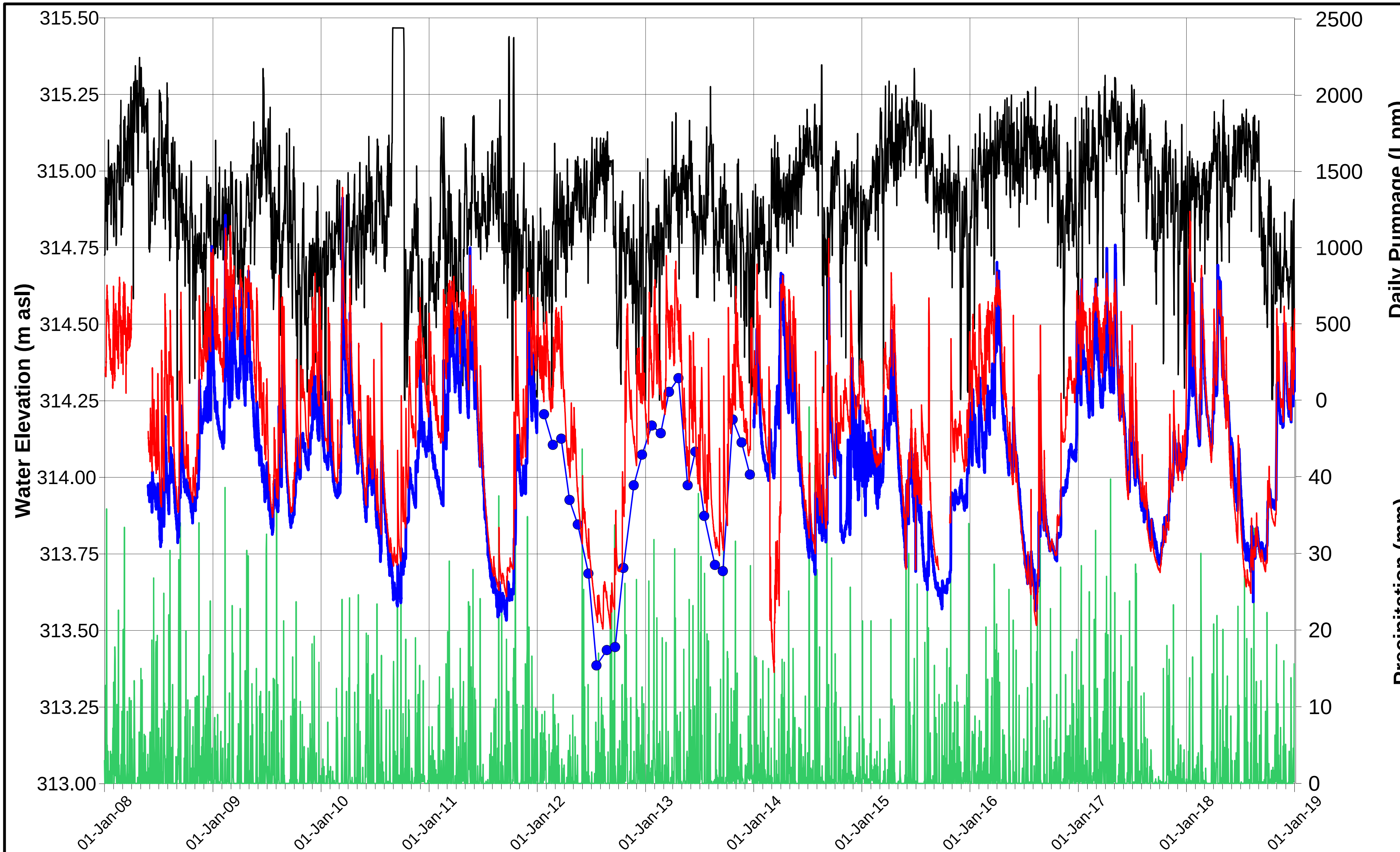
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D33



DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

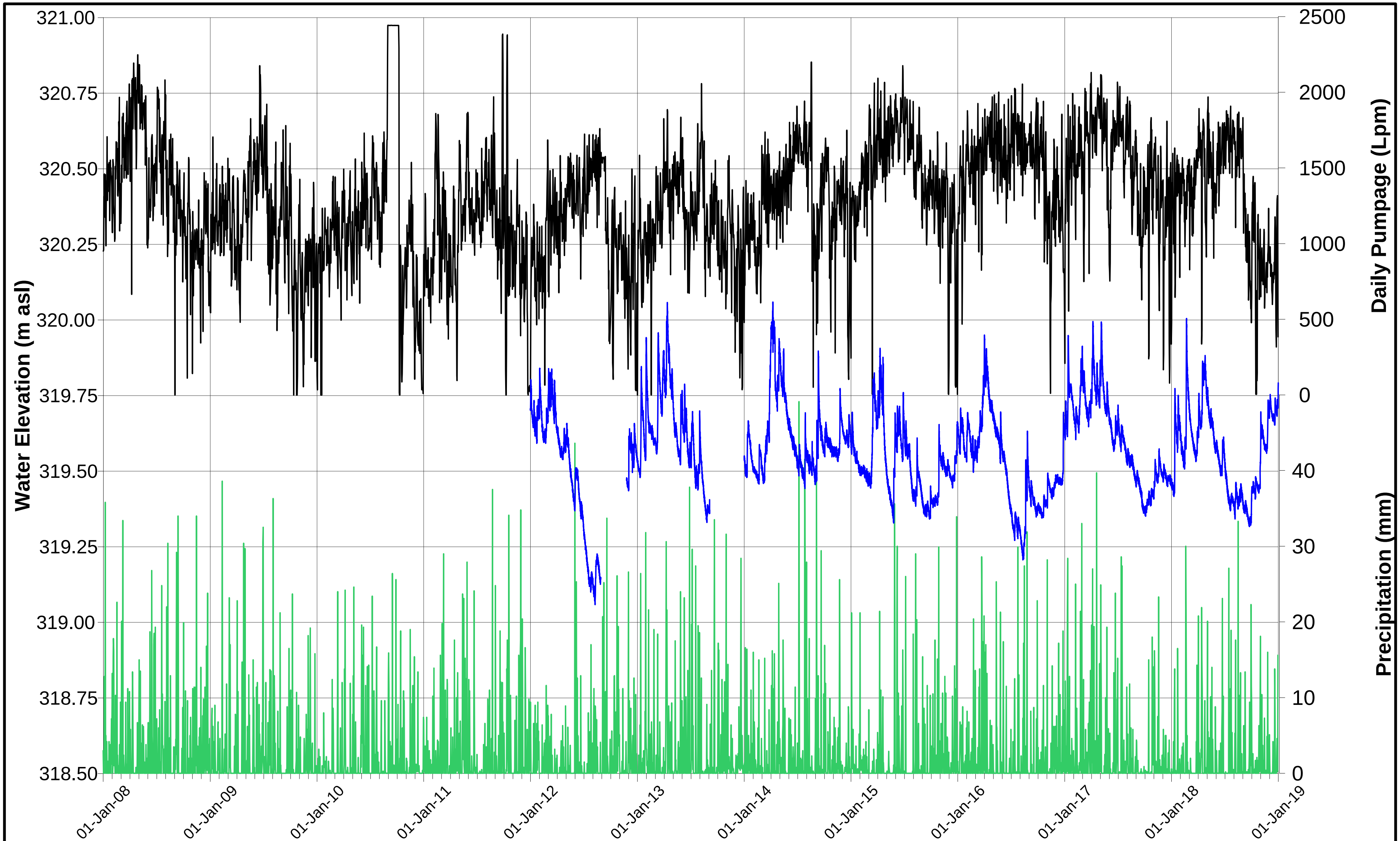
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D34



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

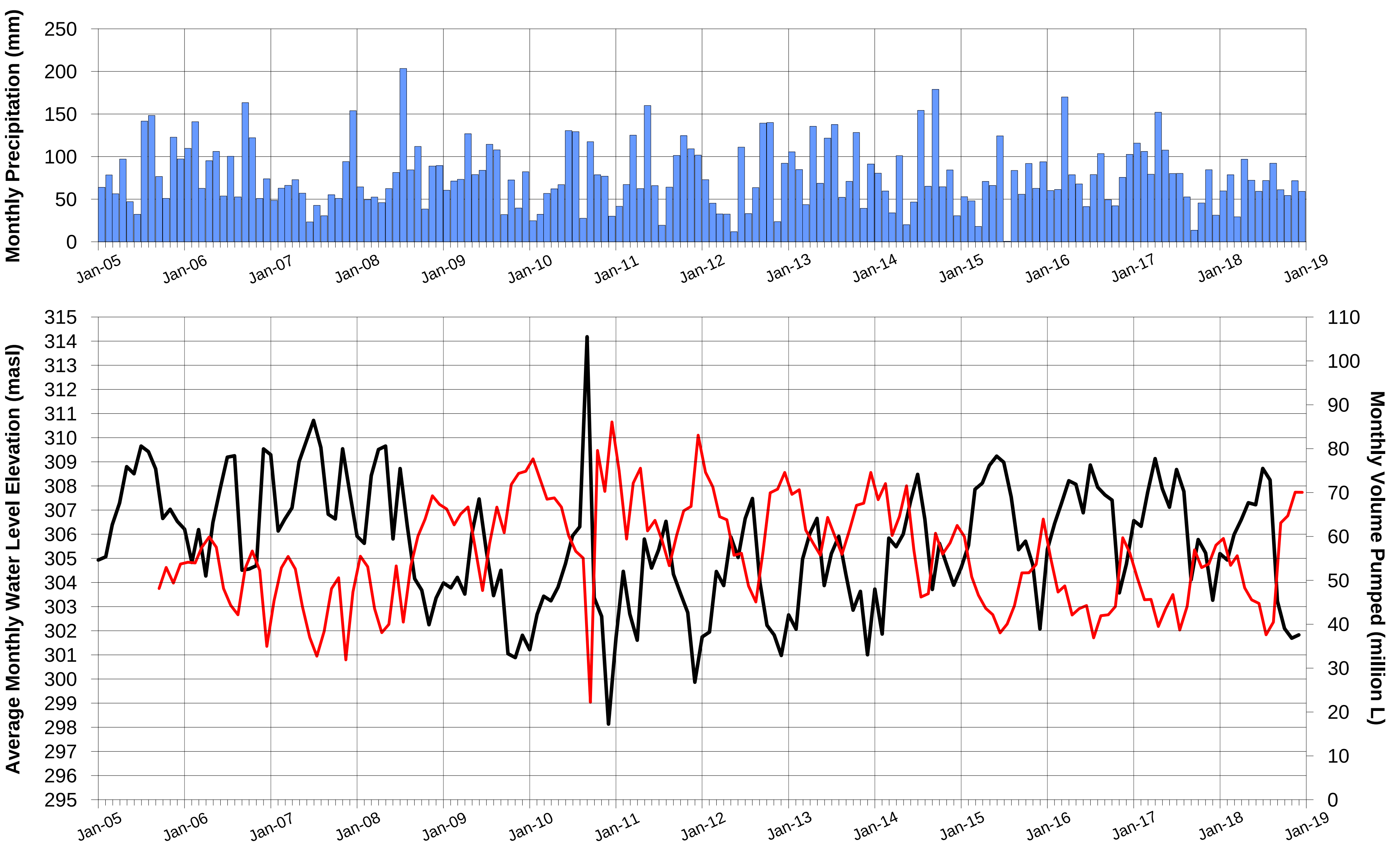
PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
OVERBURDEN HYDROGRAPHS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	D35

APPENDIX E

Groundwater Hydrographs (Average)



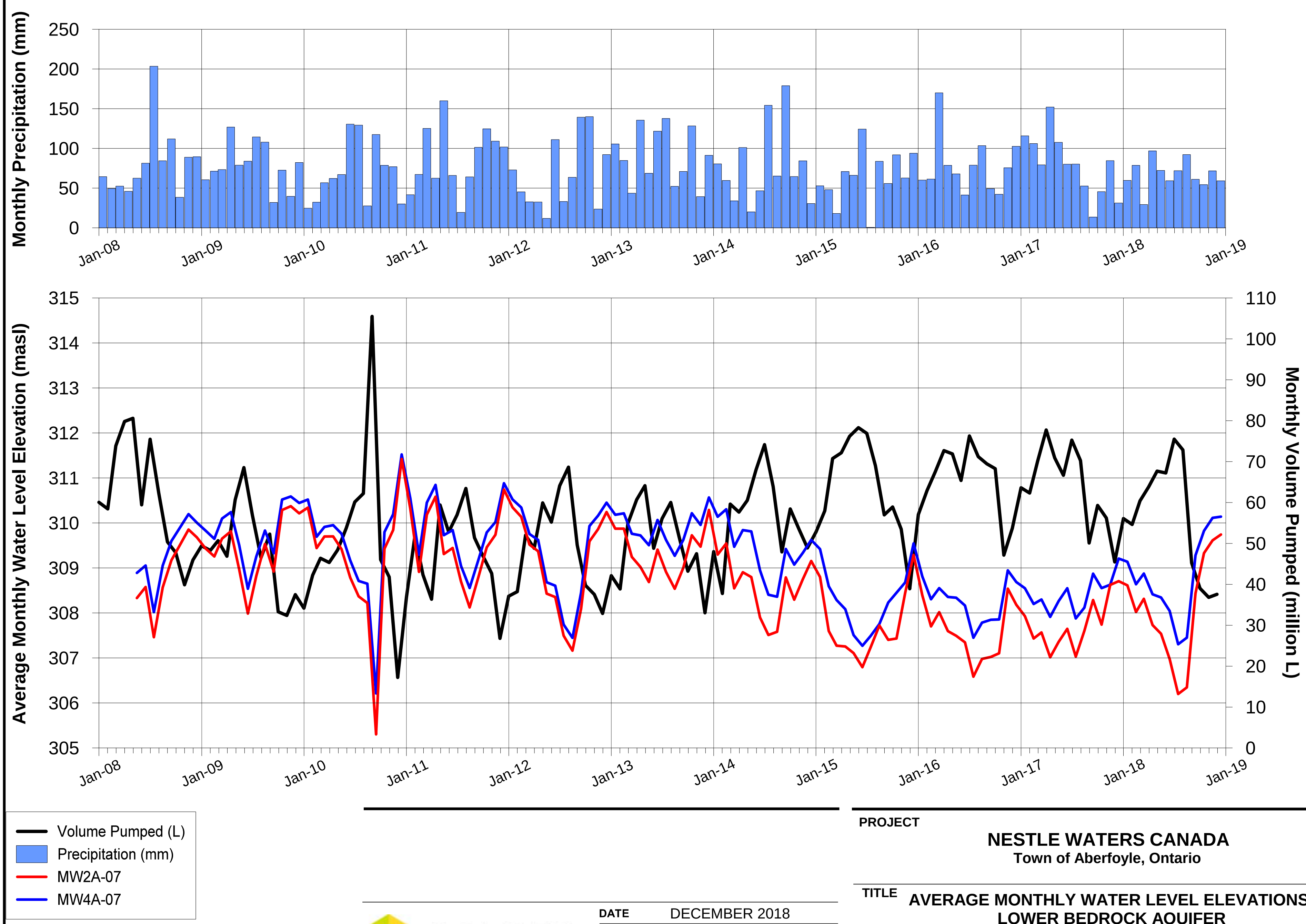
Volume Pumped (L)
Precipitation (mm)
TW3-80

DATE DECEMBER 2018
DESIGN KS
REVIEW GP
APPROVED GP

PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
AVERAGE MONTHLY WATER LEVEL ELEVATIONS
TW3-80

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E1



GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

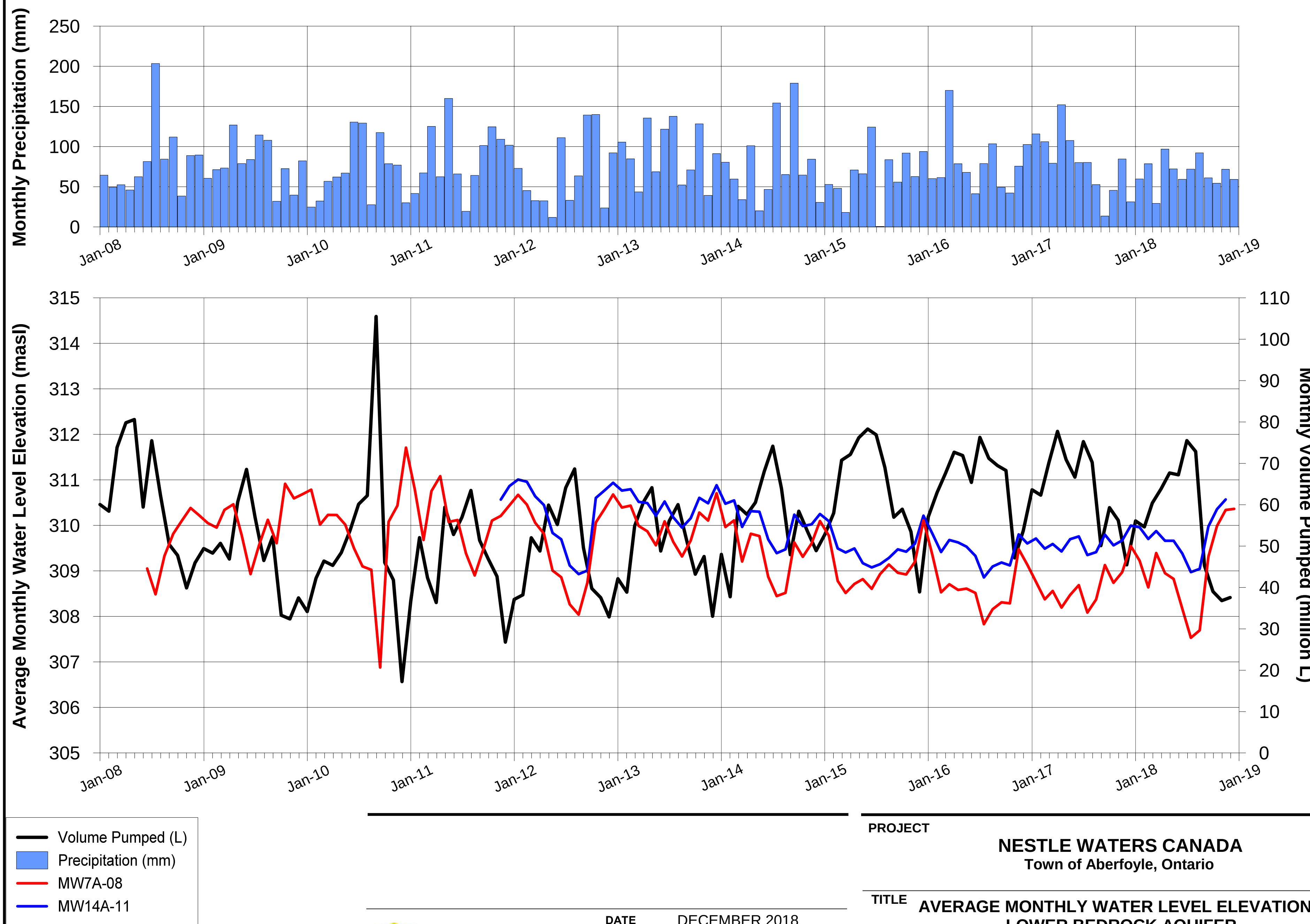
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

AVERAGE MONTHLY WATER LEVEL ELEVATIONS
LOWER BEDROCK AQUIFER
ON-SITE WELLS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E2



GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

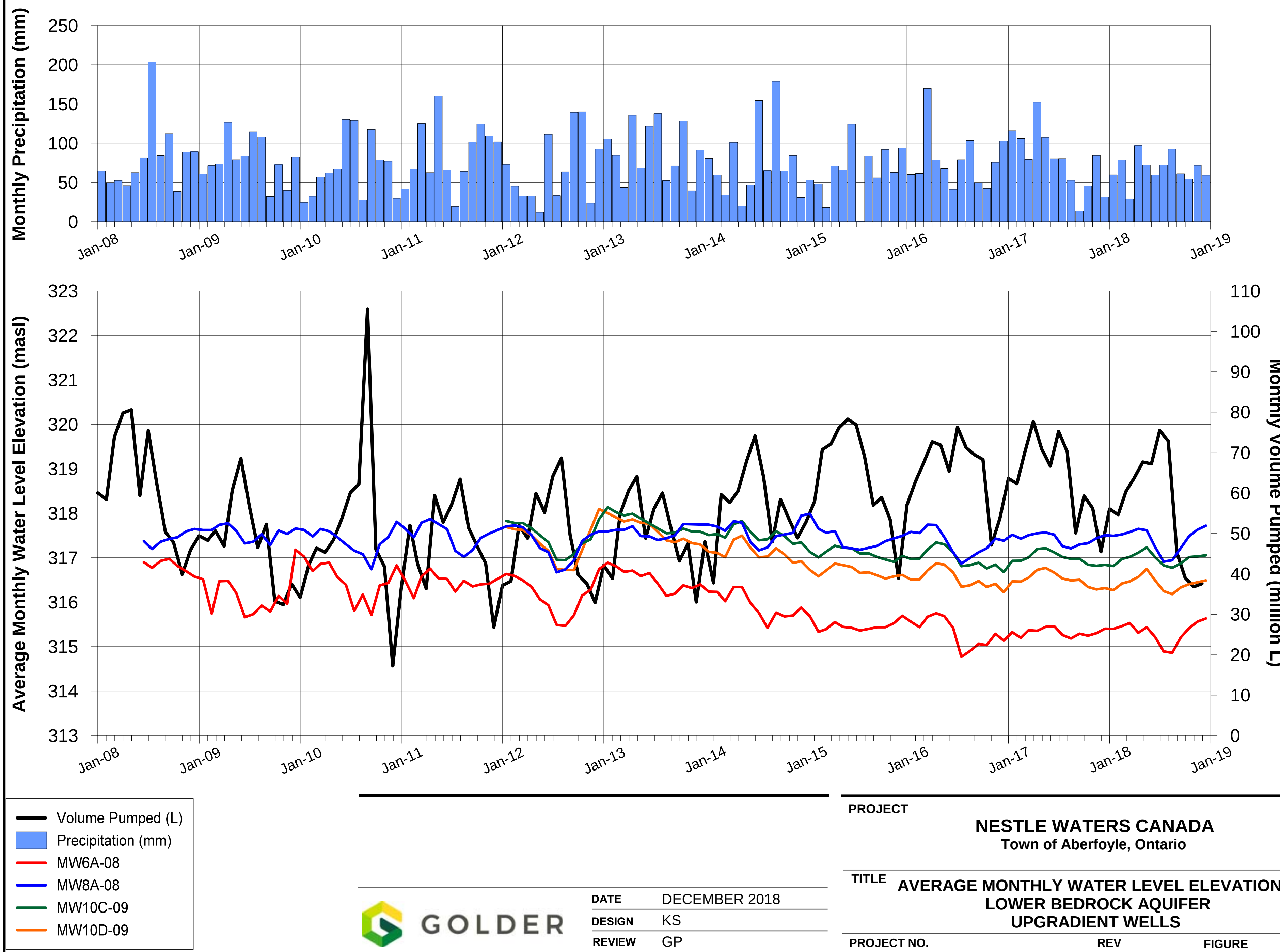
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

AVERAGE MONTHLY WATER LEVEL ELEVATIONS
LOWER BEDROCK AQUIFER
UPGRADIENT WELLS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E3



GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

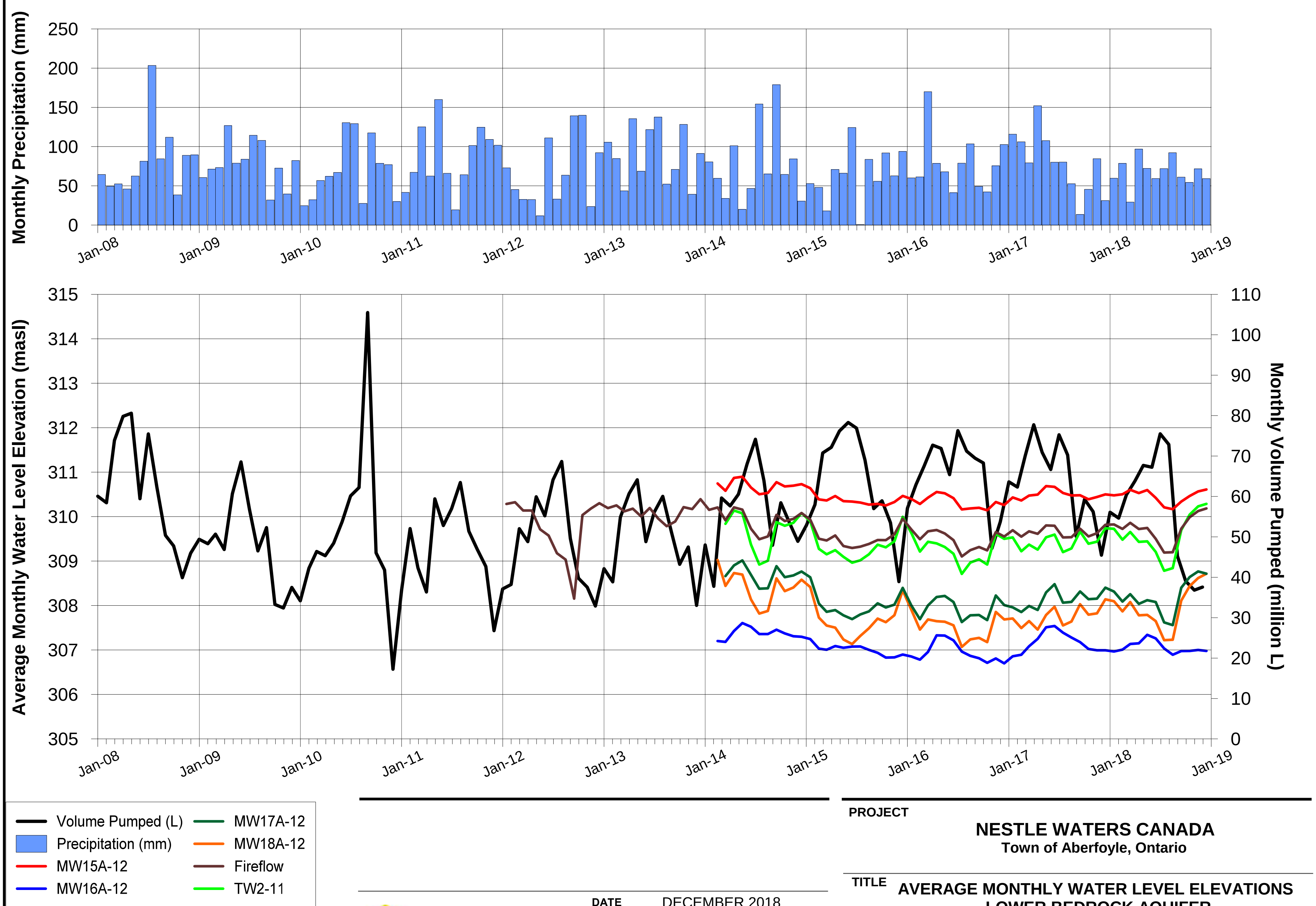
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

AVERAGE MONTHLY WATER LEVEL ELEVATIONS
LOWER BEDROCK AQUIFER
UPGRADIENT WELLS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E4



GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

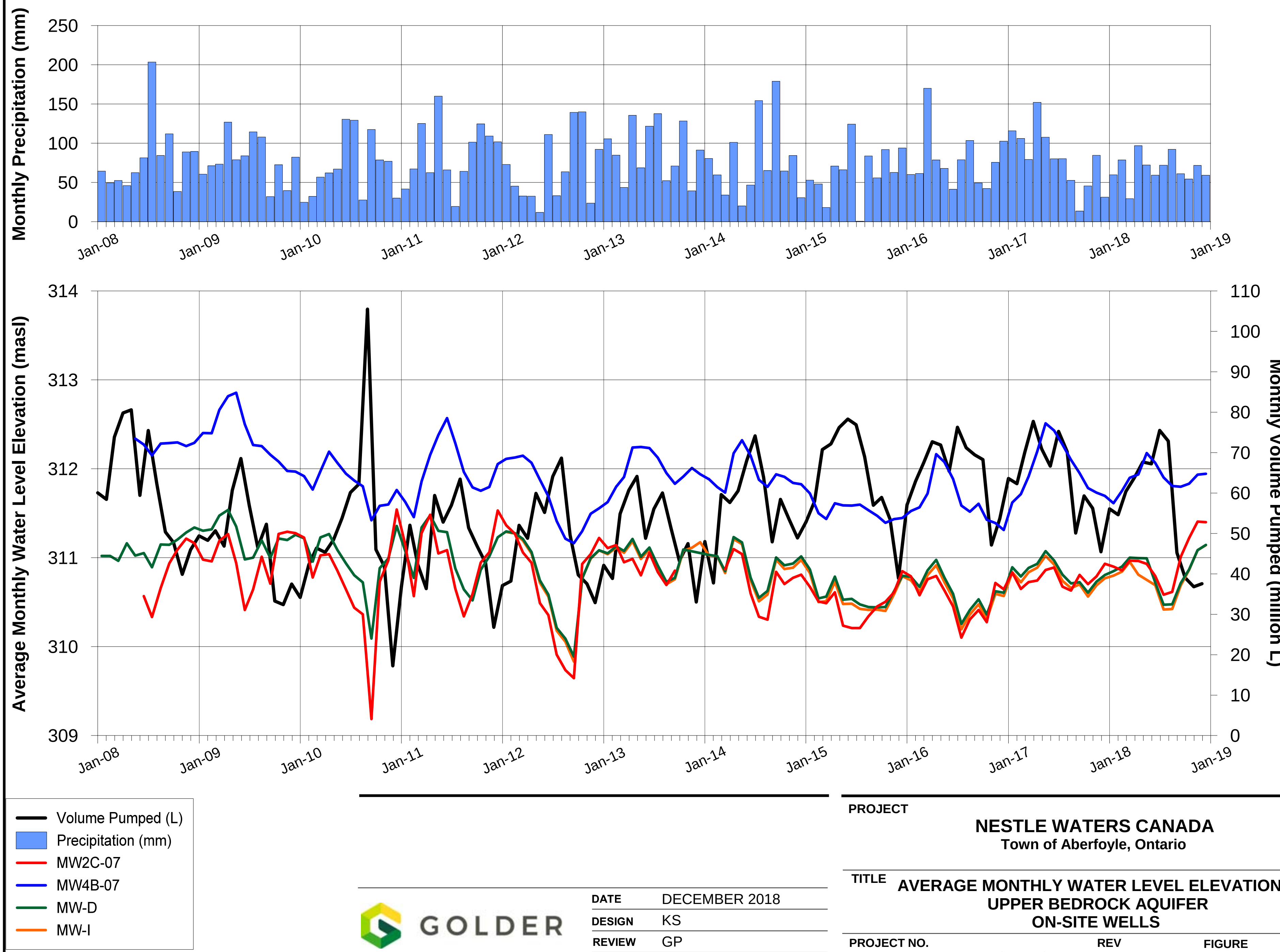
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

AVERAGE MONTHLY WATER LEVEL ELEVATIONS
LOWER BEDROCK AQUIFER
DOWNGRADIENT WELLS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E5



GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

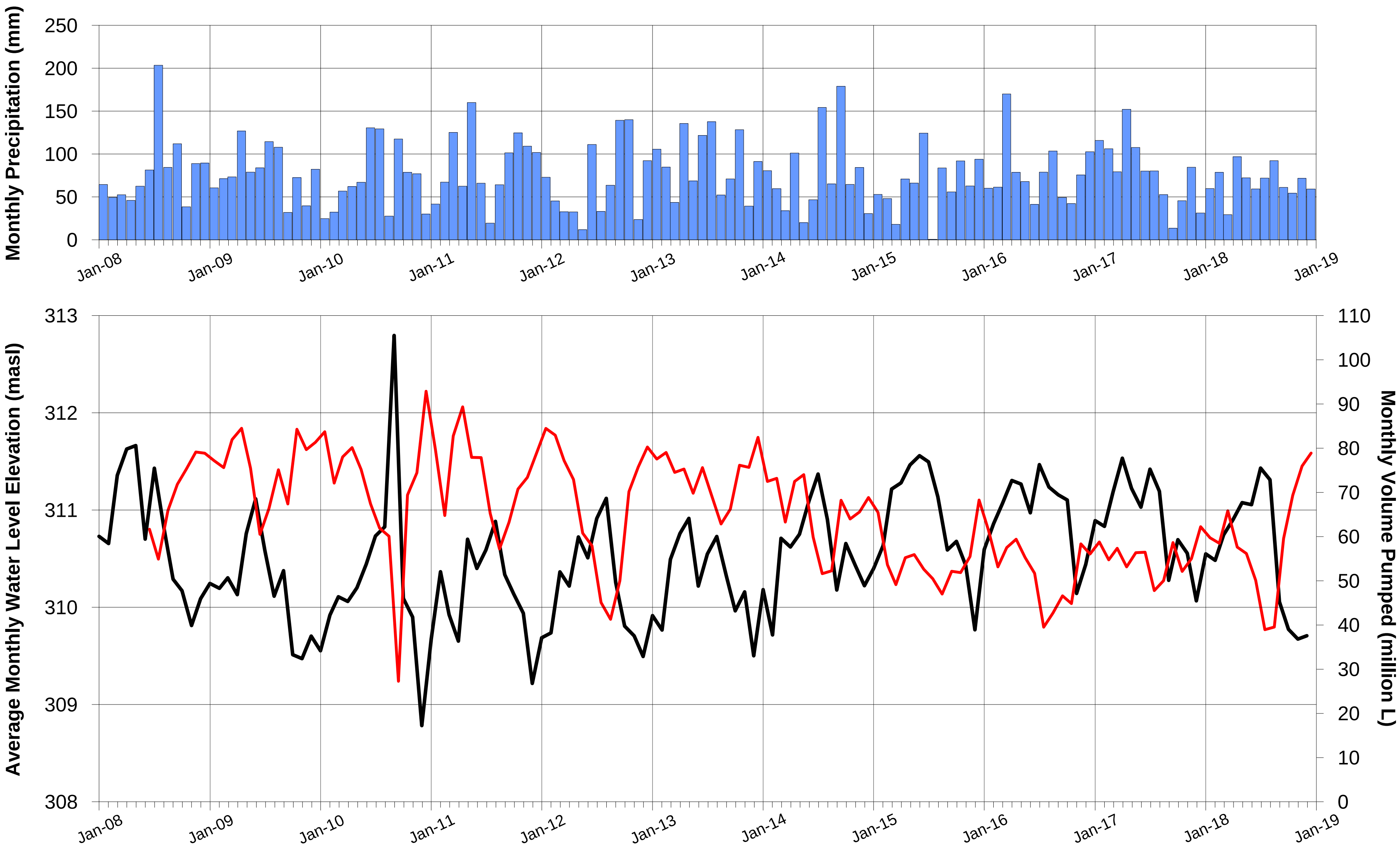
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

AVERAGE MONTHLY WATER LEVEL ELEVATIONS
UPPER BEDROCK AQUIFER
ON-SITE WELLS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E6



Volume Pumped (L)
Precipitation (mm)
MW7B-08

GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

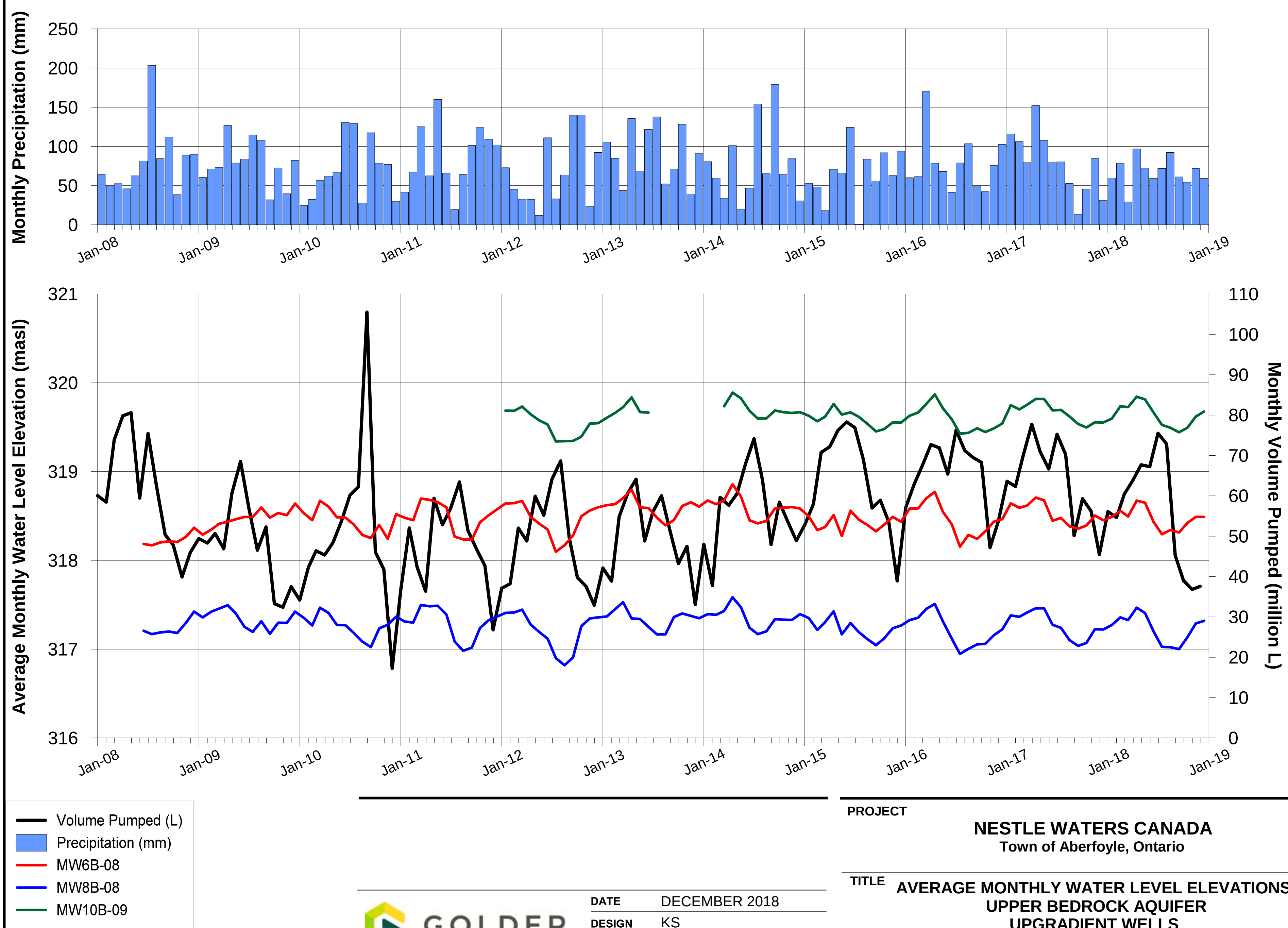
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

AVERAGE MONTHLY WATER LEVEL ELEVATIONS
UPPER BEDROCK AQUIFER
UPGRADIENT WELLS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E7



GOLDER

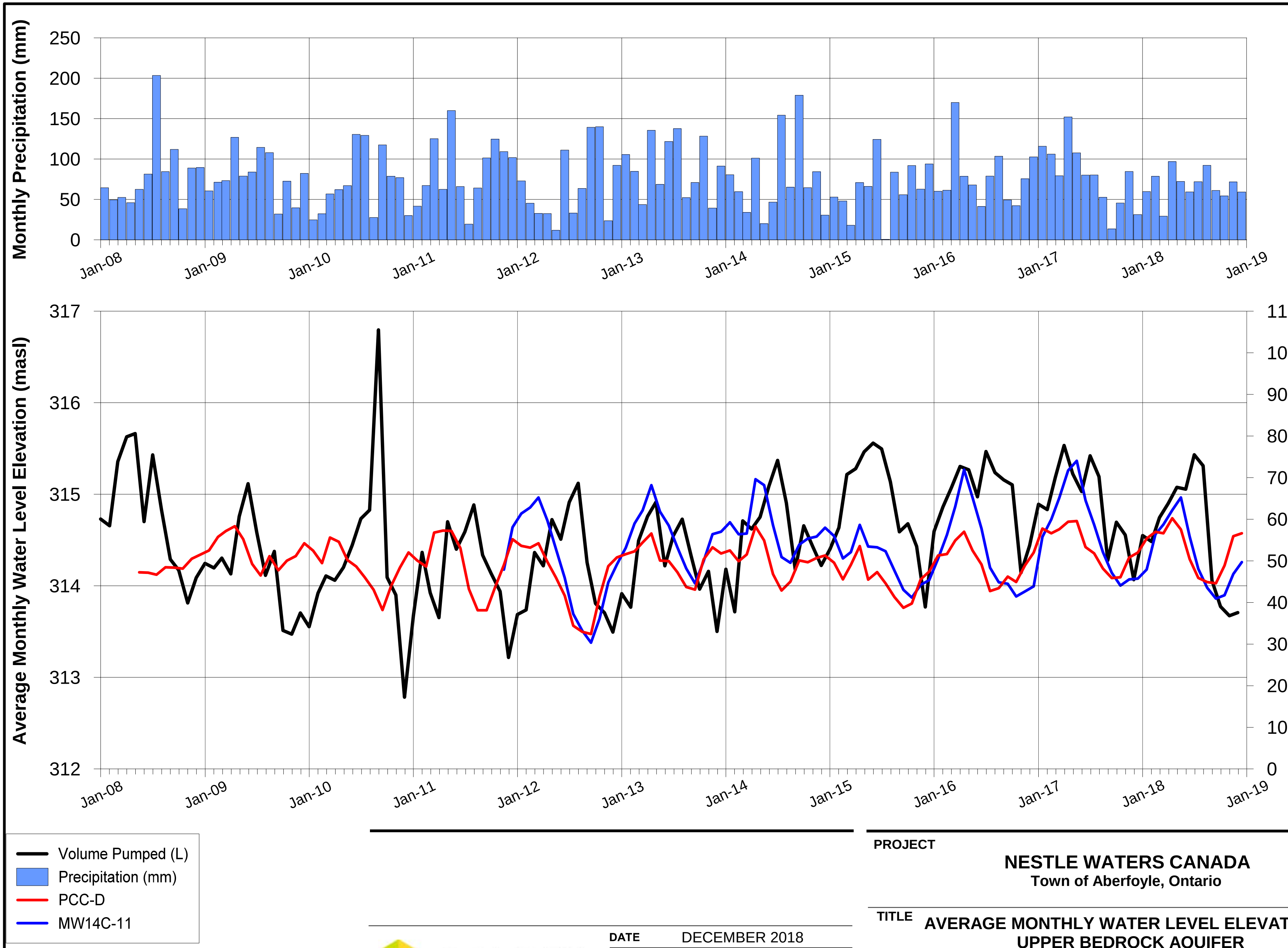
DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE **AVERAGE MONTHLY WATER LEVEL ELEVATIONS**
UPPER BEDROCK AQUIFER
UPGRADIENT WELLS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E8



GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

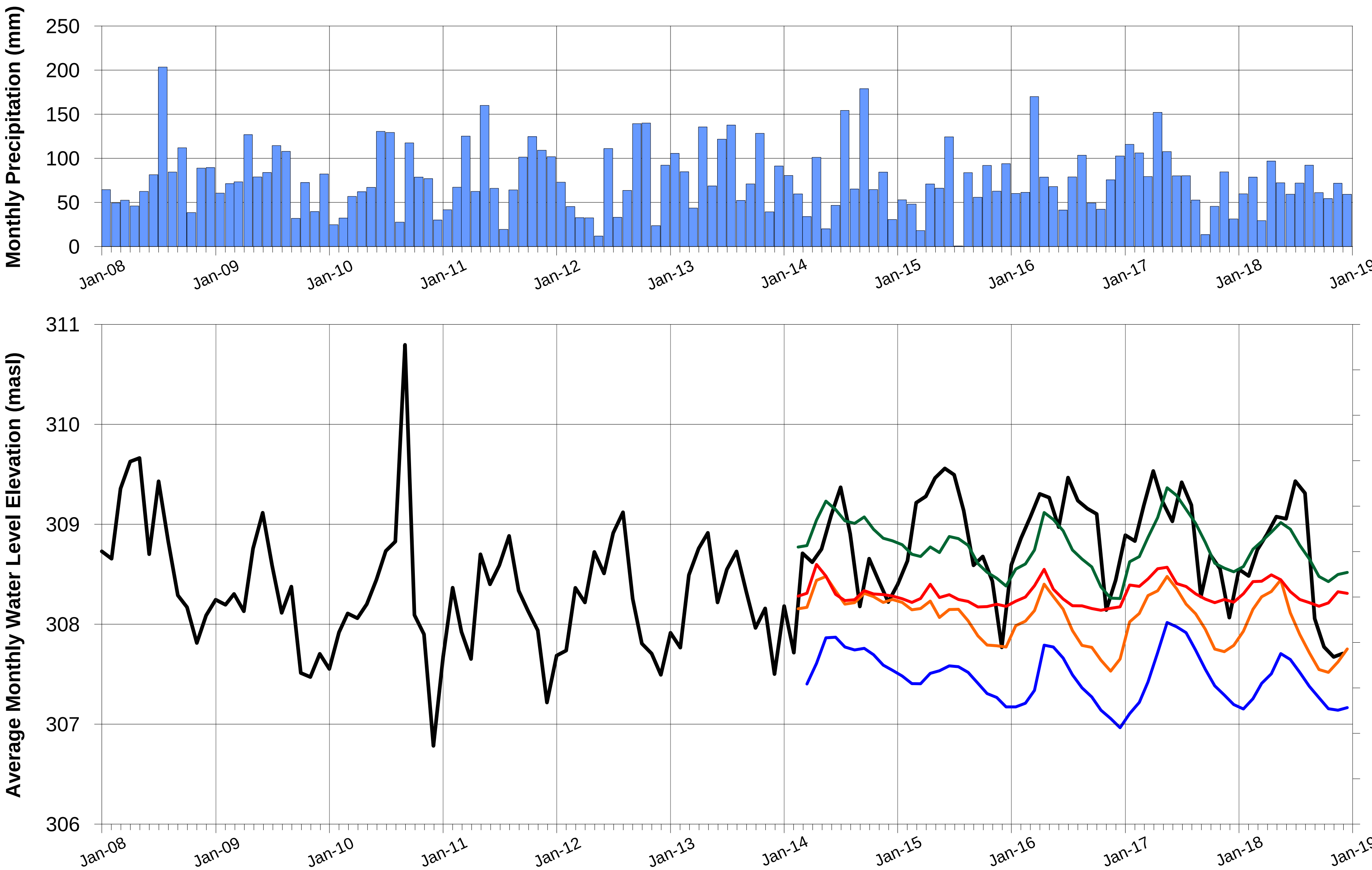
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

AVERAGE MONTHLY WATER LEVEL ELEVATIONS
UPPER BEDROCK AQUIFER
UPGRADIENT WELLS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E9



Volume Pumped (L)
Precipitation (mm)
MW15B-12
MW16B-12
MW17B-12
MW18B-12

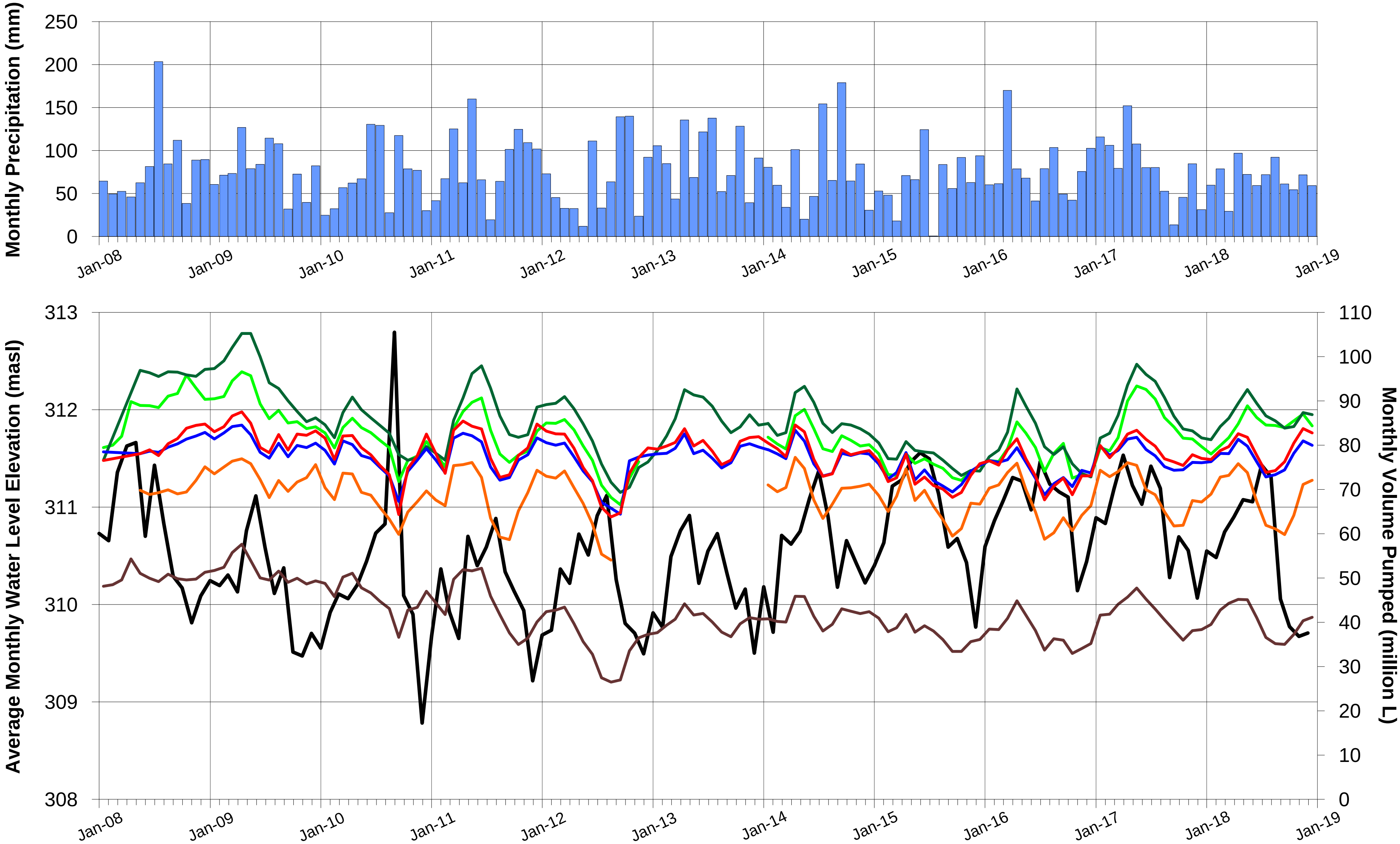
GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
AVERAGE MONTHLY WATER LEVEL ELEVATIONS
UPPER BEDROCK AQUIFER
DOWNGRADIENT WELLS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E10



GOLDER

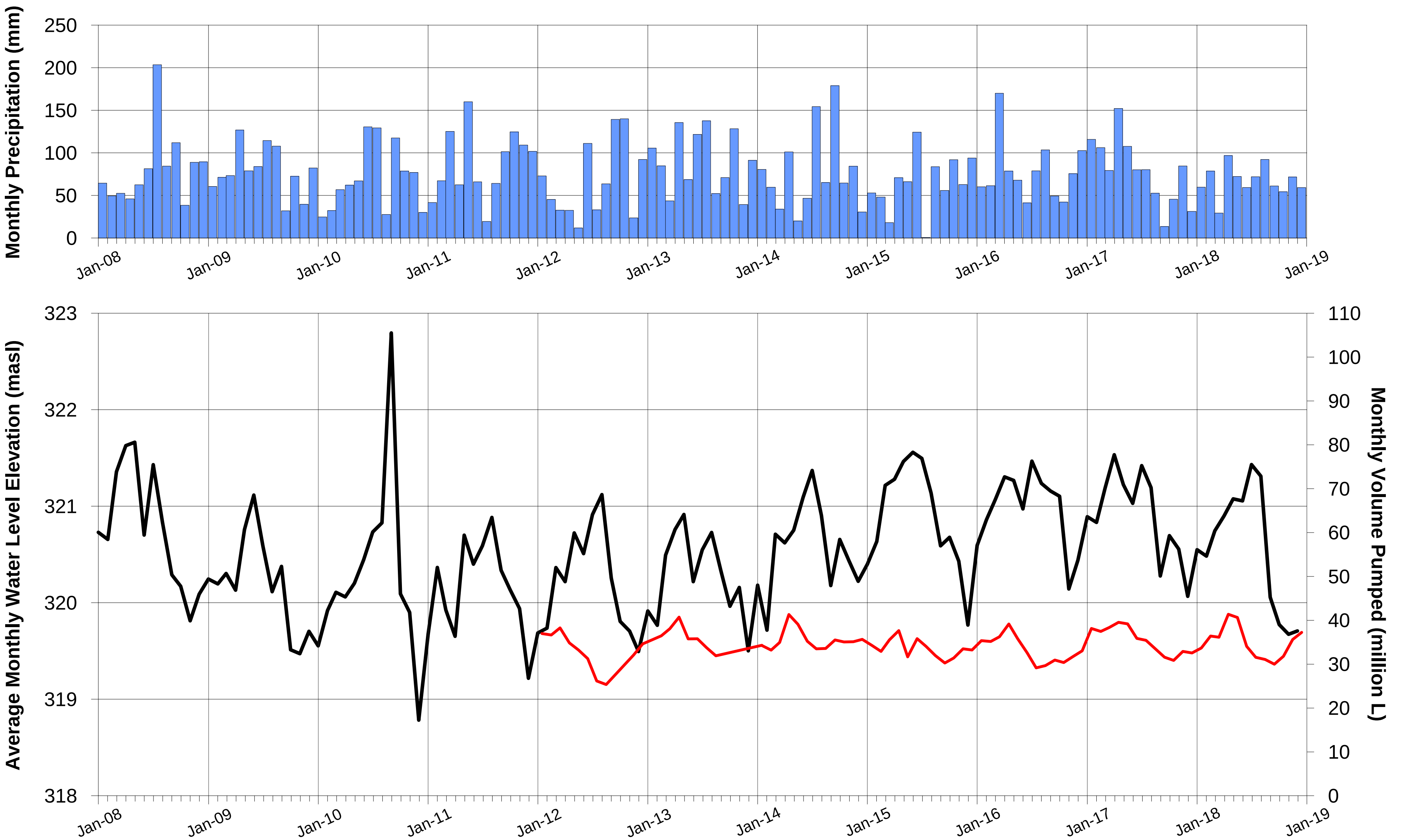
DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE **AVERAGE MONTHLY WATER LEVEL ELEVATIONS OVERBURDEN ON-SITE WELLS**

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E11



PROJECT

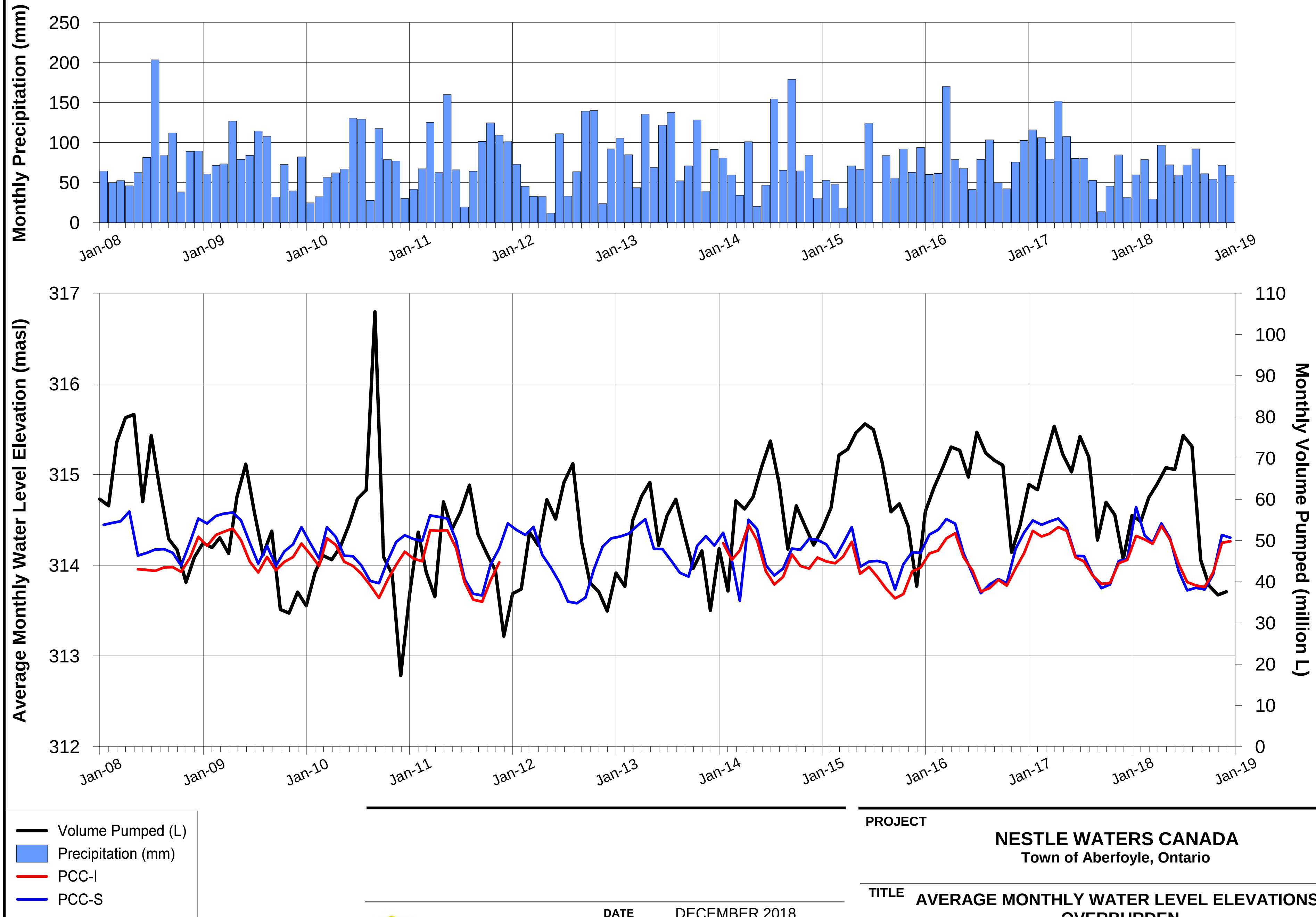
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE **AVERAGE MONTHLY WATER LEVEL ELEVATIONS OVERBURDEN UPGRADIENT WELLS**

GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E12



DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

GOLDER

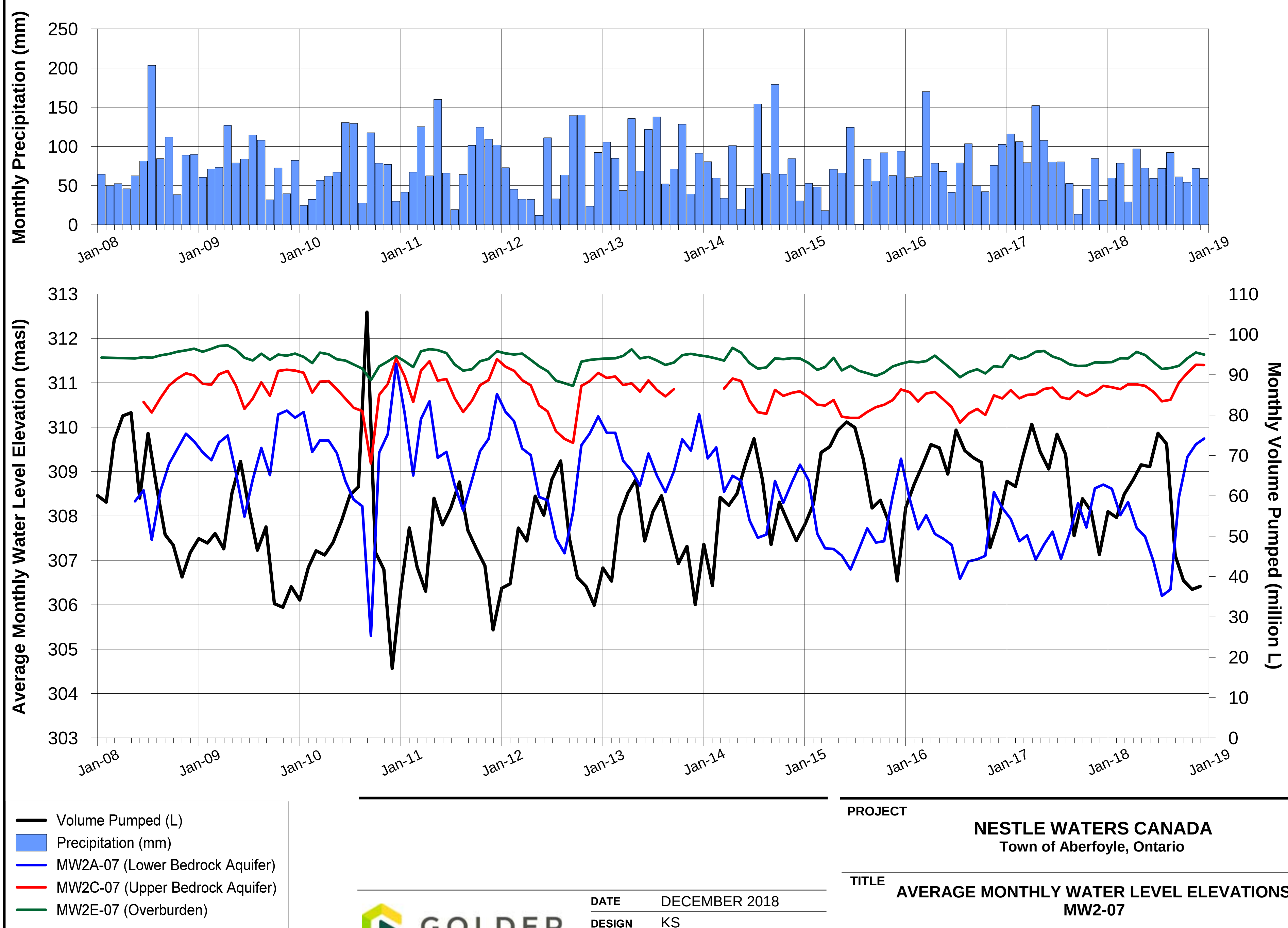
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

AVERAGE MONTHLY WATER LEVEL ELEVATIONS
OVERBURDEN
UPGRADIENT WELLS

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E13



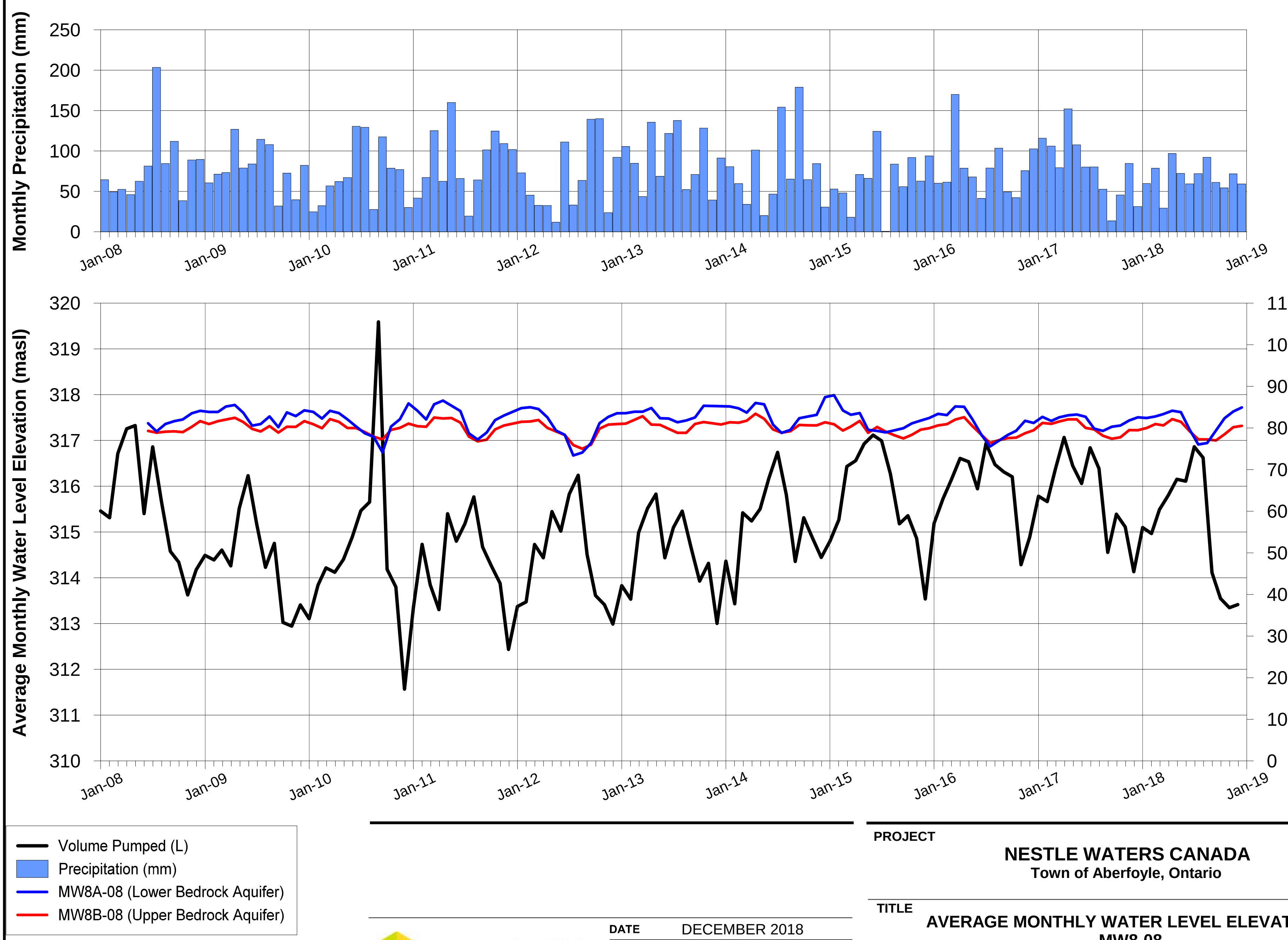
GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
AVERAGE MONTHLY WATER LEVEL ELEVATIONS
MW2-07

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E14



GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

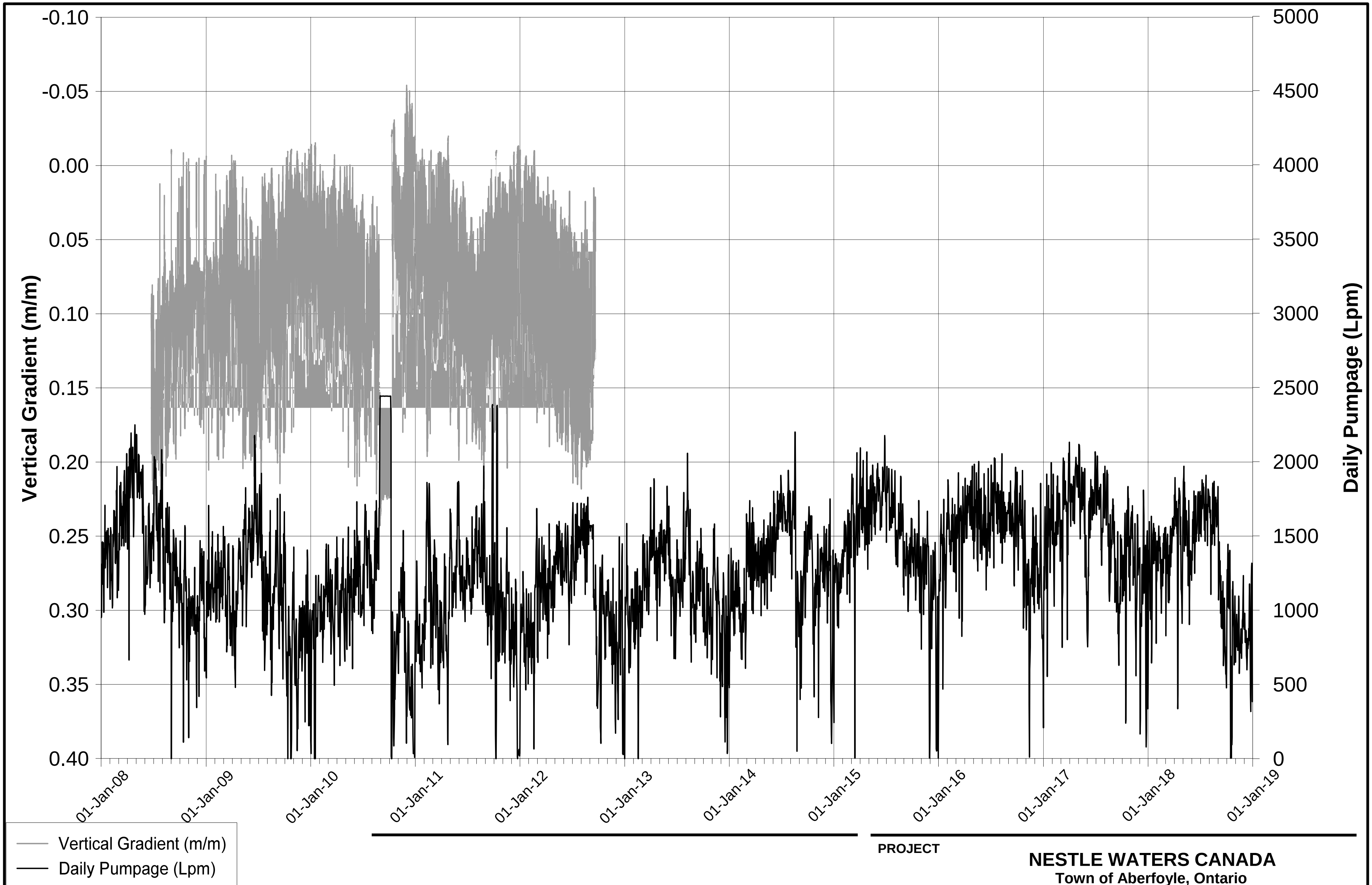
PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
AVERAGE MONTHLY WATER LEVEL ELEVATIONS
MW8-08

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	E15

APPENDIX F

Vertical Gradients (Upper Bedrock/Lower Bedrock)



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

GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

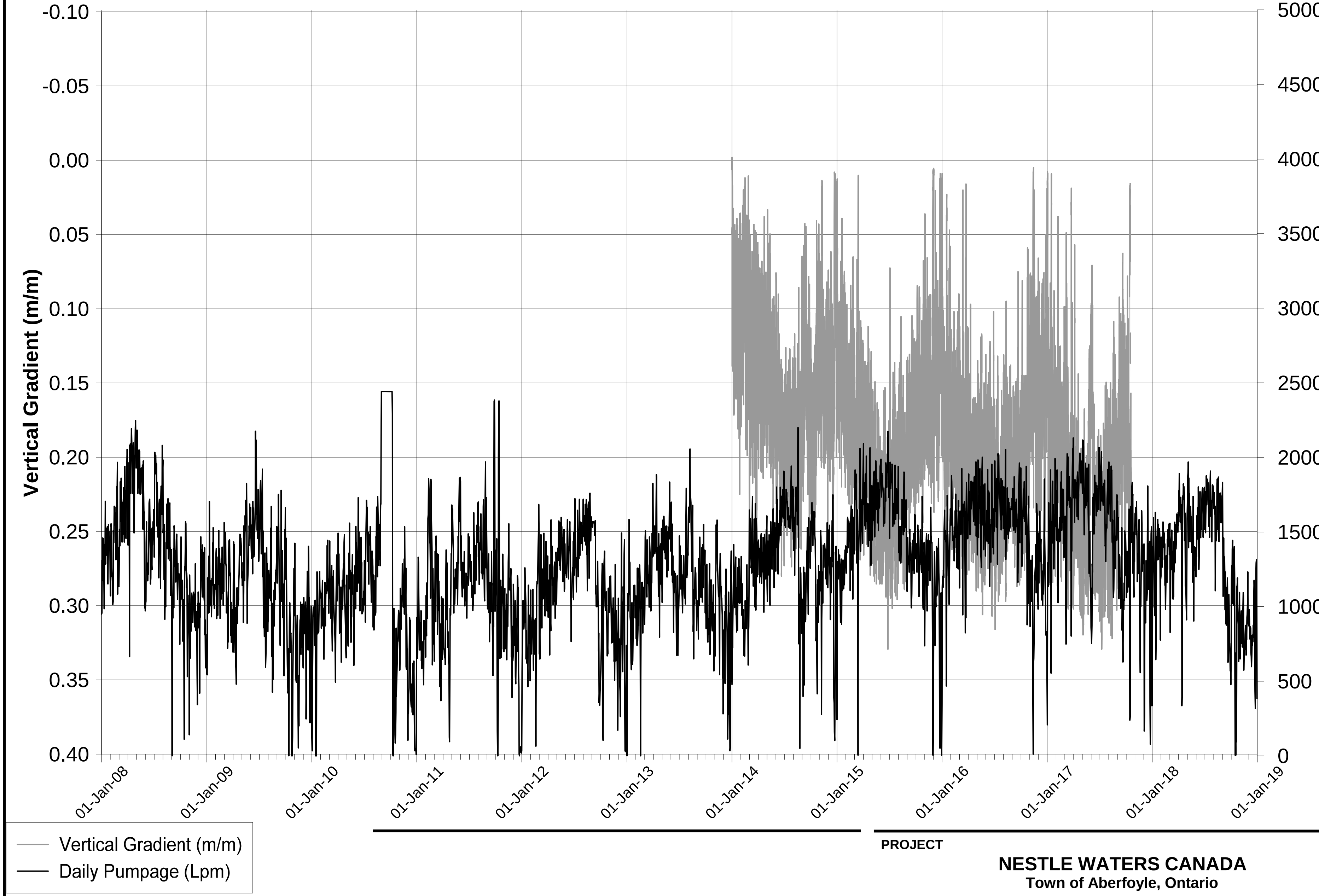
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW2 VERTICAL GRADIENT

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	F1



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

GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

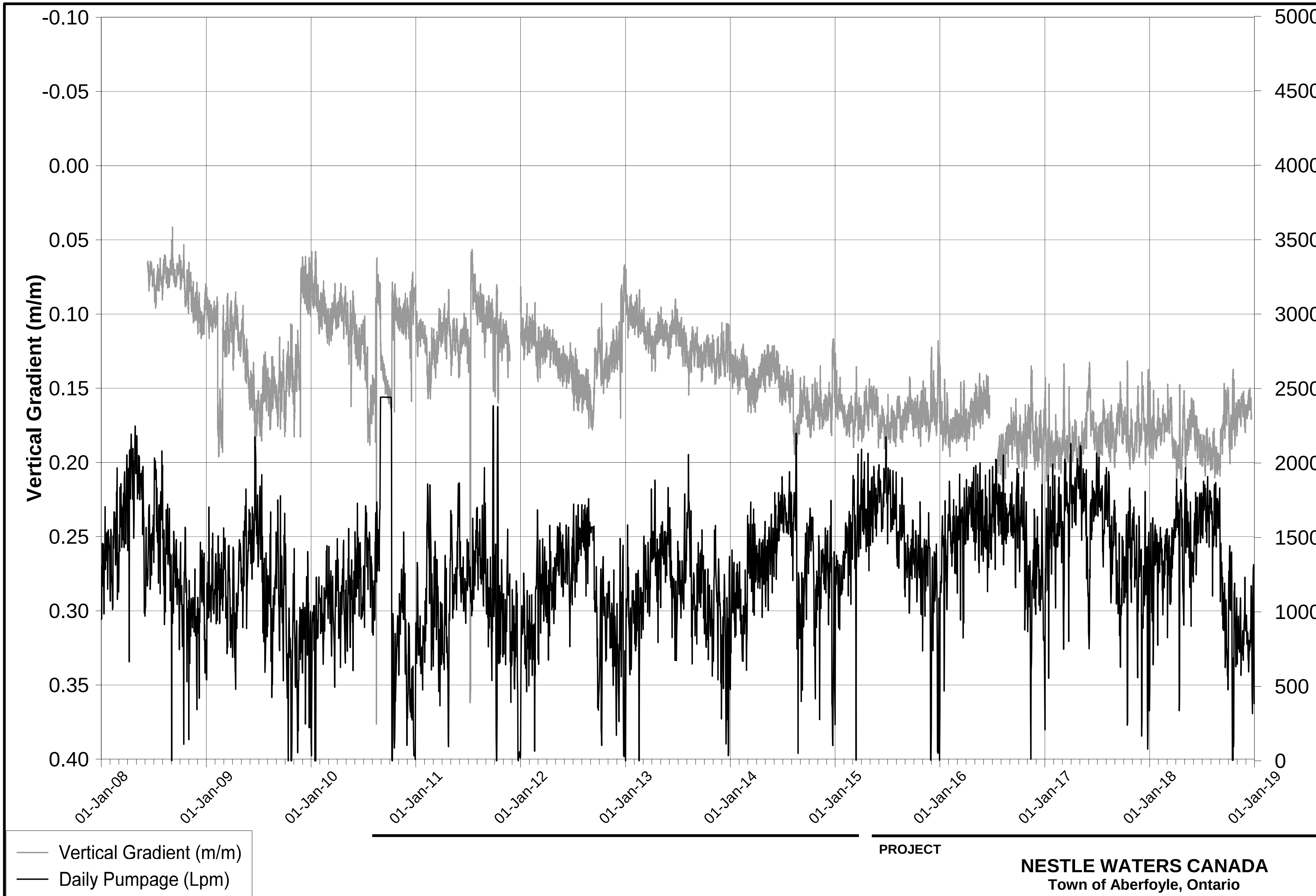
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW4 VERTICAL GRADIENT

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	F2



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

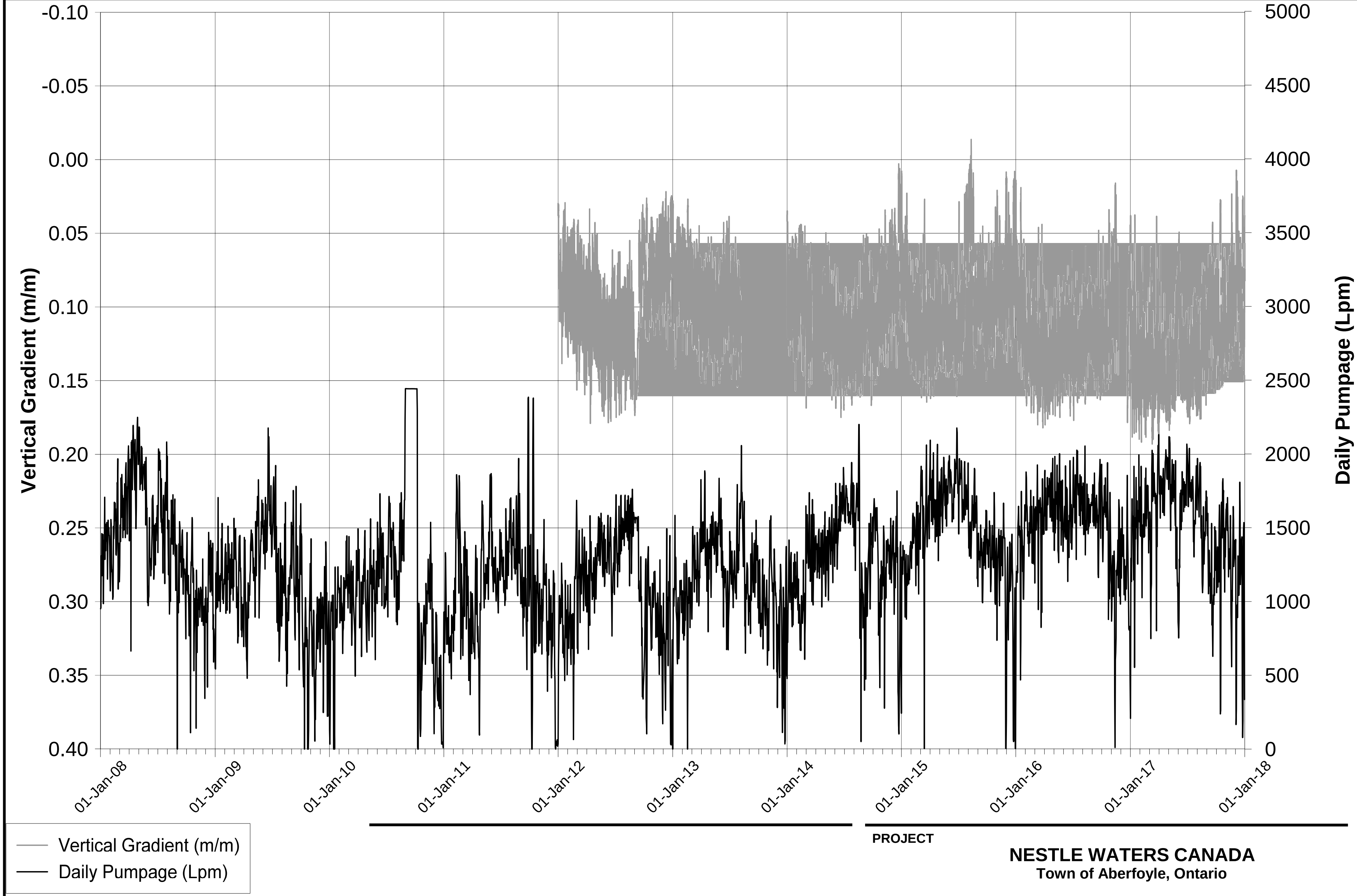
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW6 VERTICAL GRADIENT

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	F3



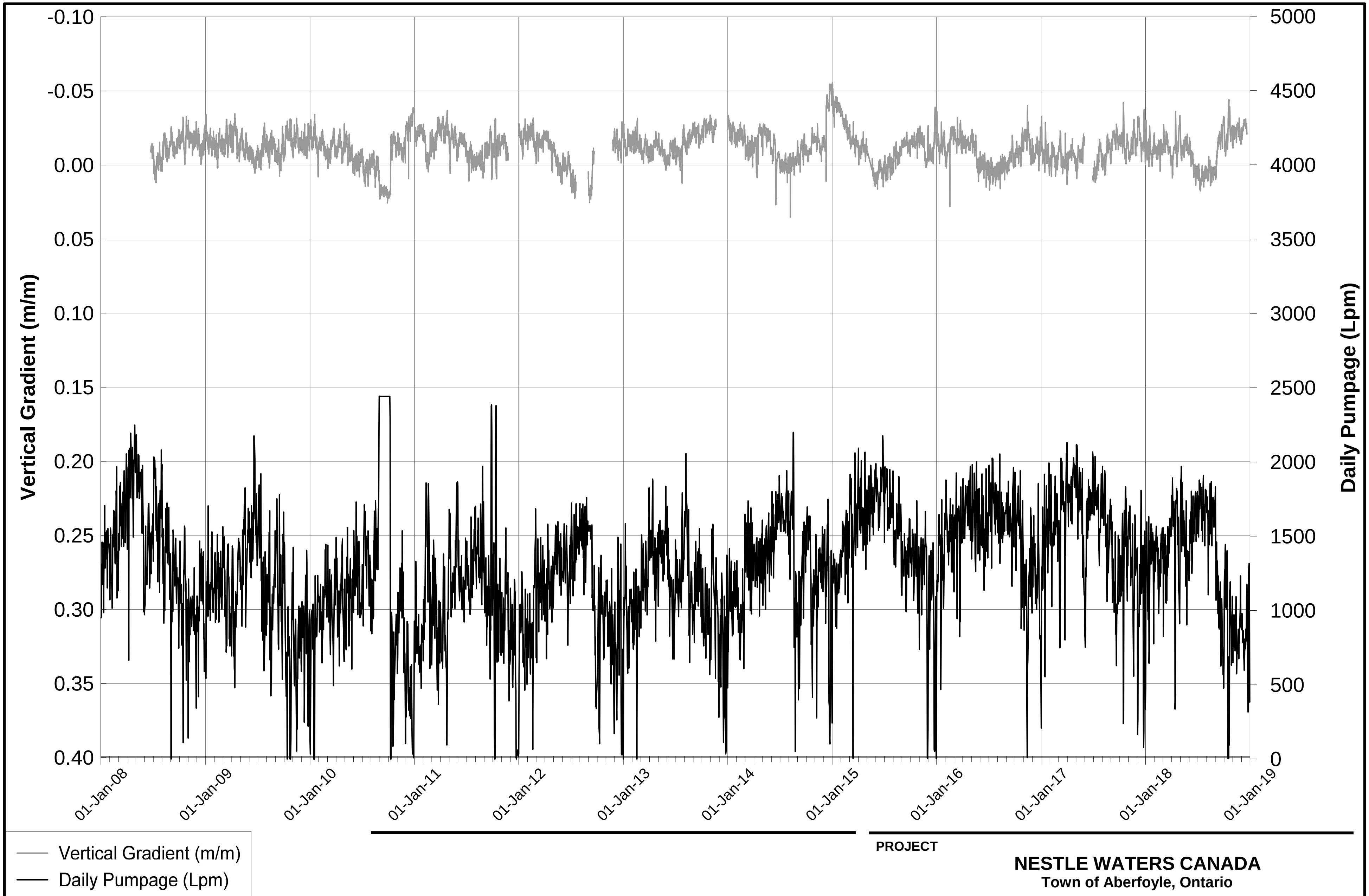
DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

GOLDER

PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
MW7 VERTICAL GRADIENT

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	F4



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

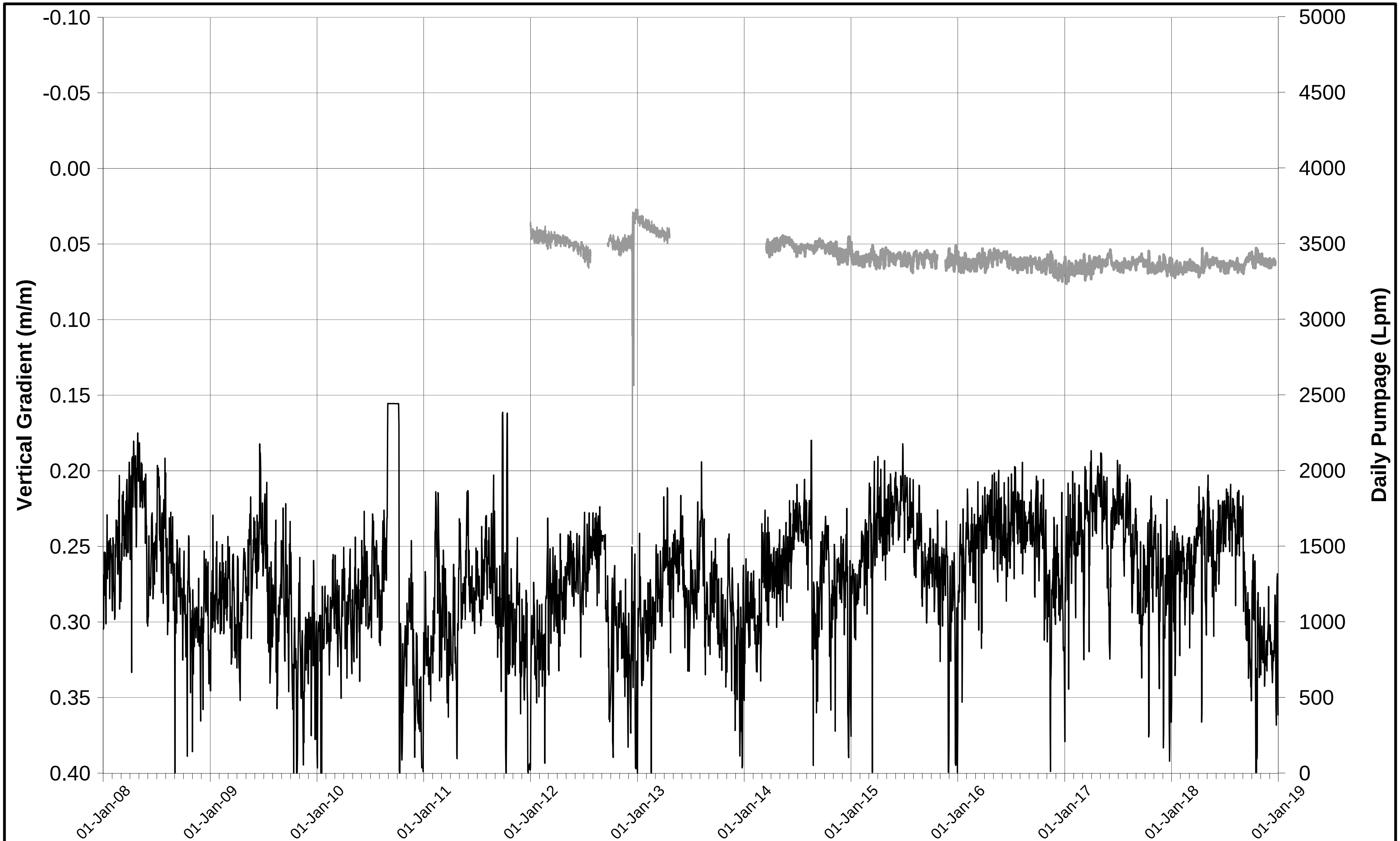
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW8 VERTICAL GRADIENT

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	F5



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

GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

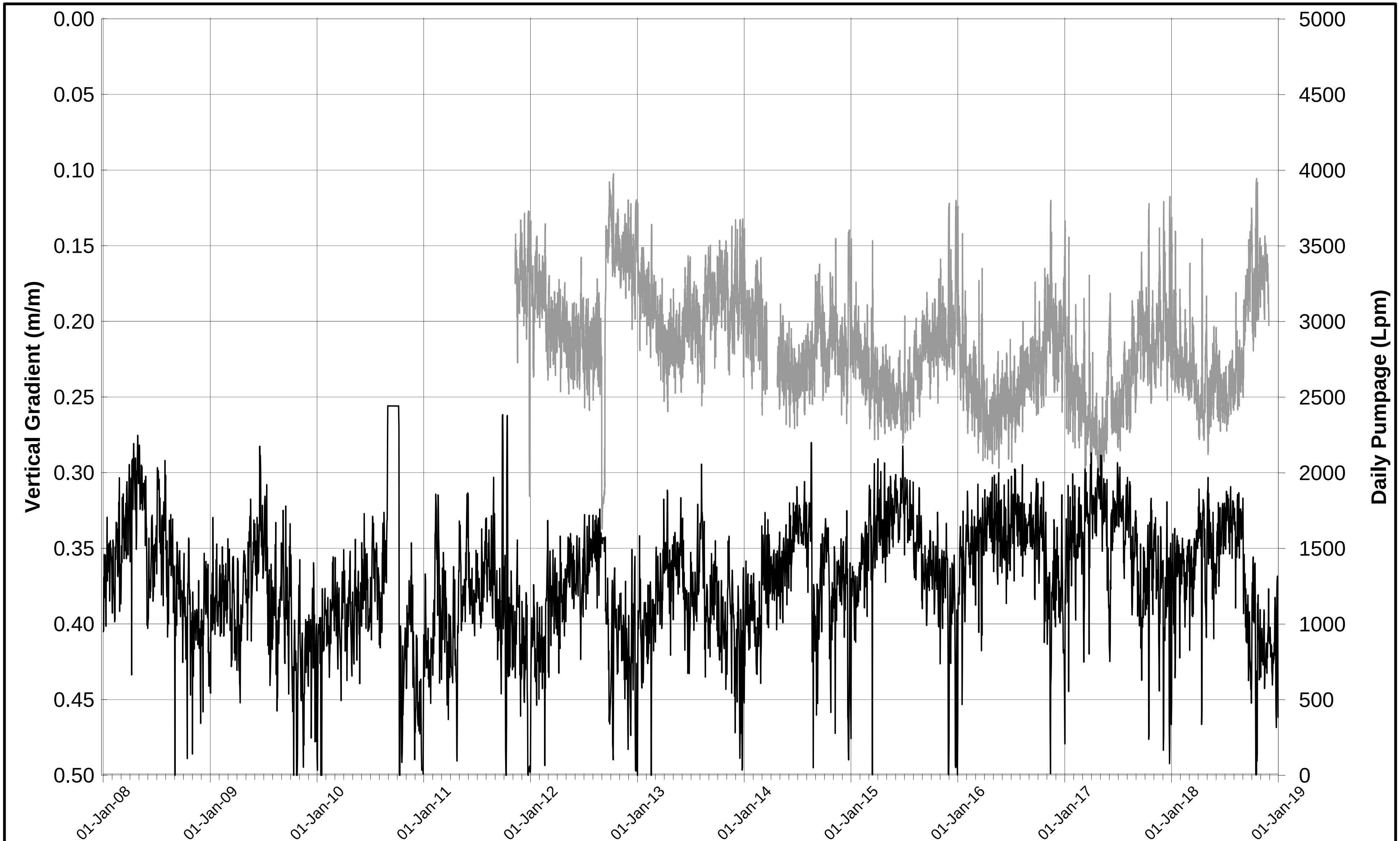
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW10 VERTICAL GRADIENT

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	F6



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

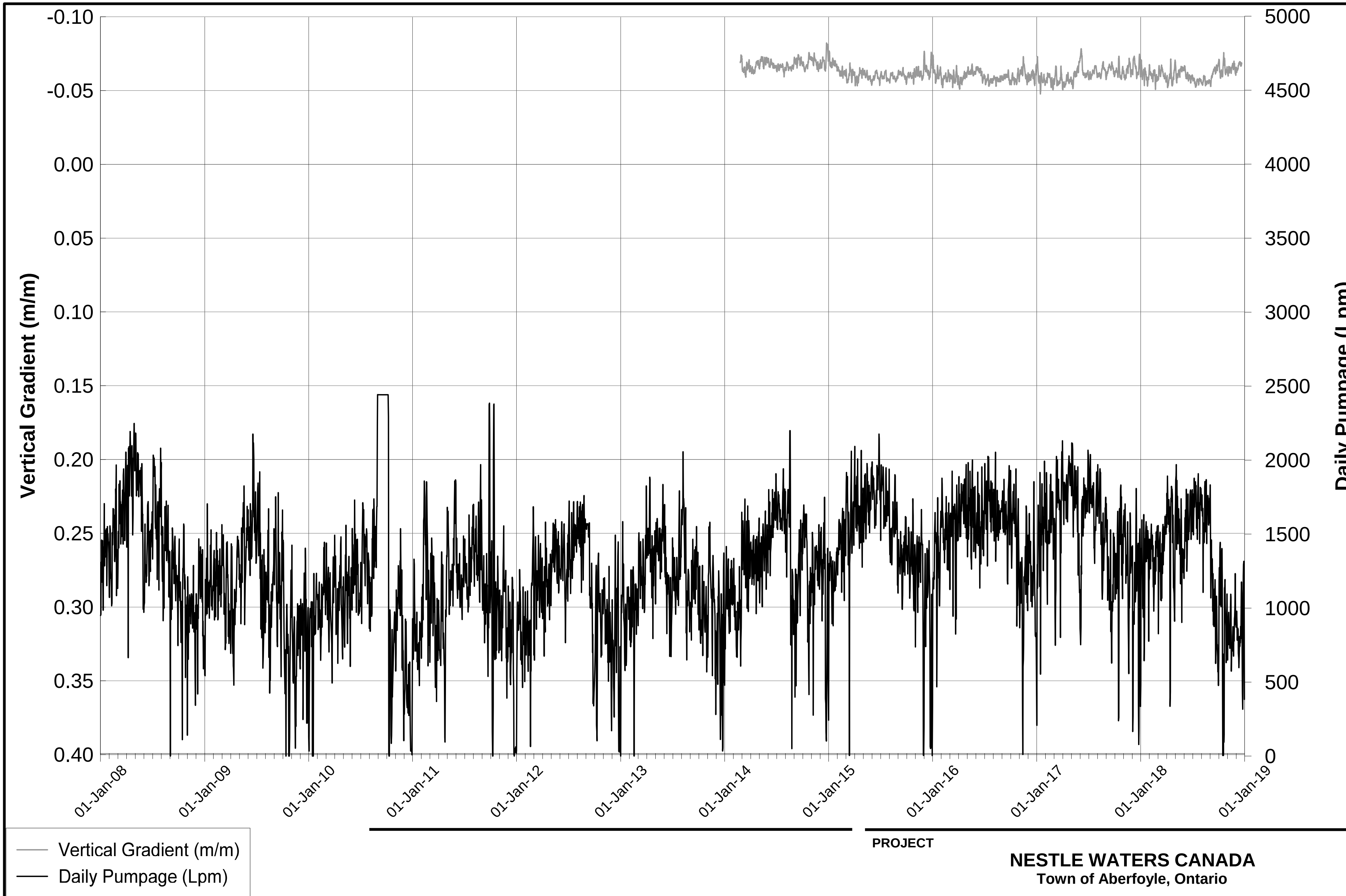
GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
MW14 VERTICAL GRADIENT

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	F7



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

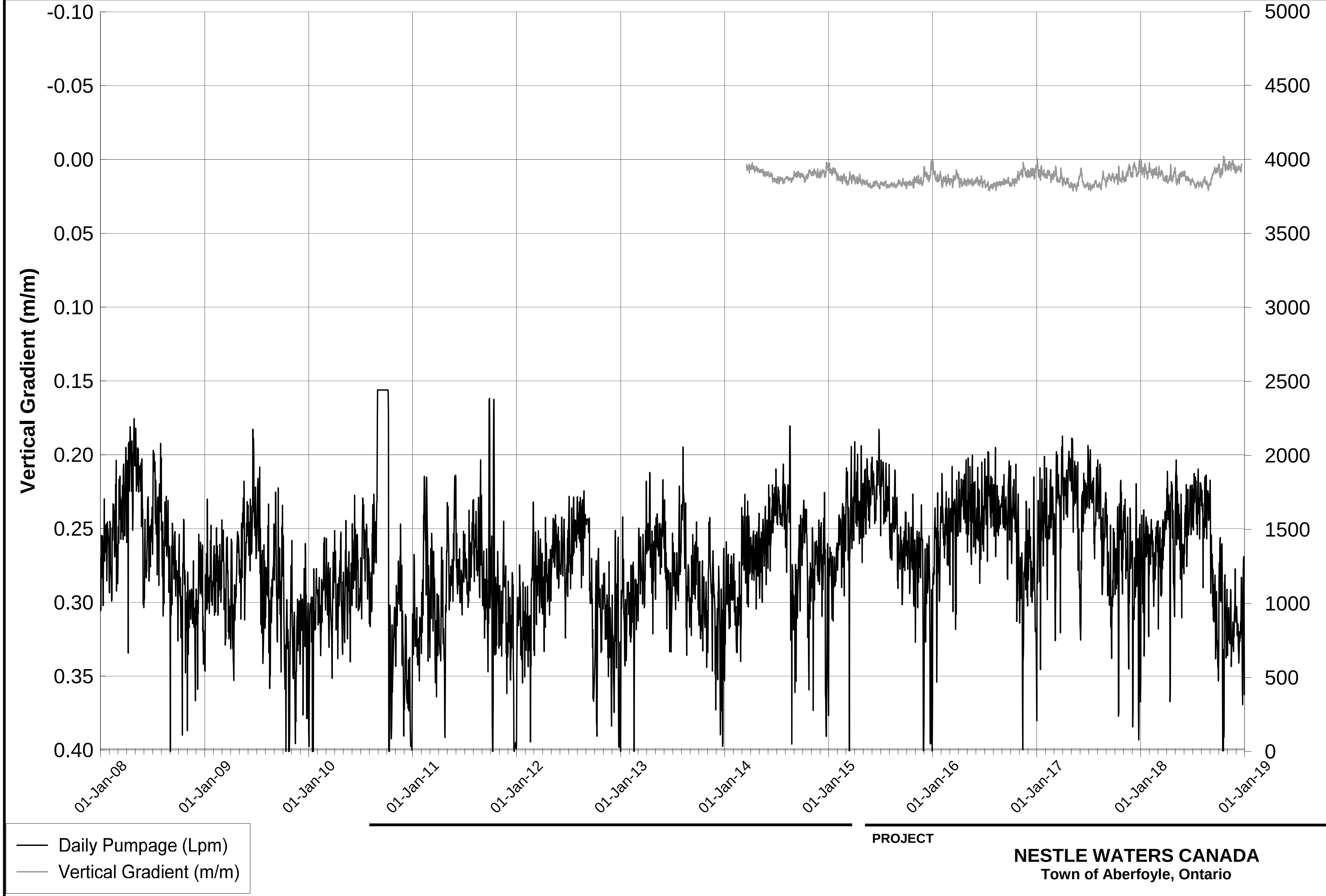
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

MW15 VERTICAL GRADIENT

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	F8



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

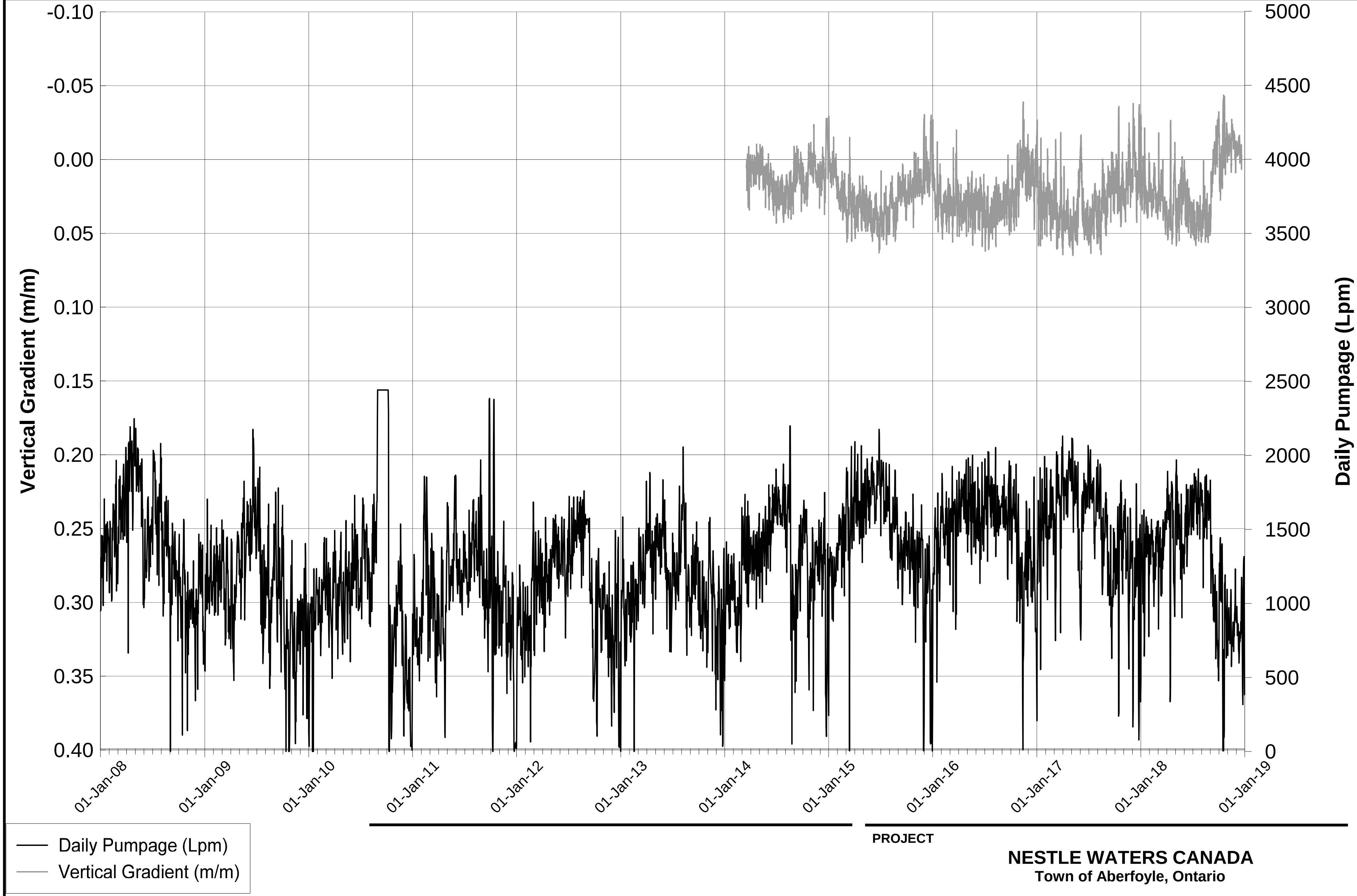
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

MW16 VERTICAL GRADIENT

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	F9



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

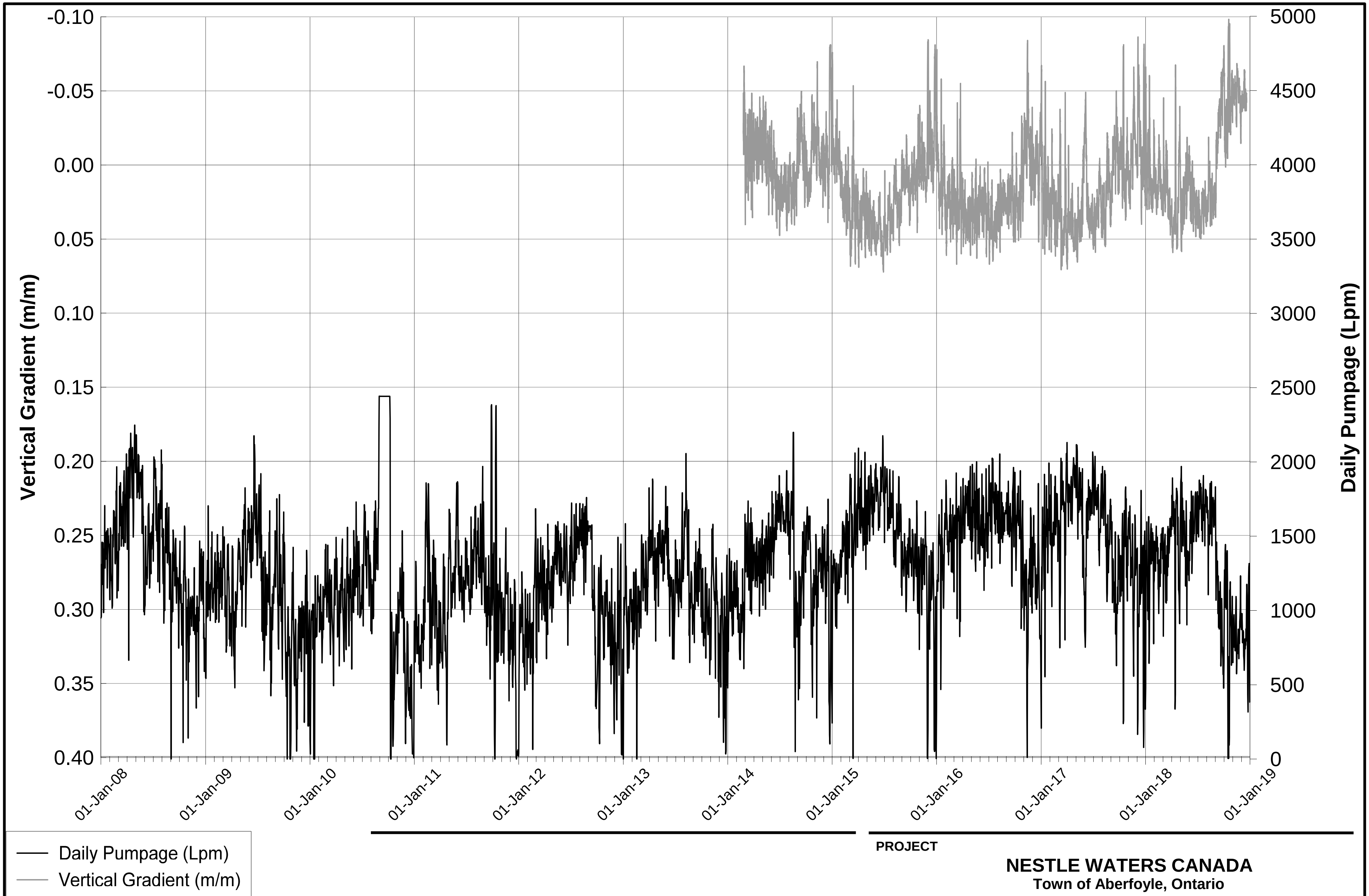
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW17 VERTICAL GRADIENT

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	F10



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

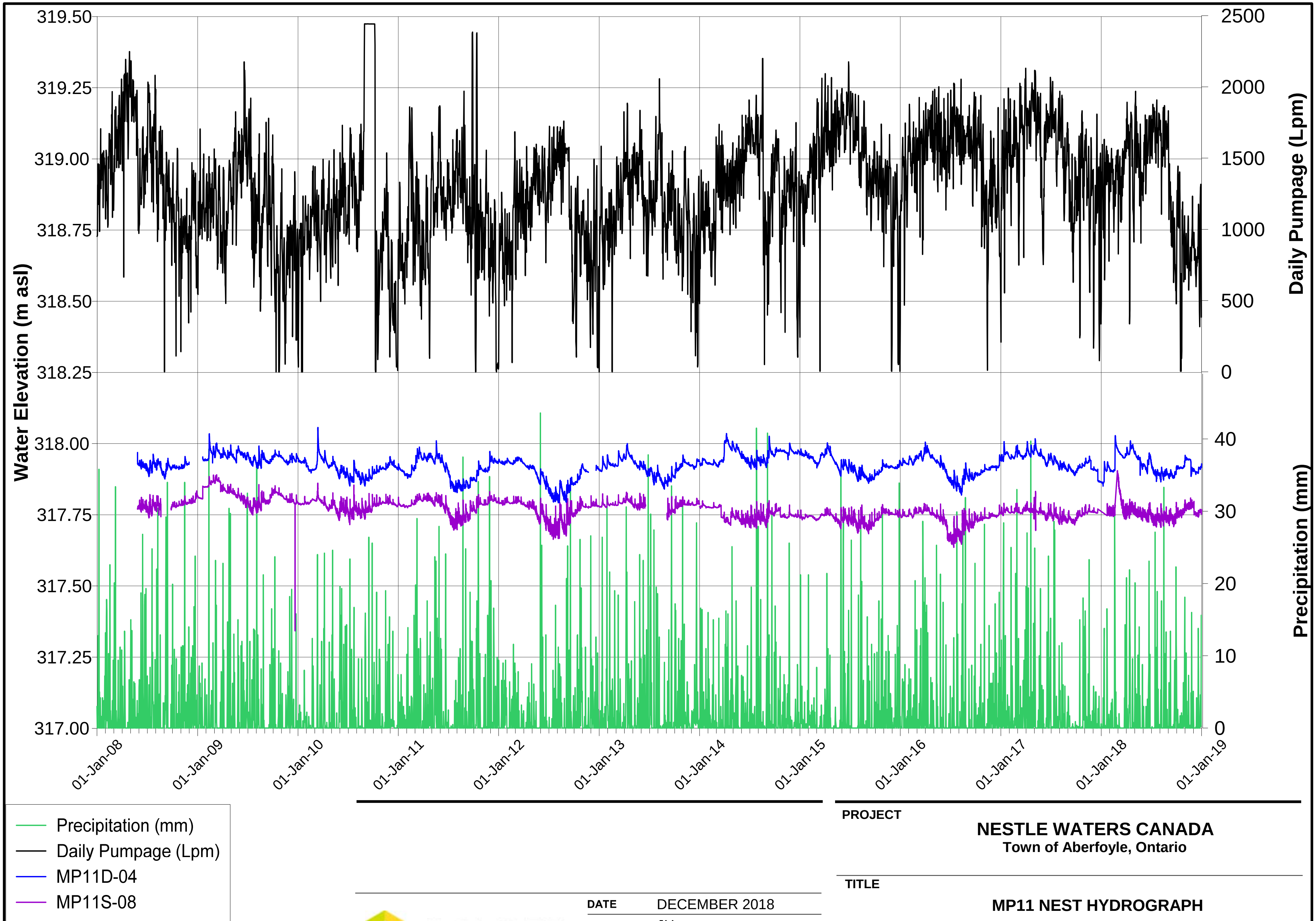
TITLE

MW18 VERTICAL GRADIENT

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	F11

APPENDIX G

Mini-Piezometer Hydrographs



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

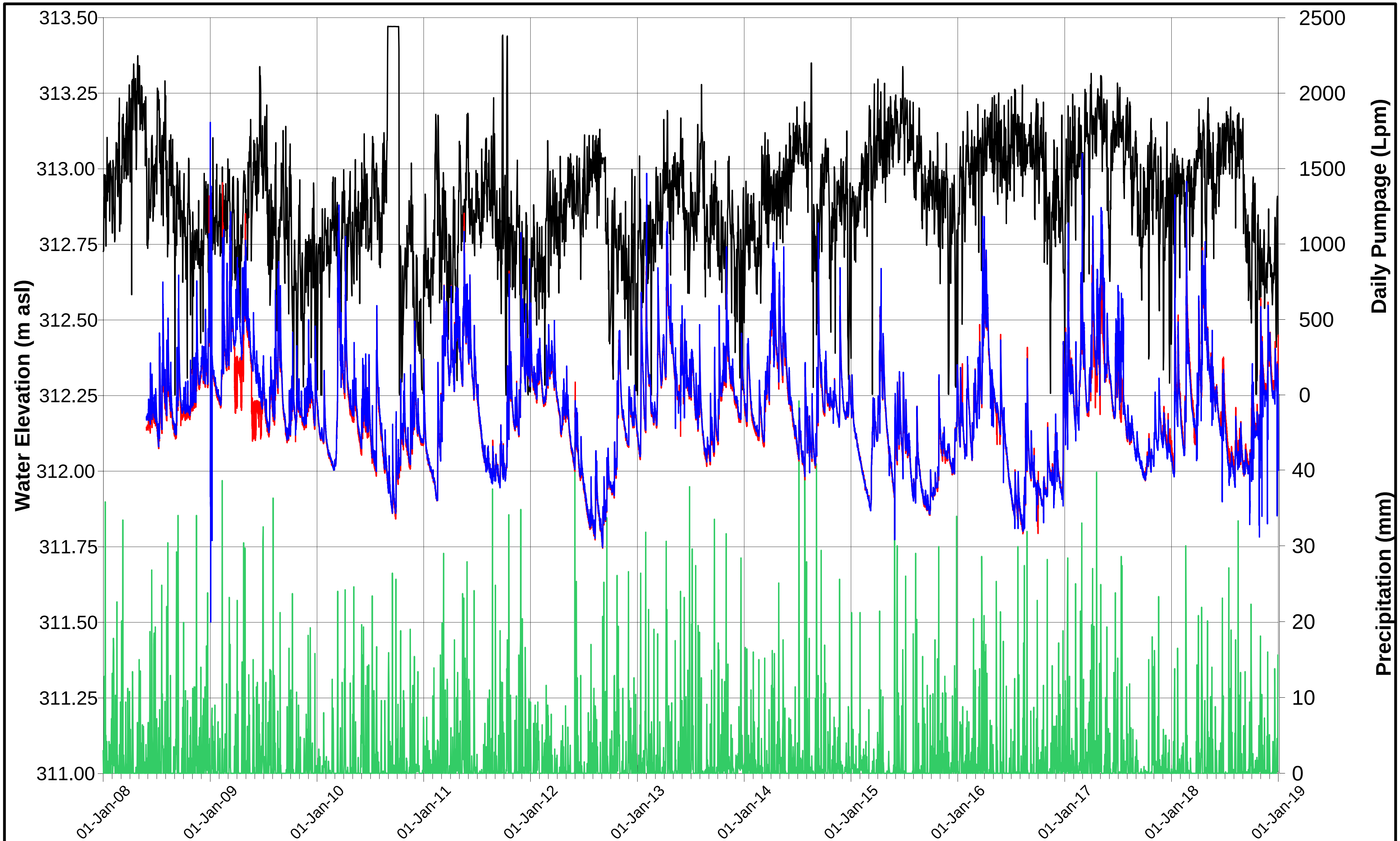
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

MP11 NEST HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	G1



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

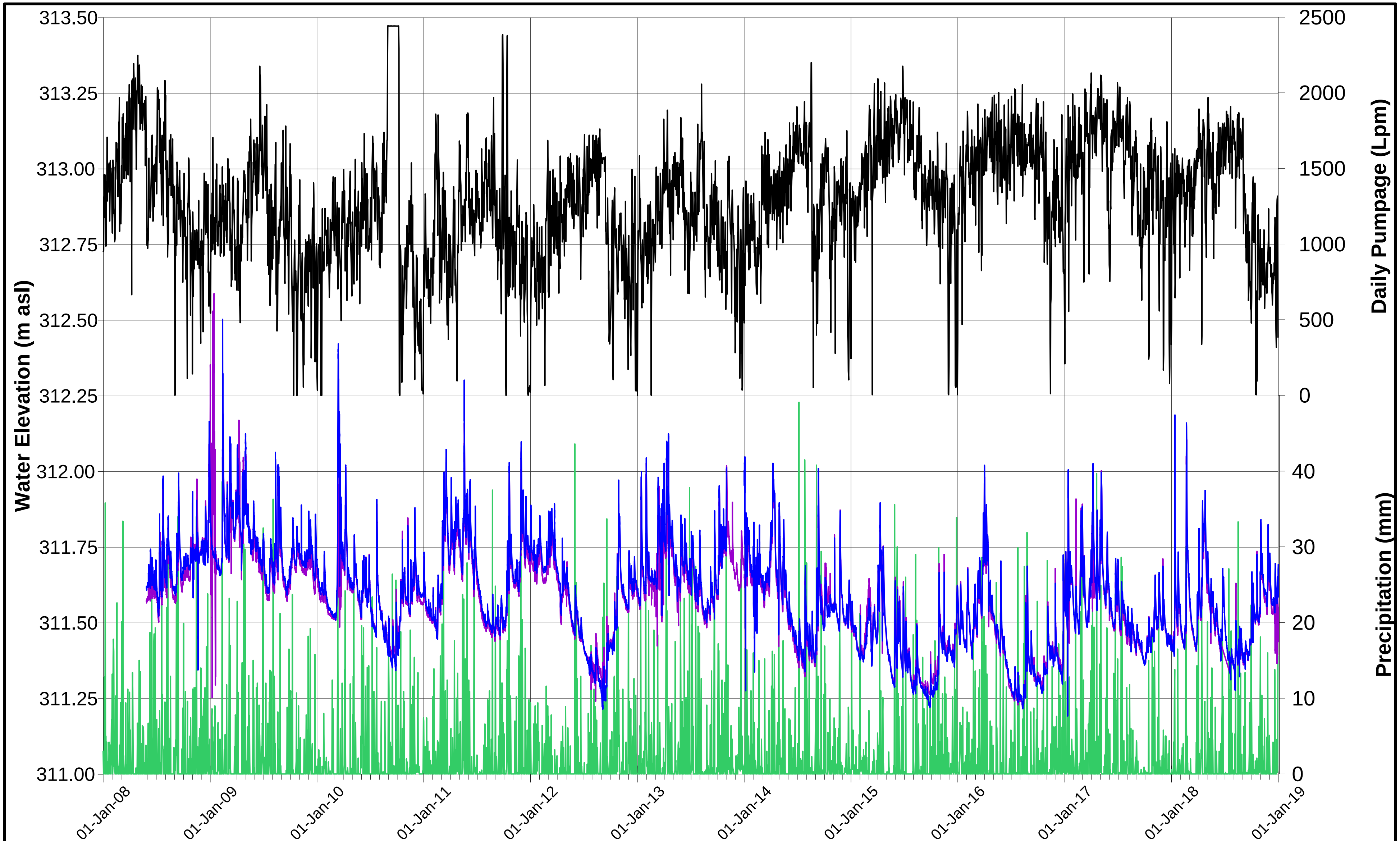
DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

GOLDER

PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
MP16 NEST HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	G2



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

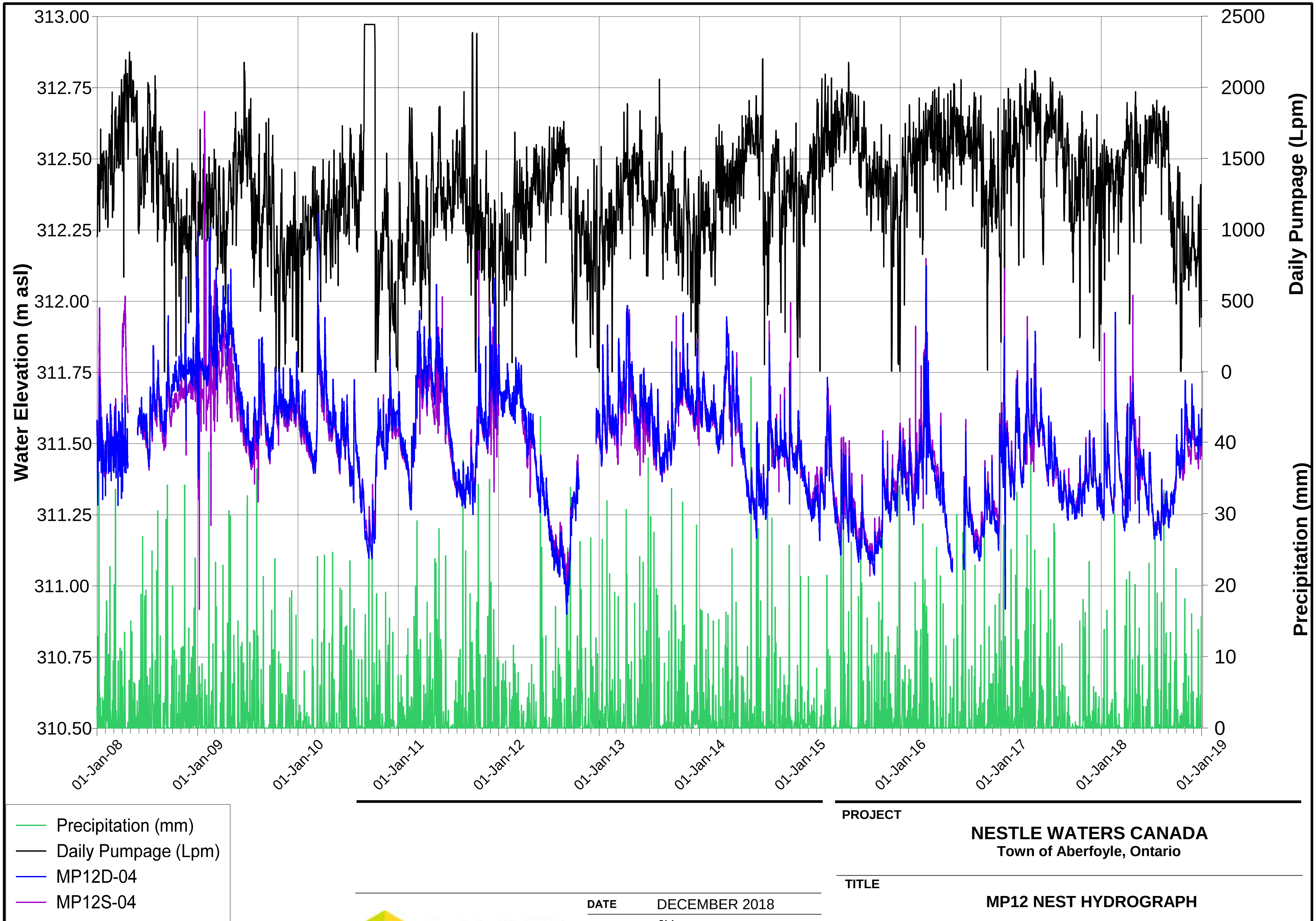
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

MP6 NEST HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	G3



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

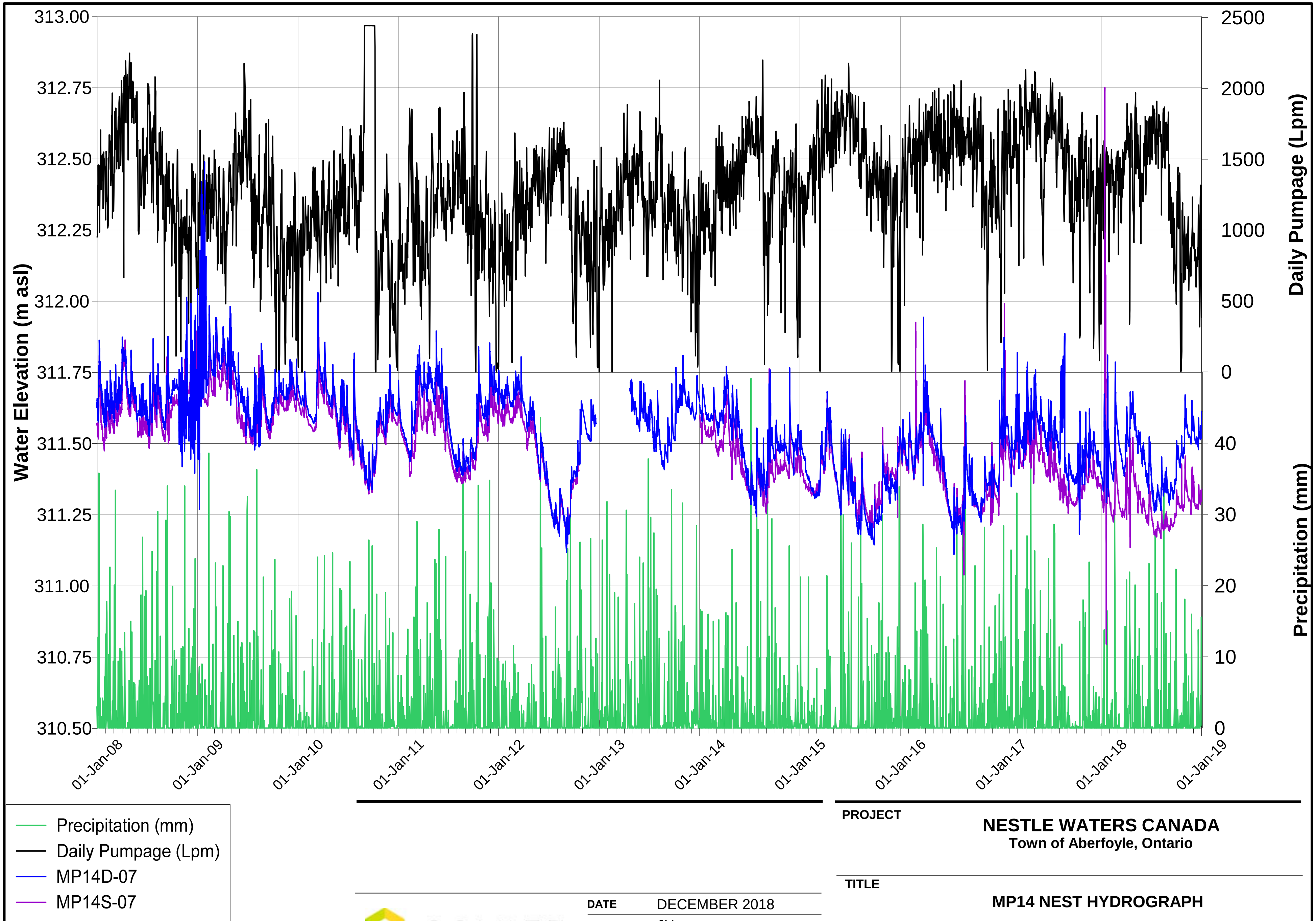
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP12 NEST HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	G4



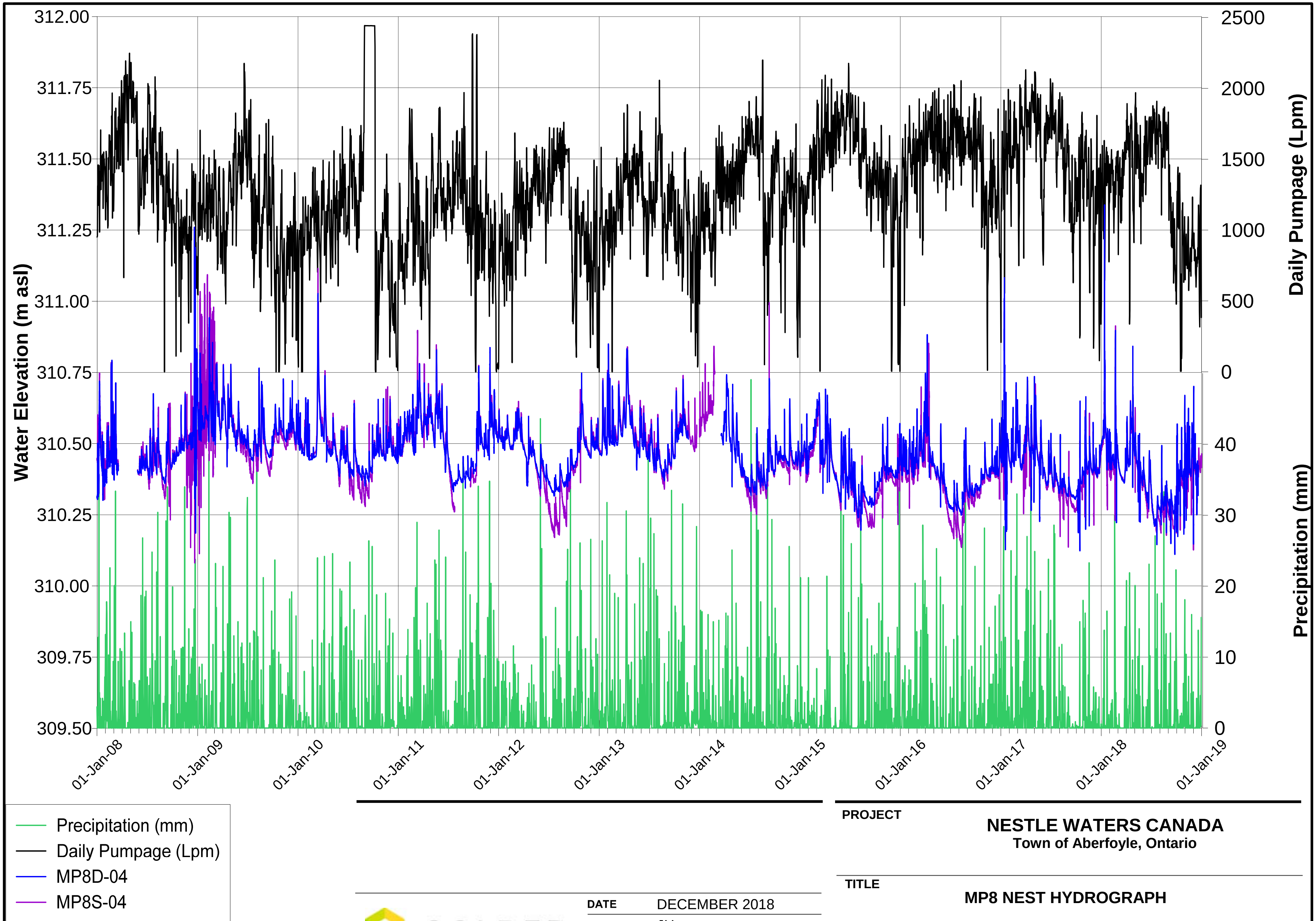
GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
MP14 NEST HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	G5



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

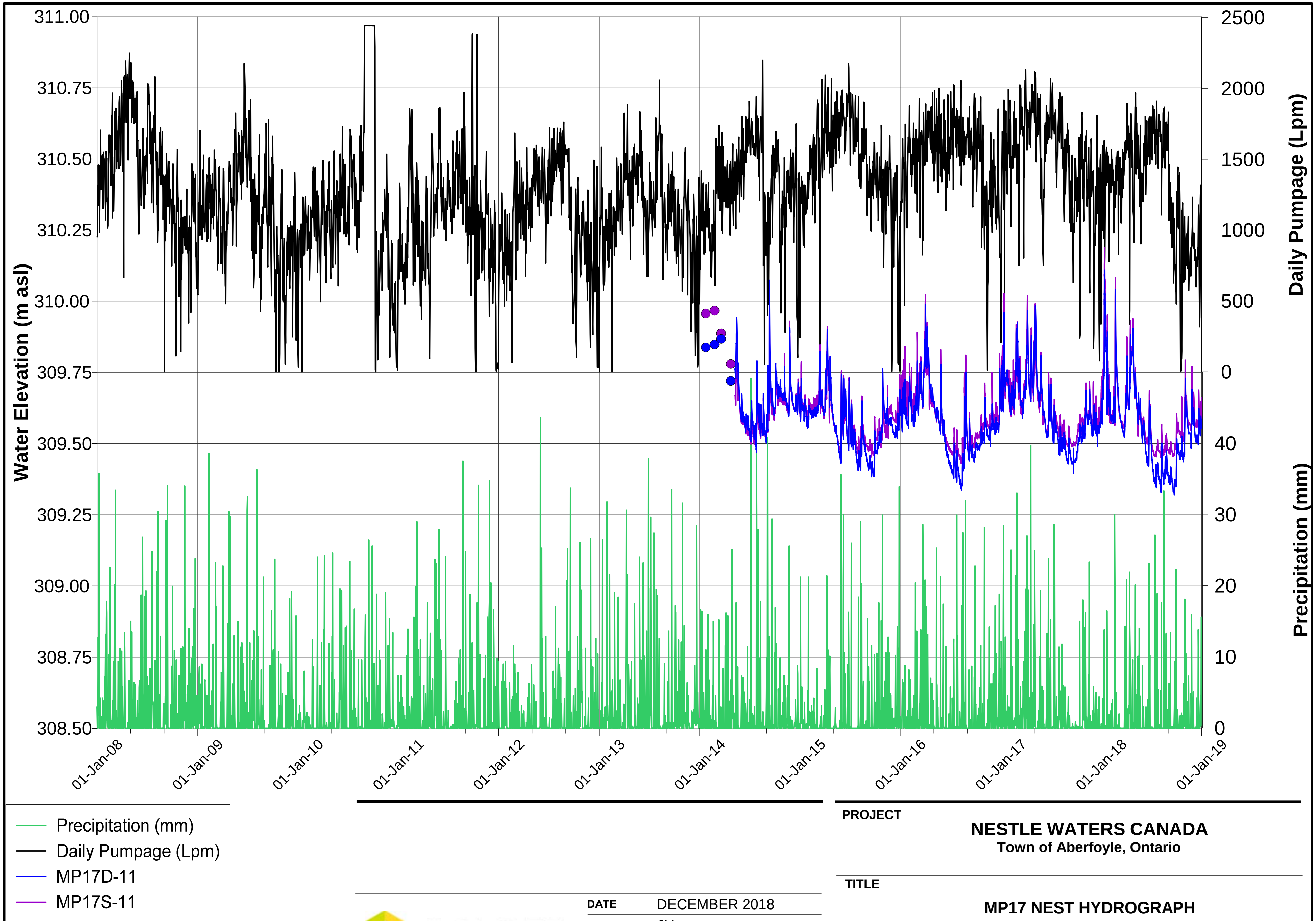
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

MP8 NEST HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	G6



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

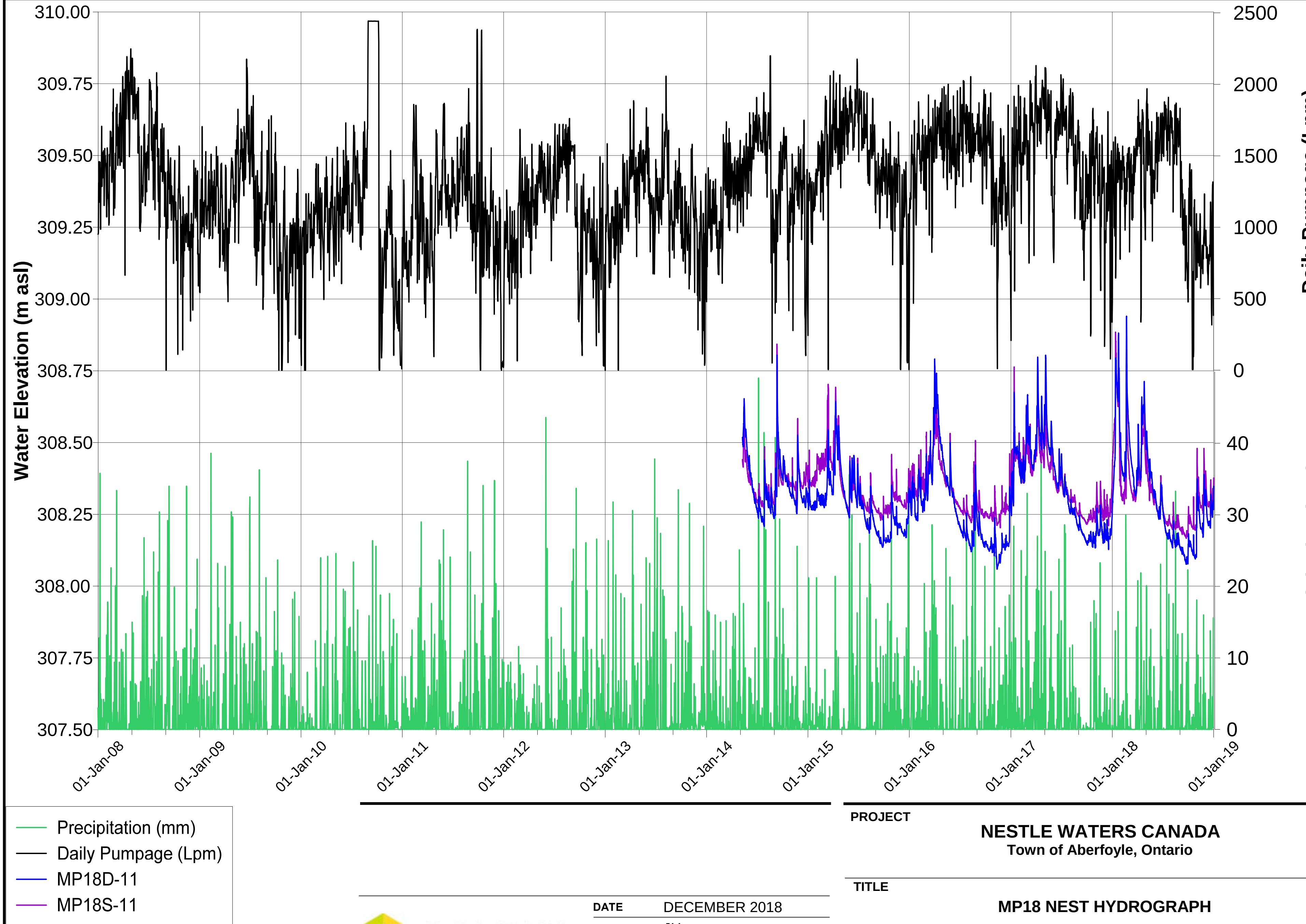
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP17 NEST HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	G7



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

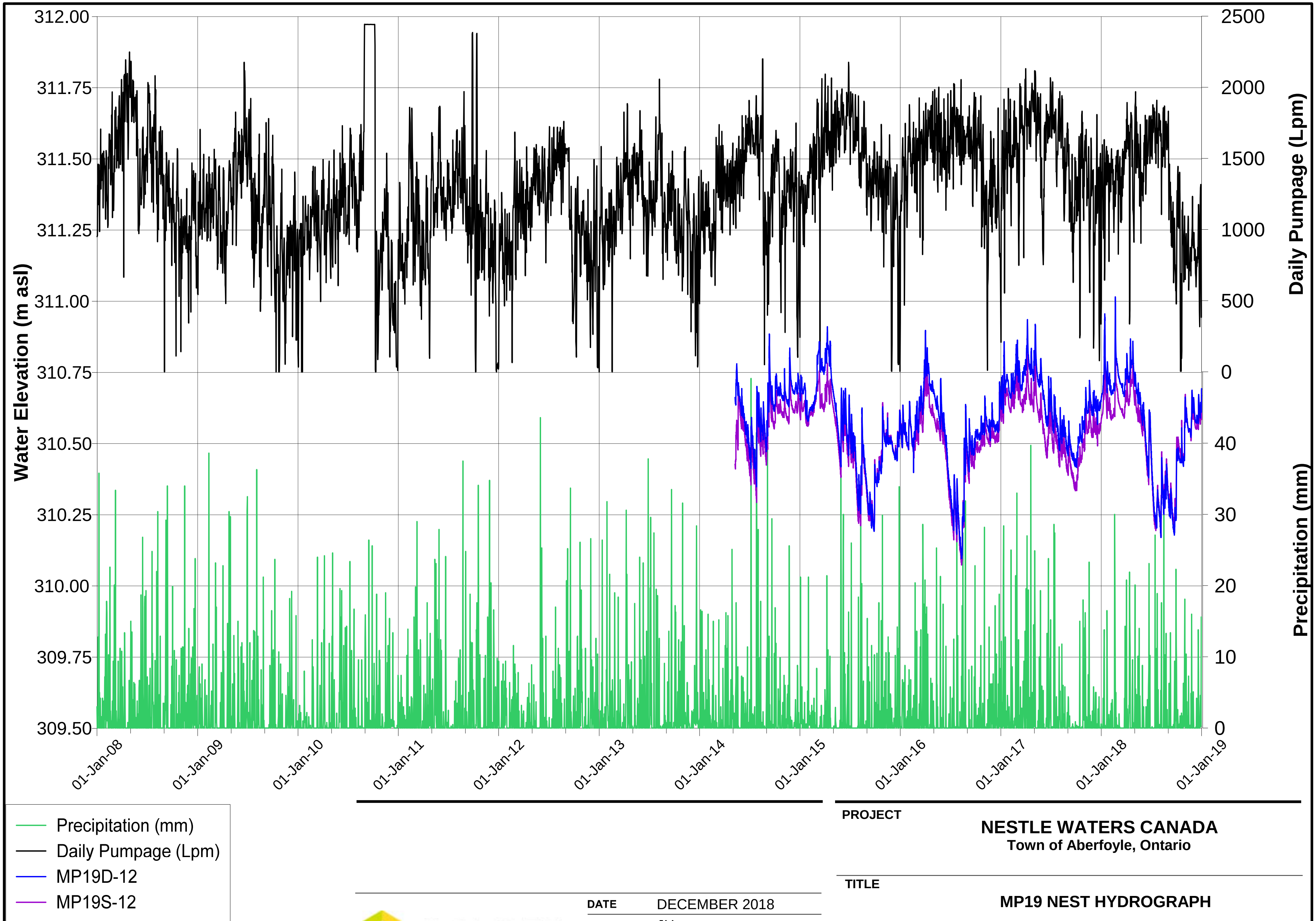
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP18 NEST HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	G8



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

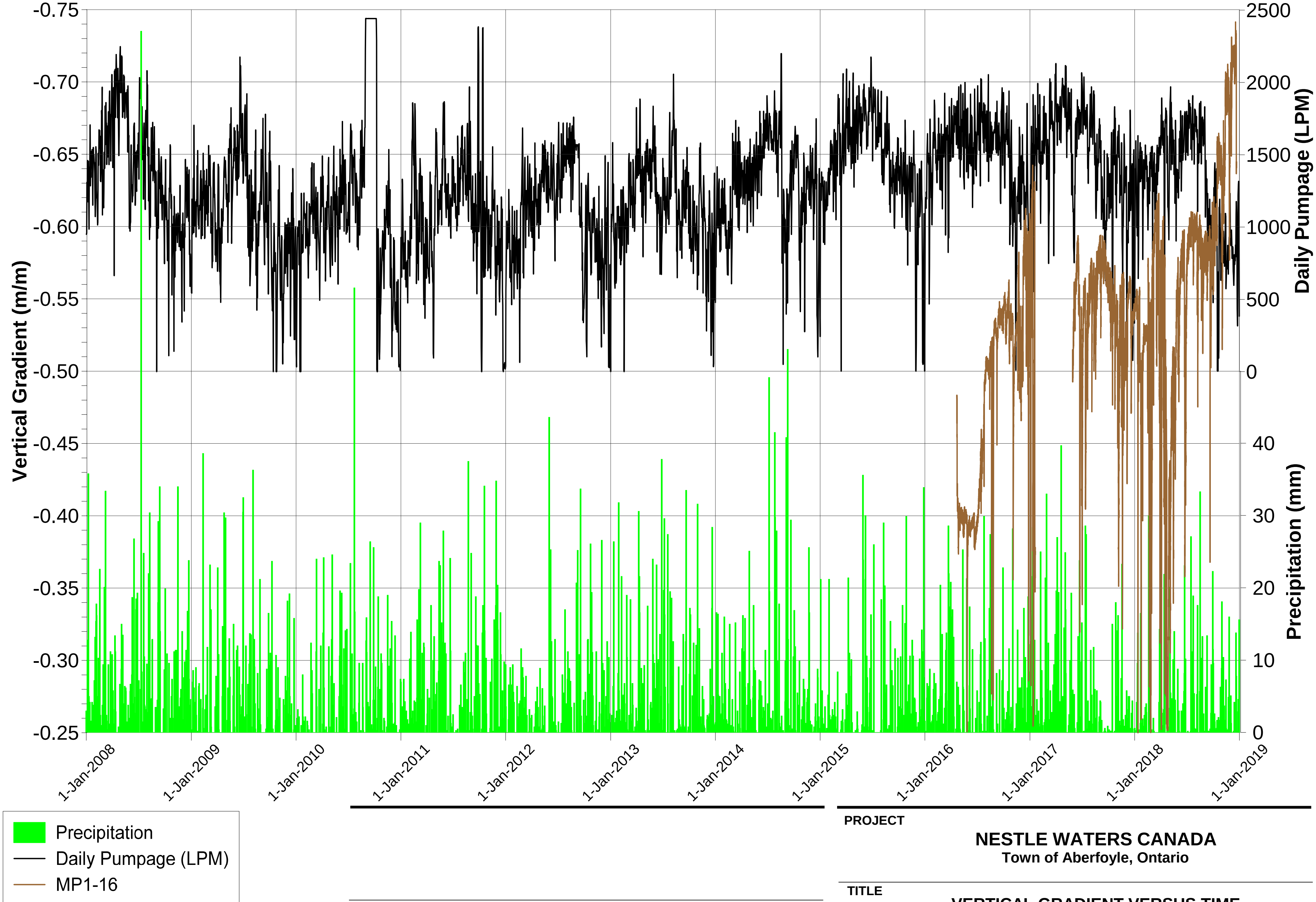
TITLE

MP19 NEST HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	G9

APPENDIX H

Vertical Gradients (Mini-Pizometers)



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

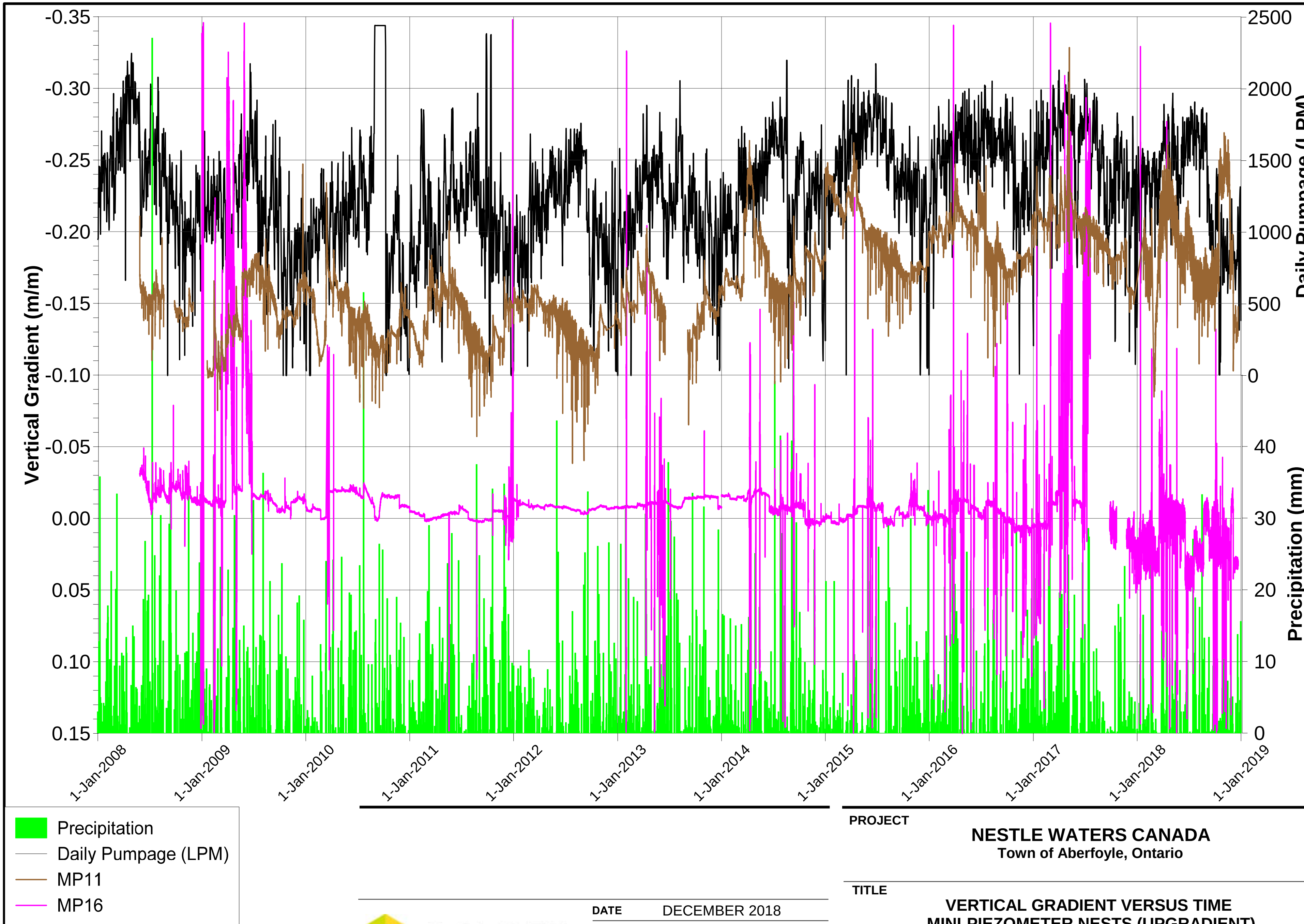
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS (UPGRADIENT)

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	H1



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

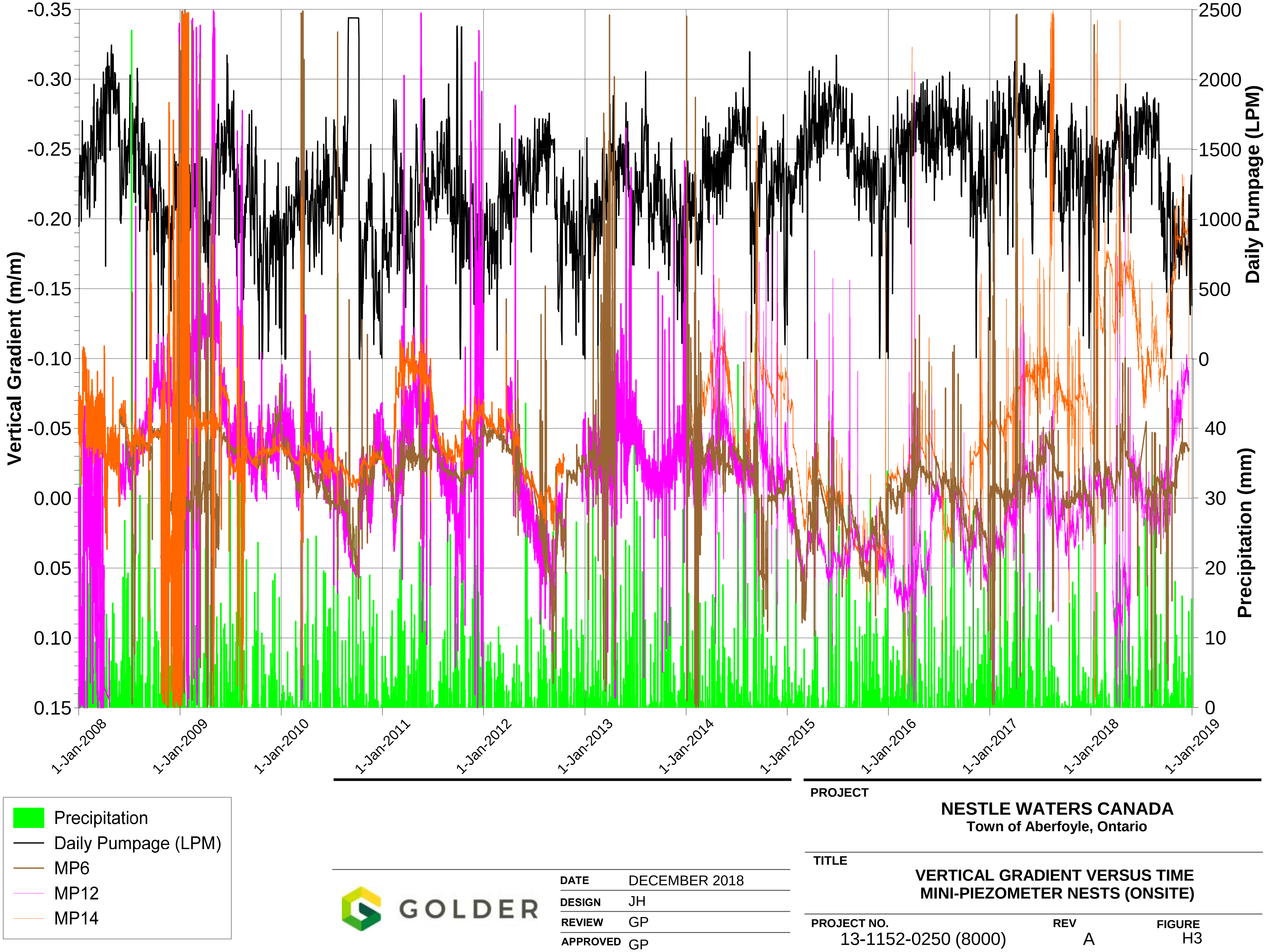
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS (UPGRADIENT)

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	H2



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

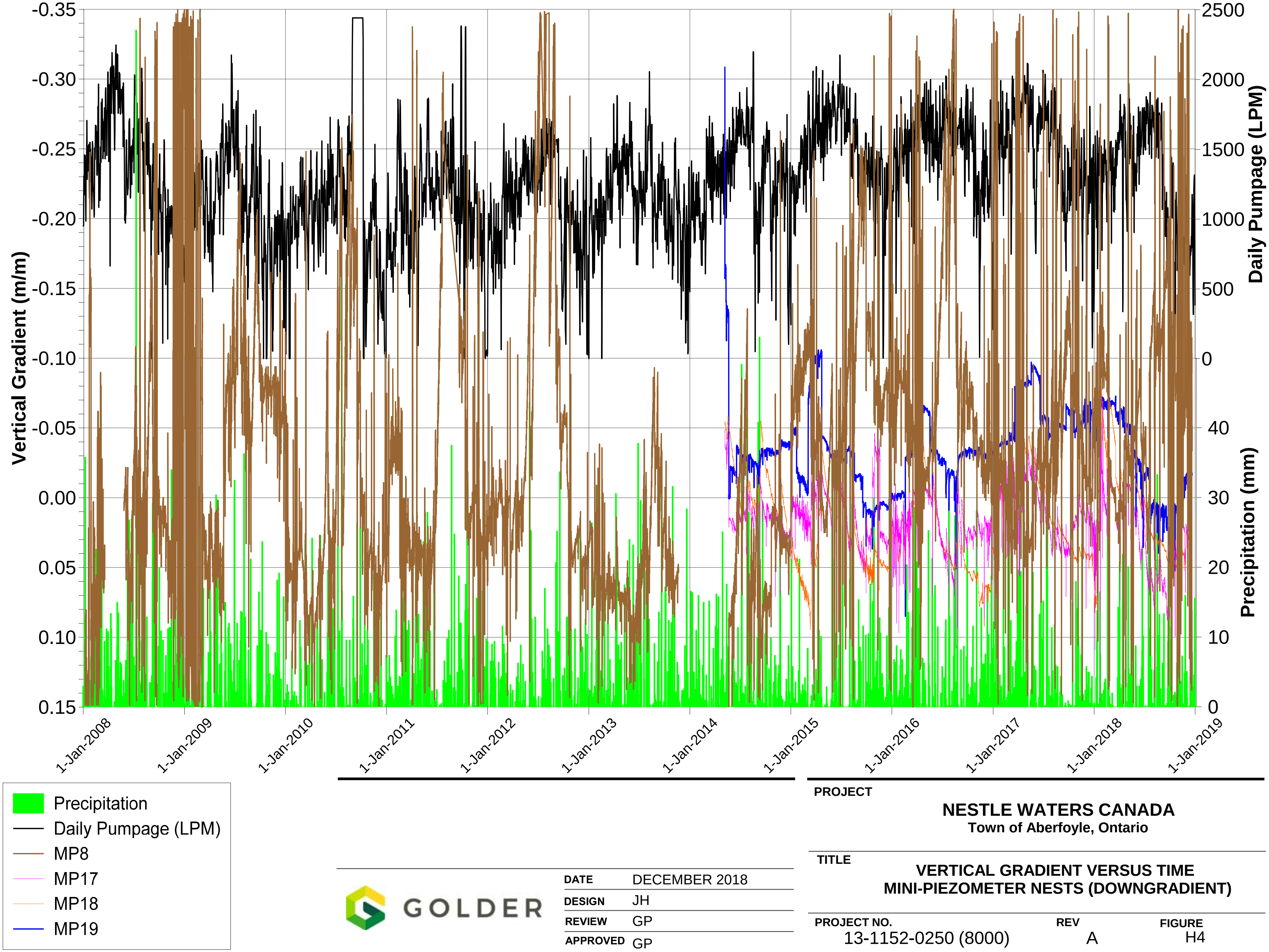
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS (ONSITE)

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	H3



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

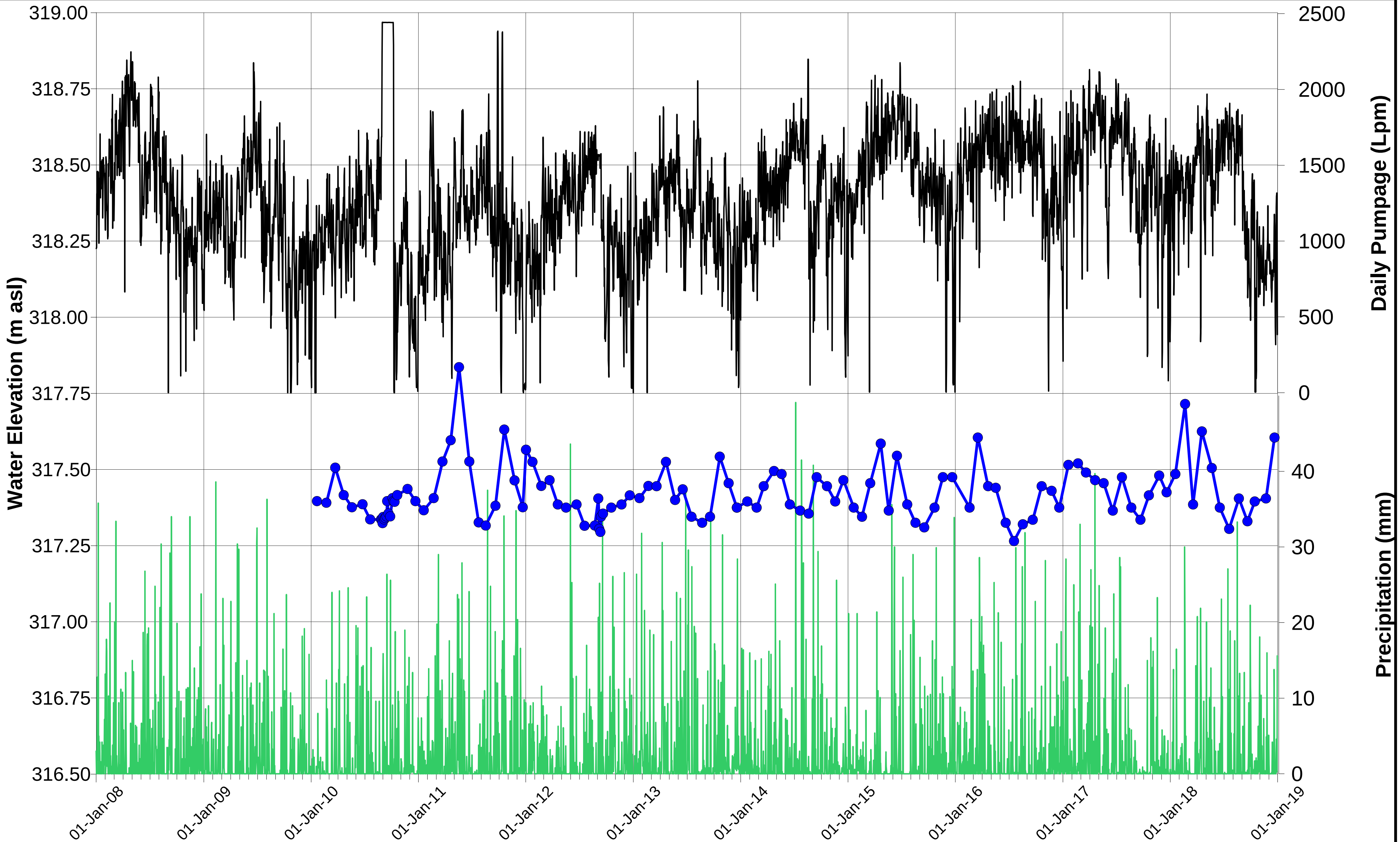
TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS (DOWNGRADIENT)

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	H4

APPENDIX I

Surface Water Hydrographs



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

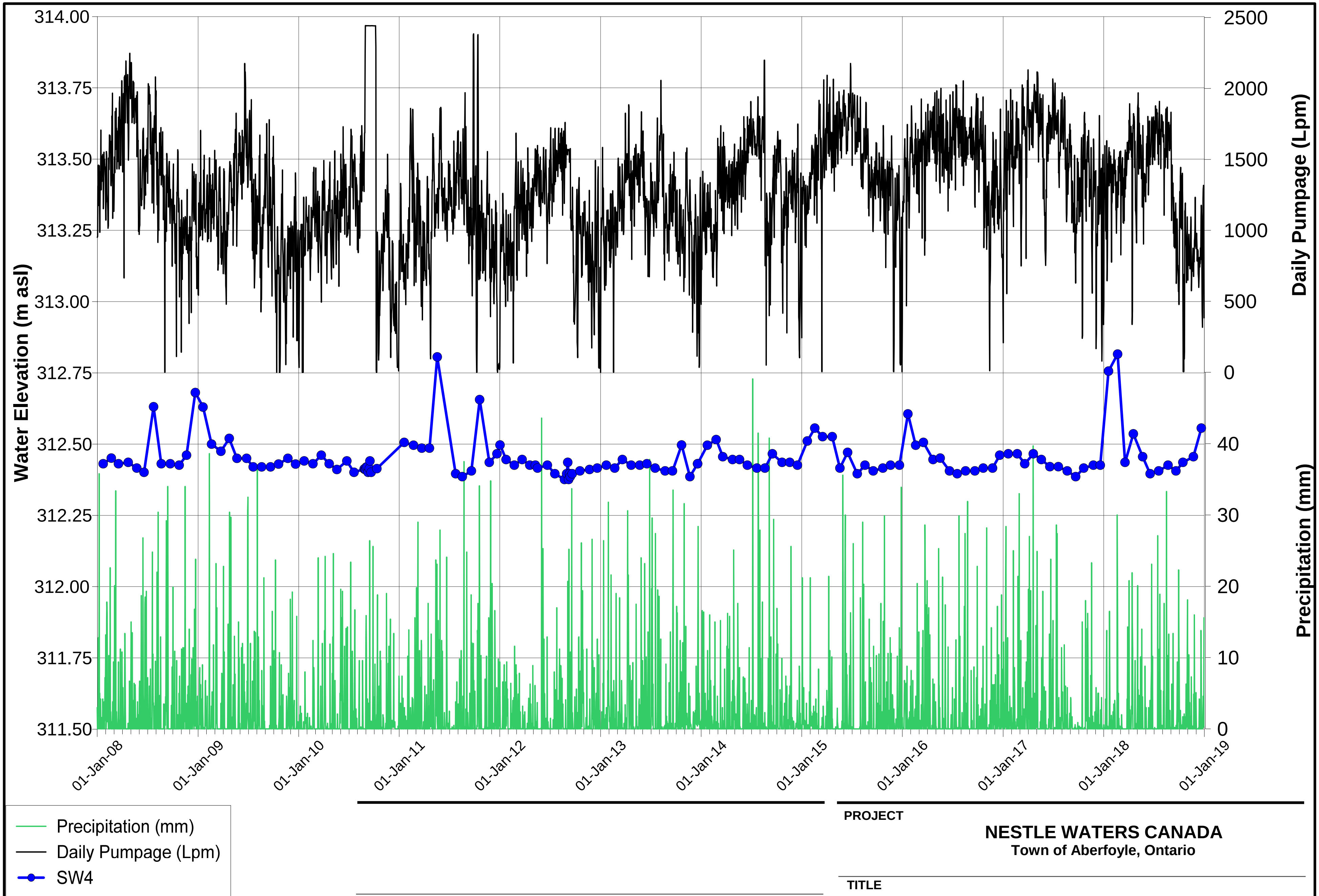
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW3 HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	I1



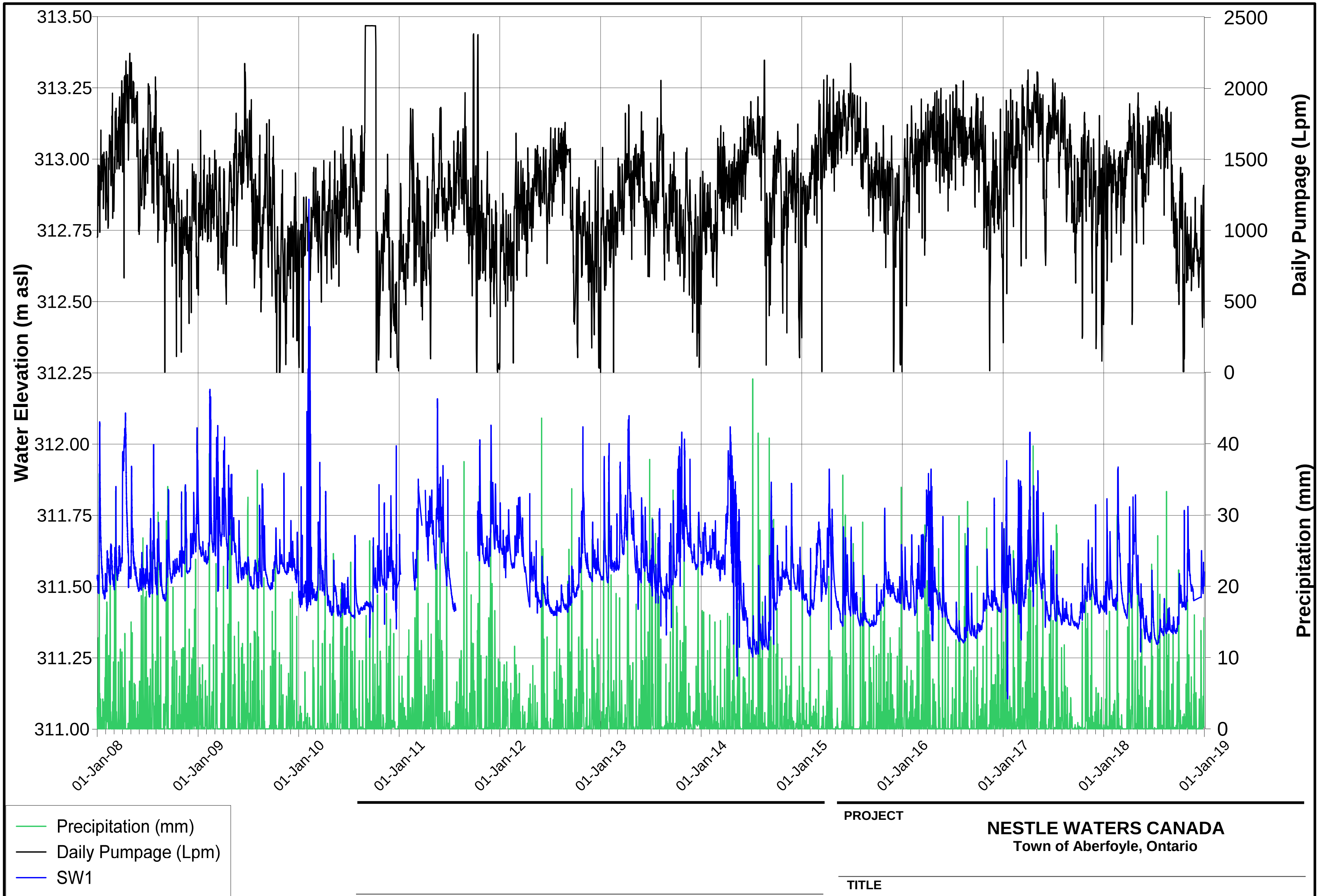
GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
SW4 HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	I2



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

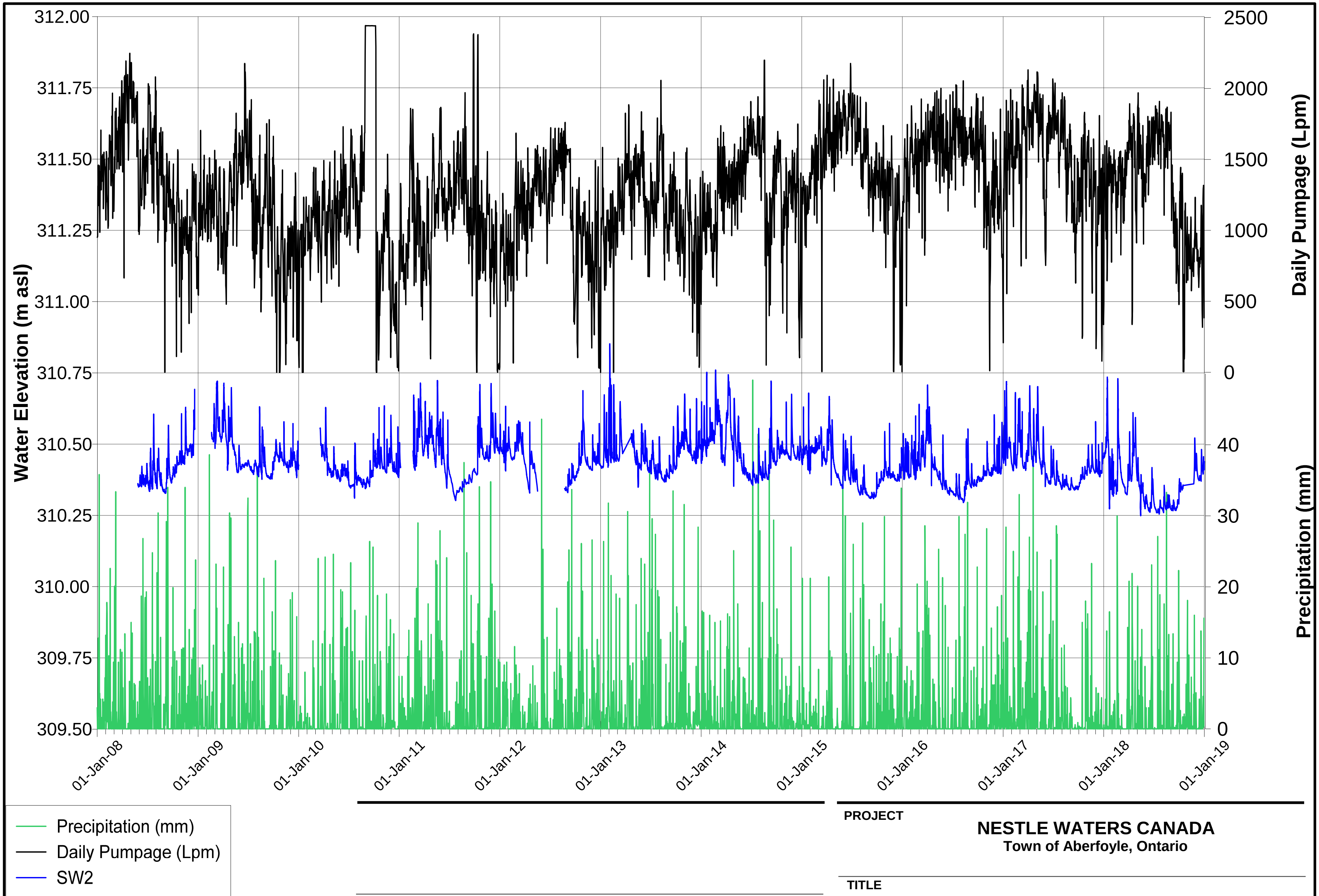
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW1 HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	I3



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

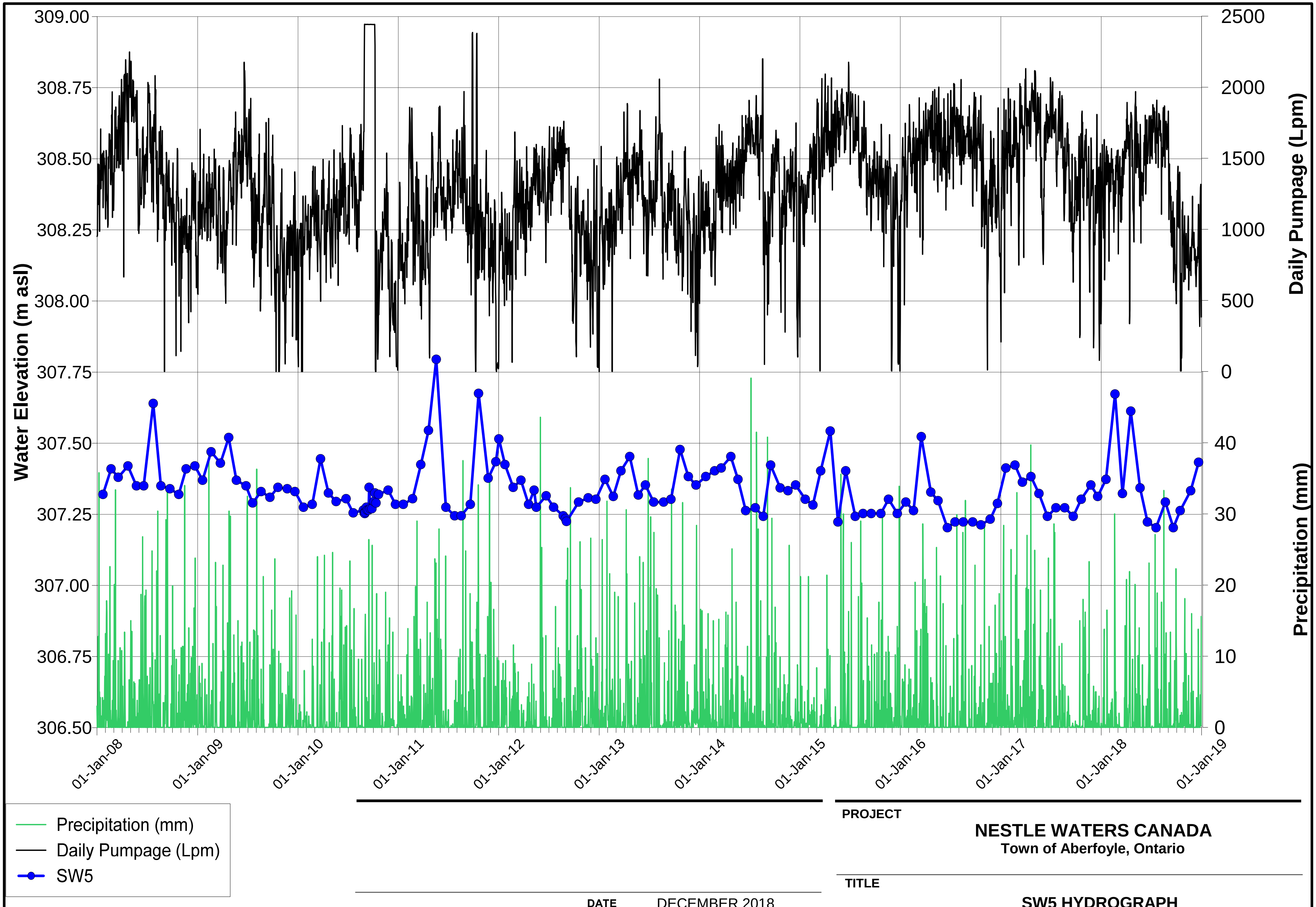
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW2 HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	I4



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

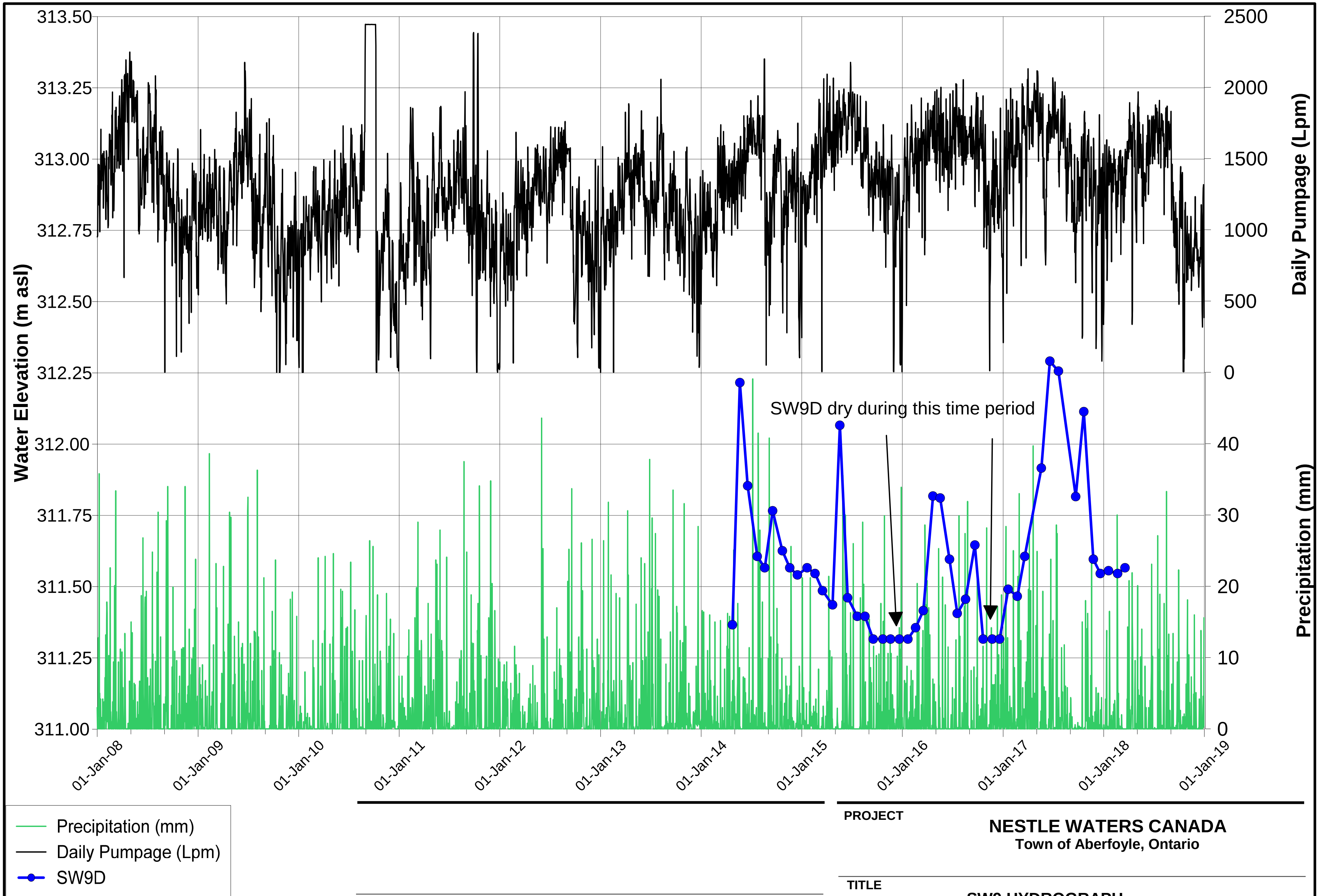
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW5 HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	I5



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

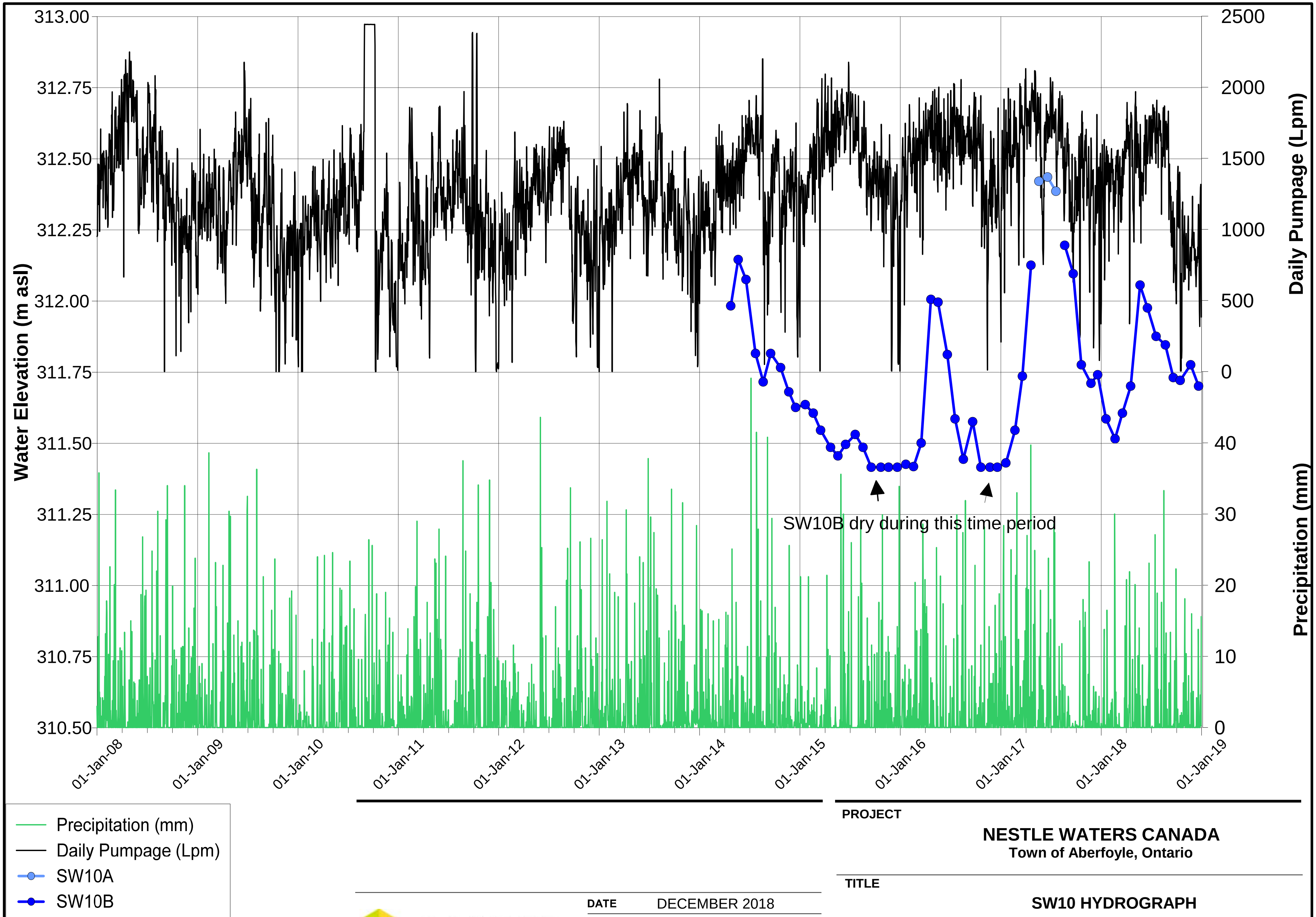
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

SW9 HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	I6



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

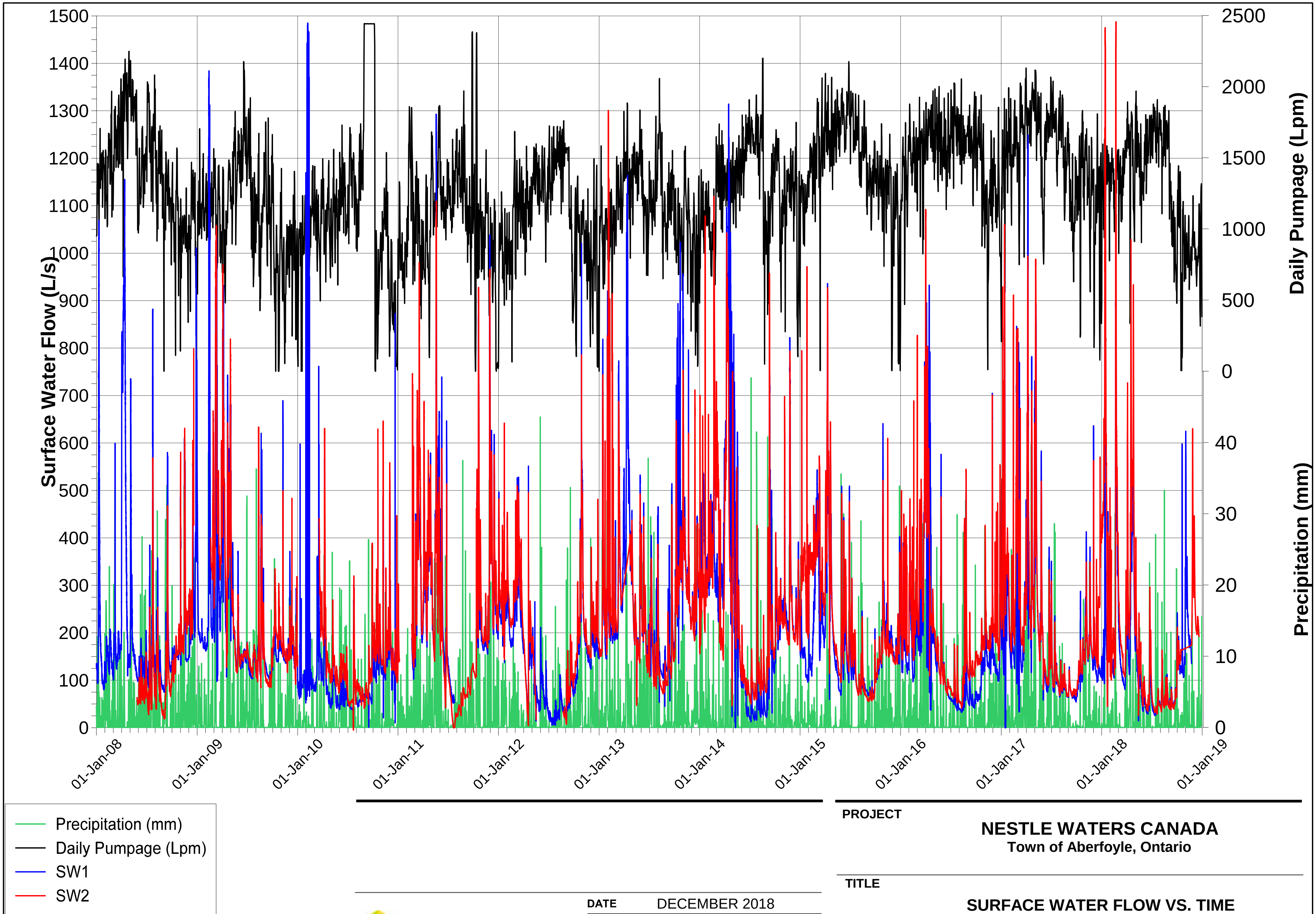
TITLE

SW10 HYDROGRAPH

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	I7

APPENDIX J

Surface Water Flow



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

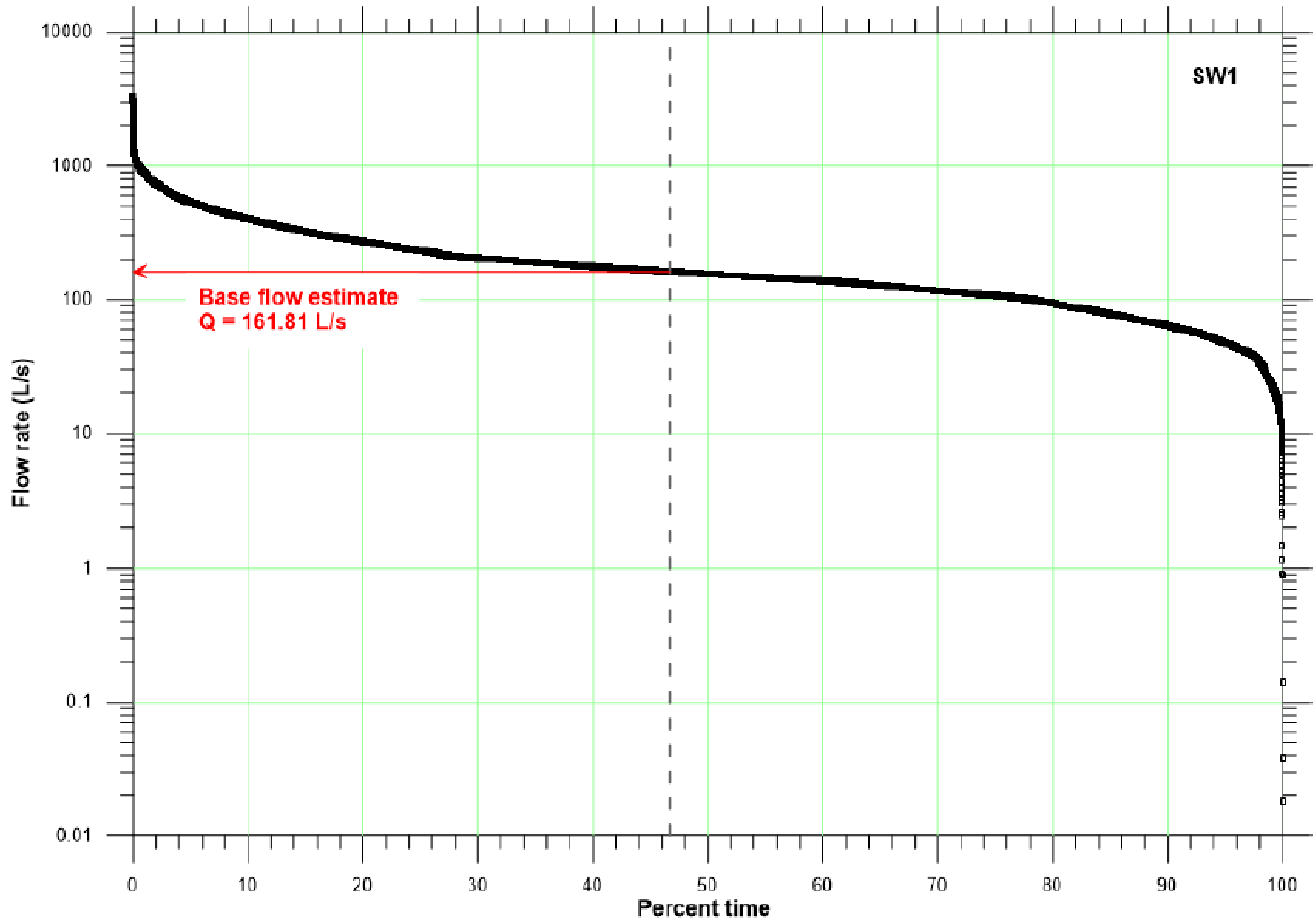
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SURFACE WATER FLOW VS. TIME

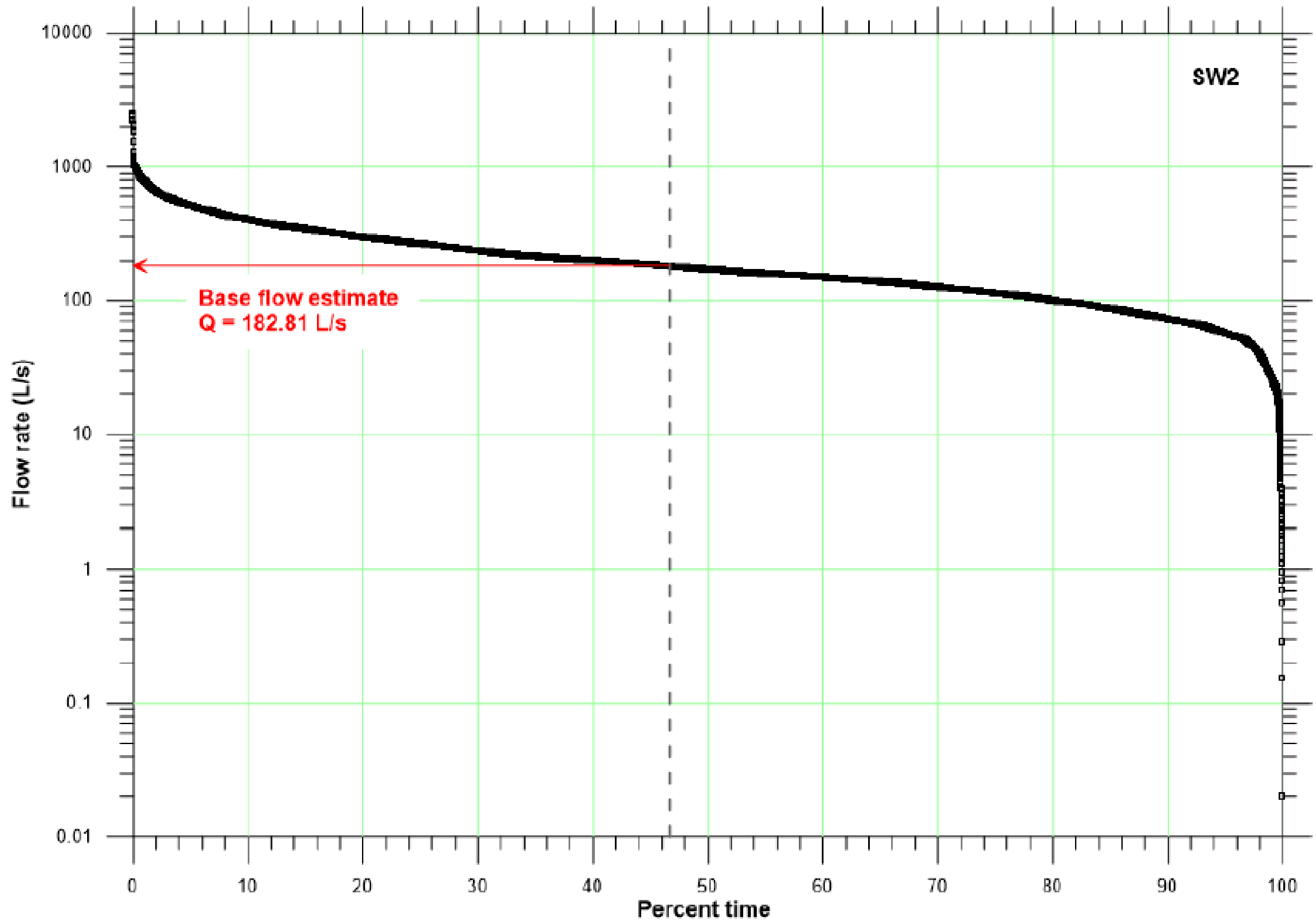
PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	J1



GOLDER

Figure J2

SW1 Ranked Flow Duration

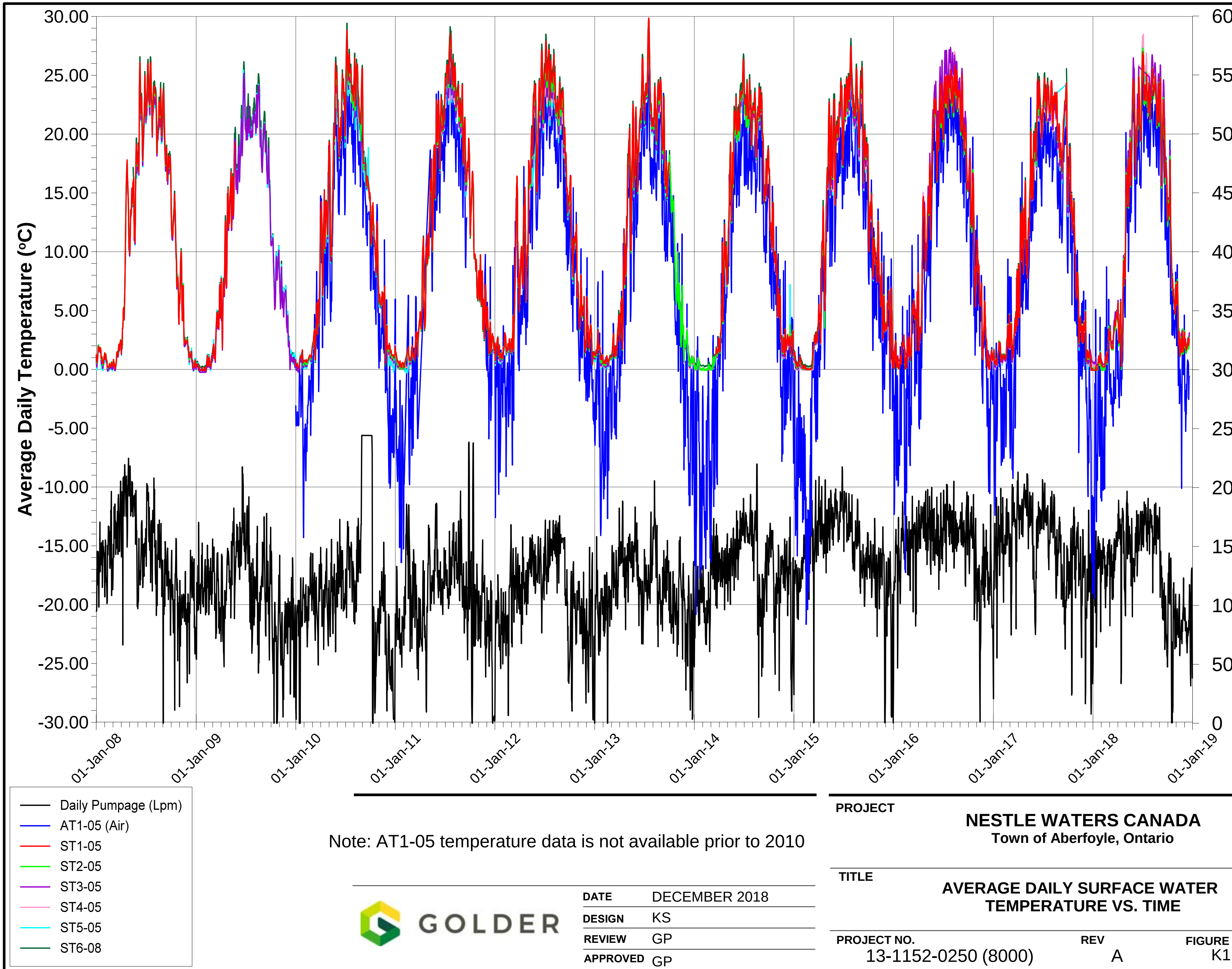


GOLDER

Figure J3
SW2 Ranked Flow Duration

APPENDIX K

Surface Water Temperature



Note: AT1-05 temperature data is not available prior to 2010

GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

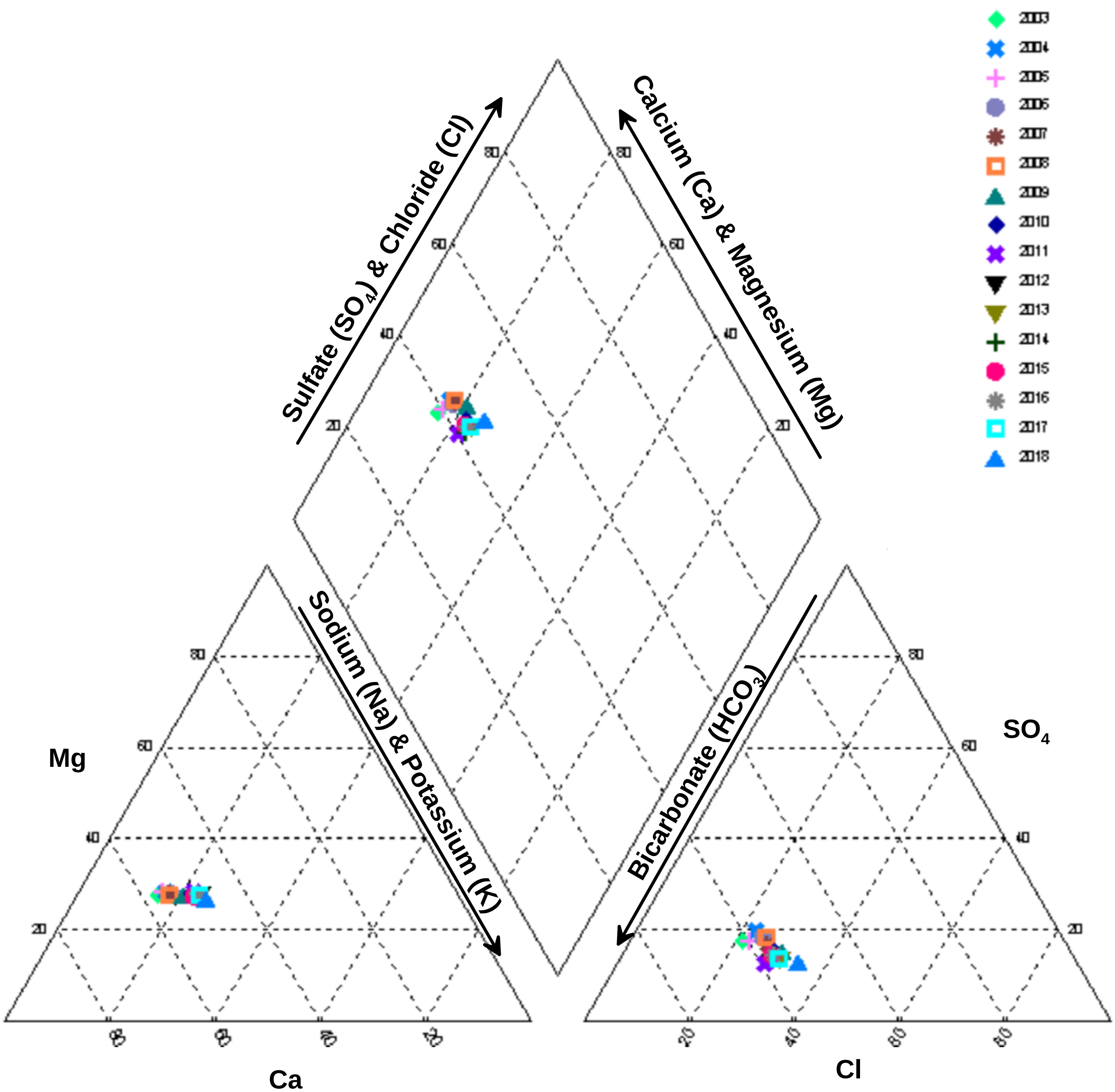
TITLE

AVERAGE DAILY SURFACE WATER TEMPERATURE VS. TIME

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	K1

APPENDIX L

Water Quality

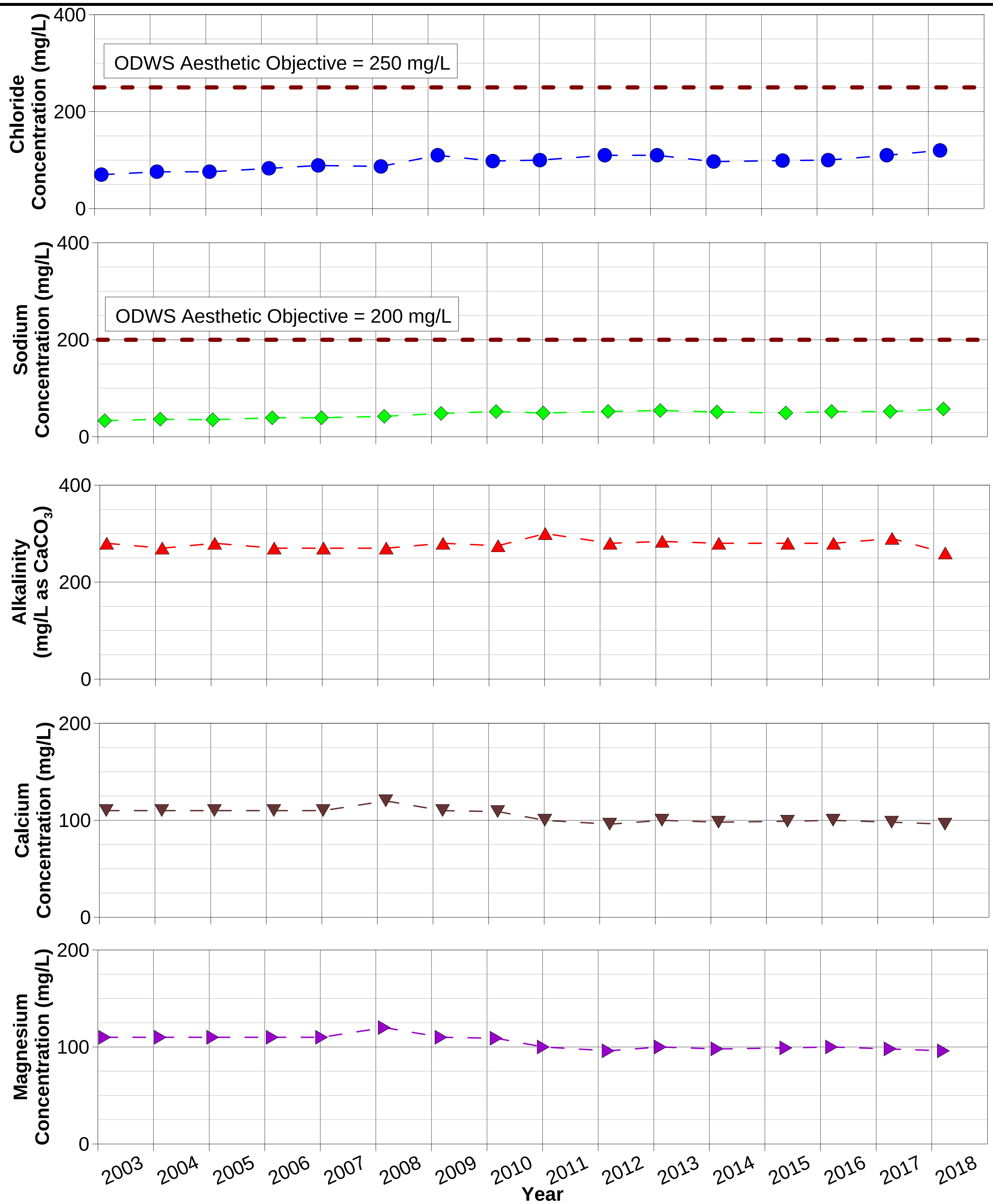


PROJECT	HYDROGEOLOGICAL STUDY NESTLE WATERS CANADA
TITLE	PIPER PLOT

GOLDER

DATE	2018-JUL-10
DESIGN	JLH
REVIEW	GRP
APPROVED	GRP

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	L1



GOLDER

DATE	2019-JUN-17
DESIGN	JLH
REVIEW	GRP
APPROVED	GRP

PROJECT
HYDROGEOLOGICAL STUDY
NESTLE WATERS CANADA

TITLE
WATER QUALITY - TIME SERIES

PROJECT NO.	REV	FIGURE
13-1152-0250 (8000)	A	L2

APPENDIX M

Groundwater Modelling Report

GROUNDWATER MODELLING REPORT
FOR RENEWAL OF THE PERMIT TO TAKE WATER FOR THE NESTLÉ WATERS CANADA ABERFOYLE AND ERIN FACILITIES

Report Prepared for:
CITY OF GUELPH AND NESTLÉ WATERS CANADA

Prepared by:
MATRIX SOLUTIONS INC.

Version 2.0
February 2019
Guelph, Ontario

Unit 7B, 650 Woodlawn Rd. W
Guelph, ON N1K 1B8
T 519.772.3777 F 226.314.1908
www.matrix-solutions.com

GROUNDWATER MODELLING REPORT

FOR RENEWAL OF THE PERMIT TO TAKE WATER FOR THE NESTLÉ WATERS CANADA

ABERFOYLE AND ERIN FACILITIES

Report prepared for City of Guelph and Nestlé Waters Canada, February 2019

PROFESSIONAL GEOSCIENTIST
JEFFREY J. MELCHIN
PRACTISING MEMBER
2338
ONTARIO

Jeffrey Melchin, M.Sc., P.Geo.
Hydrogeologist

February 11, 2019

LICENSED PROFESSIONAL ENGINEER
D. J. VAN VLIET
PROVINCE OF ONTARIO

reviewed by

David Van Vliet, M.A.Sc., P.Eng.
Senior Vice President, Eastern Canada

VERSION CONTROL

Version	Date	Issue Type	Filename	Description
V0.1	17-Sep-2018	Draft	26435-552 Groundwater Modelling R 2018-09-17 draft V0.1.docx	Issued for review
V0.2	17-Sep-2018	Draft Revised	26435-522 Groundwater Modelling R 2018-09-17 draft V0.2.docx	Issued for review with minor text revisions
V0.3	19-Dec-2018	Draft Revised 2	26435-522 Groundwater Modelling R 2018-09-17 draft V0.3.docx	Updates throughout; issued for review
V1.0	22-Jan-2019	Final	26435-522 Groundwater Modelling R 2019-01-22 final V1.0.docx	Updates throughout; issued as final
V2.0	11-Feb-2019	Final Revised	26435-552 Groundwater Modelling R 2019-02-11 final V2.0.docx	Updates throughout; issued as final revised

TABLE OF ABBREVIATIONS

CRA	Conestoga-Rovers and Associates
DEM	Digital Elevation Model
Earthfx	Earthfx Incorporated
FEFLOW	Groundwater Modelling Software
GAWSER	Guelph All-Weather Sequential Events Runoff
GCM	Global Climate Models
GRCA	Grand River Conservation Authority
GGET	City of Guelph and Township of Guelph/Eramosa
GRIN	Grand River Information Network
HSP-F	Hydrologic Simulation Program - Fortran
MECP	Ministry of Environment, Conservation, and Parks
MNR	Ministry of Natural Resources
MNRF	Ministry of Natural Resources and Forestry
MOE	Ministry of the Environment
MOECC	Ministry of Environment and Climate Change
NWC	Nestlé Waters Canada
PEST	Parameter ESTimation [Software]
PRMS	Precipitation-Runoff Modelling System
PTTW	Permit to Take Water
SSPA	S.S. Papadopulos and Associates
WWIS	Water Well Information System

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1 INTRODUCTION

The Ministry of Environment, Conservation and Parks (MECP) has provided new guidance outlining the requirements for the renewal of Permits to Take Water (PTTWs) for water bottling purposes (MOECC 2017). This guidance requires that an assessment of cumulative effects of renewed takings be completed using the highest tier water budget that has been completed under the *Clean Water Act*, 2006 (Government of Ontario 2018). In response to these requirements, Nestlé Waters Canada (NWC) arranged for the numerical groundwater flow model developed for the City of Guelph and Township of Guelph/Eramosa (GGET), *Tier Three Water Budget and Local Area Risk Assessment* (GGET Tier Three Assessment; Matrix 2017a) be updated in the areas of their Aberfoyle and Erin operations, and applied to assess cumulative effects as part of its PTTW renewal applications.

Matrix Solutions Inc. was retained by the City of Guelph, under contract with NWC, to refine the GGET Tier Three groundwater flow model (Tier Three model), to address the technical requirements of the *Interim Guidance Document* (MOECC 2017). The approach was based on the work plan agreed to by the City of Guelph and NWC (Matrix 2017b). This report outlines the work completed in support of meeting these requirements, including a cumulative effects water quantity risk assessment that considers current and drought conditions. The potential impacts of these conditions on local groundwater levels and municipal groundwater users, as well as the potential impacts on groundwater discharge to surface water features, were assessed using the refined Tier Three model. Finally, the model was applied to evaluate the potential change in groundwater levels and groundwater discharge under future climate conditions following the methodology described by Matrix (2018a).

Matrix worked with NWC and its consultants (S.S. Papadopulos & Associates [SSPA], Golder Associates, and Blackport Hydrogeology Inc.) to complete this numerical modelling project, which included the sharing of data between parties and consultations during data analysis, model refinement, and calibration. The project leveraged the experience and local knowledge of these consultants gained through multiple years of data collection and analysis in the areas of Aberfoyle and Erin. Final model review and model calibration was completed in consultation with SSPA.

This report summarizes the geologic and hydrogeologic settings (Section 2), updates made to the numerical model (Section 3), model calibration data and results (Section 4), and results of the predictive steady-state (long-term average), transient (time-varying), and future climate scenarios for the Aberfoyle and Erin sites (Section 5).

1.1 Tier Three Assessment

A Tier Three Assessment was previously completed for municipal drinking water systems of GGET within the Province of Ontario, Canada (Matrix 2017a). As a requirement under the province's *Clean Water Act* (Bill 43; Government of Ontario 2018), the purpose of the Tier Three Assessment was to identify the Water Quantity Threats to municipal drinking water systems, where those systems are located within a subwatershed classified as having a Moderate or Significant potential for water quantity stress during a Tier Two Water Quantity Stress Assessment (AquaResource 2009a; 2009b).

The scope of work completed for the GGET Tier Three Assessment and documented in Matrix (2017a) follows the Province of Ontario's *Technical Rules: Assessment Report, Clean Water Act, 2006* (Technical Rules; MOECC 2016), *Technical Bulletin: Part IX Local Area Risk Level* (Technical Bulletin; MOE and MNR 2010), and the *Memorandum: Assignment of Water Quantity Risk based on the Evaluation of Impacts to Other Water Users* (Technical Guidance Memorandum; MOE 2013). This work included the following tasks:

- Develop the conceptual understanding of the study area.
- Develop and calibrate a groundwater flow model with sufficient detail to simulate groundwater flow near municipal wells and surface water features.
- Develop and calibrate a streamflow-generation model to simulate variable streamflow in the area, and to estimate groundwater recharge rates in the study area.
- Apply the calibrated surface water and groundwater models to assess the water budget components in the Study Area and near municipal wells.
- Complete a Local Area Risk Assessment for the municipal wells located in the Study Area to determine if there is a risk that the municipal wells may not be able to meet current or future demands, while considering population growth, reduced groundwater recharge due to land development, and drought conditions.
- Identify Significant Water Quantity Threats, including consumptive water takings and areas of potential reduced groundwater recharge.

All stages of the GGET Tier Three Assessment, including development of the Tier Three model, were peer reviewed on behalf of the Lake Erie Source Protection Region by a Provincial Peer Review team consisting of hydrogeology and hydrology experts, to ensure that the technical aspects of the study complied with the *Technical Rules*. Municipalities local to the study area also provided technical review for consideration by the project team and Provincial Peer Review team.

1.1.1 Tier Three Assessment Groundwater Flow Model

To carry out the GGET Tier Three Assessment, a FEFLOW (version 6.2; Diersch 2014) groundwater flow model was developed based on the detailed conceptual model of the geologic, hydrologic, and hydrogeologic systems of the study area, with particular focus on the areas surrounding the City of Guelph and Rockwood and Hamilton Drive municipal well fields (Figure 1). The approach used to develop the Tier Three model built upon the approach followed to build the Guelph-Puslinch groundwater flow model (Golder 2006). The key advancements made in developing this updated and refined groundwater flow model were as follows:

- The geographic coverage of the Tier Three model was extended to include the Grand River to the west, and the Niagara Escarpment to the east (Figure 1). Carrying the model westward to the Grand River provided a natural boundary condition for groundwater flow. The Niagara Escarpment represents the physical location where the Gasport Formation bedrock aquifer, the main aquifer supplying the municipal water supplies, pinches out.

- The conceptual model was updated based on detailed interpretation of geologic units at numerous high-quality boreholes located throughout the area, whereas the bedrock conceptual model used in the Guelph-Puslinch groundwater flow model was simplified, and represented by layers of constant thickness.

- Groundwater level data from high quality groundwater monitoring wells installed by the City of Guelph and screened in discrete hydrogeologic units provided an improved and enhanced understanding of the bedrock flow system.

- The Township of Guelph/Eramosa conducted additional studies for the municipal systems in Rockwood that improved understanding of the bedrock system in that area.

- The groundwater flow model was refined to include additional surface water features that were not previously represented in the Guelph-Puslinch groundwater flow model.

The approach adopted to calibrate the Tier Three model included a combination of iterative manual and software-assisted (Parameter ESTimation [PEST]; version 12; Doherty 2013) calibration. The model was calibrated to long-term steady-state conditions, and to transient conditions that included the simulation of a long-term pumping test (City of Guelph) and shorter-term pumping tests. Transient model verification was also undertaken to confirm the performance of the model under transient conditions. The steady-state Tier Three model was calibrated to hydraulic head measurements from MOECC domestic water wells records, GGET high-quality monitoring wells, and other high-quality wells that are part of other studies. The model was also calibrated to streamflow targets assumed to be representative of baseflow conditions. These targets were estimated from spot baseflow observations and streamflow gauge data collected by the Grand River Conservation Authority (GRCA), Water Survey of Canada, and others, at locations throughout the study area.

Calibration of the groundwater flow model relied on estimates of groundwater recharge across the landscape represented by the model. Groundwater recharge estimates used in the calibration of the model include the following:

- The Grand River Watershed Guelph All-Weather Sequential Events Runoff (GAWSER) streamflow generation model (version 6.5; Schroeter & Associates 2004, AquaResource 2009a, Matrix 2017a).

- The Credit River Watershed HSP-F model (AquaResource 2009c).

- Halton and Hamilton Region Conservation Authorities Precipitation-Runoff Modelling System (PRMS) model (Earthfx 2009).

Additional information on the development and calibration of the groundwater and streamflow-generation and hydrologic models is provided in Appendices B, D, and E of Matrix (2017a), and references therein.

The version of the Tier Three model used in the update and calibration effort described in the following sections is based on the model developed for GGET Tier Three Risk Assessment Scenario C (Matrix 2017a), which includes consideration of average climate conditions (i.e., average recharge), existing municipal pumping, and existing non-municipal pumping. Non-municipal permits and pumping rates were updated in the model to reflect more recent data within the local groundwater vulnerable area as part of a *Water Quantity Policy Development Study* (Matrix 2018b). Specifically, the PTTW database (September 2017 data release) and Water Taking Reporting System (WTRS; 2009 to 2016) were reviewed to assess if the non-municipal permitted takings represented in the model were still representative of existing conditions. Permits that had expired were removed from the model and the rates were updated using 2016 WTRS data. Consumptive use (i.e., the amount of water removed from a source without being returned to the same source) was estimated using the method used in the GGET Tier Three Assessment. Based on this work, the total consumptive pumping in the local groundwater vulnerable area decreased by 966 m^3/day. These refined non-municipal pumping rates were carried forward for use in this project.

1.2 Nestlé Waters Canada Operations

1.2.1 Aberfoyle

The NWC Aberfoyle property is located within the Grand River Watershed, in the Township of Puslinch, approximately 3 km south of the City of Guelph, and 2 km north of Highway 401 along Wellington Road 46 (Figure 2). NWC is permitted to pump water from bedrock well TW3-80 for water bottling purposes, and bedrock well TW2-11 for miscellaneous purposes under PTTW 1381-95ATPY at a maximum total rate of 3,600 m^3/day; however, well TW2-11 has not been used to date. Permitted taking of water has been ongoing at the site since NWC purchased the pre-existing Aberfoyle Springs bottling facility in 2000, and in 2017 annual taking totaled 767,883 m^3.

NWC conducts annual environmental monitoring onsite that includes measurement of groundwater levels, mini-piezometer levels, surface water levels, flows, and temperatures. These monitoring locations are shown on Figure 2. A full description of the monitoring program and historical monitoring data is provided in annual monitoring reports prepared on behalf of NWC (e.g., Golder 2018a).

Notable surface water features in the area include Mill Creek, which runs from northeast to southwest just north of the NWC property (Figure 2). A portion of Mill Creek flow is diverted into Aberfoyle Creek in the area of the Mini Lakes community (Figure 2). At this point, Aberfoyle Creek continues south, into Aberfoyle Mill Pond, and then through the NWC property. Aberfoyle Creek rejoins Mill Creek just west of the NWC property (Figure 2).

1.2.2 Erin

The NWC Erin bedrock well TW1-88 is located in the Grand River Watershed, close to the surface water divide between the Grand River Watershed and the Credit River Watershed. It is situated in the Town of Erin, approximately 500 m southwest of the Community of Hillsburgh (Figure 1). NWC is permitted to pump water from this well for water bottling purposes, under PTTW 3716-8UZMCU, at a maximum rate of 1,113 m^3/day. Permitted water taking has been ongoing at the site since 2000 and in 2017 the annual taking was 66,075 m^3.

Similar to the Aberfoyle site, NWC conducts annual environmental monitoring onsite that includes measurement of groundwater levels, mini-piezometer levels, surface water levels and flows. These monitoring locations are shown on Figure 3. A full description of the monitoring program and historical monitoring data is provided in annual monitoring reports prepared on behalf of NWC (e.g., Golder 2018b).

Notable surface water features in the area include tributaries of the Eramosa River and the Erin Branch of the Credit River, which briefly cross into the NWC property along the northwestern and northeastern property corners, respectively (Figure 3). Tributaries and on-line ponds contributing to the Eramosa River originate on and just north of the NWC property before continuing out of the area toward the southwest and south. Similarly, tributaries and ponds associated with the Erin Branch of the Credit River originate north and northeast of the NWC property before entering the Hillsburgh Pond, flowing out of the study area to the south and east. South of the NWC property, a creek originating from Roman Lake drains toward the southeast, where it enters the main branch of the West Credit River.

2 GEOLOGIC AND HYDROGEOLOGIC SETTING

Detailed descriptions of the regional geologic and hydrologic settings are provided in Matrix (2017a). Descriptions of the local geologic and hydrogeologic settings near NWC operations are provided in the 2017 annual monitoring reports for Aberfoyle (Golder 2018a) and Erin (Golder 2018b). Summaries of how these local settings are represented in the Tier Three model are presented in the following sections.

2.1 Aberfoyle

2.1.1 Overburden

The local overburden geology of the Aberfoyle site generally consists of coarse-grained outwash and ice-contact sand and gravel deposits overlying a finer-grained stony, silt Wentworth Till. This till also makes up the Paris and Galt moraines that are mapped toward the north and south of the site, where the till thickens to surface. Overburden thickness near the site ranges from 15 to 20 m and organic deposits are mapped along Aberfoyle Creek as it crosses the NWC property (Golder 2018a).

In the Tier Three model the shallow, coarser-grained deposits are represented as “Overburden A,” upper sand and gravel aquifer. Below this, the finer-grained till deposits are represented as “Overburden B,” a lower till aquitard (Table 1).

2.1.2 Bedrock

The bedrock geology of the Aberfoyle site has been historically described (Golder 2018a) using bedrock nomenclature and interpretations made prior to more recent updates made by the Ontario Geological Survey (e.g., Brunton 2009). Under that previous framework, bedrock hydrogeologic units at the Aberfoyle site were described (from shallow to deep) as the Guelph Formation Aquifer overlying the Eramosa Member Aquitard, the Amabel Formation Aquifer, and the Cabot Head Formation Aquitard. This interpretation is consistent with the more regional bedrock interpretation that existed prior to the development of the Tier Three model, as summarized in Table 1. The development of the Tier Three model; however, incorporated the revised nomenclature (after Brunton 2009; Table 1) which included refinement into new and additional bedrock formations and members. Based on this revised framework, modelled hydrostratigraphic units included:

- Guelph Formation Aquifer
- Reformatory Quarry Member Aquifer/Aquitard (Eramosa Formation)
- Vinemount Member Aquitard (Eramosa Formation)
- Goat Island Formation Aquifer/Aquitard
- Upper Gasport Aquifer, Middle Gasport High Permeability Aquifer, and Lower Gasport Aquifer units of the Gasport Formation
- Cabot Head Formation Aquitard

A comparison of these modelled hydrostratigraphic units and how they relate to the current and previous bedrock conceptualizations is presented in Table 1. Additional details on these hydrostratigraphic units are found in Matrix (2017a).

Monitoring well calibration targets are classified with respect to dominant hydrogeological units, including the Upper Bedrock Aquifer (bedrock targets above the Vinemount Aquitard) and Lower

Bedrock Aquifer (bedrock targets below the Vinemount Aquitard). This simplified conceptualization is also provided in Table 1.

TABLE 1 Aberfoyle - Conceptualization of Stratigraphic Framework

Bedrock Conceptualization Previous to GGET Tier Three Study[1]		Bedrock Conceptualization for GGET Tier Three Study[2]		GGET Tier Three Model Representation of Hydrostratigraphic Units[3]		Simplified Conceptualization at NWC Site for Calibration Targets
Formation	**Member**	**Formation**	**Member**	**Hydrostratigraphic Unit**	**Model Layer**	
Overburden		Overburden		Overburden A (Upper Sand/Gravel Aquifer)	1-2	Overburden Targets
				Overburden B (Lower Till Aquitard)	3	
Guelph Fm.		Guelph	Hanlon	Contact Zone (fractured bedrock / basal unconsolidated deposits)	4	Upper Bedrock Aquifer Targets
			Wellington	Guelph Fm. (Aquifer)	5	
Amabel	Eramosa	Eramosa	Stone Road			
			Reformatory Quarry	Reformatory Quarry Mbr. (Aquifer/Aquitard)	6	
			Vinemount	Vinemount Mbr. (Aquitard)	7-9	Middle Bedrock Aquitard
	Wiarton / Colpoy / Lions Head	Goat Island	Ancaster / Niagara Falls	Goat Island Fm. (Aquifer/Aquitard)	10	Lower Bedrock Aquifer Targets
		Gasport	Gothic Hill	Upper Gasport Unit (Aquifer)	11	
				Middle Gasport Unit (High Permeability Aquifer)	12	
		Rochester / Irondequoit / Rockway / Merritton Fms.		Lower Gasport Unit (Aquifer)	13	
Cabot Head/Reynales Fm.		Cabot Head Fm.		Cabot Head Fm. (Aquitard)	14	Cabot Head Fm. (Aquitard)

[1] Golder (2006)
[2] After Brunton (2009)
[3] Matrix (2017a)

2.1.3 Simulated Hydrostratigraphy and Groundwater Flow

Cross-sections were created to illustrate the GGET Tier Three hydrostratigraphy compared to the interpretation provided in Golder (2018a). Figure 2 shows the locations of Cross-section A-A′ (Figure 4) extending from the northwest to the southeast, and Cross-section B-B′ (Figure 5) extending from the southwest to the northeast. Each cross-section illustrates the horizontal conductivity distribution in the calibrated Tier Three model described in Section 4. The GGET Tier Three hydrostratigraphic layers (elevation and thickness) were assumed to be acceptable for this assessment, and model modifications were made by adjusting hydraulic conductivities locally.

Figures 4 and 5 illustrate the locations of the higher permeability hydrostratigraphic units, including the overburden (Overburden A), Contact Zone, Guelph Formation, Reformatory Quarry Member, and the Middle Gasport Formation aquifers. The other units in the Aberfoyle area are simulated with relatively lower hydraulic conductivity, except for small zones in the Goat Island Formation and overlying Vinemount Member. These localized zones of higher conductivity correspond to areas where there was a stronger water level response during pumping tests, suggesting a greater hydraulic connection to the pumping well. There may be differences in bedrock formations interpreted between the cross-sections provided in Golder (2018a), and the refined interpretations presented in Figures 4 and 5. For example, the Guelph Formation is conceptualized to exist in Cross-section A-A’ of Golder (2018a); however, the Reformatory Quarry Member of the Eramosa Formation is conceptualized along the same portion of cross-section in the GGET Tier Three model (Figure 4).

NWC production well TW3-80 is completed within the high conductivity zone of the Goat Island Formation and within this unit groundwater is simulated to flow regionally from the north to the south, with a local low in the potentiometric surface from NWC pumping (Figure 6). The simulated potentiometric surface of Figure 6 is based on a simulated pumping rate of 2,113 m^3/day, representing average NWC Aberfoyle pumping conditions from 2015 to 2017. The interpreted observed potentiometric surface of the production aquifer is provided in Figure 4.3 of Golder (2018a).

2.2 Erin

2.2.1 Overburden

The local overburden geology of the Erin site is similar to that of the Aberfoyle site, with a coarser-grained glaciofluvial outwash or ice-contact stratified drift overlying a deeper, finer-grained clay to sandy silt till, with more recent organic deposits found along watercourses. The shallower sand and gravel deposits generally thicken to the northwest, whereas the deeper finer-grained till is continuous across the site, and in some areas where it thickens it outcrops at surface. The outcrop area includes portions of the NWC property and areas toward the east and south where the till is associated with topographically high areas (Golder 2018b). At NWC production well TW1-88, the overburden is approximately 20 m thick.

In the Tier Three model the shallow, coarser-grained deposits are represented as “Overburden A,” an upper sand and gravel aquifer. Below this, the finer-grained till deposits are represented as “Overburden B,” a lower till aquitard (Table 2).

2.2.2 Bedrock

The bedrock geology of the Erin site has been previously described locally using a bedrock nomenclature that includes the Guelph Formation overlying the Amabel Formation (Golder 2018b). The focus of the GGET Tier Three bedrock conceptualization was the Guelph area, and as a result, there were fewer high quality locations gathered and interpreted for the bedrock conceptualization in the Erin area. As a result, the elevations of the GGET Tier Three bedrock layers did not initially align with the bedrock layers currently conceptualized onsite. The modelled bedrock layer interpretations were refined in the Erin area based on local expertise provided by Blackport Hydrogeology Inc. and examination of local well logs. The revised model hydrostratigraphy for the Erin area is summarized in Table 2, along with the associated model layers and previous interpretation.

Based on the refined conceptualization, the updated modelled bedrock hydrostratigraphic units in the Erin area include a thicker Guelph Formation Aquifer overlying the Vinemount Aquitard, Gasport Formation Aquifer, and Cabot Head Formation Aquitard (Table 2). Similar to the Aberfoyle area, the hydraulic conductivity of simulated hydrostratigraphic units were refined locally, as opposed to introducing new layer elevations. For example, the hydraulic conductivity of model layers 5 to 10, that were previously conceptualized as four different bedrock units, were refined during the calibration process (Section 4) to the same values representing a thicker Guelph Formation.

TABLE 2 Erin - Conceptualization of Stratigraphic Framework

Tier Three Model Representation of Hydrostratigraphic Units[1]	Model Layer	Conceptualization Update for Erin Area
Overburden A (Upper Sand/Gravel Aquifer)	1-2	Overburden A (Upper Sand/Gravel Aquifer)
Overburden B (Lower Till Aquitard)	3	Overburden B (Lower Till Aquitard)
Contact Zone (fractured bedrock / basal unconsolidated deposits)	4	Contact Zone (fractured bedrock / basal unconsolidated deposits)
Guelph Fm. (Aquifer)	5	Guelph Fm. (Aquifer)
Reformatory Quarry Mbr. (Aquifer/Aquitard)	6	
Vinemount Mbr. (Aquitard)	7-9	
Goat Island Fm. (Aquifer/Aquitard)	10	
Upper Gasport Unit (Aquifer)	11	Vinemount Mbr. (Aquitard)
Middle Gasport Unit (High Permeability Aquifer)	12	Gasport Fm. (Aquifer)
Lower Gasport Unit (Aquifer)	13	
Cabot Head Fm. (Aquitard)	14	Cabot Head Fm. (Aquitard)

[1] Matrix (2017a)

2.2.3 Simulated Stratigraphy and Groundwater Flow

Cross-sections were created to illustrate the GGET Tier Three hydrostratigraphy compared to the interpretation provided in Golder (2018b). Figure 3 shows the locations of Cross-section A-A′ (Figure 7) extending from the northwest to the southeast, and Cross-section B-B′ (Figure 8) extending from the southwest to the northeast. Each of the cross-sections illustrate the final hydraulic conductivity distribution achieved following the calibration effort described in Section 4. Figures 7 and 8 illustrate the hydrostratigraphic units with relatively higher hydraulic conductivity, including the overburden (Overburden A), Contact Zone, Guelph Formation, and the Gasport Formation aquifers. The other units in the Erin area are simulated with relatively lower hydraulic conductivity.

NWC production well TW1-88 is completed within the Guelph Formation, and within this unit groundwater is simulated to flow regionally from northwest to southeast (Figure 9), with a local depression in the potentiometric surface in response to NWC pumping. The simulated hydraulic head contours also show a hydraulic gradient toward the Erin Branch of the Credit River as it flows toward the Town of Erin to the east. The simulated potentiometric surface of Figure 9 is based on a simulated pumping rate of 207 m^3/day, representing average NWC Erin pumping conditions from 2015 to 2017. The interpreted observed potentiometric surface of the bedrock aquifer is provided in Figure 4.3 of Golder (2018b).

3 TIER THREE MODEL UPDATES

Local refinements to the Tier Three model were carried out in consultation with SSPA, Golder, and Blackport. This section describes the following updates made to the Tier Three model surrounding the NWC Aberfoyle and Erin sites:

- Revisions to the distribution and properties of hydrogeologic units.
- Mesh refinement around local surface watercourses, water bodies, and pumping wells.
- Addition of, and refinements to, boundary conditions representing surface watercourses and water bodies.
- Relocation and refinements to the magnitude of existing pumping well boundary conditions.
- Local model recalibration to account for the above refinements.

These model updates are discussed in the following sections for the Aberfoyle and Erin sites. Model calibration is discussed in Section 4.

3.1 Aberfoyle

The development and calibration of the GGET Tier Three model incorporated some local information, specifically in the Goat Island Formation, where NWC production well TW3-80 is completed (Matrix 2017a, Appendix E). Further updates and calibration in the Aberfoyle area as part of this current model refinement effort included a more fulsome examination of data from Lower Bedrock Aquifer units (below the Vinemount Aquitard), Upper Bedrock Aquifer units (above the Vinemount Aquitard), overburden sediments, and surface water features. Key data sources included:

- NWC 2017 Annual Monitoring Report (Golder 2018a).
- NWC 2010 Annual Monitoring Report (CRA 2011).

- Spatial data available from the online GRCA Grand River Information Network (GRIN) - Mapping used included 1 m ground surface topography contours, water bodies, and watercourses (GRCA 2018).

With the availability of long-term average water level data (Golder 2018a) and detailed water level response observations in various hydrostratigraphic units during a 40-day constant rate pumping test at TW3-80 (CRA 2011), refinements were made to the groundwater flow model to improve local, well-field scale response to NWC pumping, including:

- Refining the finite element mesh around TW3-80 and local surface water features.
- Adjusting the simulated horizontal location of TW3-80 following mesh refinement.
- Updating hydraulic conductivity values applied in different hydrostratigraphic units based on calibration to long-term average and pumping conditions (detailed in Section 4).
- Adding new and refining existing boundary conditions representing surface watercourses and water bodies (discussed in greater detail in the following section).

3.1.1 Representation of Surface Water Features

Groundwater flow models allow water to move between groundwater and surface water features through surface water boundary conditions. Surface water features are represented in the Tier Three model by assigning a specified head (water elevation) boundary condition to each model node along streams or rivers. The specified head, or water elevation, at each boundary condition was assumed to be the ground surface elevation at that location, as estimated from the 10 m Digital Elevation Model (DEM) of the ground surface available at the time of the GGET Tier Three Assessment. Observed water level elevation data were used for assigning specified head boundaries for larger water bodies in the model (e.g., lakes and reservoirs) where those data were available.

For this model update, the addition of new and refined boundary conditions was important to represent watercourses at a finer scale than was incorporated into the Tier Three model. In particular, Aberfoyle Creek, which runs through the NWC Aberfoyle property (Figure 2) was not previously represented in the Tier Three model due to its small size. NWC has collected water levels and flows along Aberfoyle Creek as part of the annual monitoring program (Golder 2018a). As the predicted change in groundwater discharge to Mill Creek is being assessed as part of this project, and since Aberfoyle Creek feeds into Mill Creek just west of the NWC property, Aberfoyle Creek was represented in the model.

Spatial watercourse mapping from the GRCA's online GRIN dataset (GRCA 2018) was used to approximate the location and path of the creek, and average observed water levels (Golder 2018a) were used to assign specified head boundary conditions at surface water monitoring stations SW01 and SW02 (Figure 2). Boundary conditions along Aberfoyle Creek between these stations were linearly interpolated along the creek from the observed water levels. Other parts of Aberfoyle Creek, as well as other local water bodies (e.g., Aberfoyle Mill Pond and Mini Lakes) and streams were incorporated into the model with assigned specified head values estimated from current topographic mapping available through the GRCA GRIN dataset (GRCA 2018).

3.2 Erin

The Erin NWC site is located more than 15 km from the municipal supply wells of the City of Guelph, Town of Rockwood, and community of Hamilton Drive, where the physical characterization and model calibration was focussed. Additional local information was obtained for the site to improve characterization and calibration locally. Key data sources included:

- NWC Annual Monitoring Reports (Golder 2018b and CRA 2014a).
- *Well Construction and Testing Investigations* (CRA 1989).
- Insights from Blackport Hydrogeology Inc., who have considerable local hydrogeological experience.
- Spatial data available from the online GRCA GRIN dataset. Mapping used included 1 m ground surface topography contours, water bodies, and watercourses (GRCA 2018).

The following refinements were made to the Tier Three model using these data sources, and the long-term water level monitoring data contained therein, to support local, well-field scale calibration:

- Refining the finite element mesh around TW1-88 and local surface water features.
- Adjusting the simulated horizontal and vertical locations of TW1-88, Hillsburgh municipal Wells 2 and 3.
- Updating the pumping rates of Hillsburgh Wells 2 and 3 from the original estimates in the Tier Three model (i.e., 216 m^3/day [H2] and 216 m^3/day [H3]) to more recent (2011 to 2013) average pumping rates (i.e., 67 m^3/day [H2] and 101 m^3/day [H3] [Blackport Pers. Comm. 2018]). Total pumping from the Hillsburgh municipal wells has remained relatively constant (e.g., 163 to 179 m^3/day from 2016 to 2017; Town of Erin 2017, 2018).
- Updating hydraulic conductivity values applied in different hydrostratigraphic units based on the local hydrostratigraphy and calibration to long-term average and pumping conditions (detailed in Section 4).
- Adding new and refining existing boundary conditions representing surface watercourses and water bodies (discussed in greater detail in the following section).

3.2.1 Representation of Surface Water Features

Boundary conditions representing interactions between groundwater and surface water were added in the NWC Erin area following the same approach used in Aberfoyle. The location and path of new stream and pond boundary conditions were guided by spatial data from the GRCA GRIN dataset for the Grand River Watershed and from the Ontario Ministry of Natural Resources and Forestry (MNRF) for the Credit River Watershed.

Average observed water levels (Golder 2018b) were used to assign specified head boundary conditions at local surface water monitoring locations SW1-08, SW3-08, SW4-08, SW5-08, SW7-08, and SW7A-16 (Figure 3). Boundary conditions in other areas were assigned based on where 1 m ground surface topography contours cross surface water features. Linear interpolation was used to assign boundary conditions between locations assigned using observed water levels or topography contours, and to link them to surface water features already represented in the model. Blackport Hydrogeology Inc. provided water level data for the pond in Hillsburgh (Blackport Pers. Comm. 2018). Finally, boundary conditions were assigned using the elevation of the existing simulated ground surface in the Credit River Watershed where more detailed information was lacking.

4 MODEL CALIBRATION

Given the model updates described in Section 3, and the availability of long-term average and pumping water level monitoring data, local-scale model calibration was completed in the Tier Three model at the NWC Aberfoyle and Erin sites. The calibration effort was carried out in consultation with SSPA, Golder, and Blackport. Following calibration to observed water levels (Appendix A), simulated groundwater discharge to local streams was compared to baseflow and streamflow estimates to verify that the model adequately represents observed streamflow conditions. These calibrations are further discussed in Section 4.1 and 4.2 for the Aberfoyle and Erin sites, respectively.

4.1 Aberfoyle

Calibration in the Aberfoyle area involved making local refinements to zones of hydraulic conductivity in different hydrostratigraphic units in the Tier Three model to achieve a match between observed and simulated water levels. Both long-term average water level data, as well as measured recovery following a 40-day constant rate pumping test were used during the calibration process. The objective was to improve agreement with the model against both datasets.

4.1.1 Hydraulic Conductivity

Hydraulic conductivity values were adjusted during model calibration within the range of hydraulic conductivity and transmissivity estimates from other studies (e.g., Matrix 2017a, CRA 2014b, CRA 2011, and Golder 2018a) and references therein. Table 3 summarizes the final calibrated range of revised hydraulic conductivity values applied to the update areas in each hydrostratigraphic unit, along with the ranges used prior to the update and values estimated from field data. In general, the refined hydraulic conductivity values were within, or very close to, the estimated ranges derived from field data (Table 3). Figures B1 to B7 (Appendix B) present the final conductivity values applied for the zones that were updated in each hydrostratigraphic unit of the model. No updates were made to the hydraulic conductivity values for the contact zone (Layer 4) or Cabot Head Formation (Layer 14). Changes included the following:

- Addition of multiple, small, high conductivity zones extending from ground surface to the top of the fine-grained till unit (Layers 1 and 2), representing the excavated space and ponds created by sand and gravel aggregate operations (Figure B1).
- The creation of a low conductivity zone in the fine-grained overburden unit (Layer 3; Figure B2).
- The creation of a narrow zone in the Guelph Formation and Reformatory Quarry Member of the Eramosa Formation where the vertical conductivity was increased (Layer 5 and 6; Figure B3). The horizontal conductivity remained the same.
- The creation of a narrow zone in the Vinemount Member of the Eramosa Formation where the conductivity was increased (Layer 7-9; Figure B4).
- The creation of a relatively high conductivity zone within a larger, relatively low conductivity zone in the Goat Island Formation (Layer 10; Figure B5).
- The creation of a conductivity zone in the Upper, Middle, and Lower Gasport Formation, where conductivity was decreased relative to the surrounding regional area (Layer 11, 12, and 13; Figures B6, B7, and B8). This zone was required to match the drawdown cone interpreted from point observations of drawdown.

TABLE 3 Aberfoyle - Summary of Hydraulic Conductivity Changes

Model Layer(s)[1]	Unit	Previous Calibrated Hydraulic Conductivity of Update Areas (m/s)		Revised Calibrated Hydraulic Conductivity of Update Areas (m/s)		Estimates of Horizontal Hydraulic Conductivity from Field Data (m/s)[2]	
		Min	Max	Min	Max	Min	Max
1-2	Overburden A (Coarser-grained)	$Kx = 1 \times 10^{-4}$ $Kz = 5 \times 10^{-5}$	$Kx = 2 \times 10^{-4}$ $Kz = 2 \times 10^{-4}$	$Kx = 1 \times 10^{-1}$ $Kz = 1 \times 10^{-1}$	$Kx = 1 \times 10^{-1}$ $Kz = 1 \times 10^{-1}$	$Kx = 4 \times 10^{-6}$	$Kx = 2 \times 10^{-2}$
3	Overburden B (Finer-grained)	$Kx = 1 \times 10^{-6}$ $Kz = 5 \times 10^{-7}$		$Kx = 2 \times 10^{-7}$ $Kz = 1 \times 10^{-7}$		$Kx = 2 \times 10^{-9}$	$Kx = 9 \times 10^{-5}$
5-6	Guelph Fm. and Eramosa Fm., Reformatory Quarry Mbr.	$Kx = 3 \times 10^{-6}$ $Kz = 3 \times 10^{-8}$		$Kx = 3 \times 10^{-6}$ $Kz = 3 \times 10^{-7}$		$Kx = 2 \times 10^{-7}$	$Kx = 6 \times 10^{-4}$
7-9	Eramosa Fm., Vinemount Mbr.	$Kx = 1 \times 10^{-7}$ $Kz = 1 \times 10^{-9}$		$Kx = 3 \times 10^{-6}$ $Kz = 3 \times 10^{-7}$		$Kx = 5 \times 10^{-7}$	$Kx = 3 \times 10^{-5}$
10	Goat Island Fm.	$Kx = 5 \times 10^{-6}$ $Kz = 8 \times 10^{-8}$	$Kx = 2 \times 10^{-4}$ $Kz = 3 \times 10^{-6}$	$Kx = 8 \times 10^{-8}$ $Kz = 1 \times 10^{-9}$	$Kx = 1 \times 10^{-3}$ $Kz = 1 \times 10^{-4}$	$Kx = 9 \times 10^{-8}$	$Kx = 4 \times 10^{-4}$

Model Layer(s)[1]	Unit	Previous Calibrated Hydraulic Conductivity of Update Areas (m/s)		Revised Calibrated Hydraulic Conductivity of Update Areas (m/s)		Estimates of Horizontal Hydraulic Conductivity from Field Data (m/s)[2]	
		Min	Max	Min	Max	Min	Max
11 and 13	Upper and Lower hydrostratigraphic units of the Gasport Fm.	$Kx = 2 \times 10^{-6}$ $Kz = 2 \times 10^{-8}$	$Kx = 2 \times 10^{-6}$ $Kz = 2 \times 10^{-7}$	$Kx = 1 \times 10^{-7}$ $Kz = 1 \times 10^{-8}$		$Kx = 2 \times 10^{-8}$	$Kx = 5 \times 10^{-4}$
12	Middle hydrostratigraphic unit of the Gasport Fm.	$Kx = 8 \times 10^{-5}$ $Kz = 4 \times 10^{-5}$		$Kx = 4 \times 10^{-6}$ $Kz = 2 \times 10^{-6}$		$Kx = 2 \times 10^{-6}$	$Kx = 1 \times 10^{-2}$

[1] No hydraulic conductivity changes made to model layer 4 (Contact Zone) and 14 (Cabot Head Fm.)
[2] From (Matrix 2017a), (CRA 2014b), (CRA 2011), and (Golder 2018a)
Kx - Horizontal Hydraulic Conductivity
Kz - Vertical Hydraulic Conductivity

4.1.2 Calibration to Pumping Conditions

4.1.2.1 Approach

The calibration to pumping conditions was completed using water level monitoring data collected as part of a long-term constant rate test at NWC well TW3-80 (CRA 2011). The test occurred from August to October 2010, at a rate of 3,542 m^3/day, for approximately 40 days, and water levels were measured at monitoring wells completed within the overburden and Upper and Lower Bedrock aquifers. Conestoga-Rovers and Associates (CRA; CRA 2011) reported the maximum measured water level recovery following 3.4 days after pumping ceased. CRA also estimated recoveries at each well that would occur due to pumping at the permitted rate of 3,600 m^3/day, assuming "*linear proportionality between an increase in rate and an increase in drawdown*" (CRA 2011). S.S. Papadopulos and Associates (SSPA) assembled these estimated recovery values for use as calibration targets to permitted pumping conditions.

To supplement the calibration data provided by the 40-day pumping test, SSPA estimated additional drawdown values using water level monitoring data collected from five bedrock wells installed after the 2010 pumping test. Calibration targets for these wells were developed using observed drawdown measurements collected during the 2010 Christmas season when NWC pumping operations were shut down. These targets were estimated by scaling the observed drawdown during this time by the ratio of the pre-shutdown pumping rate and 3,600 m^3/day (Neville 2018, Pers. Comm.).

In total, 56 drawdown targets were used for monitoring wells completed in the overburden (18), Upper Bedrock Aquifer (18), and Lower Bedrock Aquifer (20). A list of the drawdown targets is provided in Appendix A (Table A1), and the locations are shown on Figures 10, 11, and 12.

The calibration approach consisted of estimating simulated drawdown by subtracting water levels between two steady-state conditions: pumping TW3-80 at 3,600 m^3/day and no pumping at TW3-80. The simulated drawdown was then compared to the observed drawdown targets, and the difference between the two were minimized during the calibration process. This is an approximate analysis approach as observed water levels at some well locations may not have fully recovered after 3.4 days. However, the approach is considered appropriate for this application, especially at key monitoring well nests where the water levels were approaching stable levels. Visual inspection of the observed hydrographs of these wells during the 2010 testing (CRA 2011) suggests that the difference in water elevation arising from assuming fully recovered conditions after 3.4 days is a small fraction of the total interpreted drawdown.

Note that while some calibration to the same 40-day test was completed as part of the GGET Tier Three Assessment (Matrix 2017a), that effort focussed on calibration to drawdown in the Lower Bedrock Aquifer. The present effort included calibration to drawdown in the Lower Bedrock, Upper Bedrock, and overburden units.

4.1.2.2 Results

The approach to assessing the goodness-of-fit between modelled and simulated pumping conditions (drawdown) was to evaluate the calibration results using maps comparing simulated drawdown contours with those interpreted from point drawdown observations. The primary objective of the calibration to pumping conditions was to approximate the general shape and extent of the drawdown contours in the Upper and Lower Aquifer units. Figures 10, 11, and 12 illustrate simulated and interpreted drawdown contours for the Reformatory Quarry Member of the Eramosa Formation (Upper Bedrock) and the Goat Island and Middle Gasport formations (Lower Bedrock), respectively. The observed drawdown contours were interpreted by CRA (2011) and were made using a variety of assumptions based on the hydrogeological formation represented by each monitoring well.

Figure 10 illustrates interpreted and simulated drawdown contours for the Upper Bedrock Aquifer (Simulated Reformatory Quarry Member). In general, the simulated drawdown contours match the trend of the interpreted drawdown contours, with a narrow, elongated shape extending from pumping well TW3-80 to monitoring well MW7B-08.

Figures 11 and 12 illustrate interpreted drawdown for wells completed in the Lower Bedrock Aquifer versus simulated drawdown from the Goat Island Formation and Middle Gasport Formation, respectively. As the Lower Bedrock Aquifer includes all calibration targets below the Vinemount Aquitard, two figures are provided to show the difference between the simulated drawdown of two Lower Bedrock Aquifer units. The figures show simulated contours approximating the circular shape of the interpreted contours. The calibrated model results in an under-prediction of the extent of the 1 m drawdown contour in the Goat Island Formation (Figure 11) and a slight over-prediction in the Middle Gasport Formation (Figure 12).

4.1.3 Calibration to Long-term Average Conditions

4.1.3.1 Approach

Steady-state calibration to long-term average conditions was completed using groundwater level monitoring data collected as part of the annual monitoring program at the Aberfoyle site (Golder 2018a). SSPA used these data to estimate average water levels for the period of 2009 to 2015 (except 2014) for use as steady-state calibration targets. In total, 79 water level targets were estimated for monitoring wells completed in the overburden (21), Upper Bedrock Aquifer (31), and Lower Bedrock Aquifer (27). Well completion elevation details were used to assign water level targets to hydrostratigraphic units under the revised bedrock nomenclature in the model where the unit was not already identified by SSPA. Table 1 was also used to guide translation of bedrock names between the previous and revised bedrock nomenclature where necessary.

Water level calibration targets used in the GGET Tier Three Assessment and derived from the Water Well Information System (WWIS) were used as additional calibration targets for the Aberfoyle area to broaden the coverage of the assessment. In total, 555 targets (i.e., 415 in bedrock and 140 in overburden) from the GGET Tier Three Assessment were used, covering a 3 km radius surrounding the Aberfoyle property. These WWIS static water level observations offer the benefit of having a high number of calibration targets that cover a wide area; however, there can be uncertainty associated with individual observations. These uncertainties may include errors in the reported locations and depths of wells, coarse water level measurement techniques, and water levels that may have been collected in different years or seasons, or under different stages of pumping/non-pumping conditions. Based on professional experience, individual groundwater elevation estimates as calculated from the WWIS dataset may have an average error, or uncertainty, of 5 to 10 metres as compared to actual conditions. Because of these uncertainties, the water level targets derived from WWIS data are considered lower quality than those from annual NWC monitoring activities and higher priority is given to calibrating the higher quality calibration targets.

Details of the calibration targets used in the Aberfoyle area are provided in Appendix A (Table A1).

An average pumping rate of 1,690 m^3/day over the calibration period was estimated for TW3-80 using annual water taking data provided in Golder (2018a). This rate was used for the calibration to long-term average conditions, and represents an average for the same 2009 to 2015 (except 2014) period as determined for the water level targets.

4.1.3.2 Results

The steady-state calibration to long-term average conditions involved comparing simulated hydraulic heads against those measured in high-quality monitoring wells and lower quality WWIS wells completed within overburden and bedrock units. The scatter plot for long-term average conditions at the Aberfoyle site is presented on Chart 1, and a table of the observed and simulated values are provided in Appendix A (Table A1).

The scatter plot (Chart 1) illustrates the goodness-of-fit for hydraulic head targets with model-simulated heads plotted on the vertical axis, and observed hydraulic heads plotted on the horizontal axis. The 1:1 line corresponds to simulated head being equal to observed head, and the objective of the calibration effort is to have the points as close as possible to this line. Deviations of ±5 m are shown on the plot as parallel lines offset from the 1:1 line. Points falling outside of the ±5 m lines represent observation locations where the simulated hydraulic head differs from the observed value by more than 5 m. This difference may be due to model error, assumptions in the conceptual model, or may also be due to errors associated with the field-observed data.

The scatter plot shows that the simulated hydraulic heads are within the ± 5 m bounds for almost all of the higher quality targets. Overall, the calibration error is generally distributed both above and below the 1:1 line. Simulated hydraulic head is somewhat over-simulated in the Lower Bedrock; however, the highest simulated heads from this unit are from private wells (Chart 1), which may indicate gaps in the model-conceptualization of these wells, or an indication that these wells may be lower quality data points. Many of the bedrock domestic wells are completed as open bedrock boreholes and as a result there is uncertainty as to the specific bedrock formation associated with the measured water level.

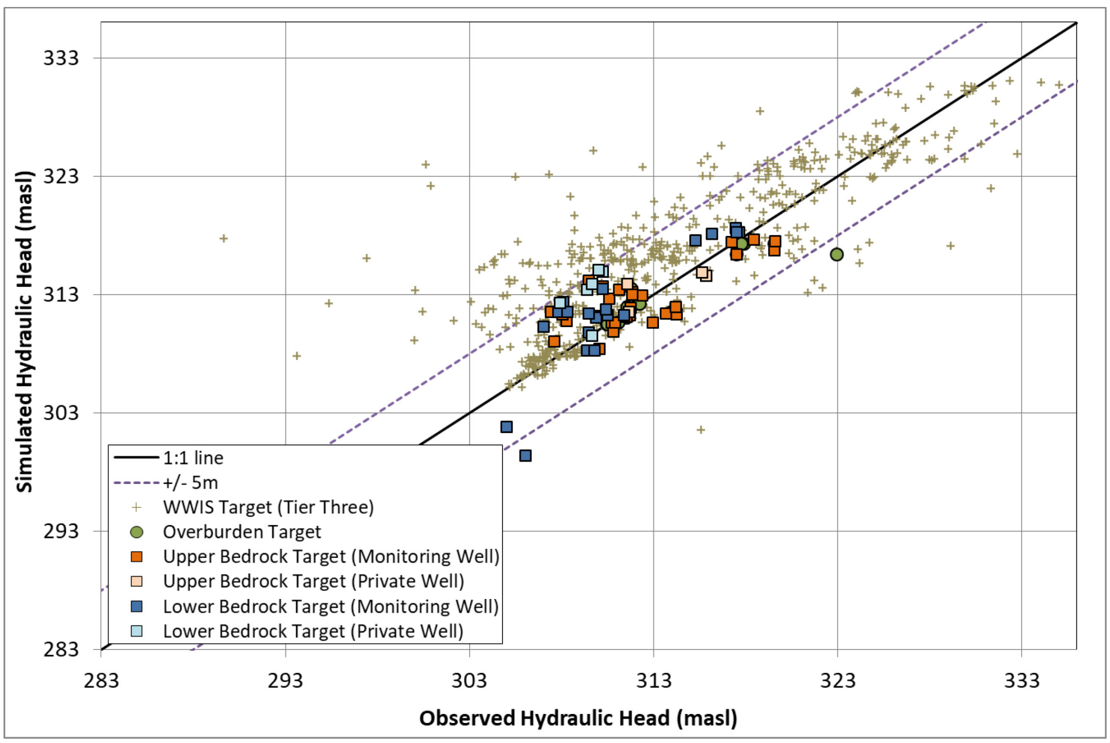

Chart 1 Aberfoyle Scatter Plot of Average Hydraulic Head (2009 to 2013 and 2015) - All Targets

Chart 2 illustrates the same data as Chart 1, except for just the higher quality calibration targets. Lines representing ± 2.4 m were added to the chart to illustrate the range of the root mean squared error of these targets. The chart illustrates that the majority of predicted higher quality water levels would fall within 2.4 m of the observed value, which is a smaller range than observed with the WWIS targets (i.e., 4.9 m). Additional information is provided about this calibration statistic later in this section.

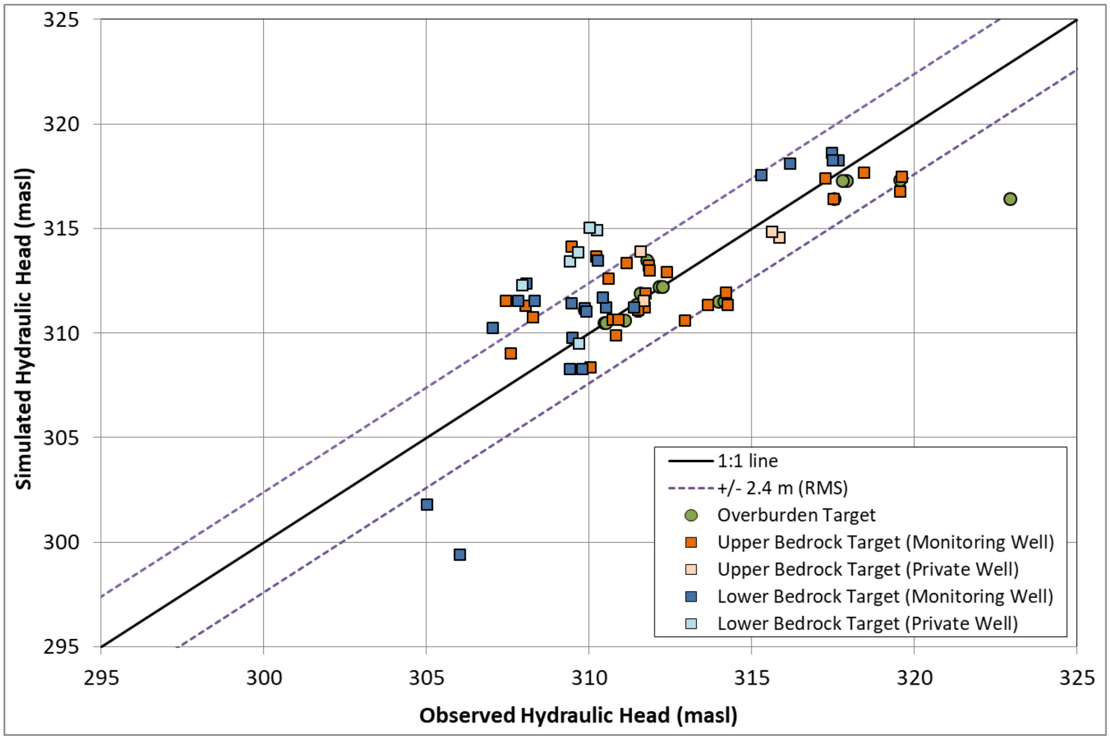

Chart 2 Aberfoyle Scatter Plot of Average Hydraulic Head (2009 to 2013 and 2015) - High Quality Targets

Chart 3 illustrates a cumulative probability plot of the difference between the simulated and observed hydraulic head (i.e., the residual) for the higher quality calibration targets. Following the guidance of Spitz and Moreno (1996, p. 244-245) and Hill (1998), the residuals from a calibration should be normally distributed, confirming that there is no systematic bias in the model results. Where residuals do not follow a normal distribution there may be structural uncertainties in the model, which introduce a limitation to the degree of calibration that is possible. The majority of the residuals in Chart 3 approximate a straight line, following a normal distribution. Two outliers (NWC production well TW3-80 and overburden monitor MW01C-04) fall outside the normal distribution, suggesting that these observed water levels may represent small-scale geological heterogeneities. Achieving a better fit to these points may not be possible given the current model conceptualization.

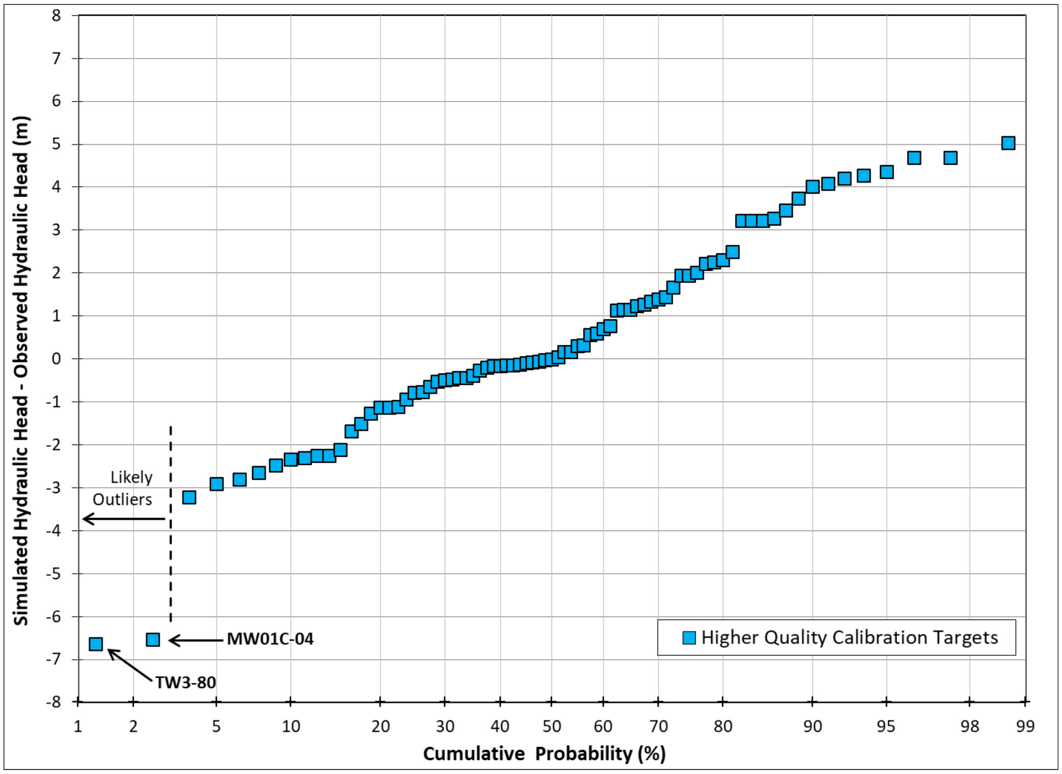

Chart 3 Aberfoyle Cumulative Probability Plot of Higher Quality Targets at Aberfoyle

Chart 4 illustrates the cumulative probability distribution for the calibration targets derived from the WWIS records. Similar to the match to the higher quality targets, the majority of these residuals approximated a straight line when plotted on a normal probability axis. Some targets were identified as potential outliers (Chart 4) and, as discussed previously, these may highlight lower quality targets where there may be errors in the reported well locations and depths, errors in how the water levels were measured, and spatial differences caused by water levels that may have been collected in different years or seasons, or under different stages of pumping/non-pumping conditions.

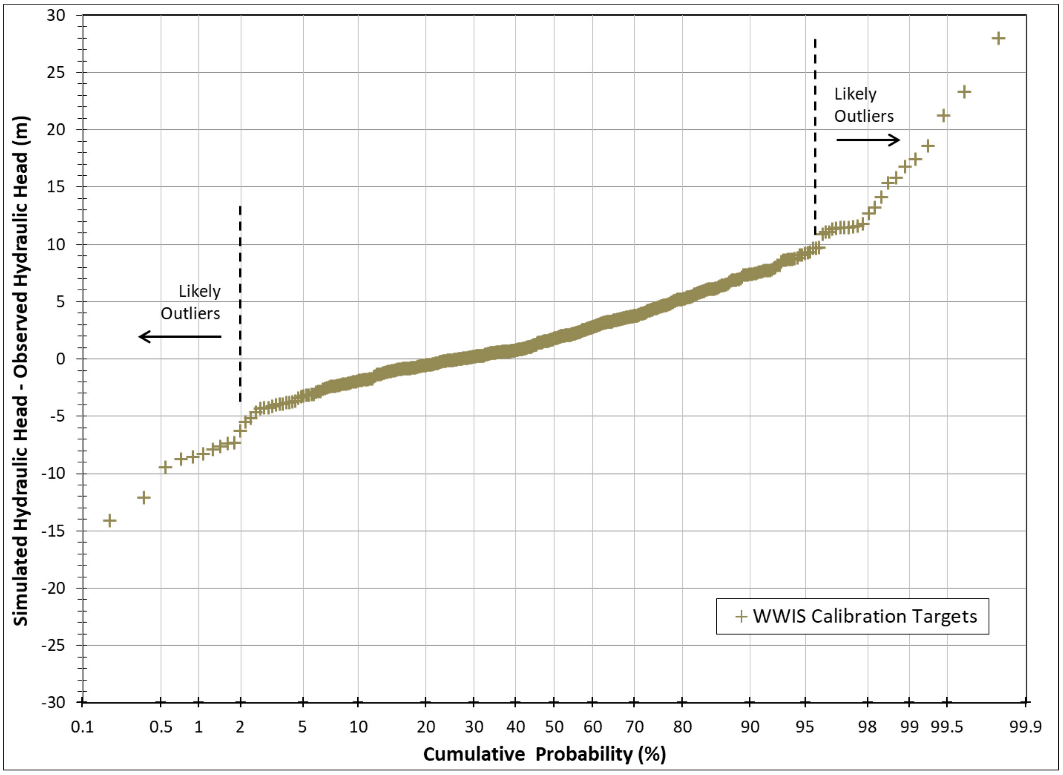

Chart 4 Aberfoyle Cumulative Probability Plot of Lower Quality (WWIS) Targets at Aberfoyle

Table 4 summarizes the calibration statistics computed as measures of the goodness-of-fit between model-simulated and observed hydraulic heads for all calibration targets, high quality Upper and Lower Bedrock targets, overburden targets, and targets from the WWIS.

TABLE 4 Aberfoyle - Hydraulic Head Calibration Statistics

Calibration Statistic	All Targets	High Quality Upper Bedrock Targets	High Quality Lower Bedrock Targets	High Quality Overburden Targets	All High Quality Targets	WWIS Targets
Number of Calibration Targets	634	31	27	21	79	555
Mean Error (m)	2.1	0.2	1.5	-0.7	0.4	2.3
Mean Absolute Error (m)	3.2	1.7	2.4	1.0	1.8	3.4
Root Mean Squared Error (m)	4.6	2.1	3.0	1.8	2.4	4.9

The calibration statistics and results, as listed in the above table, are described as follows:

- Mean Error. The mean error is a measure of whether, on average, simulated water levels are higher or lower than those observed. Ideally, the mean error should be as close as possible to zero. This statistic indicates that on average, all the simulated water levels are higher than the observed values by 2.1 m. The mean error is 0.4 m for the high quality calibration targets.

- Mean Absolute Error. The mean absolute error is a measure of the average deviation between simulated and observed water levels. During model calibration, this statistic should be minimized as much as possible. The mean absolute error for the 634 calibration targets is 3.2 m and is equal to 1.8 m for the high quality targets.

- Root Mean Squared Error. The root mean squared error is similar to standard deviation in providing a measure of the degree of scatter about the 1:1 line. This statistic is calculated by averaging the squares of each residual error, and then taking the square root of that average. In squaring the residual errors, the root mean squared error gives higher weighting to larger residuals. The root mean squared error for the full calibration dataset is 4.6 m, meaning that the majority of predicted water levels would fall within 4.6 m of the observed value. The value for the high quality targets is 2.4 m.

4.1.4 Groundwater Discharge to Streams

In addition to simulated aquifer water levels and drawdown, the groundwater flow model also estimates the contribution of groundwater discharge to streams toward streamflow. Baseflow is a term given to the portion of streamflow that remains in the absence of direct overland runoff. Baseflow may be a result of groundwater discharge in addition to other contributions, such as sewage treatment plant discharges, water diversion, and the release of water from lakes, reservoirs, or wetlands. In this assessment, a key calibration assumption is that estimated stream baseflow is mostly due to groundwater discharge, and not any other factors. As discussed below, this assumption should be generally valid for Mill Creek; however, measured streamflow in Aberfoyle Creek is likely impacted by the release of water from Aberfoyle Pond.

The refined GGET Tier Three model was assessed on how well simulated groundwater discharge matched estimated baseflows. Surface water flow data from two GRCA flow gauges on Mill Creek (2GAC19 and 3AQ131; Figure 1) and two NWC surface water monitoring stations on Aberfoyle Creek (SW01 and SW02; Figure 2) were assessed for the Aberfoyle area. Baseflow estimates were derived by others using streamflow data, and provide a benchmark range against which simulated groundwater discharge can be compared. Baseflow estimates include those derived for Mill Creek during the GGET Tier Three Assessment (Matrix 2017a) and those derived by SSPA for Mill Creek and Aberfoyle Creek (SSPA 2016, Golder and SSPA 2018). Table 5 summarizes available baseflow estimates, model calibration targets, and the simulated groundwater discharge for each of the four monitoring locations. The model calibration targets for the Mill Creek gauges were selected as the range in the median baseflow values estimated from Matrix (2017a) and SSPA (2016). The model calibration targets for Aberfoyle Creek were selected as the low end of the Golder and SSPA (2018) baseflow estimate range as this range reflects streamflow measurements that include the impacts of Aberfoyle Pond and other upstream factors. The simulated groundwater discharge is based on the long-term average conditions described in Section 4.1.3.1.

TABLE 5 Aberfoyle - Summary of Estimated and Simulated Groundwater Discharge (m^3/day)

Locations	Estimated Baseflow		Model Calibration Target	Simulated Groundwater Discharge
	SSPA	Matrix[1]		
Mill Creek Near Aberfoyle (GRCA Gauge 3AQ131)	17,300[2]	18,900	17,300 to 18,900	17,900
Mill Creek @ Side Rd. 10 (GRCA Gauge 2GAC19)	45,500[2]	55,500	45,500 to 55,500	40,000
Increase from 3AQ131 to 2GAC19	**n/a**	**n/a**	**26,600 to 38,200**	**22,100**
Aberfoyle Creek - SW01	5,616 to 14,861[3]	n/a	5,616	3,790[4]
Aberfoyle Creek - SW02	6,739 to 15,811[3]	n/a	6,739	4,593[4]
Increase from SW01 to SW02	**n/a**	**n/a**	**1,123**	**803**

n/a - not available
[1] Matrix (2017a).
[2] SSPA (2016)
[3] Golder and SSPA (2018)
[4] Discharge does not include impacts from Aberfoyle Pond and upstream confluence with Mill Creek

4.1.4.1 Results

Table 5 shows that simulated groundwater discharge was predicted to be within the estimated baseflow range provided by SSPA for gauge 2GAC19 (Mill Creek at Side Rd. 10), and less than the range from Matrix (2017a). The simulated groundwater discharge was within all estimated baseflow ranges for gauge 3AQ131 (Mill Creek near Aberfoyle).

Simulated groundwater discharge for monitoring stations along Aberfoyle Creek (SW01 and SW02) was found to be slightly under-simulated compared to the estimated baseflow counterparts. Baseflow in Aberfoyle Creek is likely an over-estimate of groundwater discharge due to the effects of Aberfoyle Pond, which contributes to baseflow by the release of surface water from storage.

4.1.5 Overall Calibration Summary

Local updates to the calibrated model in the Aberfoyle area largely included refinements of surface water boundary conditions and adjustments to hydraulic conductivity. The calibration results illustrated that:

- **Pumping conditions -** The refined model adequately approximated the trends of the interpreted drawdown contours in the Upper and Lower Bedrock aquifers as delineated using water level recovery data from a long-term pumping test at TW3-80.

- **Long-term average conditions –** The model refinements resulted in improved calibration to local conditions as compared to the GGET Tier Three Assessment. The calibration error for the high quality NWC monitoring targets is improved as compared to the WWIS calibration targets used for the GGET Tier Three Assessment. The results indicate that the model is reflective of groundwater flow conditions in the local Aberfoyle area as well as in the regional area.

- **Streamflow/groundwater discharge -** Simulated groundwater discharge was slightly less than estimated baseflow targets for Aberfoyle Creek but acceptable given that baseflow estimates are not exact representations of groundwater discharge. The results suggest that the overall water balance within the assessment area as reflected by groundwater recharge and discharge is reasonable.

The results suggest that the updated model appropriately represents the hydrogeologic conditions in the area of NWC TW3-80, and is suitable for the assessment of future pumping scenarios.

4.2 Erin

Calibration in the Erin area consisted of local and regional refinements to zones of hydraulic conductivity in different hydrostratigraphic units during calibration to average non-pumping and pumping conditions at NWC well TW1-88.

4.2.1 Hydraulic Conductivity

Similar to the updates made in the Aberfoyle area, hydraulic conductivity values in the Erin area were refined during model calibration, and the final values assigned were guided by the range of hydraulic conductivity and transmissivity estimates from other studies (e.g., Matrix 2017a, Terraqua 1991, CRA 1989; and Blackport [Pers. Comm. 2018]) and references therein. In some cases, refinements to hydraulic conductivity were made as surrogate to making refinements to modelled hydrostratigraphic unit surface elevations and thicknesses. The final calibrated range of revised hydraulic conductivity values applied to the update areas in each hydrostratigraphic unit is presented in Table 6, along with the ranges used prior to the update and values estimated from field data. The refined hydraulic conductivity values applied in the model for the Guelph Formation were very close to the estimated ranges derived from local and regional estimates (Table 6). Conductivity values applied in the overburden and contact zone units were generally higher than the estimates available from field data; however, field estimates were based on a limited number of data points. The final values applied are still considered reasonable when compared to typical ranges of conductivity for similar materials cited in literature (Freeze and Cherry 1979). Figures B8 to B11 (Appendix B) present the final conductivity values applied for zones that were updated in each hydrostratigraphic unit of the model. No updates were made to the hydraulic conductivity values for the model layers representing the Vinemount Member (Layer 11), or Gasport (Layer 12 and 13) and Cabot Head (Layer 14) formations. Changes included the following:

- The creation of a relatively low conductivity zone within the coarse-grained overburden unit north of the NWC site, and a conductivity zone to the south where vertical conductivity was decreased. The conductivity of zones representing finer-grained tills outcropping in the coarser deposits were refined to be consistent values both north and south of the site (Layer 1 and 2; Figure B8).

- The creation of a relatively lower conductivity northern zone and relatively higher conductivity southern zones in the till overburden (Layer 3; Figure B9).

- The creation of three conductivity zones within the contact zone aquifer unit where conductivity was decreased to the north and increased to the south. The conductivity of a smaller local zone was increased just south of the Erin site (Layer 4; Figure B10).

- The creation of four conductivity zones within the Guelph Formation where conductivity was increased to varying amounts (Layer 5 to 10; Figure B11).

TABLE 6 Erin - Summary of Hydraulic Conductivity Changes

Model Layer(s)[1]	Unit	Previous Calibrated Hydraulic Conductivity of Update Areas (m/s)		Revised Calibrated Hydraulic Conductivity of Update Areas (m/s)		Estimates of Horizontal Hydraulic Conductivity from Field Data (m/s)[2]	
		Min	Max	Min	Max	Min	Max
1-2	Overburden A (Coarser-grained)	Kx =1 × 10^{-4} Kz = 1 × 10^{-4}	Kx =5 × 10^{-4} Kz = 5 × 10^{-4}	Kx = 1 × 10^{-4} Kz =1 × 10^{-5}	Kx = 5 × 10^{-4} Kz = 5 × 10^{-5}	Kx = 2 × 10^{-6}	Kx =6 × 10^{-6}
3	Overburden B (Finer-grained)	Kx =1 × 10^{-6} Kz =3 × 10^{-8}	Kx =3 × 10^{-5} Kz =3 × 10^{-6}	Kx =6 × 10^{-8} Kz =6 × 10^{-9}	Kx =1 × 10^{-5} Kz =5 × 10^{-6}	Kx = 7 × 10^{-8}	Kx =5 × 10^{-7}
4	Contact Zone	Kx = 3 × 10^{-5} Kz = 3 × 10^{-6}		Kx = 1 × 10^{-5} Kz = 1 × 10^{-6}	Kx =5 × 10^{-4} Kz = 5 × 10^{-5}	Kx = 2 × 10^{-6}	
5-10	Guelph Fm.	Kx = 2 × 10^{-7} Kz =2 × 10^{-9}	Kx =5 × 10^{-6} Kz = 2 × 10^{-7}	Kx =6 × 10^{-6} Kz = 6 × 10^{-7}	Kx = 8 × 10^{-4} Kz = 8 × 10^{-5}	Kx = 4 × 10^{-7}	Kx = 6 × 10^{-4}

[1] No hydraulic conductivity changes made to model layer 11 (Vinemount Member), 12 and 13 (Gasport Fm.), and 14 (Cabot Head Fm.)
[2] From Matrix (2017a), Terraqua (1991), CRA (1989) and (Blackport 2018, Pers. Comm.)
Kx - Horizontal Hydraulic Conductivity
Kz - Vertical Hydraulic Conductivity

4.2.2 Calibration to Pumping Conditions

4.2.2.1 Approach

Calibration to pumping conditions at the Erin site was completed using the 2016 to 2017 average pumping and non-pumping water level data available from the annual monitoring program. SSPA used these data to estimate drawdown at monitoring wells where there was a clear pumping and non-pumping trend. SSPA estimated drawdown for the remainder of the monitoring wells using drawdown data from a constant rate test conducted in 2005 (CRA 2006, Neville 2018, Pers. Comm.). This was completed by linearly scaling the observed drawdown based on the difference between the pumping rate during the constant rate test and the average daily pumping rate estimated during 2016 to 2017. In total, 18 drawdown calibration targets for the overburden (8) and bedrock (10) monitoring wells were provided. A list of these targets is provided in Appendix A (Table A2).

The calibration approach consisted of estimating simulated drawdown by subtracting water levels between two steady-state conditions: no pumping of TW1-88, and pumping at 890 m^3/day. This pumping rate was developed by SSPA, using an average (2016 to 2017) daily pumping rate of

195 m^3/day, and estimating that this average represents pumping TW1-88 for 5.3 hours at a rate of 890 m^3/day, followed by recovery (Neville 2018, Pers. Comm.). The simulated drawdown was then compared to the observed drawdown targets, and the difference between the two was minimized during the calibration process.

4.2.2.2 Results

The observed and simulated drawdown values for each of the monitoring points are provided in Table A2 (Appendix A). The simulated drawdown at pumping well TW1-88 was 7.49 m, which is 1.09 m larger than the observed drawdown of 6.40 m. The simulated drawdowns at the remaining monitoring wells were within ± 0.5 m of those observed for the bedrock and overburden targets. These results suggest a good fit between observed and simulated values.

An aerial map showing the interpolated simulated drawdown contours for the Guelph Formation Aquifer is provided on Figure 13 to view the simulation results spatially. The figure shows drawdown extending radially away from the pumping well, in a slightly northwesterly direction that is consistent with a simulated regional gradient from the northwest to south and south east (Figure 9).

4.2.3 Calibration to Long-term Non-pumping Conditions

4.2.3.1 Approach

Steady-state calibration to long-term average conditions was completed using groundwater level monitoring data collected as part of the annual monitoring program at the Erin site (Golder 2018b). SSPA used these data to estimate average water levels for the period of 2016 to 2017 when well TW1-88 was not pumping and when it was pumping. Inferred non-pumping data were used as steady-state calibration targets in the Tier Three model where they were available. In total, 25 water level targets were provided for monitoring wells completed in the overburden (11) and bedrock (14). Of these water levels, three non-pumping average water levels were inferred from the available data. A single average water level was reported for the remainder of the wells where it was not possible to infer separate non-pumping versus pumping conditions due to NWC pumping. While it is uncertain whether these water levels explicitly represent pumping or non-pumping conditions, they were used for calibrating to non-pumping conditions in the absence of other high quality data onsite. Well completion elevation details were used to assign water level targets to hydrostratigraphic units under the revised conceptualization in the model where the unit was not already identified by SSPA. Table 2 was also used to guide calibration target assignment where necessary in the model.

Water level calibration targets used in the GGET Tier Three Assessment and derived from the WWIS were used as additional calibration targets for the Erin area to increase the coverage of the calibration area. In total, 289 targets (i.e., 278 in bedrock and 11 in overburden) from the GGET Tier Three Assessment were used, covering a 3 km radius surrounding the Erin site, with additional targets located further upgradient, toward the northwest. Similar to what was described for the WWIS targets near

Aberfoyle (Section 4.1.3.1), the uncertainty of individual groundwater elevation estimates as calculated from the WWIS dataset may have an average error, or uncertainty, of 5 to 10 m as compared to actual conditions. Because of these uncertainties, the water level targets derived from WWIS data are considered lower quality than those from annual NWC monitoring activities.

A list of the calibration targets used in the Erin area is provided in Appendix A (Table A2).

4.2.3.2 Results

The steady-state calibration to long-term average, non-pumping conditions at NWC TW1-88 involved comparing simulated hydraulic heads against those measured in both higher-quality and lower-quality wells completed within overburden and bedrock units. The scatter plot used to visualize the goodness-of-fit for these hydraulic head targets is presented on Chart 5, and a table of the observed and simulated values are provided in Appendix A (Table A2).

The scatter plot shows that the majority of the simulated hydraulic heads are within the ± 5 m bounds. Further, the calibration error is generally distributed both above and below the 1:1 line.

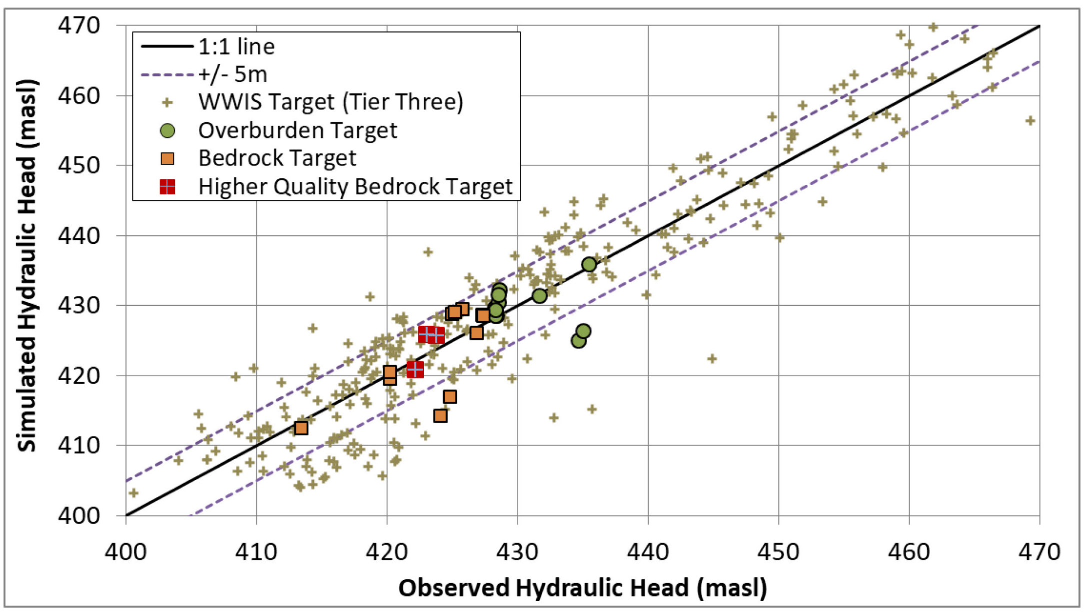

Chart 5 Erin Scatter Plot of Average Hydraulic Head (0 m^3/day NWC Pumping)

Table 7 lists the calibration statistics that are computed as measures of the goodness-of-fit between model-simulated and observed hydraulic heads for all calibration targets, higher quality bedrock and overburden targets, and targets from the WWIS. Definitions for each calibration statistic can be found in Section 4.1.3.2. The calibration statistics are typical of a regional groundwater flow model and the calibration to higher quality bedrock and overburden monitoring wells onsite is slightly improved over the calibration to water levels from WWIS wells (Table 7).

TABLE 7 Erin - Hydraulic Head Calibration Statistics

Calibration Statistic	All Targets	High Quality Bedrock Targets	High Quality Overburden Targets	WWIS Targets
Number of Calibration Targets	314	14	11	289
Mean Error (m)	0.1	-0.2	-0.7	0.2
Mean Absolute Error (m)	4.5	2.9	2.8	4.6
Root Mean Squared Error (m)	5.8	4.0	4.3	5.9

4.2.4 Groundwater Discharge to Streams

Surface water spotflow data from two NWC surface water monitoring stations along a tributary to the Eramosa River (SW1 and SW3; Figure 3) were used to qualitatively assess simulated groundwater discharge in the Erin area. While baseflow estimates have not been derived for these locations, the estimated average spotflows as calculated using 2017 monthly manual flow measurements (Golder 2018b) provide rough estimates for relative magnitude of what the baseflow/groundwater discharge could look like. Table 8 summarizes the average spotflow measurements at NWC stations SW1 and SW3, and the simulated groundwater discharge for each of these monitoring locations. The simulated groundwater discharge is within the range of spotflow measurements at SW1 and SW3 and similar in magnitude to the average values. The simulated groundwater discharge is based on long-term climate conditions, while the spotflow measurements reflect single points in time during 2017.

TABLE 8 Erin - Summary of Estimated and Simulated Groundwater Discharge (m^3/d)

Locations	Range of 2017 Spotflow Measurements	Average 2017 Spotflow Measurement[1]	Simulated Groundwater Discharge
SW1	1,218 to 4,260	2,271	1,900
SW3	354 to 2,160	1,113	1,724

[1] Estimated using 2017 monthly manual spotflow measurements (Golder 2018b)

4.2.5 Overall Calibration Summary

Local updates to the calibrated model in the Erin area largely included refinements of surface water boundary conditions and adjustments to hydraulic conductivity. The calibration results illustrated that:

- **Pumping conditions -** Simulated drawdown at non-pumping monitoring wells were within ± 0.5 m of the observed drawdown targets measured in bedrock and overburden wells.

- **Long-term average, non-pumping conditions** - The model refinements resulted in improved calibration to local conditions as compared to the GGET Tier Three Assessment. The calibration error for the high quality NWC monitoring targets is slightly improved as compared to the WWIS calibration targets used for the GGET Tier Three Assessment. The results indicate that the model is reflective of groundwater flow conditions in the local area as well as in the regional area.

- **Streamflow/groundwater discharge -** Simulated groundwater discharge was similar to the estimated 2017 average spotflow measurements at two surface water monitoring stations, suggesting that the overall water balance within the assessment area as reflected by groundwater recharge and discharge is reasonable.

The results suggest that the updated model appropriately represents the hydrogeologic conditions in the area of NWC TW1-88, and is suitable for the assessment future pumping scenarios.

5 MODEL SCENARIOS

The Tier Three model was updated and calibrated locally in the Aberfoyle and Erin areas to better reflect the high-quality data collected from long-term annual monitoring and from a long-term pumping test. The model reflects local groundwater flow under long-term average pumping conditions (Aberfoyle) or non-pumping conditions (Erin), as well as higher rate pumping conditions (Aberfoyle and Erin). As a result, the model is an appropriate tool to estimate the general effects of changes in pumping. The following sections describe the application of the refined model to assess potential changes in groundwater levels and groundwater discharge due to future pumping at the NWC Aberfoyle and Erin sites, as well as potential effects considering drought and climate change. Section 5.1 provides a description of the predictive scenarios, and Sections 5.2 and 5.3 summarize the results for the Aberfoyle and Erin sites, respectively.

5.1 Scenario Descriptions

Nine predictive scenarios were developed to compare and assess the potential impacts and cumulative effects associated with NWC pumping. These scenarios assess long-term average conditions, historical climate and drought conditions, and climate change. They are summarized in Table 9, and additional details are presented in the following subsections.

TABLE 9 Scenario Summary

Scenario	Assessment	NWC Pumping Rate	Climate Time Period	Climate Change Scenario	Model Simulation
1 (Baseline Average)	Long-term Average	Average TW3-80 = 2,113 m^3/day TW1-88 = 207 m^3/day	Long-term Average	n/a	Steady-state
2	Long-term Average	Maximum Permitted TW3-80 = 3,600 m^3/day TW1-88 = 1,113 m^3/day	Long-term Average	n/a	Steady-state
3 (Baseline Transient)	Historical Climate Variability and Drought	Average TW3-80 = 2,113 m^3/day TW1-88 = 207 m^3/day	1960 to 2005	n/a	Transient
4	Historical Climate Variability and Drought	Maximum Permitted TW3-80 = 3,600 m^3/day TW1-88 = 1,113 m^3/day	1960 to 2005	n/a	Transient
5a	Climate Change	Average TW3-80 = 2,113 m^3/day TW1-88 = 207 m^3/day	1960 to 2005	1	Transient
5b				2	
5c				3	
5d				4	

n/a - not applicable

5.1.1 Scenario 1 - Current Average NWC Pumping (Baseline Average Conditions, Steady-state)

Scenario 1 is the baseline steady-state scenario designed to reflect current, long-term average conditions. The assumptions in this scenario included the following:

- Average (2015-2017) NWC pumping rate at TW3-80 (2,113 m^3/day).
- Average (2015-2017) NWC pumping rate at TW1-88 (207 m^3/day).
- Average municipal pumping rates, consistent with the existing rates used in the GGET Tier Three Assessment scenarios (Matrix 2017a).
- Non-municipal pumping rates, consistent with those used in the GGET Tier Three Assessment (Matrix 2017a) and updated as part of the *Guelph-Guelph/Eramosa Water Quantity Policy Development Study* (Matrix 2018b).
- Average groundwater recharge rates in the Grand River Watershed estimated from a 45-year surface water modelling scenario (1961 to 2005; Matrix 2017a). Average groundwater recharge rates in the Credit River Watershed were provided by AquaResource (2009c) and recharge within the Halton and Hamilton Region Conservation Authorities was reported in Earthfx (2009).

5.1.2 Scenario 2 - Maximum Permitted NWC Pumping (Steady-state)

Scenario 2 was designed to show long-term average conditions considering the same steady-state model setup described for Scenario 1, except for the following assumptions:

- Maximum permitted NWC pumping rate at TW3-80 (3,600 m^3/day).
- Maximum permitted NWC pumping rate at TW1-88 (1,113 m^3/day).

5.1.3 Scenario 3 - Current Average NWC Pumping (Baseline Conditions, Transient)

Scenario 3 is the transient baseline scenario designed to test the response of the system with current average NWC pumping rates, under typical climate variability, and a severe drought represented by the driest period observed in the local contemporary climate record. This drought period was observed locally in the 1960s. The variability of groundwater recharge rates over the simulation period reflects actual historic conditions and is therefore a suitable surrogate for future climate variability. The results of the scenario are hypothetical, as NWC has only been pumping since 2000 (Erin) and 2001 (Aberfoyle).

The setup of this scenario included the following:

- Average (2015-2017) NWC pumping rate at TW3-80 (2,113 m^3/day).
- Average (2015-2017) NWC pumping rate at TW1-88 (207 m^3/day).
- Average municipal pumping rates, consistent with the existing rates used in the GGET Tier Three Assessment scenarios (Matrix 2017a).
- Non-municipal pumping rates, consistent with those used in the GGET Tier Three Assessment (Matrix 2017a) and updated as part of the *Guelph-Guelph/Eramosa Water Quantity Policy Development Study* (Water Quantity Policy Study; Matrix 2018b).
- Transient historical climate variability and drought conditions represented by estimated monthly recharge (1960 to 2005). This model input was generated using Guelph All-Weather Sequential-Events Runoff (GAWSER) as part of the climate change component of the Water Quantity Policy Study as documented in Matrix (2018a).
- Transient monthly municipal pumping from the Eramosa River and into the Arkell Artificial Recharge System (1960 to 2005). This model input was generated using GAWSER as part of the climate change component of the Water Quantity Policy Study as documented in Matrix (2018a).

5.1.4 Scenario 4 - Maximum Permitted NWC Pumping (Transient)

Scenario 4 was designed to show historical climate variability and drought conditions, considering the same transient setup described for Scenario 3a, except for the following:

- Maximum permitted NWC pumping rate at TW3-80 (3,600 m^3/day).
- Maximum permitted NWC pumping rate at TW1-88 (1,113 m^3/day).

5.1.5 Scenario 5 - Current Average NWC Pumping with Climate Change Projections (Transient)

Scenario 5 represents a set of four climate change scenarios (i.e., 5a, 5b, 5c, and 5d) that use the methodology developed for the climate change assessment completed for the GGET municipal water supply systems (Matrix 2018a).

The primary tools used to estimate future climate are Global Climate Models (GCMs). GCMs are complex, physically-based, three-dimensional models that represent the earth's atmosphere, oceans, and land surfaces and simulate, over several decades, the interactions of processes that determine the climate for an area. These tools have evolved since the 1970s to their present level of sophistication. Modelling centres around the world have developed numerous GCMs used for long-term simulations to characterize the evolution of temperature, precipitation, solar radiation, winds, and other parameters well into the future.

There are many uncertainties in future climate predictions relating to unknown future emissions of greenhouse gases and aerosols, the conversion of emissions to atmospheric gases, modelling the response of the climate system, and methods for downscaling GCMs to be representative of local climates. As a result, uncertainties will remain inherent in predicting the hydrologic and hydrogeologic response to future climate change.

Figure 14 illustrates a scatter plot of simulated annual mean change in temperature and precipitation for the 2041-2070 period (2050s), as compared to the 1981-2010 period (current) for the results of 57 GCM scenarios in the Guelph area. This figure displays the level of uncertainty among GCM models as mean annual temperatures range from +1.7 to +4.6 $^{\circ}$C, while annual precipitation changes range from -4 to +20%.

EBNFLO and AquaResource (2010) recommends that practitioners evaluate potential climate change impacts using a large number of future climate scenarios to reflect the uncertainty that exists in individual model results; however, it is not generally feasible to evaluate all of the GCMs available. EBNFLO and AquaResource (2010) describe the 'Percentiles' method used to select a subset of individual GCM results, followed by the application of the 'Change Field' method to estimate climate change impacts using traditional hydrologic methods. Figure 14 illustrates a set of ten individual scenarios (orange squares) selected for the assessment completed for GGET (Matrix 2018a), and a smaller set of four scenarios (circled squares) selected for the groundwater modelling assessment.

The change field method is a methodology for estimating future local climate datasets from larger scale GCM results. This method uses the GCM simulations to estimate monthly changes for each climate variable for a future time period relative to a baseline climate period. These relative changes, termed 'change fields', are used to adjust observed climate station data time series to reflect future conditions. This approach results in an altered input climate time series that reflects the average relative change in each parameter and, through the use of local observations, the local climate. Matrix (2018a) describes the application of the Grand River hydrology model, GAWSER, to estimate the hydrologic response to the future climate datasets developed using the 'change field' method and the selected GCM results.

Figure 15 illustrates average daily groundwater recharge rates for each month for a silty sand soil in the Guelph area for the four selected future climate scenarios. Each future climate scenario was developed by adjusting the 1950-2005 existing climate dataset by the 2050's change fields for that scenario. The average daily recharge rate for a given month represents the GAWSER-predicted daily recharge averaged over all days of that month for the entire GAWSER model simulation. As shown on this figure, the average daily rate predicted for the future climate scenarios is higher than baseline conditions during the months of December through March; this is a result of having less frozen soil and increased precipitation. Groundwater recharge during the summer months is generally less than baseline conditions and similar to baseline during spring and fall.

The climate change assessment was completed with the following steps:

1. Select GCMs encompassing the range in projected changes in climate for the 2050s period. There is a great deal of uncertainty in making projections of future climates, and it is common practice to assess impacts of climate change using multiple future climate datasets to reflect the range of variability in potential future conditions.

2. Create a 45-year dataset of hourly temperature and precipitation projections (2050s) for each of the GCMs using the 'change field' methodology further described in Matrix 2018a.

3. Create a 45-year time series of groundwater recharge projections (2050s) for each of the GCMs using the temperature and precipitation datasets, and the GAWSER hydrology model.

4. Run the GGET Tier Three groundwater flow model to simulate groundwater levels and groundwater discharge for each of the 2050s groundwater recharge scenarios.

Scenarios 5a, 5b, 5c, and 5d are four 45-year scenarios, each representing a future (2050s) climate projection from a different GCM. These scenarios include the following assumptions:

- Average (2015 to 2017) NWC pumping rate at TW3-80 (2,113 m^3/day).

- Average (2015 to 2017) NWC pumping rate at TW1-88 (207 m^3/day).
- Average municipal pumping rates, consistent with the existing rates used in the GGET Tier Three Assessment scenarios (Matrix 2017a).
- Non-municipal pumping rates, consistent with those used in the GGET Tier Three Assessment (Matrix 2017a) and updated as part of the Water Quantity Policy Study (Matrix 2018b).
- A 45-year transient monthly recharge time series representing a prediction of future climate made by a GCM for the 2050s period.
- Transient monthly municipal pumping from the Eramosa River and into the Arkell Artificial Recharge System (1960 to 2005), adjusted to incorporate the effects of climate change.

5.2 Scenario Results - Aberfoyle

All predictive scenarios were assessed based on simulated changes in water levels and groundwater discharge with respect to current average NWC pumping conditions (i.e., 2015 to 2017). In the Aberfoyle area, simulated impacts to water levels were assessed locally on the NWC property at monitoring well MW2A-07, at the nearest City of Guelph municipal bedrock well (the Burke Well), and also assessed more regionally within the Upper and Lower Bedrock aquifers. Simulated impacts to groundwater discharge were assessed at GRCA gauge 2GAC19 (Mill Creek at Side Rd. 10). Selection of this gauge to evaluate changes in surface water was agreed upon between Ministry of the Environment, Conservation and Parks and NWC.

5.2.1 Steady-state Scenario Results

The steady-state scenario results include the simulated average additional drawdown and groundwater discharge associated with the increase in pumping from the current average NWC pumping rate (Scenario 1) to the maximum permitted NWC pumping rate (Scenario 2).

Figures 16, 17, and 18 show the predicted additional drawdown within the simulated Upper and Lower Bedrock Aquifer layers due to increased pumping. The drawdown contours extend in a north to south direction, from MW07-08 to just south of the NWC property for all three figures. The shape of the drawdown contours change with depth, from an elongated shape in the Reformatory Quarry Member (Figure 16) to a slightly wider, oval shape in the Middle Gasport Formation (Figure 18). The maximum extent of the largest 1 m drawdown contour for all three figures is from approximately 1.2 km to the northwest, and approximately 500 m to the southeast.

Locally, the simulated drawdown associated with increasing pumping from average NWC rates to permitted NWC rates was predicted to be 3.7 m in the Lower Bedrock Aquifer at the closest non-pumping monitoring well on the NWC Aberfoyle property (MW2A-07). Drawdown at the closest City of Guelph municipal well, the Burke Well (Figure 19), was estimated to be less than 2 cm.

Groundwater discharge at GRCA gauge 2GAC19 (Mill Creek at Side Rd. 10; Figure 19) in Scenario 1 to 2 is predicted to decrease by 3%, from 39,544 m^3/day to 38,271 m^3/day due to the increase in pumping (Table 10).

TABLE 10 Aberfoyle Simulated Groundwater Discharge - Average NWC Pumping to Permitted NWC Pumping

Location	Simulated Groundwater Discharge (m^3/day)		Change in Groundwater Discharge (m^3/day)	Change in Groundwater Discharge (%)
	Average NWC Pumping (Scenario 1)	Permitted NWC Pumping (Scenario 2)		
Mill Creek at Side Rd. 10 - 2GAC19	39,544	38,273	-1,271	-3%

5.2.2 Drought Scenario Results

The drought scenario results include the simulated transient impacts to water levels and groundwater discharge associated with the increase in pumping from average NWC rates (Scenario 3) to permitted NWC rates (Scenario 4), while considering a 45-year climate record (1960 to 2005) that includes drought periods (e.g., the 1960s).

Figures 20 and 21 show the predicted water level variability on NWC property at MW2A-07 and at the Burke municipal well, respectively over the 45-year record. At MW2A-07, water levels are predicted to vary within approximately 0.75 m over the course of the 45-year record. The results indicate that bedrock water levels at or near the NWC property are not significantly impacted by climate variability. Further, additional water level decline associated with increased pumping is predicted to be approximately 3.75 m (Figure 20), which is considerably greater than the impact of climate variability.

In comparison to the NWC property, water levels at the Burke Well (Figure 21) are predicted to be more sensitive to climate variability. Water levels at the Burke Well are predicted to decline by approximately 3 m during the drought period, which is much greater than any potential impact from increased pumping by NWC.

Simulated groundwater discharge variability at Mill Creek at the Side Rd. 10 gauge (2GAC19) is shown on Figure 22 as a time series, and Figure 23 as ranked duration curves for average (Scenario 3) and permitted (Scenario 4) NWC pumping rates. Figure 22 shows simulated groundwater discharge ranging from approximately 7,000 m^3/day (during the 1960s drought) to 87,000 m^3/day, and a minimal difference between the simulated groundwater discharge between average NWC pumping and permitted NWC pumping. When that same data are graphed as ranked duration curves (Figure 23), the differences between the simulated groundwater discharge of Scenarios 3 and 4 are easier to visualize.

These differences are summarized in Table 11, where the results are grouped into three classifications where groundwater discharge is exceeded 20%, 50%, and 80% of the time. Table 11 summarizes that groundwater discharge is predicted to be decreased by 3% at the 20% and 50% levels, and by 6% at the 80% level.

TABLE 11 Aberfoyle Simulated Groundwater Discharge Ranked Duration Analysis - Average NWC Pumping to Permitted NWC Pumping

Location	% Time where Groundwater Discharge was Equalled or Exceeded	Simulated Groundwater Discharge (m^3/day)		Change in Groundwater Discharge (m^3/day)	Change in Groundwater Discharge (%)
		Average NWC Pumping (Scenario 3)	Permitted NWC Pumping (Scenario 4)		
Mill Creek at Side Rd. 10 - 2GAC19	20	53,696	52,206	-1,490	-3%
	50	38,423	37,082	-1,341	-3%
	80	24,992	23,532	-1,460	-6%

5.2.3 Climate Change Scenario Results

The future climate change scenarios reflect an increase in groundwater recharge rates as compared to historical climate conditions (Figure 15). Figure 24 illustrates an increased range of groundwater elevations predicated at MW2A-07 under the future climate scenarios as compared to the historical climate. The average increase in groundwater elevation is on the order of 0.10 m, which is relatively small when compared to the decrease in groundwater levels associated with increased NWC pumping to the maximum permitted rate (Scenario 4).

The future climate change simulations predict that groundwater levels at the City of Guelph Burke Well will increase by 0.5 m to 1.5 m as compared to historical climate (Figure 25). This increase in groundwater levels is higher than at MW2A-07, as the Burke Well water levels reflect shallower groundwater, and a greater connection to shallow overburden and changes in groundwater recharge.

Figure 26 illustrates that groundwater discharge into Mill Creek, as simulated at the Sideroad 10 gauge (2GAC19), may increase considerably in the future climate. This increase in groundwater discharge is much greater than the anticipated decrease in groundwater discharge in response to an increase in NWC pumping to the maximum permitted rate. The increased discharge is more prominent during the January-June period, and as discussed previously, this is due to greater amounts of precipitation in the winter, less frozen ground, and greater groundwater recharge rates.

5.3 Scenario Results - Erin

In the Erin area, simulated impacts to water levels were assessed locally on the NWC property at monitoring well MW05A-05, at the nearest municipal wells (Hillsburgh Well 2 and 3), and also assessed more regionally within the bedrock aquifer. Simulated impacts to groundwater discharge were assessed at NWC surface water monitoring station SW1.

5.3.1 Steady-state Scenario Results

Figure 27 shows the predicted additional drawdown in the Guelph Formation due to the increase in pumping from average NWC pumping (Scenario 1) to permitted NWC pumping (Scenario 2). The contours extend away from pumping well TW1-88 in a radial fashion, with a slight preferred orientation toward the northwest.

Locally, the simulated additional drawdown associated with increasing pumping from average NWC rates to permitted NWC rates was predicted to be 4.1 m at the closest non-pumping monitoring well on the NWC Erin property (MW05A-05). The additional simulated drawdown was predicted to be 0.3 m at both Hillsburgh municipal wells (Figure 28).

Groundwater discharge at NWC surface water monitoring station SW1 (Figure 27) in Scenarios 1 and 2 was simulated to decrease by 3%, from 1,880 m^3/day to 1,822 m^3/day due to the increase in pumping (Table 12).

TABLE 12 Erin Simulated Groundwater Discharge - Average NWC Pumping to Permitted NWC Pumping

Location	2017 Observed Flow[1] (m^3/day)	Simulated Groundwater Discharge (m^3/day)		Change in Groundwater Discharge (m^3/day)	Change in Groundwater Discharge (%)
		Average NWC Pumping (Scenario 1)	Permitted NWC Pumping (Scenario 2)		
Downstream of Onsite Pond - SW1	1,218 to 4,260	1,880	1,822	-58	-3%

[1] Range from Golder (2018b)

5.3.2 Drought Scenario Results

Figures 29, 30, and 31 show the predicted water level variability at NWC monitoring well MW05A-05, and Hillsburgh Well 2 and 3, respectively, over the 45-year record for average NWC pumping (Scenario 3) and permitted NWC pumping (Scenario 4). At MW05A-05, water levels are predicted to vary by up to 3 m over the 45-year record, with the lowest level predicted during the drought of the 1960s (Figure 29). Water levels decline during this time by a magnitude of approximately 1.25 m. The additional water level decline associated with increased pumping from average to permitted NWC rates is predicted to be approximately 4 m (Figure 29).

Water levels at the Hillsburgh Well 2 and 3 (Figures 30 and 31) are predicted to vary by more than 4 m in response to normal climate variability over the 45-year record. If drought conditions similar to those observed in the 1960s were to reoccur, water levels are predicted to decline by approximately 2.3 m. Finally, the additional water level decline at the Hillsburgh Well 2 and 3 associated with increased NWC pumping is predicted to be 0.3 m to 0.4 m on average over the 45-year time frame.

Simulated groundwater discharge variability at the surface water monitoring station SW1 is shown on Figure 32 as a time series, and Figure 33 as ranked duration curves for average (Scenario 3) and permitted (Scenario 4) NWC pumping rates. Figure 32 shows simulated groundwater discharge ranging from less than 1,200 m^3/day during the 1960s drought, to a maximum of almost 2,900 m^3/day. A minimal difference exists between the simulated groundwater discharge between average NWC pumping and permitted NWC pumping. These differences are examined closer using the ranked duration curves of Figure 33 and the analysis shown in Table 13. Here groundwater discharge is predicted to decrease by 3% at the 20% and 50% levels, and decrease by 4% at the 80% level.

TABLE 13 Erin Simulated Groundwater Discharge Ranked Duration Analysis - Average NWC Pumping to Permitted NWC Pumping

Location	% Time where Groundwater Discharge was Equalled or Exceeded	Simulated Groundwater Discharge (m^3/day)		Change in Groundwater Discharge (m^3/day)	Change in Groundwater Discharge (%)
		Average NWC Pumping (Scenario 3)	Permitted NWC Pumping (Scenario 4)		
Downstream of Onsite Pond - SW1	20	2,195	2,130	-65	-3%
	50	1,871	1,814	-58	-3%
	80	1,600	1,542	-57	-4%

5.3.3 Climate Change Scenario Results

Similar to the Aberfoyle site, the future climate change scenarios for the Erin site reflect an increase in groundwater recharge rates as compared to historical climate conditions. Figure 34 illustrates an increased range of groundwater elevations predicated at MW5A-05 under the future climate scenarios as compared to the historical climate. The average increase in groundwater elevation is on the order of 0.50 m, which is relatively small when compared to the decrease in groundwater levels associated with increased NWC pumping to the maximum permitted rate (Scenario 4).

The future climate change simulations predict that groundwater levels at Hillsburgh Well 2 and 3 will increase between approximately 0.2 m to 1.8 m as compared to historical climate (Figure 35 and 36).

Figure 37 illustrates that groundwater discharge into an unnamed headwater tributary to the Eramosa River, as simulated at SW1, may increase in the future climate. This increase in groundwater discharge is greater than the anticipated decrease in groundwater discharge in response to increased NWC pumping at the maximum permitted rate. The increased discharge is more prominent during the January-June period, and as discussed previously, this is due to greater amounts of precipitation in the winter, less frozen ground, and greater groundwater recharge rates.

6 CLOSURE

The groundwater flow model developed for the GGET Tier Three Assessment was refined and applied in the areas of NWC's Aberfoyle and Erin water bottling operations to assess potential cumulative effects associated with NWC's permitted takings. The work was completed in response to the Interim Procedural and Technical Guidance Document for Bottle Water Renewals (MOECC 2017) that requires an assessment of cumulative effects of renewed water bottling takings using the highest tier water budget completed under the *Clean Water Act*.

The Tier Three model was refined in the areas of the Aberfoyle and Erin NWC properties, calibrated to water levels under long-term average and pumping conditions, and was shown to adequately represent the hydrogeologic conditions in these areas. The model was applied to predict the potential impacts of NWC takings on local groundwater levels, on groundwater levels at municipal wells, and on groundwater discharge to surface water features. These impacts were assessed under steady-state (long-term average) and transient (time-varying) conditions, while considering current climate, drought periods, and the potential impacts due to climate change.

The results of the model scenarios completed in this assessment indicate the following:

- Increasing the pumping rates at the NWC Aberfoyle and Erin facilities from current rates to permitted rates will not affect groundwater levels at the closest City of Guelph municipal well (Burke Well) and will have minimal impact to groundwater levels at the Hillsburgh municipal wells.

- Increasing the pumping rate at NWC Aberfoyle and Erin facilities from current rates to permitted rates will result in a 3% reduction in groundwater discharge to the identified surface water features.

- The future climate change scenarios result in greater amounts of groundwater recharge and increased groundwater elevations and groundwater discharge to surface water features.

The modelling results presented in this report are based on the modelling approach employed for the GGET Tier Three Assessment (Matrix 2017a) and Assessment of Climate Change in Support of the Guelph-Guelph/Eramosa Water Quantity Policy Study (Matrix 2018a), and represents the state of the practice at the time of this assessment. This report describes modifications made to the Tier Three model based on data provided by NWC and is assumed correct. The results of the model scenarios reflect the current scientific understanding, but are uncertain due limitations of data and scientific characterization reflected in the model. It is recommended that the numerical model employed to complete this assessment be updated in the future to reflect new data or if observed conditions change as compared to those represented in this assessment.

7 REFERENCES

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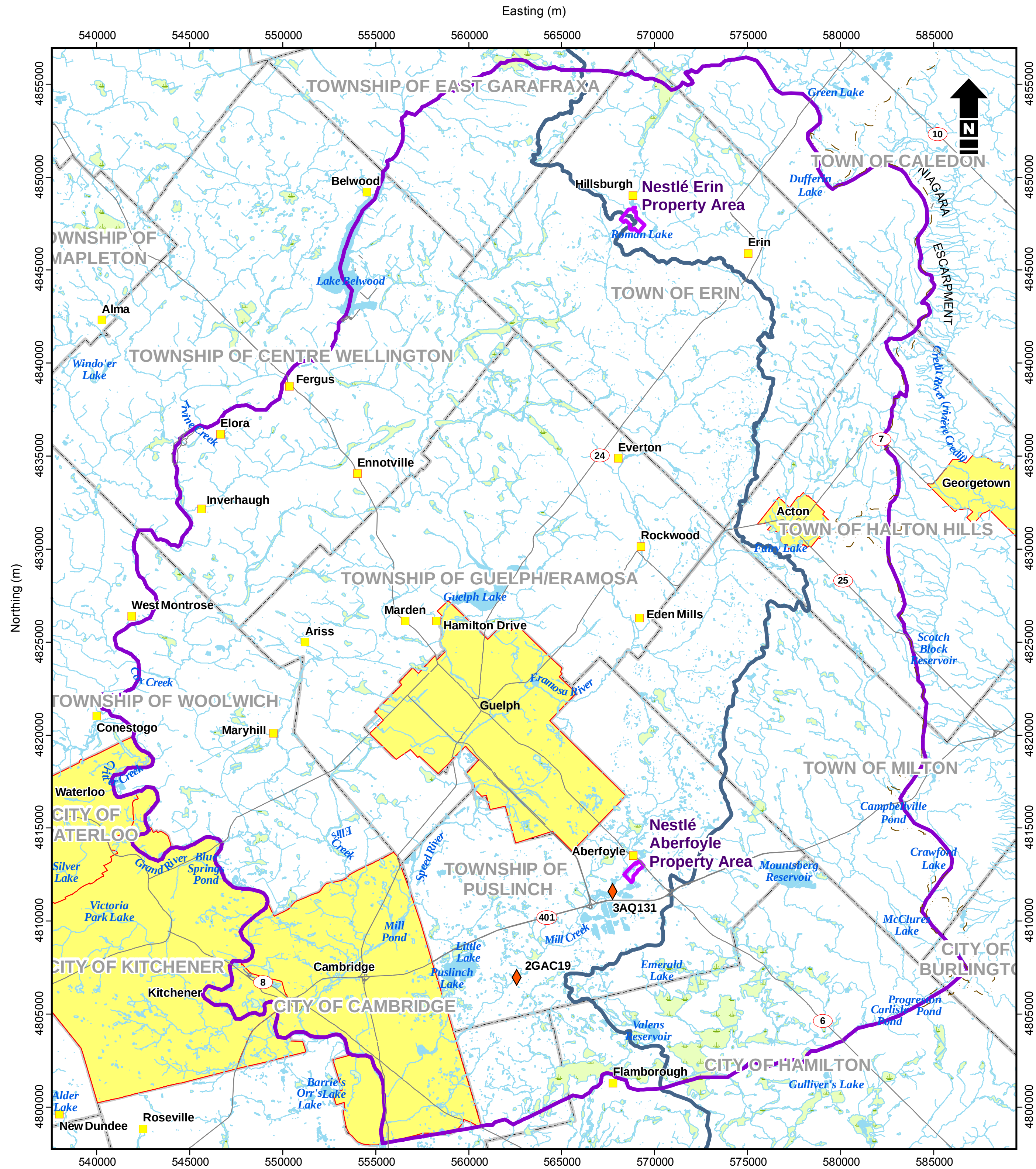

- Nestlé Waters Canada Property Boundary
- Tier Three Model Boundary
- Grand River Watershed Boundary
- Community
- Wetland
- Water Body
- Watercourse
- Major Road
- Niagara Escarpment
- GRCA Flow Gauge

1:300,000 metres
3,000 0 3,000 6,000
NAD 1983 UTM Zone 17N

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City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

City of Guelph and Township of Guelph/Eramosa Tier Three Assessment Model Area

Date:	Project:	Submitter:	Reviewer:
September, 2018	26435	J. Melchin	D. Van Vliet

Figure 1

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Figure-1-City_of_Guelph_and_Township_of_Guelph_Eramosa_Tier_Three_Assessment_Model_Area.mxd - Letter_P - 13-Sep-18, 01:41 PM - ccurry - TID001

Nestlé Waters Canada Property Boundary
Water Body
Watercourse
Highway
Road
Cross-section
Monitoring Well (Bedrock)
Monitoring Well (Overburden)
Piezometer
Private Well (Bedrock)
Production Well
Surface Water Station
Surface Water Temperature Station

Reference: Contains information licensed under the Open Government Licence – Ontario and information made available under the copyright © of Grand River Conservation Authority Open Data Licence v3.0. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:13,500 metres
140 0 140 280
NAD 1983 UTM Zone 17N

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City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfolye Site Map

Date:	Project:	Submitter:	Reviewer:
December 2018	26435	J. Melchin	D. Van Vliet

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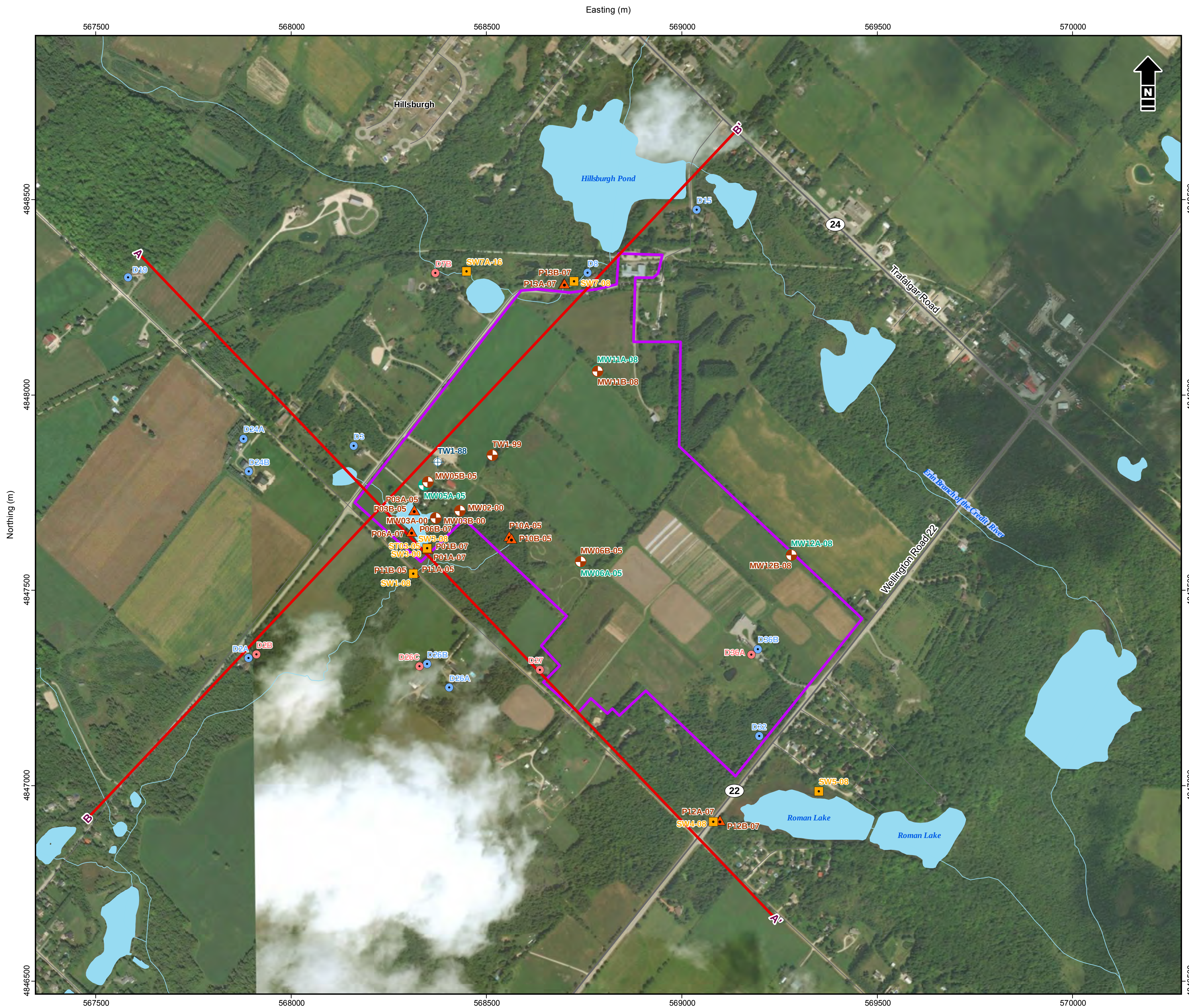
Figure 2



Nestlé Waters Canada Property Boundary
Water Body
Watercourse
Highway
Road
Cross-section
Monitoring Well (Bedrock)
Monitoring Well (Overburden)
Piezometer
Private Well
Private Well (Bedrock)
Production Well
Surface Water Station

Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:10,000 metres
100 0 100 200
NAD 1983 UTM Zone 17N

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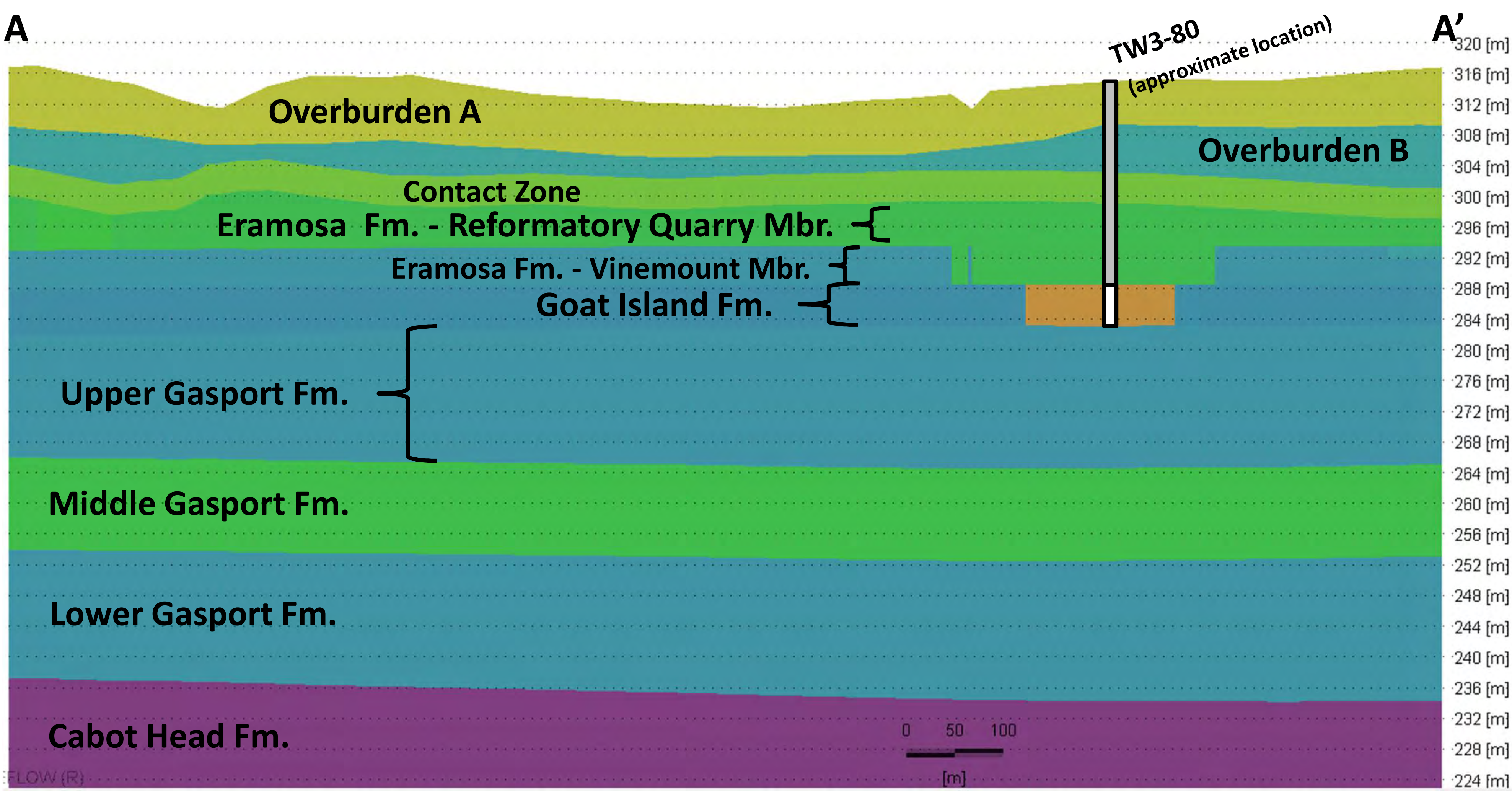
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Erin Site Map

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

Figure
3



Note: 8x Vertical Exaggeration

Conductivity: K_xx
- Patches -
[m/s]
1.0E-02
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
1.0E-08
1.0E-09
1.0E-10

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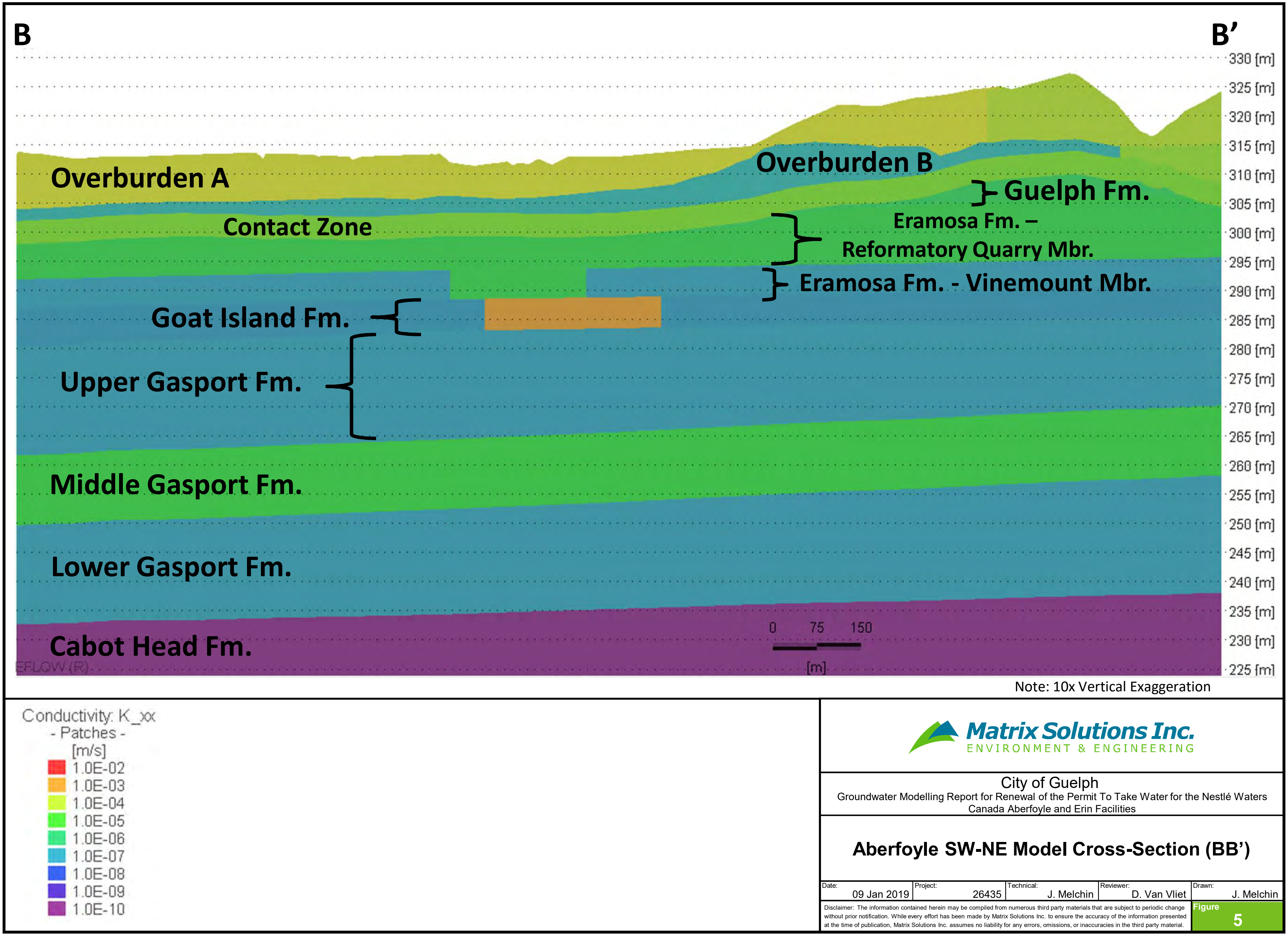
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

Aberfoyle NW-SE Model Cross-Section (AA')

Date:	Project:	Technical:	Reviewer:	Drawn:
09 Jan 2019	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 4



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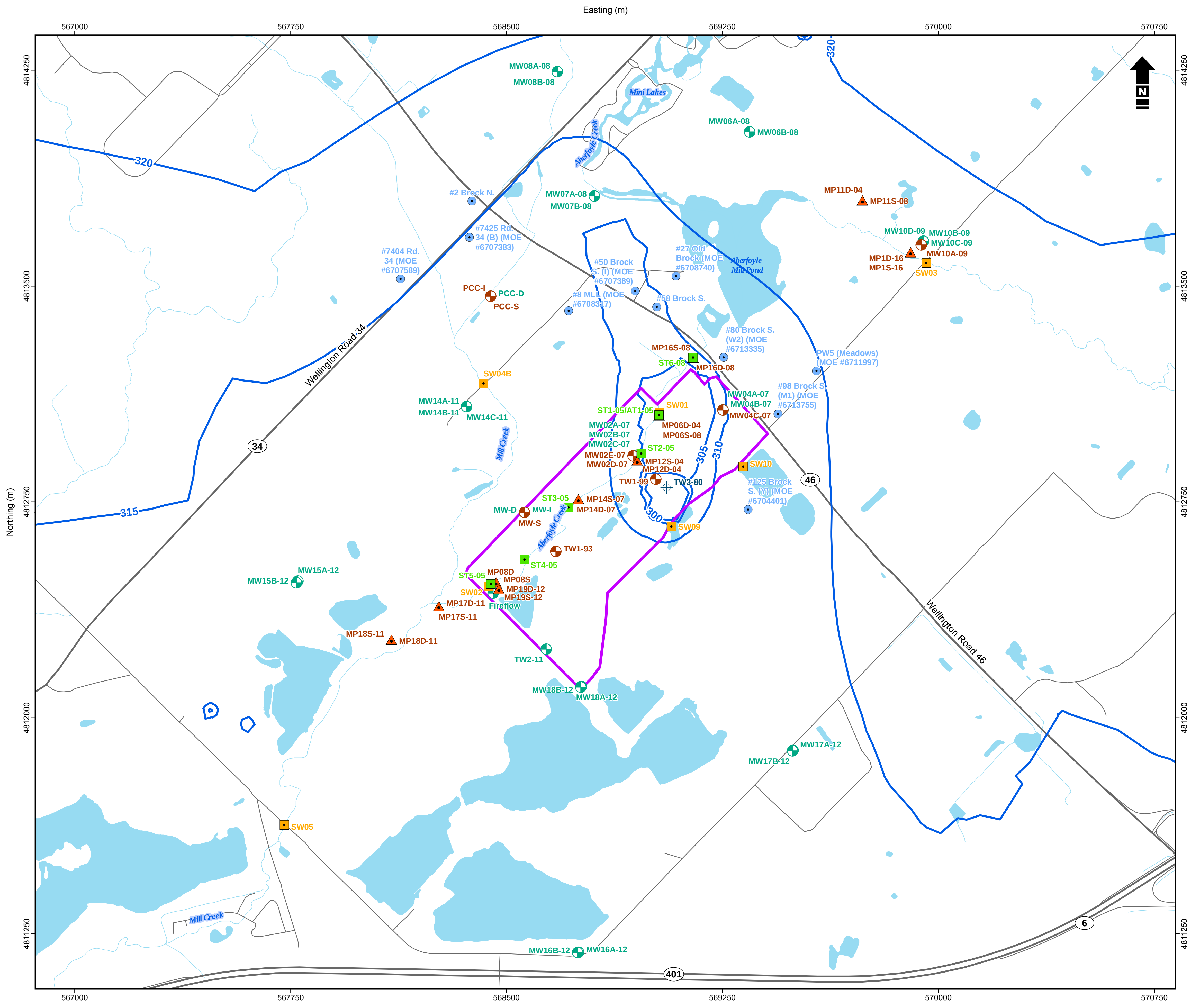
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

Aberfoyle SW-NE Model Cross-Section (BB')

Date:	Project:	Technical:	Reviewer:	Drawn:
09 Jan 2019	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 5



Nestlé Waters Canada Property Boundary
Water Body
Watercourse
Hydraulic Head Contour | 5m (masl)
Highway
Road
Monitoring Well (Bedrock)
Monitoring Well (Overburden)
Piezometer
Private Well (Bedrock)
Production Well
Surface Water Station
Surface Water Temperature Station

1:13,500 metres
140 0 140 280
NAD 1983 UTM Zone 17N

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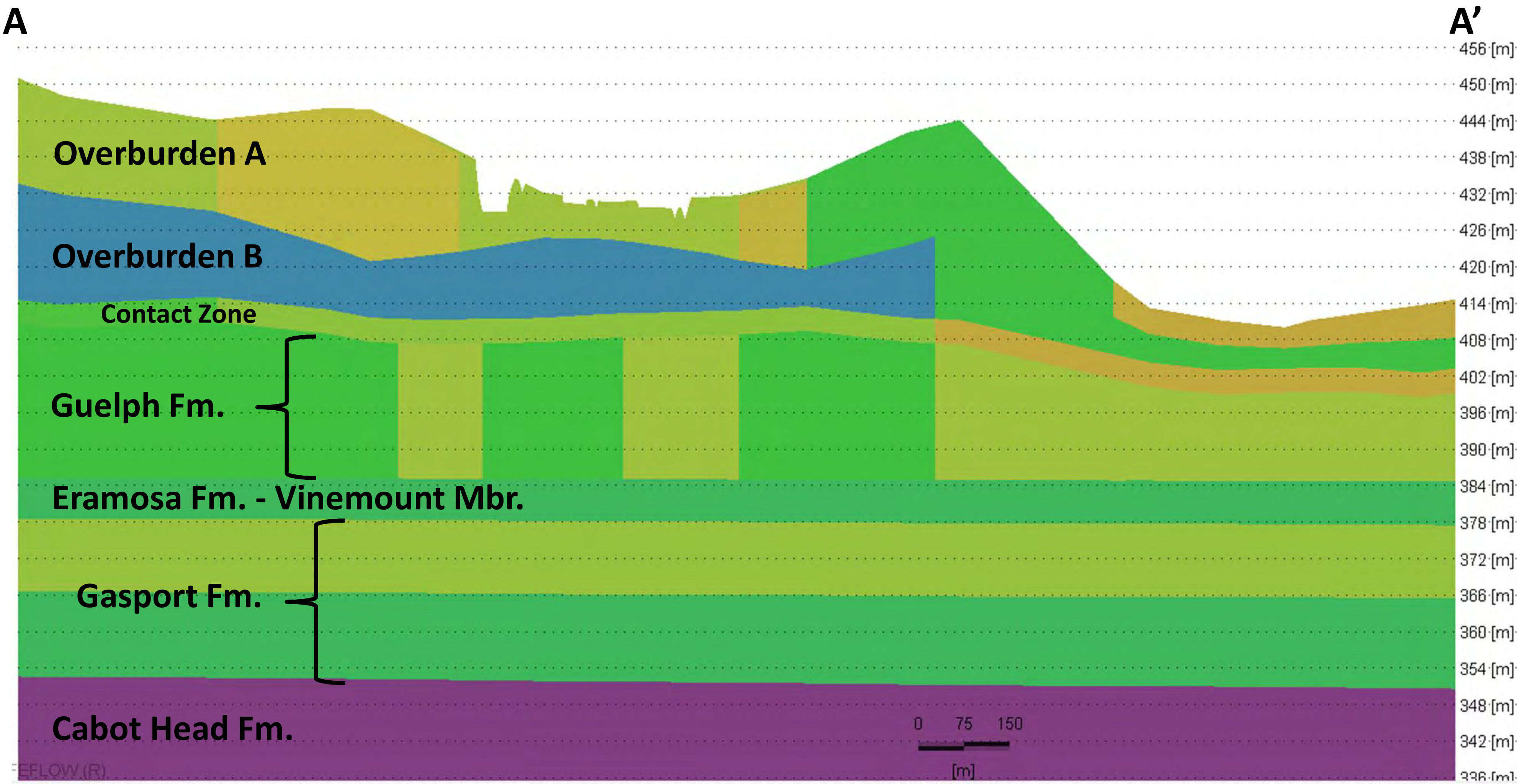
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

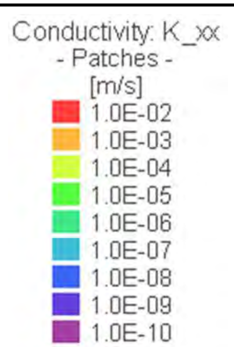
Aberfoyle - Simulated Goat Island Fm. Potentiometric Surface (Layer 10)

Date:	Project:	Submitter:	Reviewer:
December 2018	26435	J. Melchin	D. Van Vliet

Figure
6



Note: 10x Vertical Exaggeration



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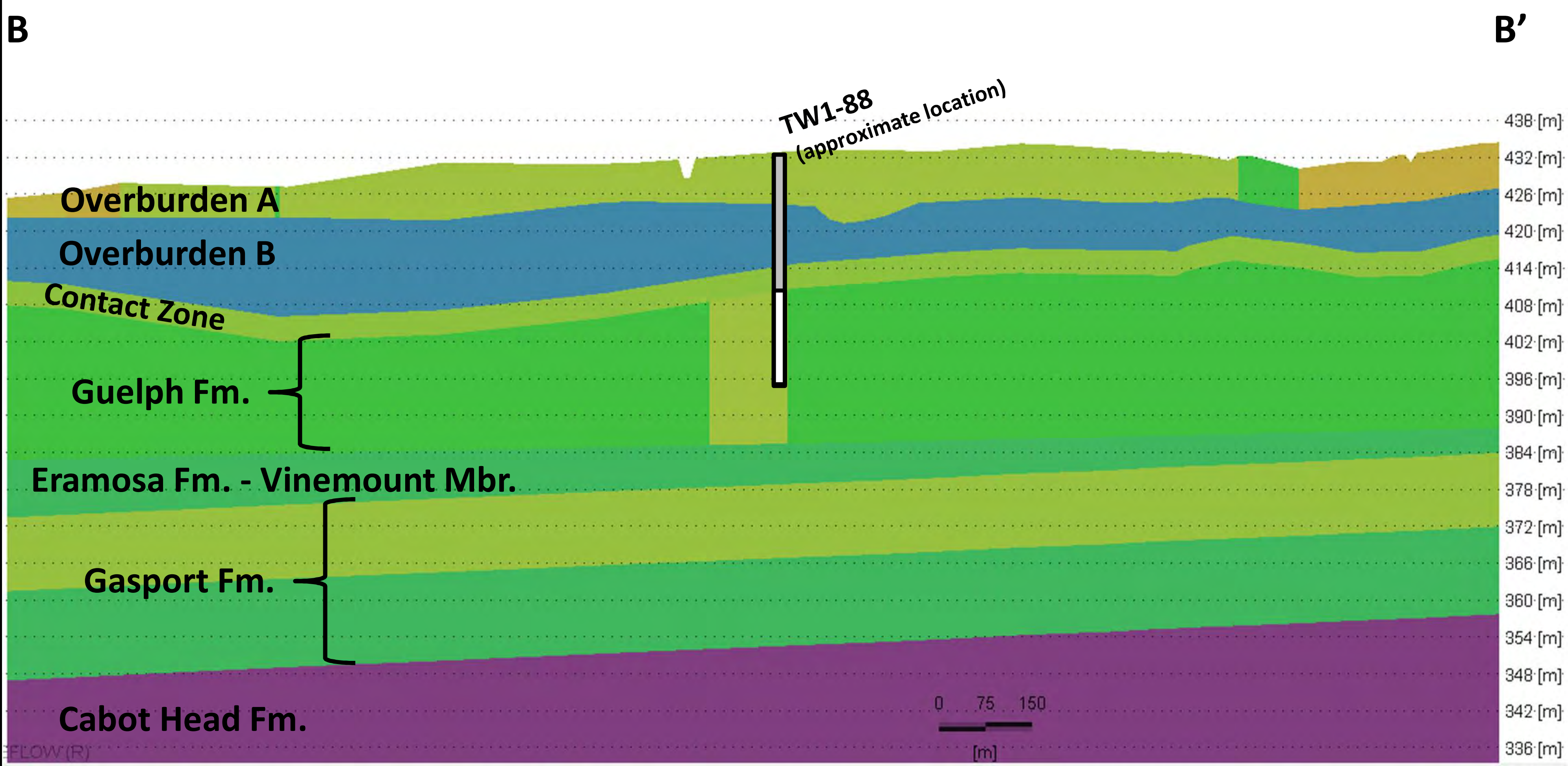
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

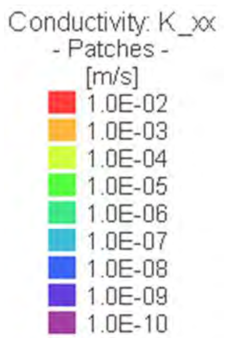
Erin NW-SE Model Cross-Section (AA’)

Date:	Project:	Technical:	Reviewer:	Drawn:
09 Jan 2019	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 7



Note: 10x Vertical Exaggeration



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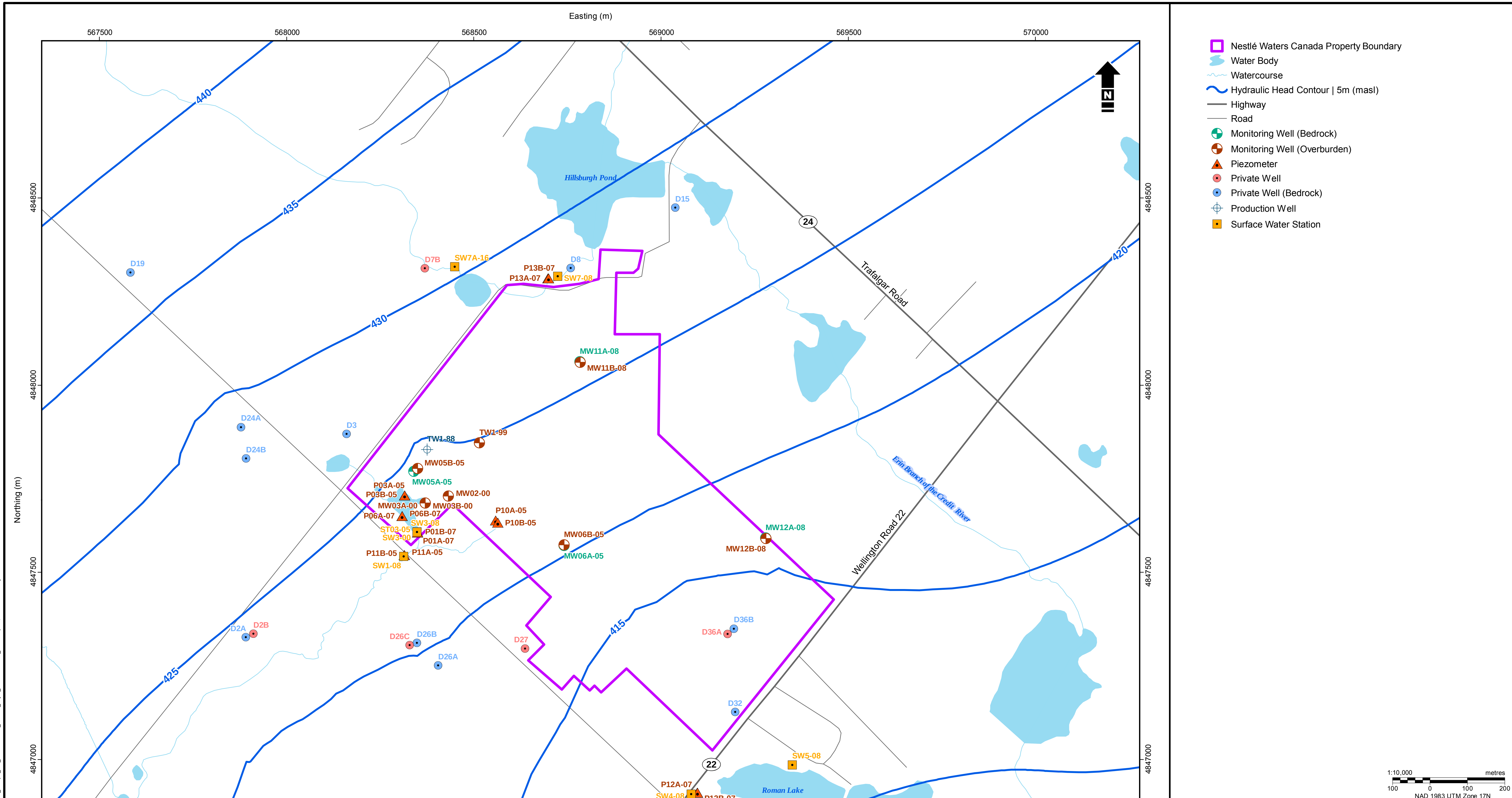
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

Erin SW-NE Model Cross-Section (BB’)

Date:	Project:	Technical:	Reviewer:	Drawn:
09 Jan 2019	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 8



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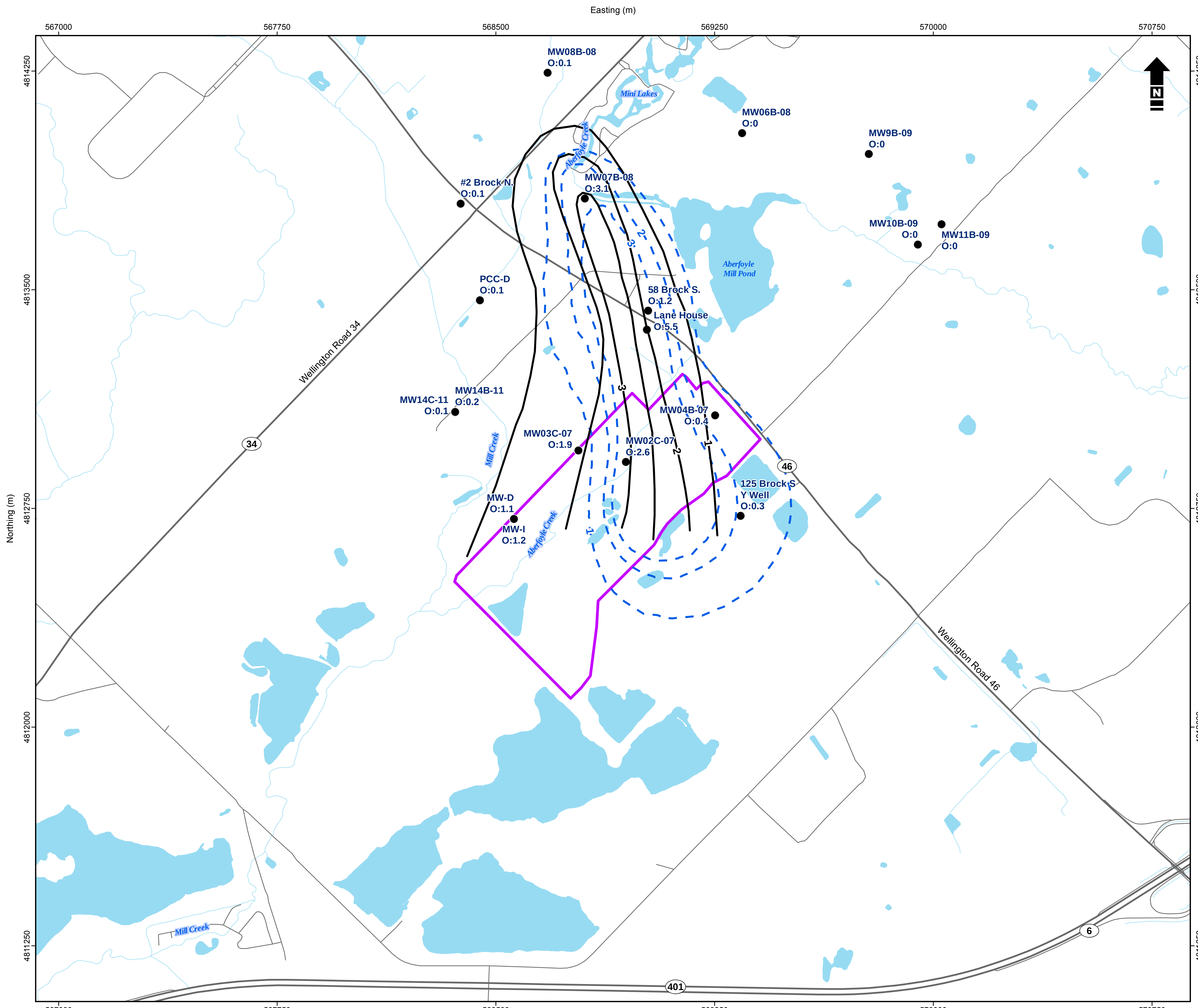
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Erin - Simulated Guelph Fm. Potentiometric Surface (Layer 7)

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

Figure 9



Nestlé Waters Canada Property Boundary
Water Body
Watercourse
Interpreted Drawdown Contour | 1m
Simulated Drawdown Contour | 1m
Highway
Road
Upper Bedrock Monitoring Well
O: x.x Observed Drawdown Value

1:13,500 metres
140 0 140 280
NAD 1983 UTM Zone 17N

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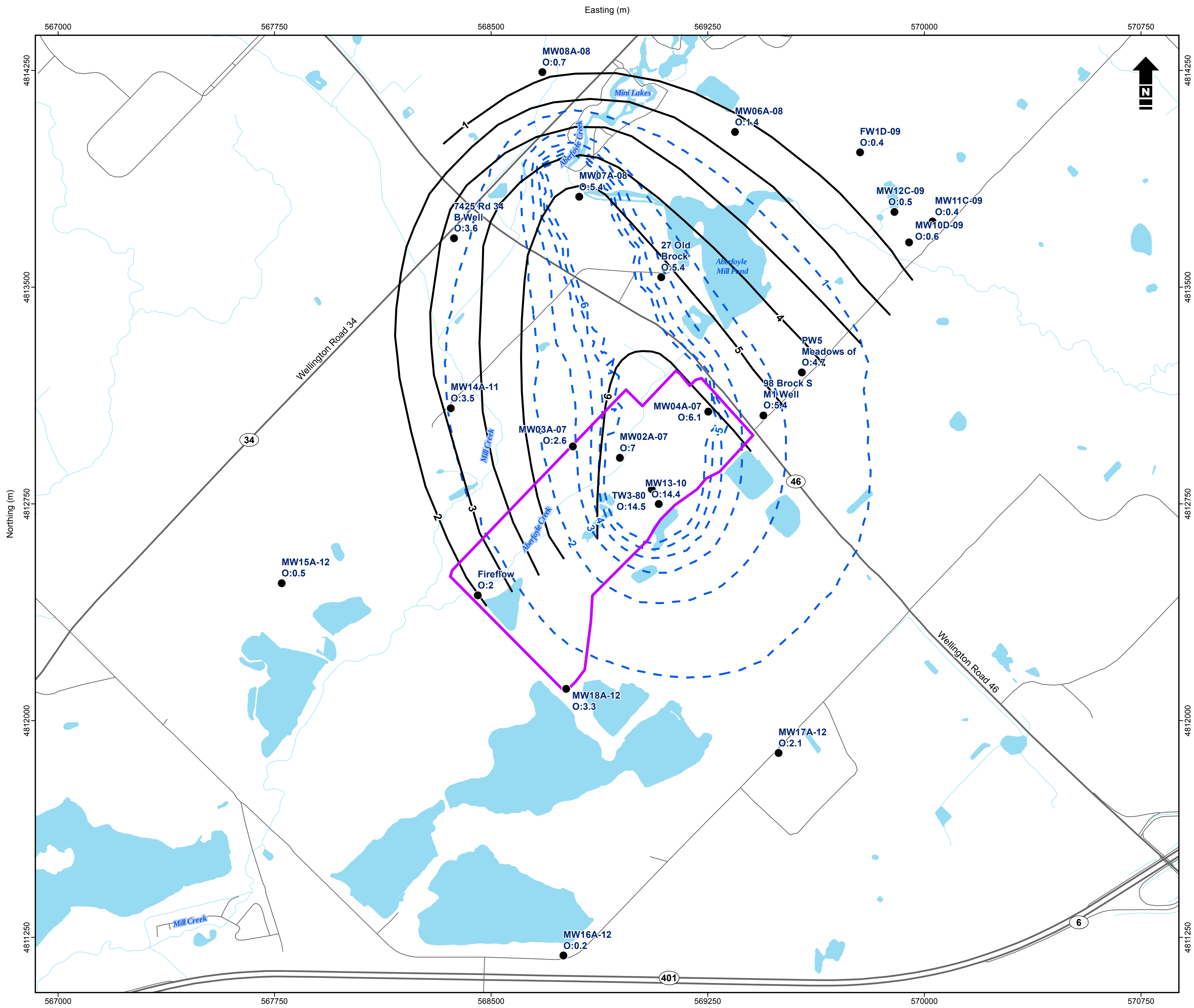
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfoyle - Simulated vs. Interpreted Drawdown in the Upper Bedrock (Layer 6 - Reformatory Quarry Mbr.) due to 2010 NWC Pumping Test

Date:	Project:	Submitter:	Reviewer:
December 2018	26435	J. Melchin	D. Van Vliet

Figure
10



- Nestlé Waters Canada Property Boundary
- Water Body
- Watercourse
- Interpreted Drawdown Contour | 1m
- Simulated Drawdown Contour | 1m
- Highway
- Road
- Lower Bedrock Monitoring Well
- O: x.x Observed Drawdown Value

1:13,500 metres
140 0 140 280
NAD 1983 UTM Zone 17N

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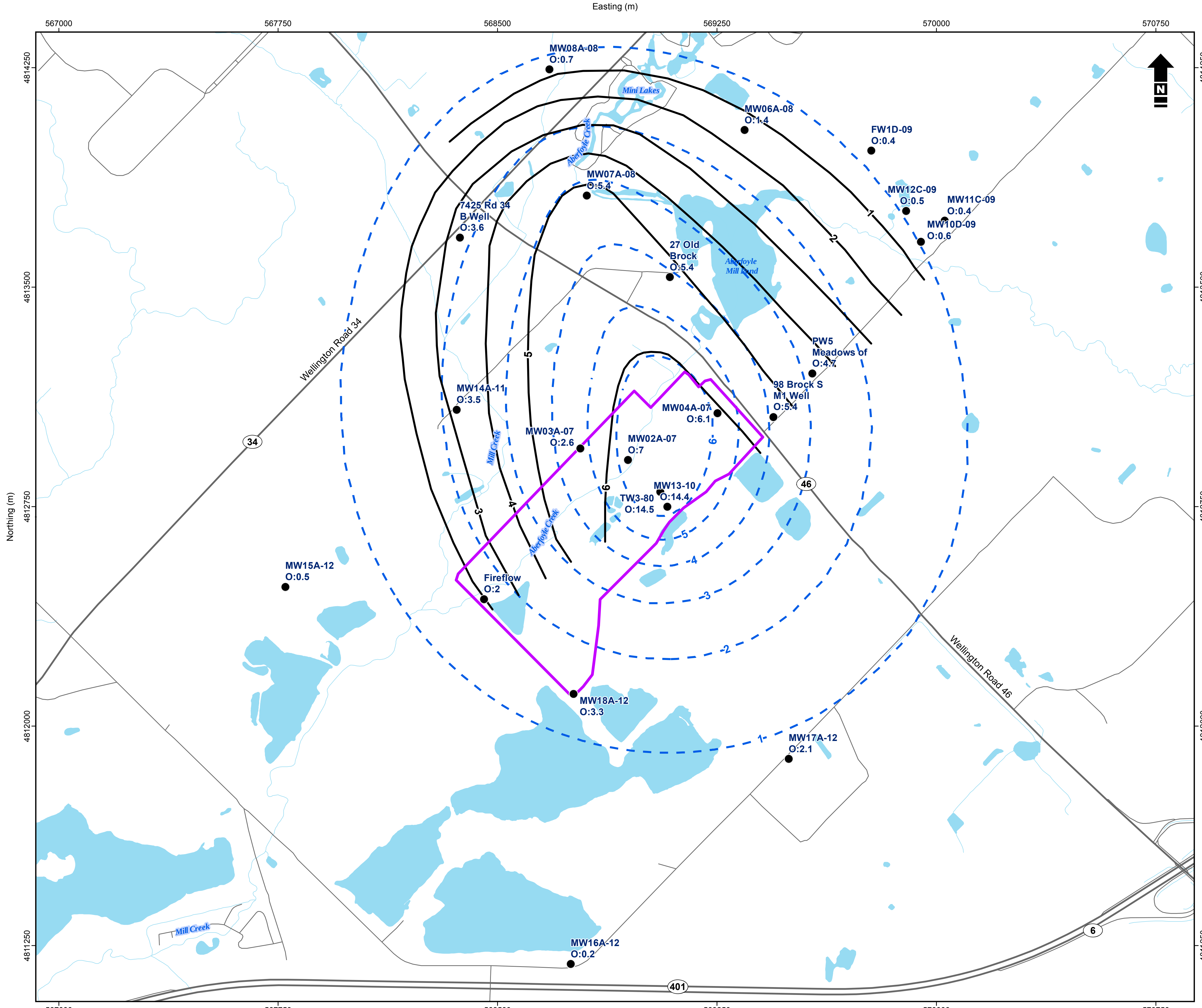
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfoyle - Simulated vs. Interpreted Drawdown in the Lower Bedrock (Layer 10 – Goat Island Fm.) due to 2010 NWC Pumping Test

Date:	Project:	Submitter:	Reviewer:
December 2018	26435	J. Melchin	D. Van Vliet

Figure
11



Nestlé Waters Canada Property Boundary
Water Body
Watercourse
Interpreted Drawdown Contour | 1m
Simulated Drawdown Contour | 1m
Highway
Road
Lower Bedrock Monitoring Well
O: x.x Observed Drawdown Value

1:13,500 metres
140 0 140 280
NAD 1983 UTM Zone 17N

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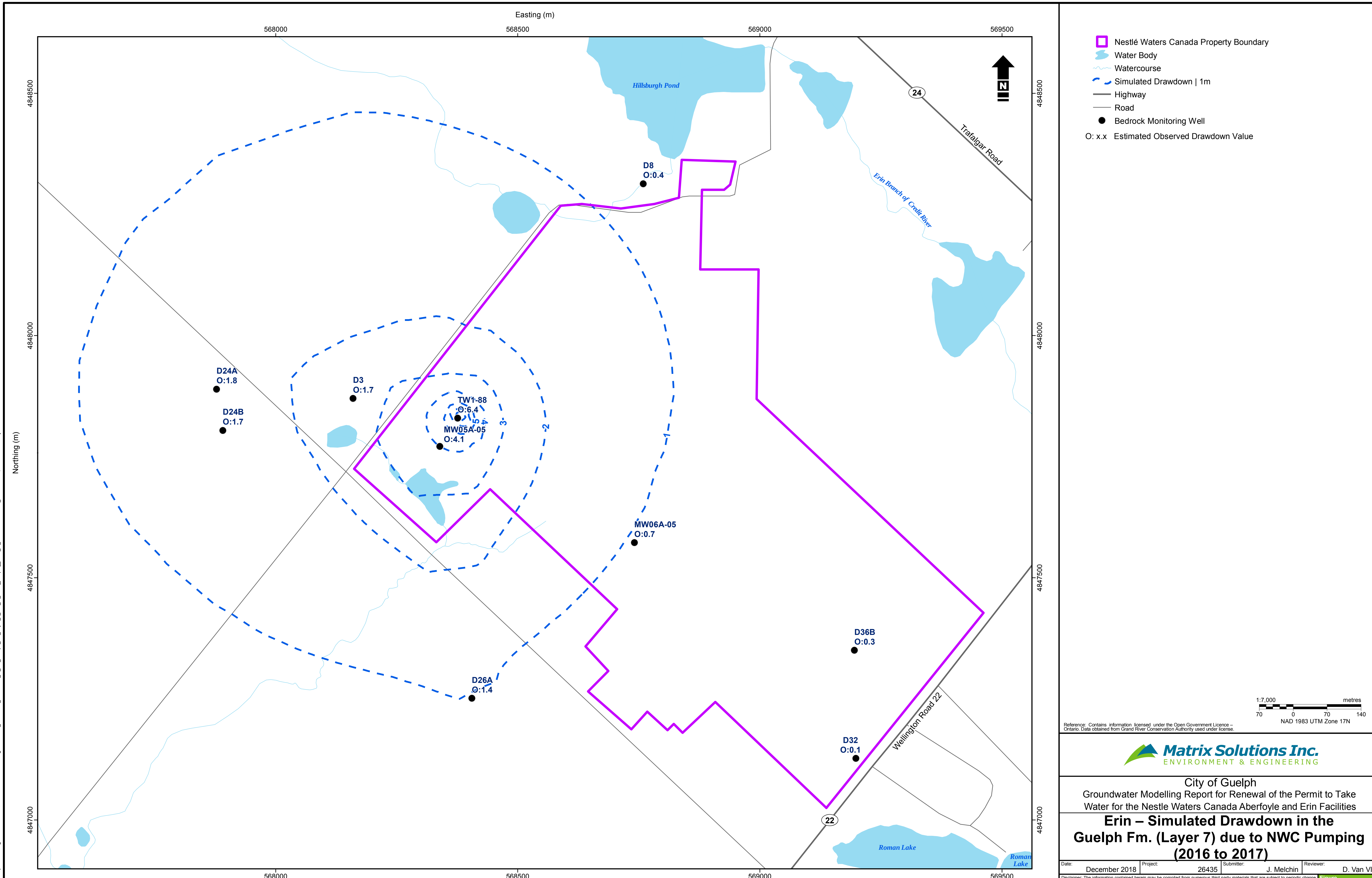
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfoyle - Simulated vs. Interpreted Drawdown in the Lower Bedrock (Layer 12 – Middle Gasport Fm.) due to 2010 NWC Pumping Test

Date:	Project:	Submitter:	Reviewer:
December 2018	26435	J. Melchin	D. Van Vliet

Figure
12



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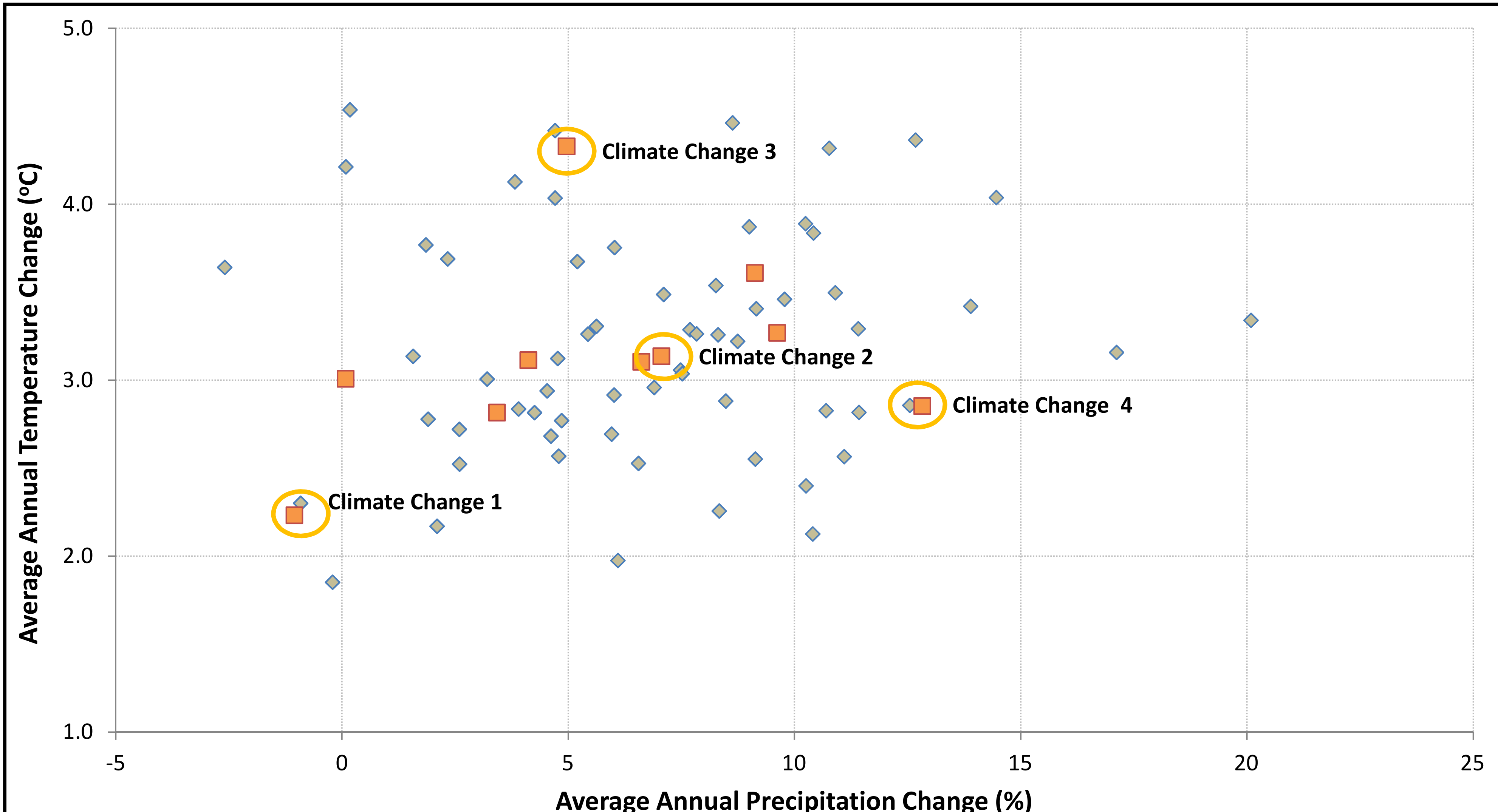
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Erin – Simulated Drawdown in the Guelph Fm. (Layer 7) due to NWC Pumping (2016 to 2017)

Date:	Project:	Submitter:	Reviewer:
December 2018	26435	J. Melchin	D. Van Vliet

Figure
13



◆ Climate Change Scenarios

■ Representative Climate Change Scenarios

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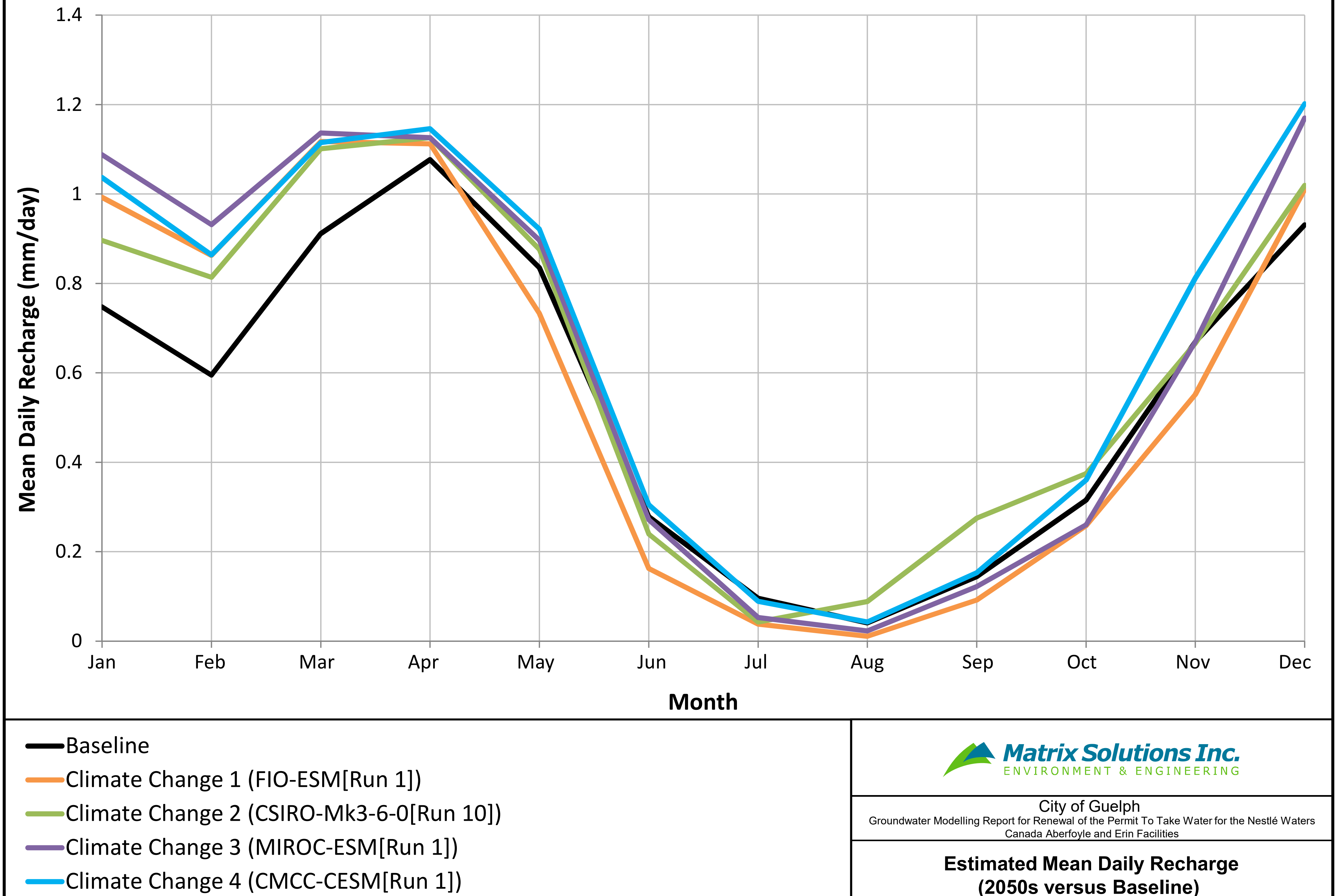
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

Scatter Plot of Future Climate Models Selected for Hydrologic Modelling (2050s versus Current)

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 14



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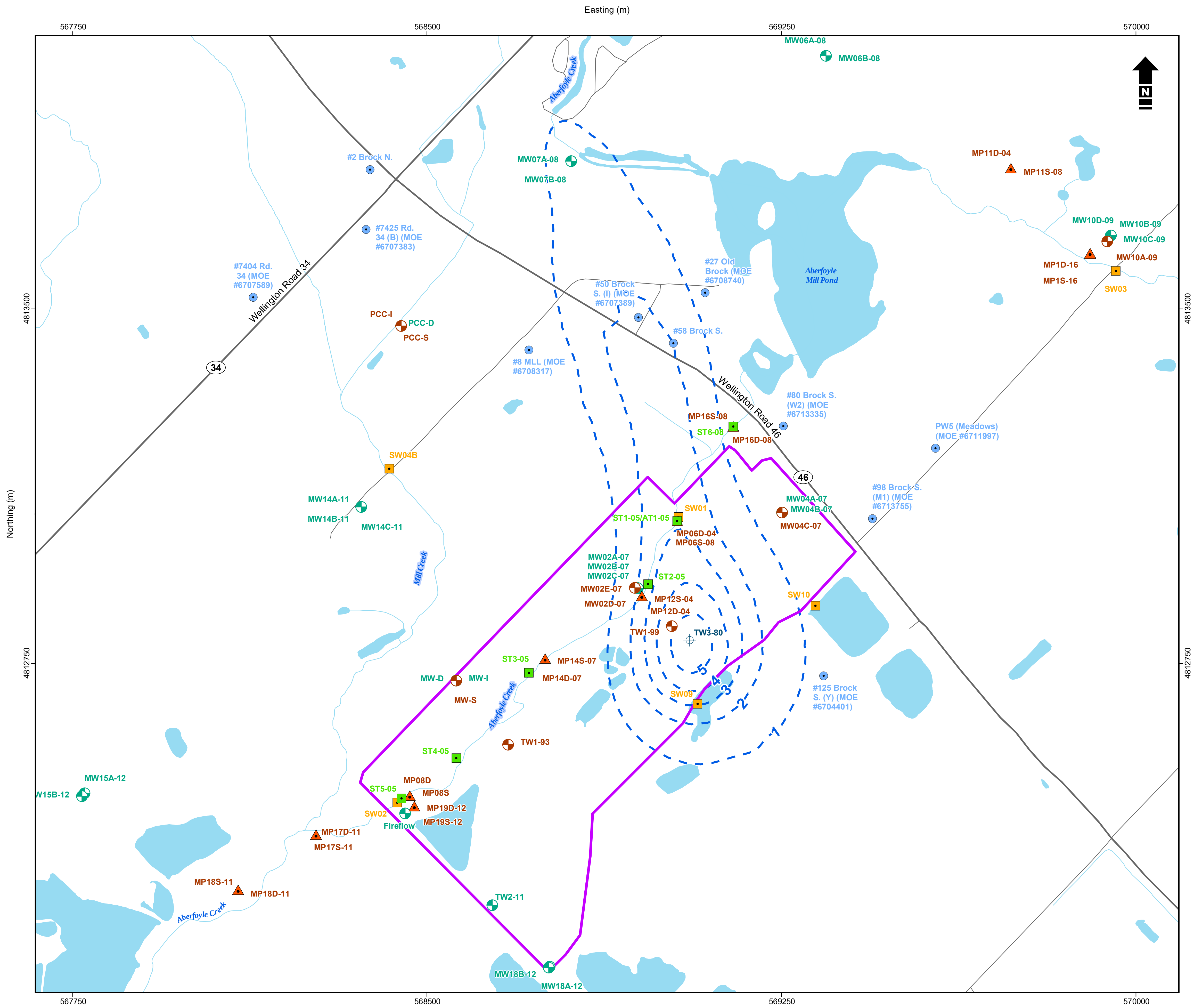
City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

Estimated Mean Daily Recharge (2050s versus Baseline)

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 15



Nestlé Waters Canada Property Boundary
Water Body
Watercourse
Simulated Drawdown | 1m
Highway
Road
Monitoring Well (Bedrock)
Monitoring Well (Overburden)
Piezometer
Private Well (Bedrock)
Production Well
Surface Water Station
Surface Water Temperature Station

1:8,250 metres
80 0 80 160
NAD 1983 UTM Zone 17N

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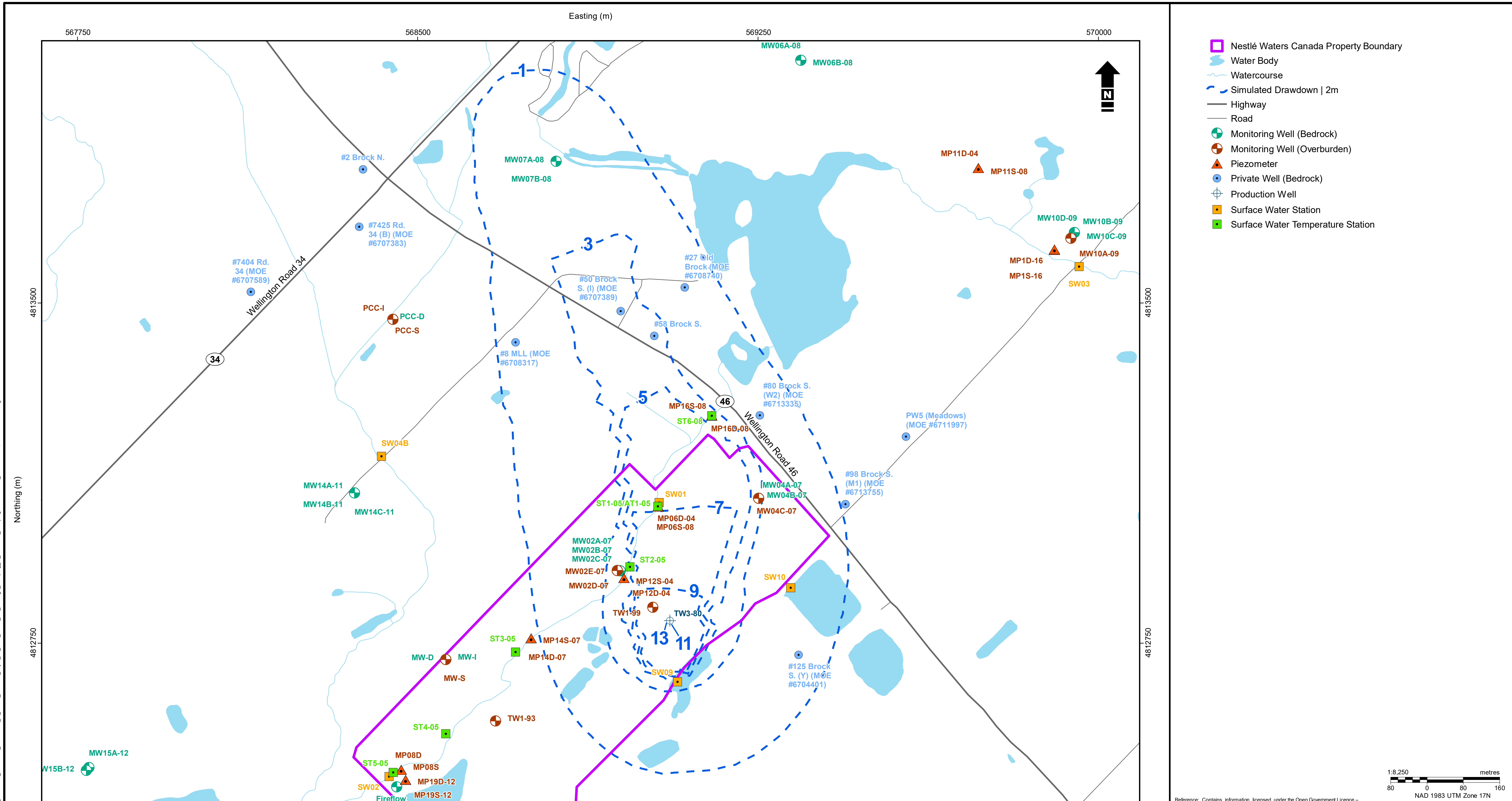
City of Guelph

Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfoyle - Simulated Additional Drawdown in Upper Bedrock (Layer 6 – Reformatory Quarry Mbr.) – Average Pumping to Permitted Pumping

Date:	Project:	Submitter:	Reviewer:
January 2019	26435	J. Melchin	D. Van Vliet

Figure
16



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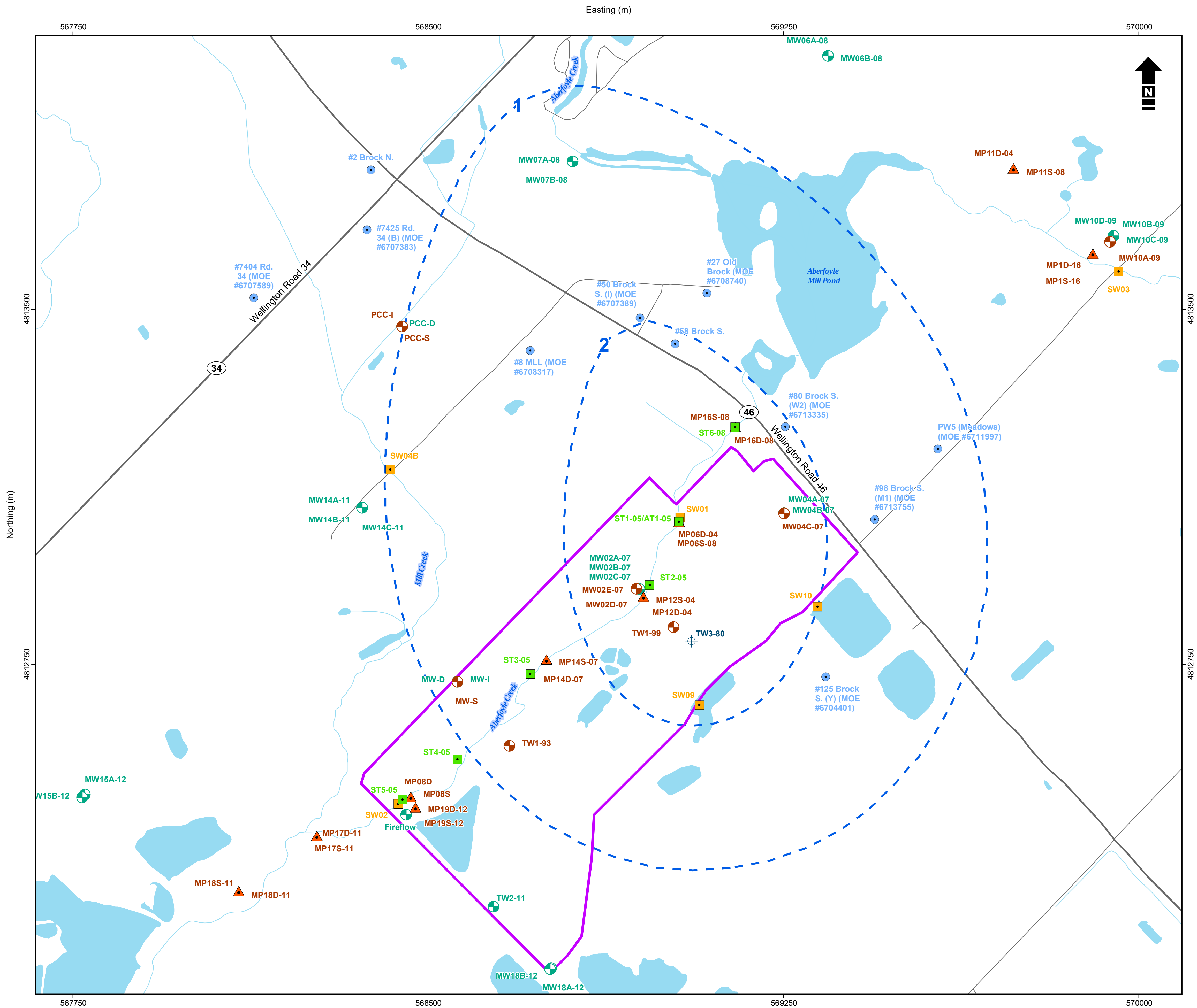
City of Guelph

Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfoyle - Simulated Additional Drawdown in Lower Bedrock (Layer 10 – Goat Island Fm.) – Average Pumping to Permitted Pumping

Date: January 2019	Project: 26435	Submitter: J. Melchin	Reviewer: D. Van Vliet

Figure 17



Nestlé Waters Canada Property Boundary
Water Body
Watercourse
Simulated Drawdown | 1m
Highway
Road
Monitoring Well (Bedrock)
Monitoring Well (Overburden)
Piezometer
Private Well (Bedrock)
Production Well
Surface Water Station
Surface Water Temperature Station

1:8,250 metres
80 0 80 160
NAD 1983 UTM Zone 17N

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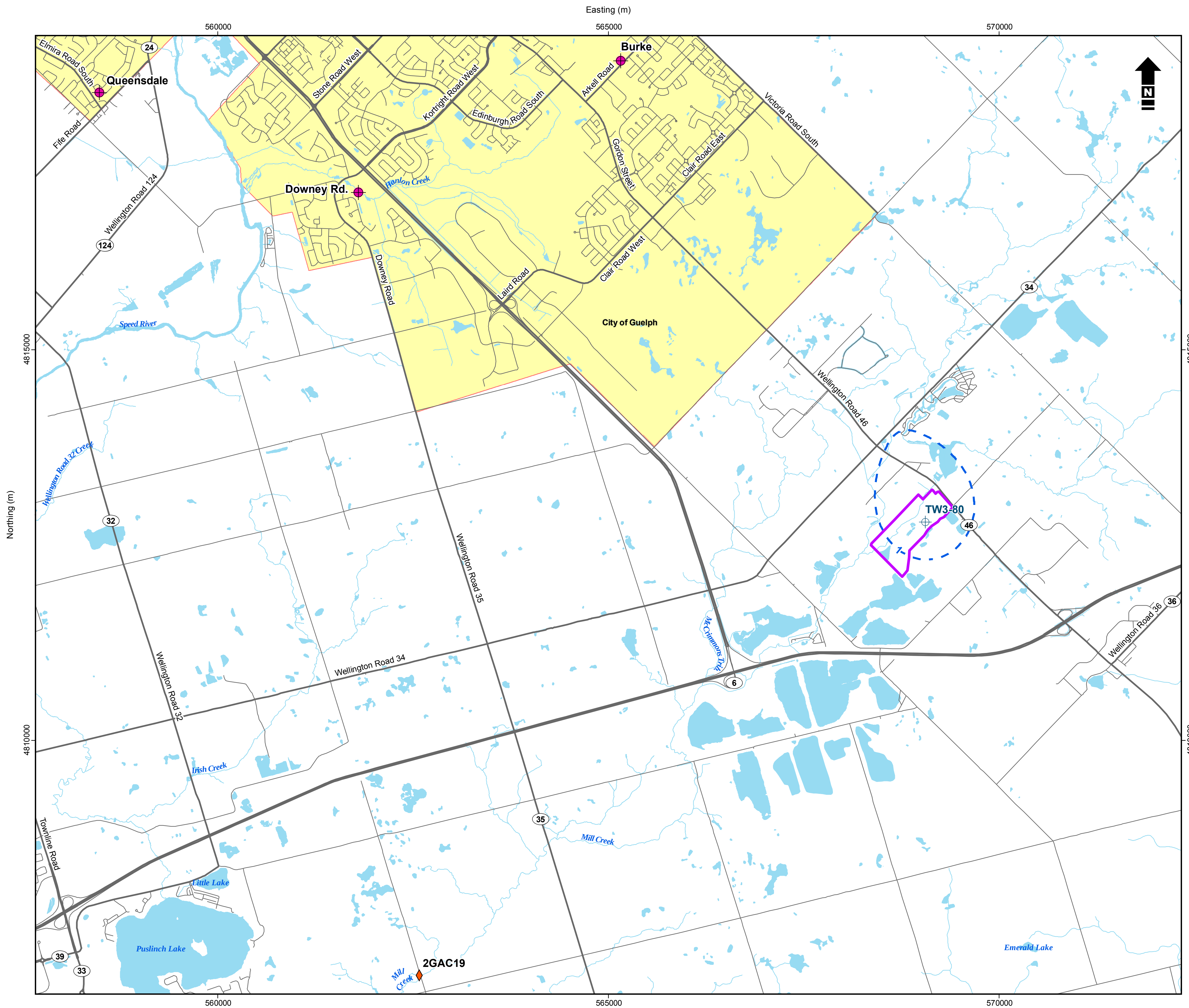
City of Guelph

Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Local Aberfoyle Extent - Simulated Additional Drawdown in Lower Bedrock (Layer 12 – Middle Gasport Fm.) – Average Pumping to Permitted Pumping

Date:	Project:	Submitter:	Reviewer:
January 2019	26435	J. Melchin	D. Van Vliet

Figure 18



Nestlé Waters Canada Property Boundary
Community
Water Body
Watercourse
Simulated Drawdown | 1m
Highway
Road
Production Well
Municipal Well
GRCA Flow Gauge

1:50,000 metres
520 0 520 1,040
NAD 1983 UTM Zone 17N

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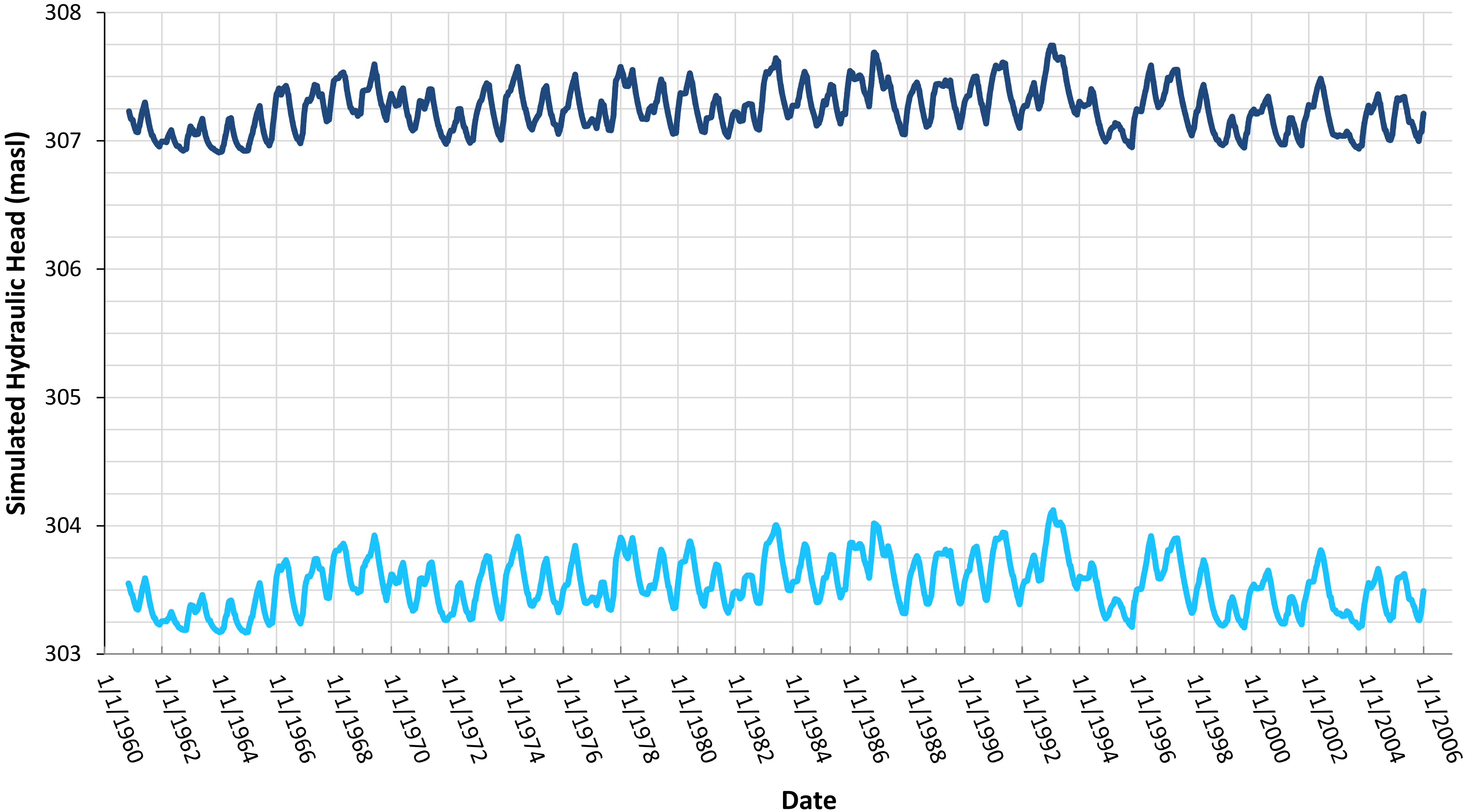
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Regional Aberfoyle Extent - Simulated Additional Drawdown in Lower Bedrock (Layer 12 – Middle Gasport Fm.) – Average Pumping to Permitted Pumping

Date:	Project:	Submitter:	Reviewer:
December 2018	26435	J. Melchin	D. Van Vliet

Figure 19



MW2A-07 - Average NWC Pumping (2,113 m³/day; Scenario 3)

MW2A-07 - Permitted NWC Pumping (3,600 m³/day; Scenario 4)

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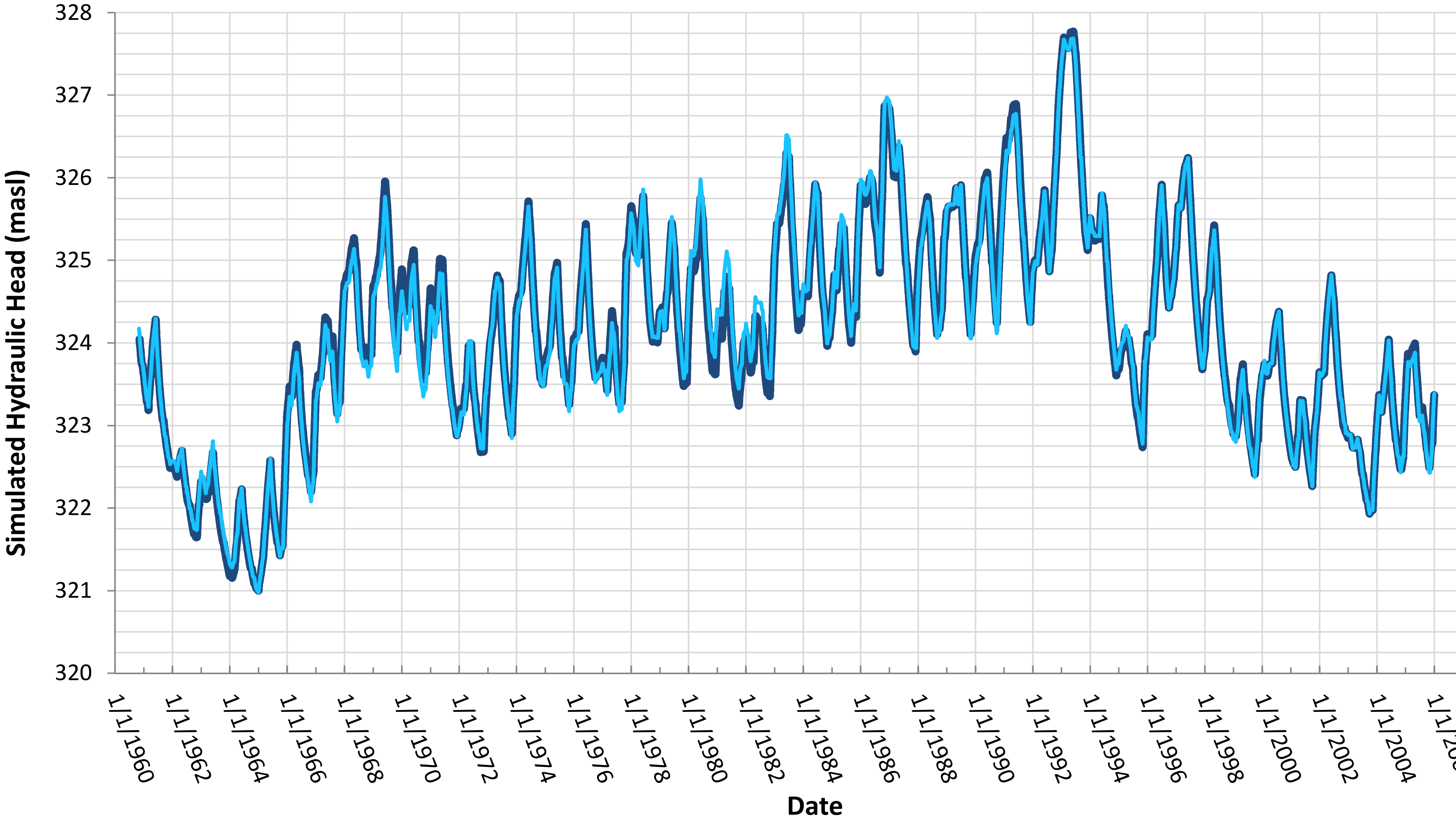
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

Aberfoyle – Simulated Water Level Variability at MW2A-07 – Drought Scenarios

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure
20



Burke Well - Average NWC Pumping (2,113 m³/day: Scenario 3)

Burke Well - Permitted NWC Pumping (3,600 m³/day; Scenario 4)

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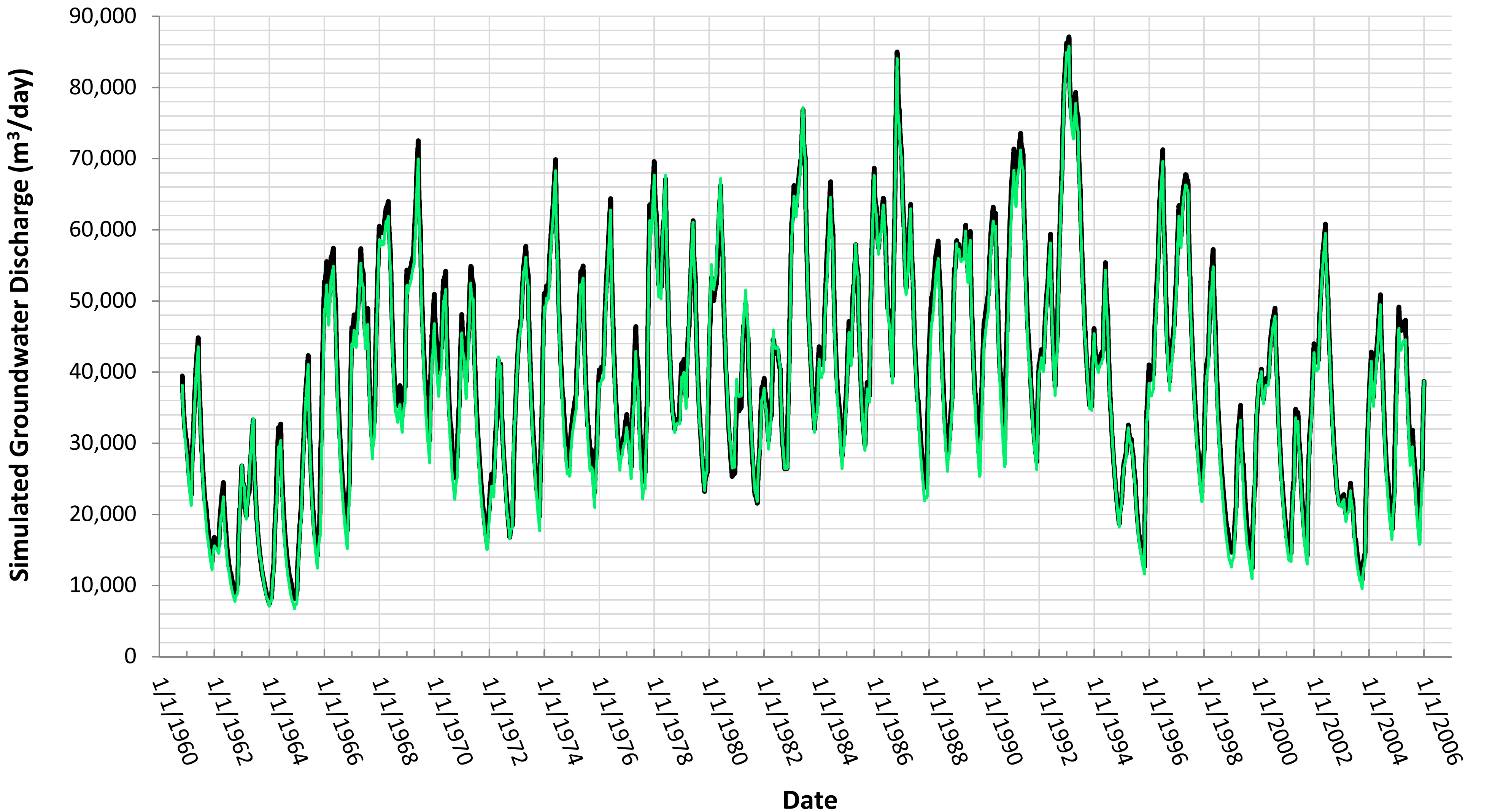
Aberfoyle – Simulated Water Level Variability at Burke Well – Drought Scenarios

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure
21



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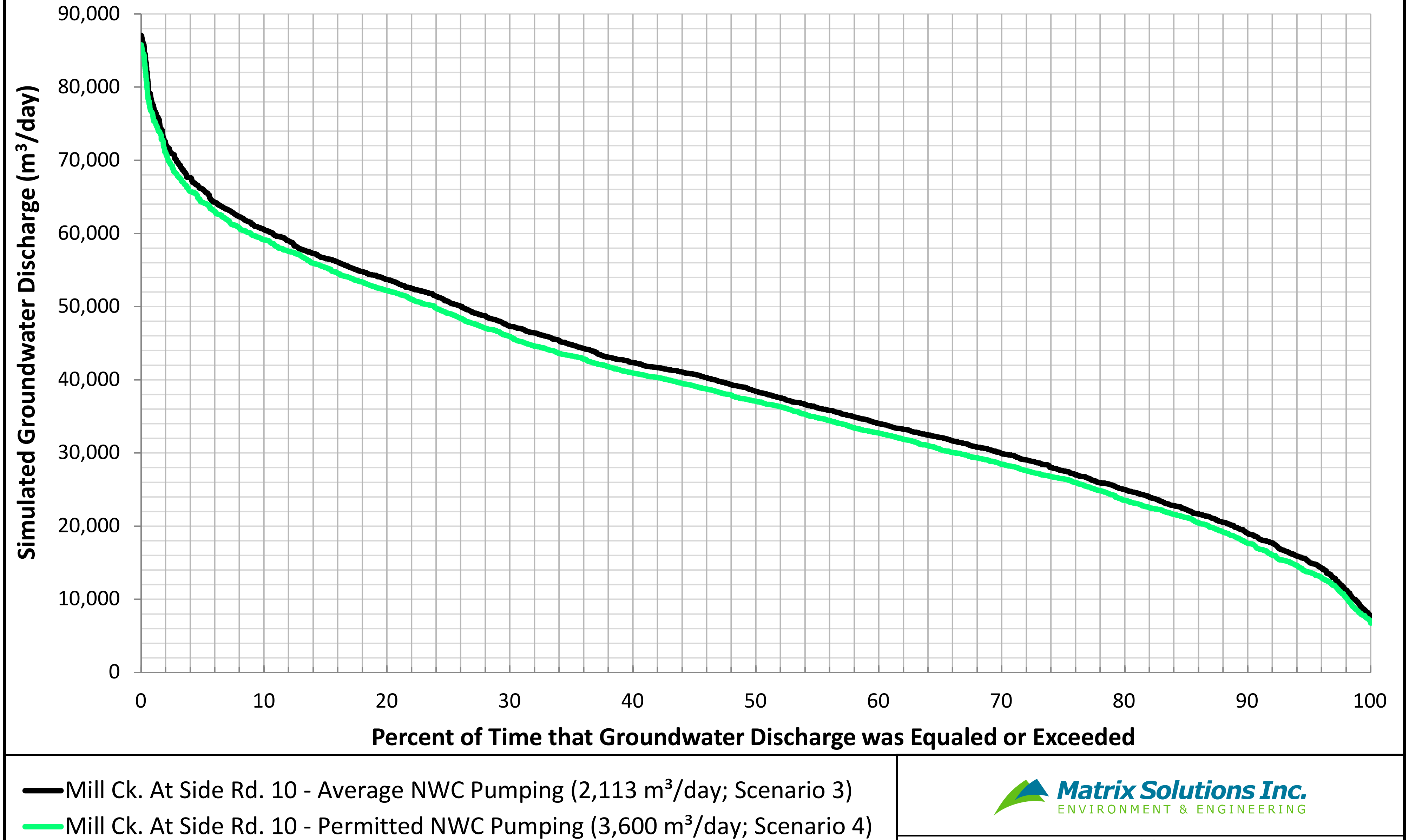
Aberfoyle – Simulated Groundwater Discharge at Mill Creek at Side Rd. 10 Gauge – Drought Scenarios Time Series

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 22



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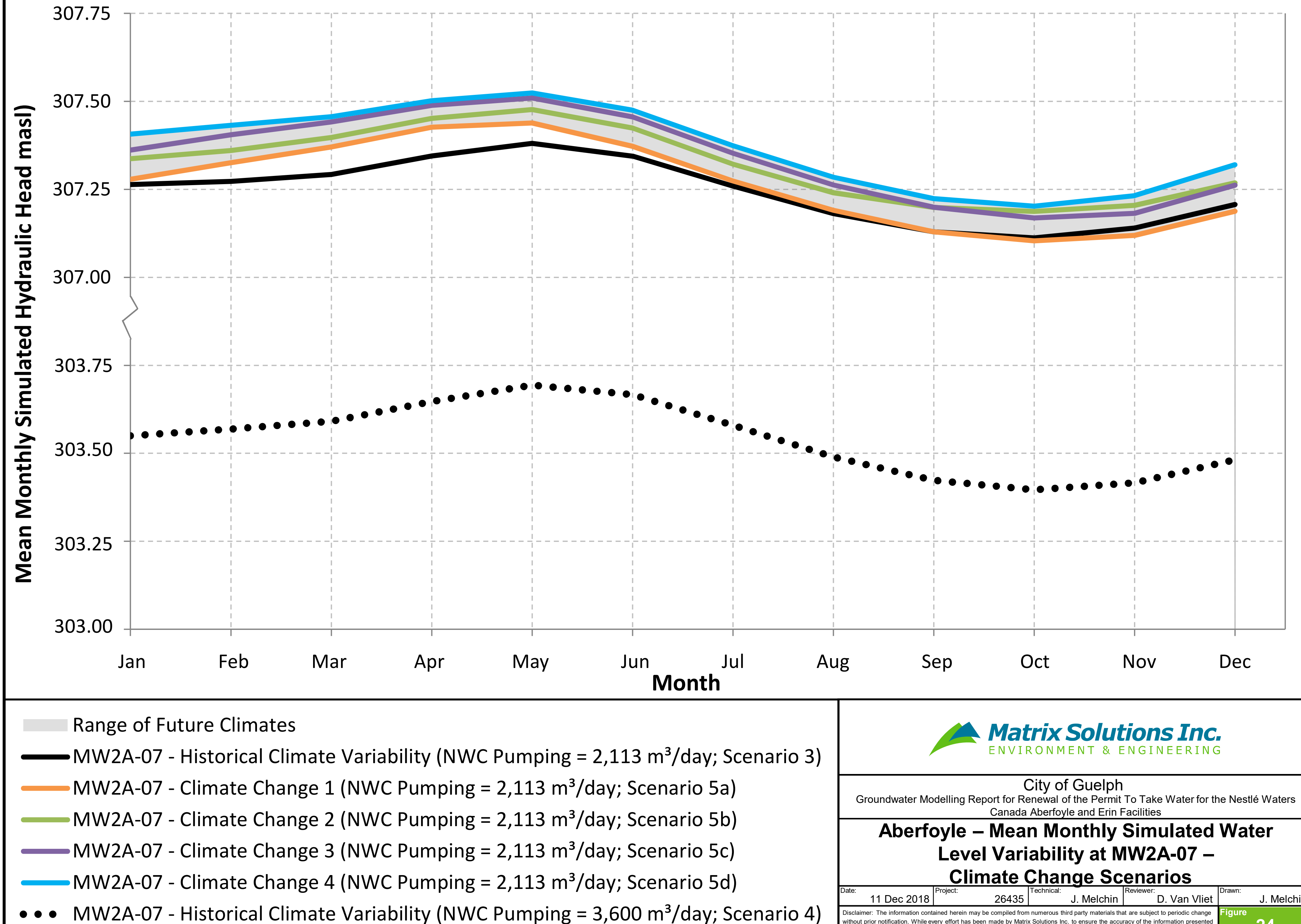
Aberfoyle – Simulated Groundwater Discharge at Mill Creek at Side Rd. 10 Gauge – Drought Scenarios Ranked Duration Curves

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 23



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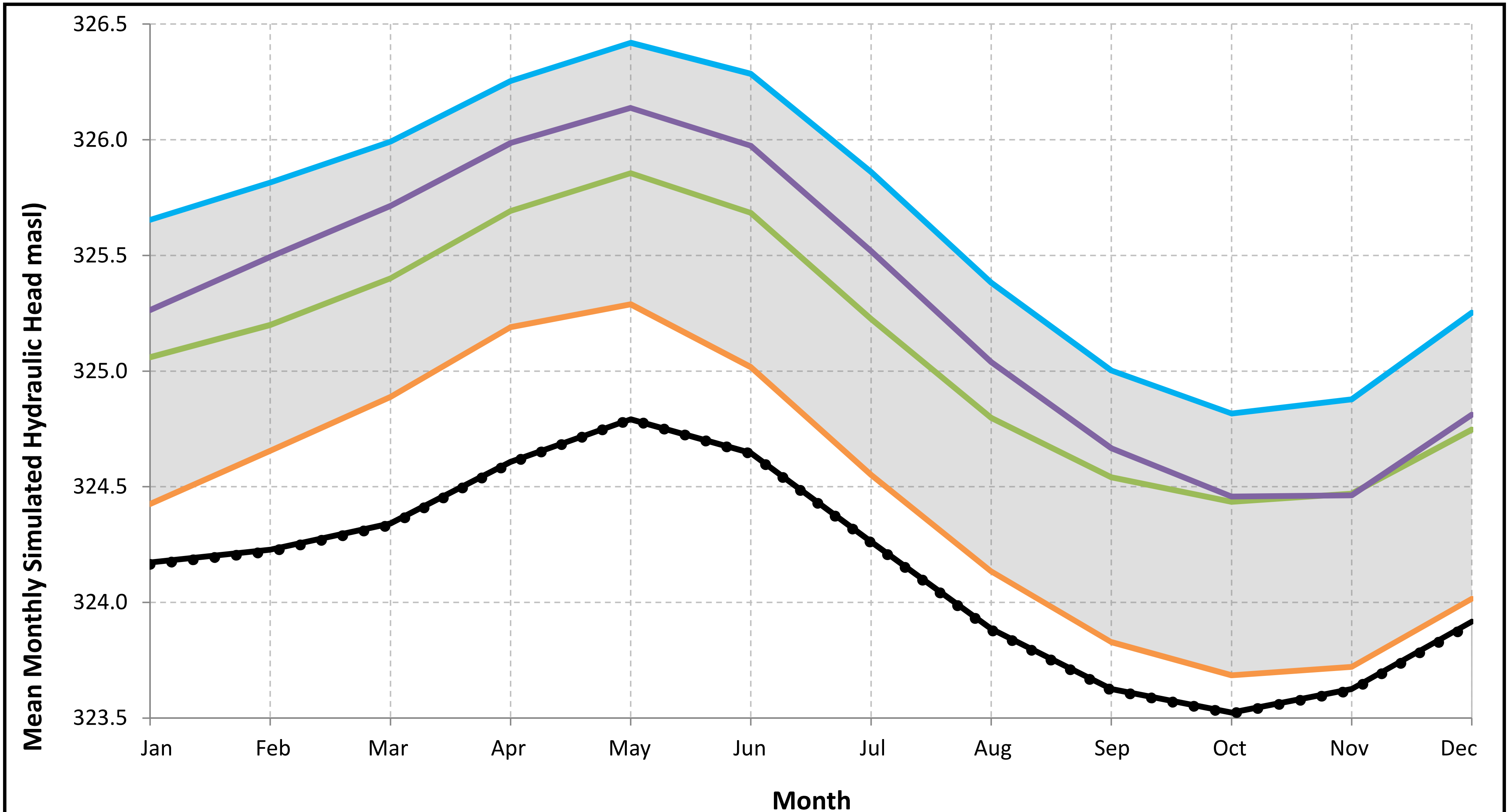
Aberfoyle – Mean Monthly Simulated Water Level Variability at MW2A-07 – Climate Change Scenarios

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 24



Range of Future Climates
Burke Well - Historical Climate Variability (NWC Pumping = 2,113 m³/day; Scenario 3)
Burke Well - Historical Climate Variability (NWC Pumping = 3,600 m³/day; Scenario 4)
Burke Well - Climate Change 1 (NWC Pumping = 2,113 m³/day; Scenario 5a)
Burke Well - Climate Change 2 (NWC Pumping = 2,113 m³/day; Scenario 5b)
Burke Well - Climate Change 3 (NWC Pumping = 2,113 m³/day; Scenario 5c)
Burke Well - Climate Change 4 (NWC Pumping = 2,113 m³/day; Scenario 5d)

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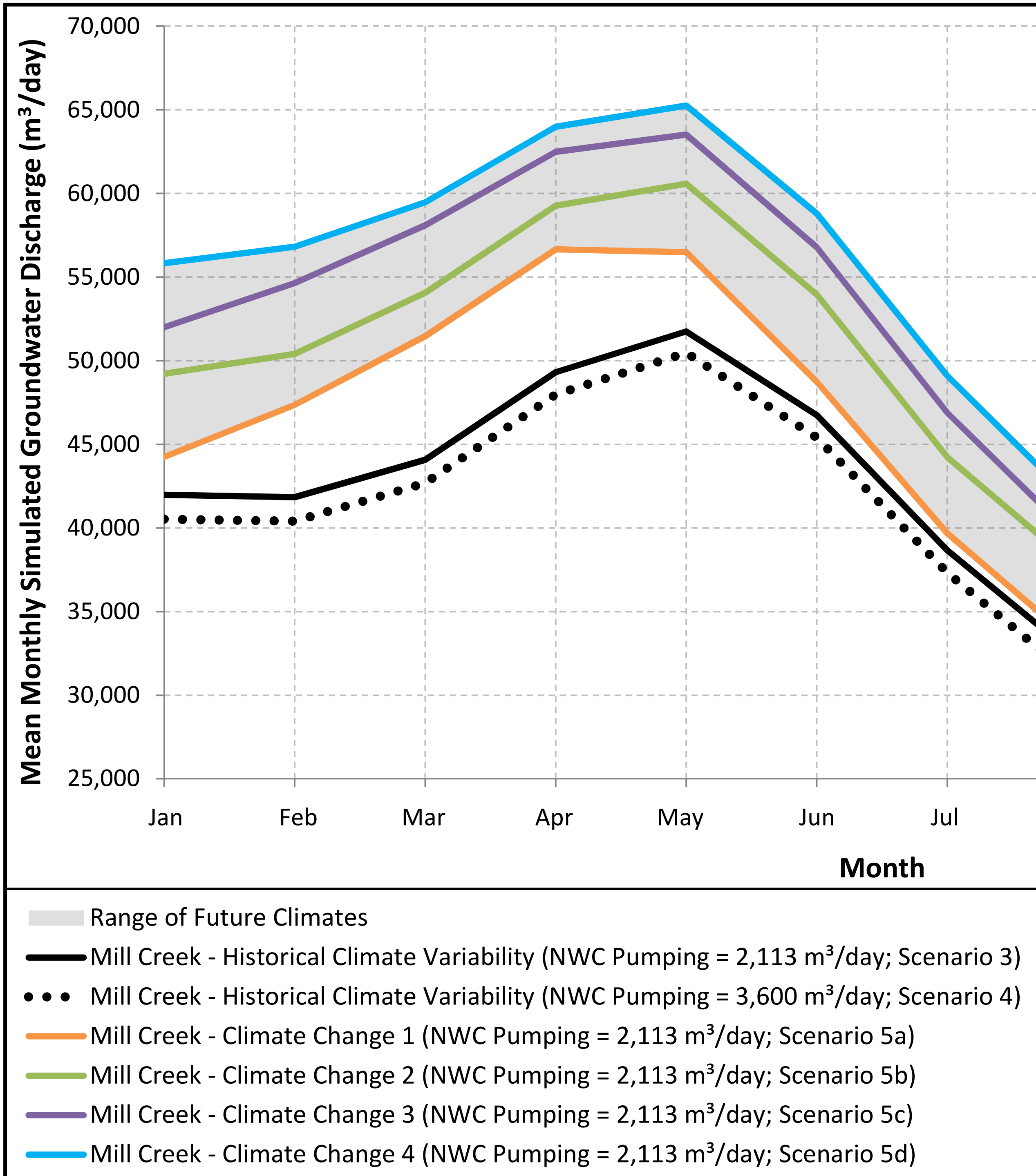
Aberfoyle – Mean Monthly Simulated Water Level Variability at Burke Well – Climate Change Scenarios

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 25



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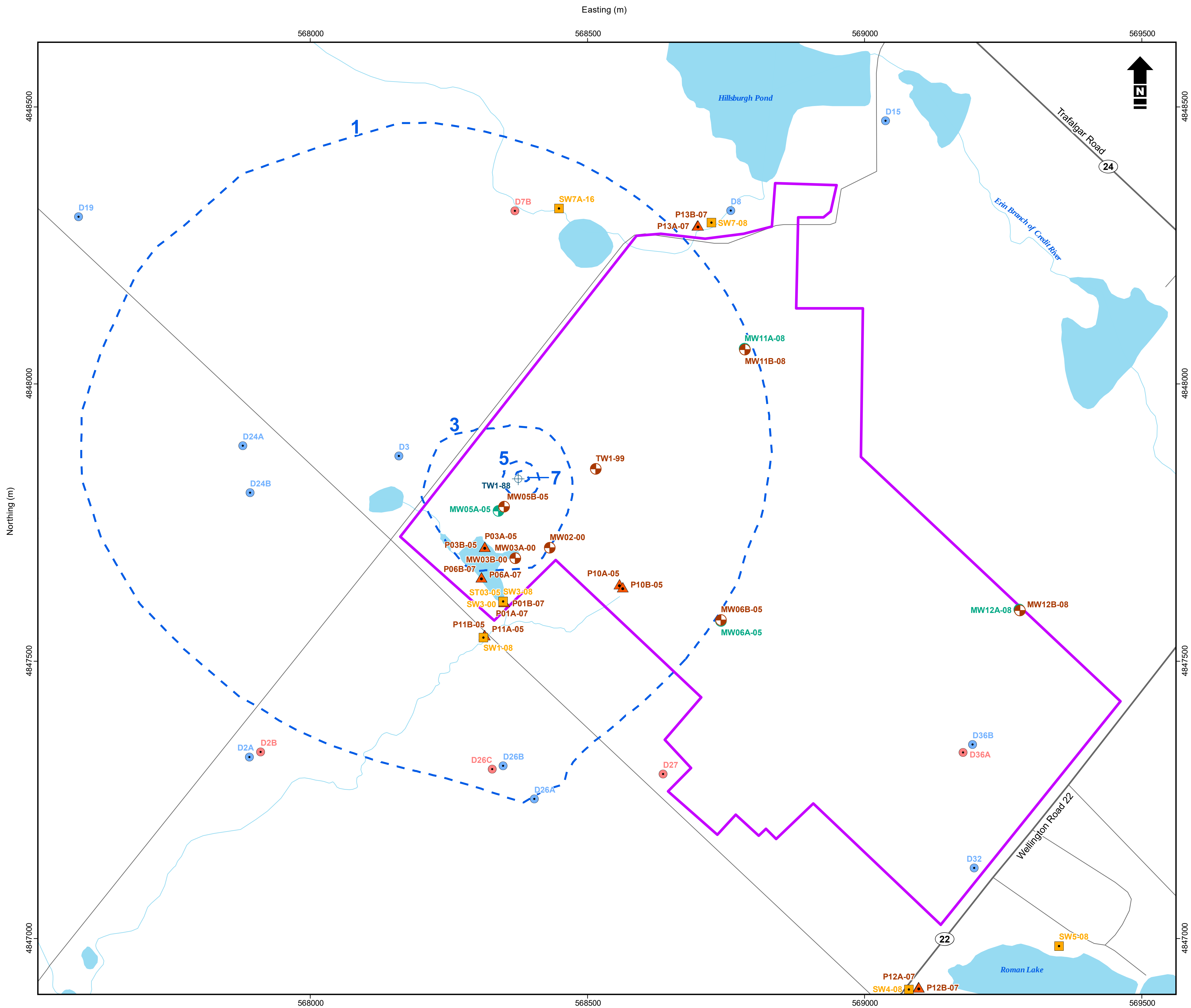
Aberfoyle – Mean Monthly Simulated Groundwater Discharge at Mill Creek at Side Rd. 10 Gauge – Climate Change Scenarios

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 26



Nestlé Waters Canada Property Boundary
Water Body
Watercourse
Simulated Drawdown | 2m
Highway
Road
Monitoring Well (Bedrock)
Monitoring Well (Overburden)
Piezometer
Private Well
Private Well (Bedrock)
Production Well
Surface Water Station

1:7,000 metres
70 0 70 140
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

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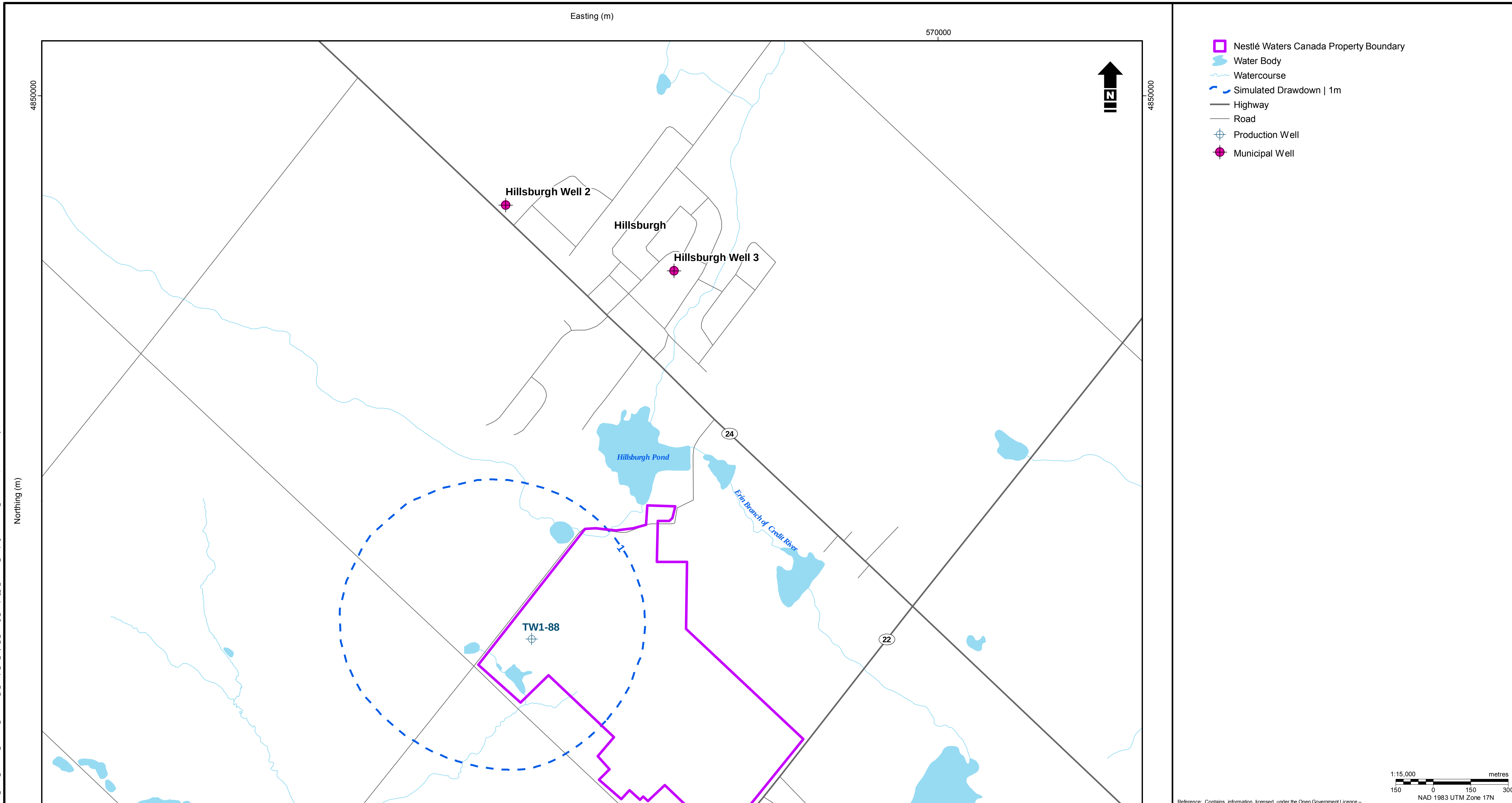
Local Erin Extent - Simulated Additional Drawdown in the Guelph Fm. (Layer 7) – Average Pumping to Permitted Pumping

Date:	Project:	Submitter:	Reviewer:
January 2019	26435	J. Melchin	D. Van Vliet

Figure
27



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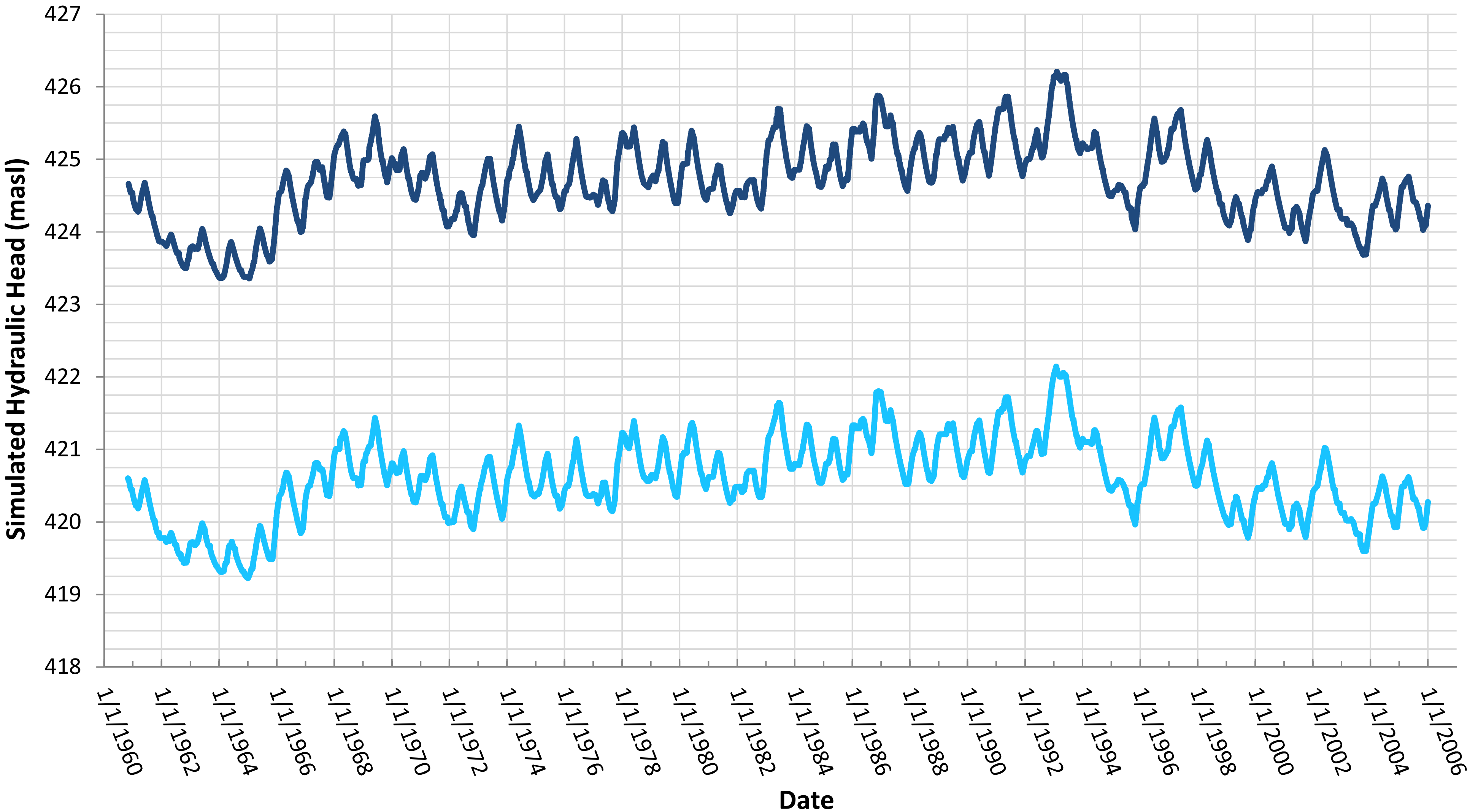
Regional Erin Extent - Simulated Additional Drawdown in the Guelph Fm. (Layer 7) - Average Pumping to Permitted Pumping

Date:	Project:	Submitter:	Reviewer:
December 2018	26435	J. Melchin	D. Van Vliet

Figure 28



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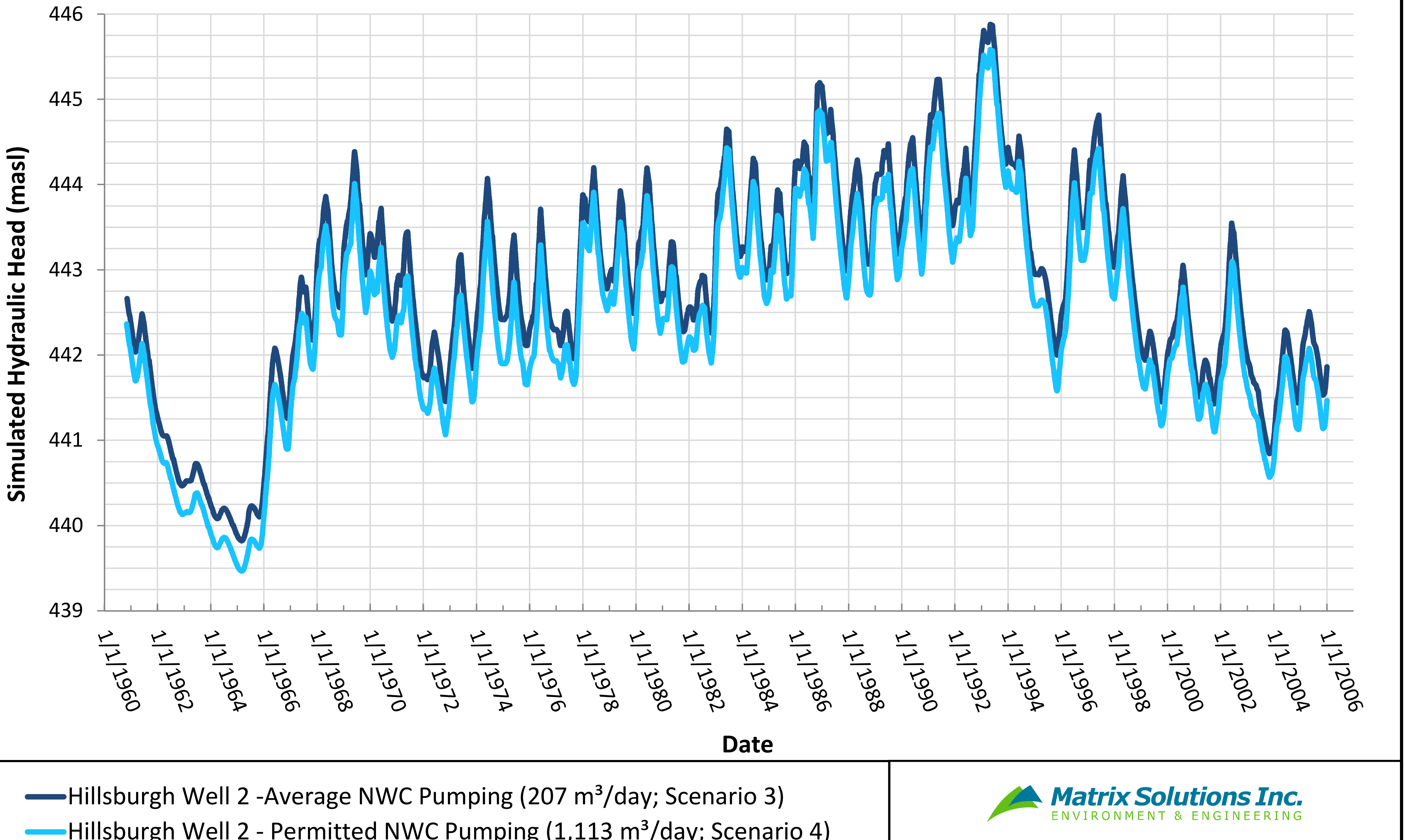
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

Erin – Simulated Water Level Variability at MW05A-05 – Drought Scenarios

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 29



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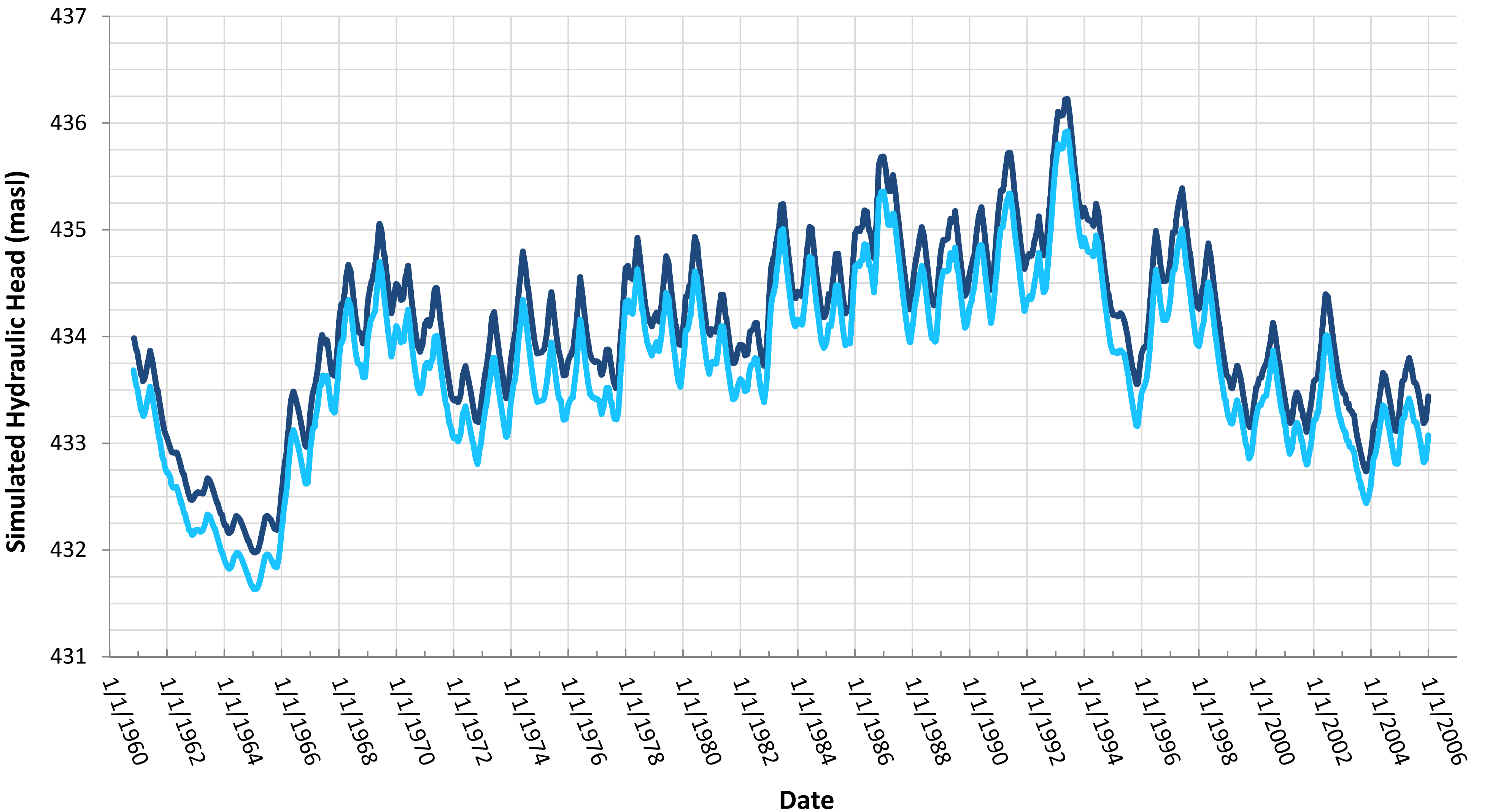
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

Erin – Simulated Water Level Variability at Hillsburgh Well 2 – Drought Scenarios

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 30



Hillsburgh Well 3 - Average NWC Pumping (207 m³/day; Scenario 3)
Hillsburgh Well 3 - Permitted NWC Pumping (1,113 m³/day; Scenario 4)

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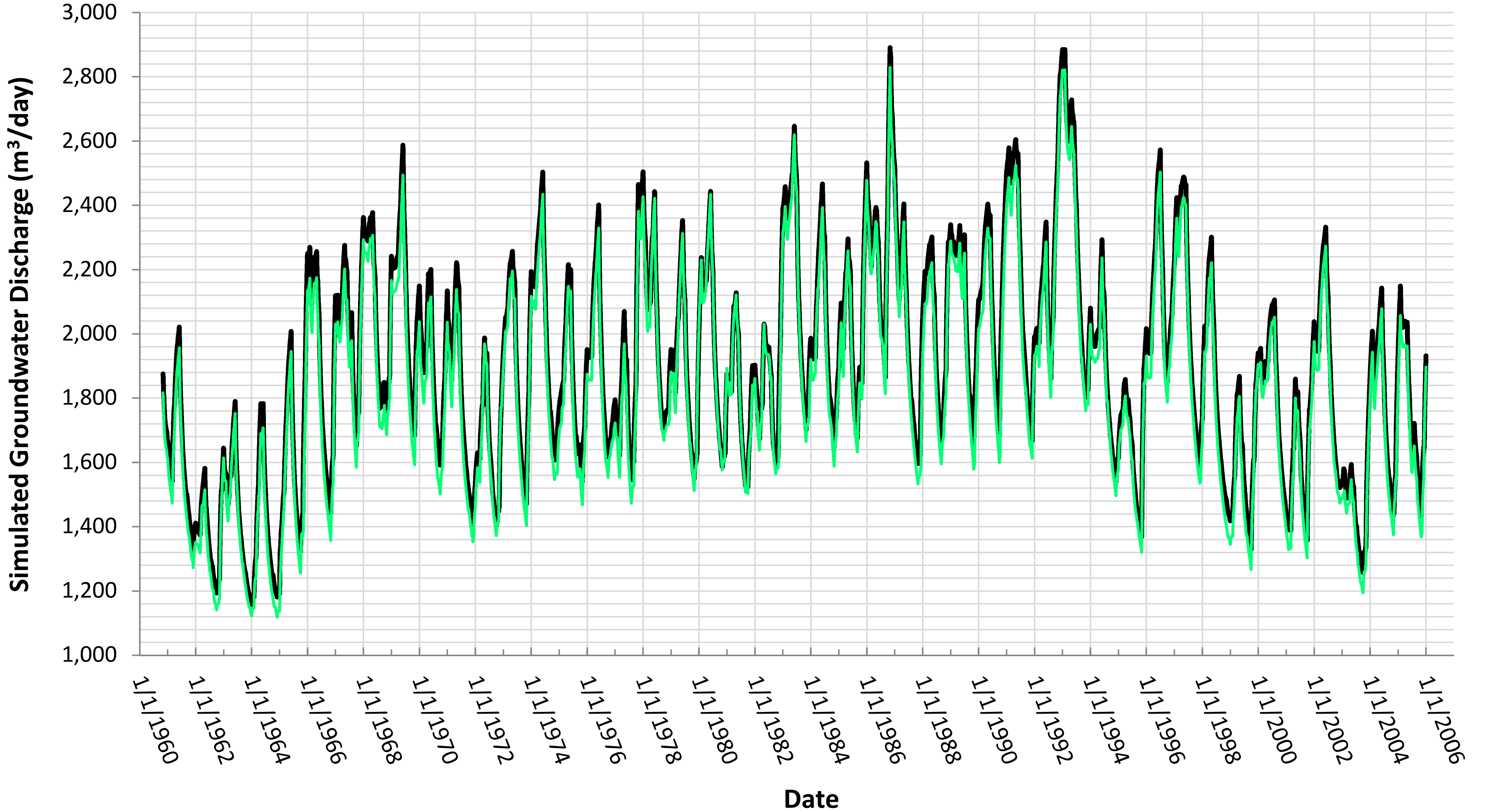
Erin – Simulated Water Level Variability at Hillsburgh Well 3 – Drought Scenarios

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 31



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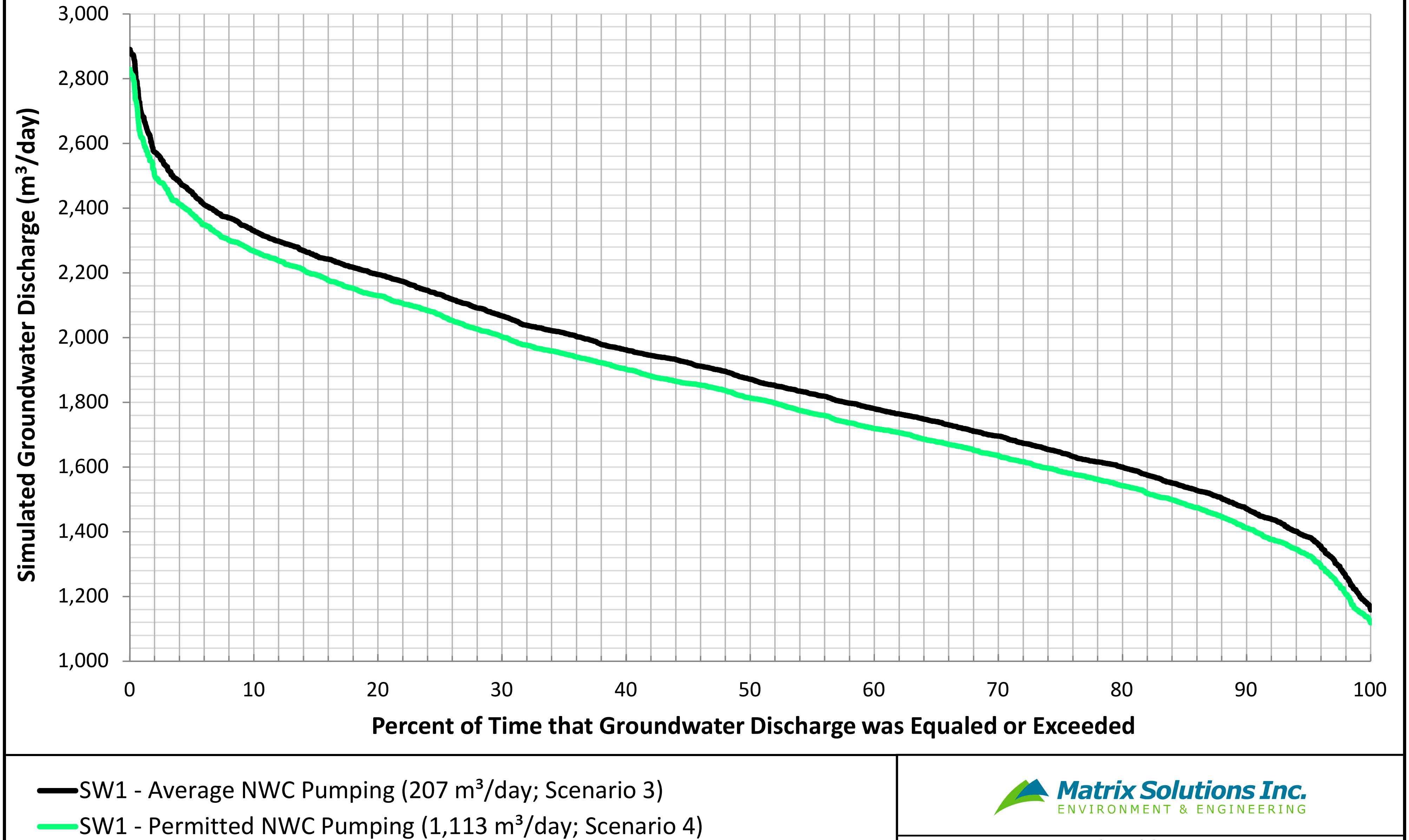
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

Erin – Simulated Groundwater Discharge at SW1 – Drought Scenarios Time Series

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 32



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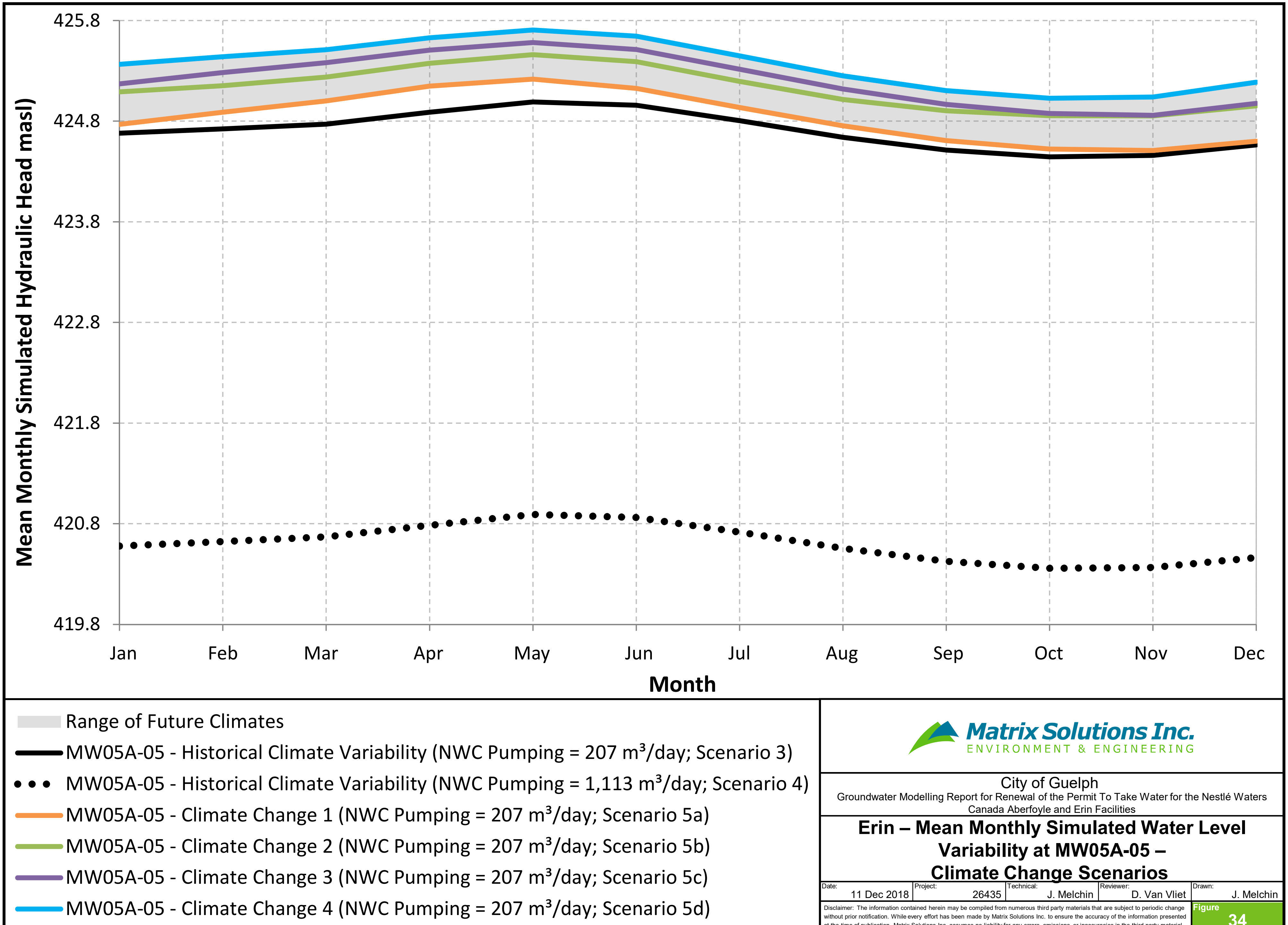
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

Erin – Simulated Groundwater Discharge at SW1 – Drought Scenarios Ranked Duration Curves

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 33



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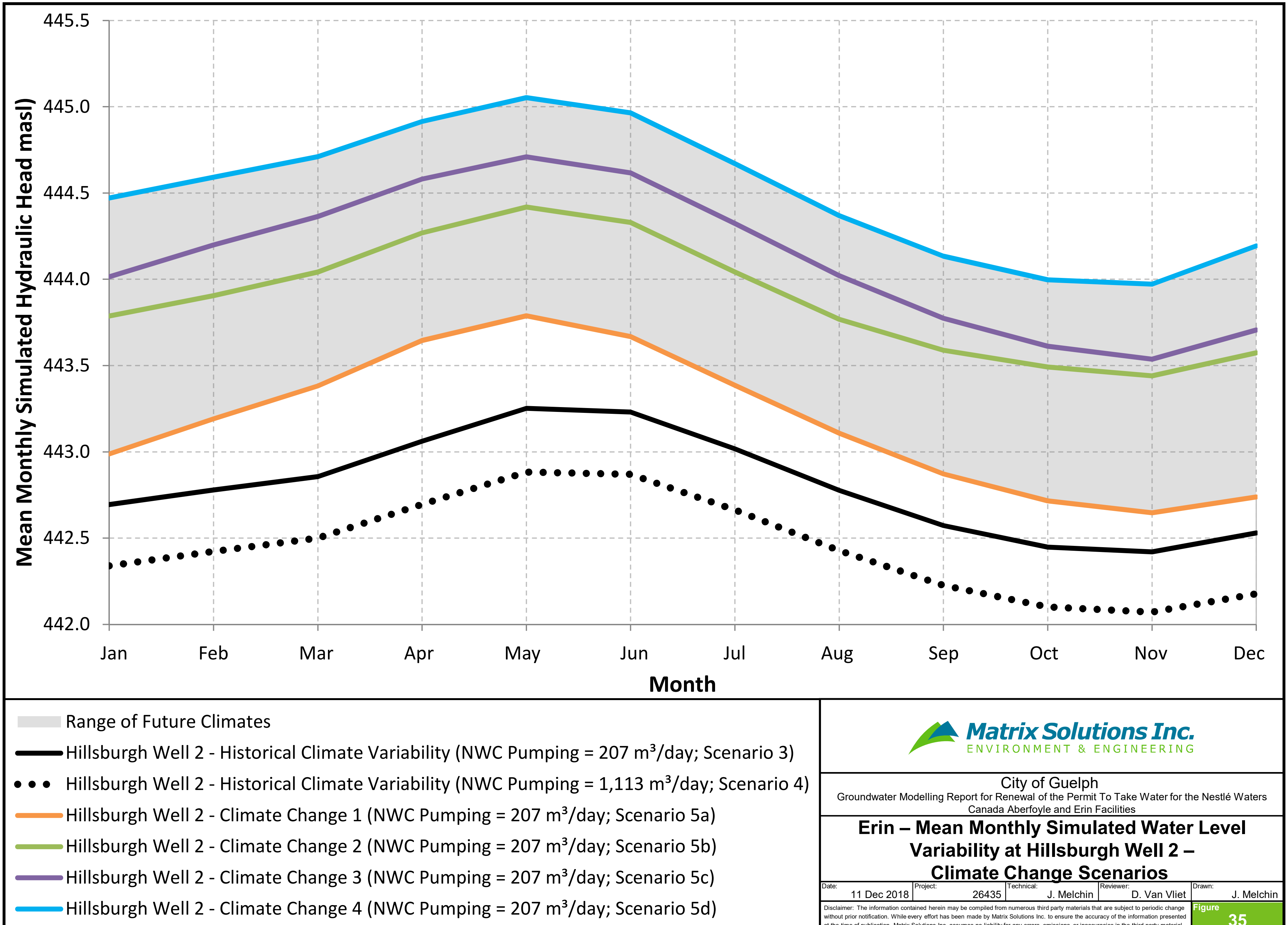
Erin – Mean Monthly Simulated Water Level Variability at MW05A-05 – Climate Change Scenarios

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure
34



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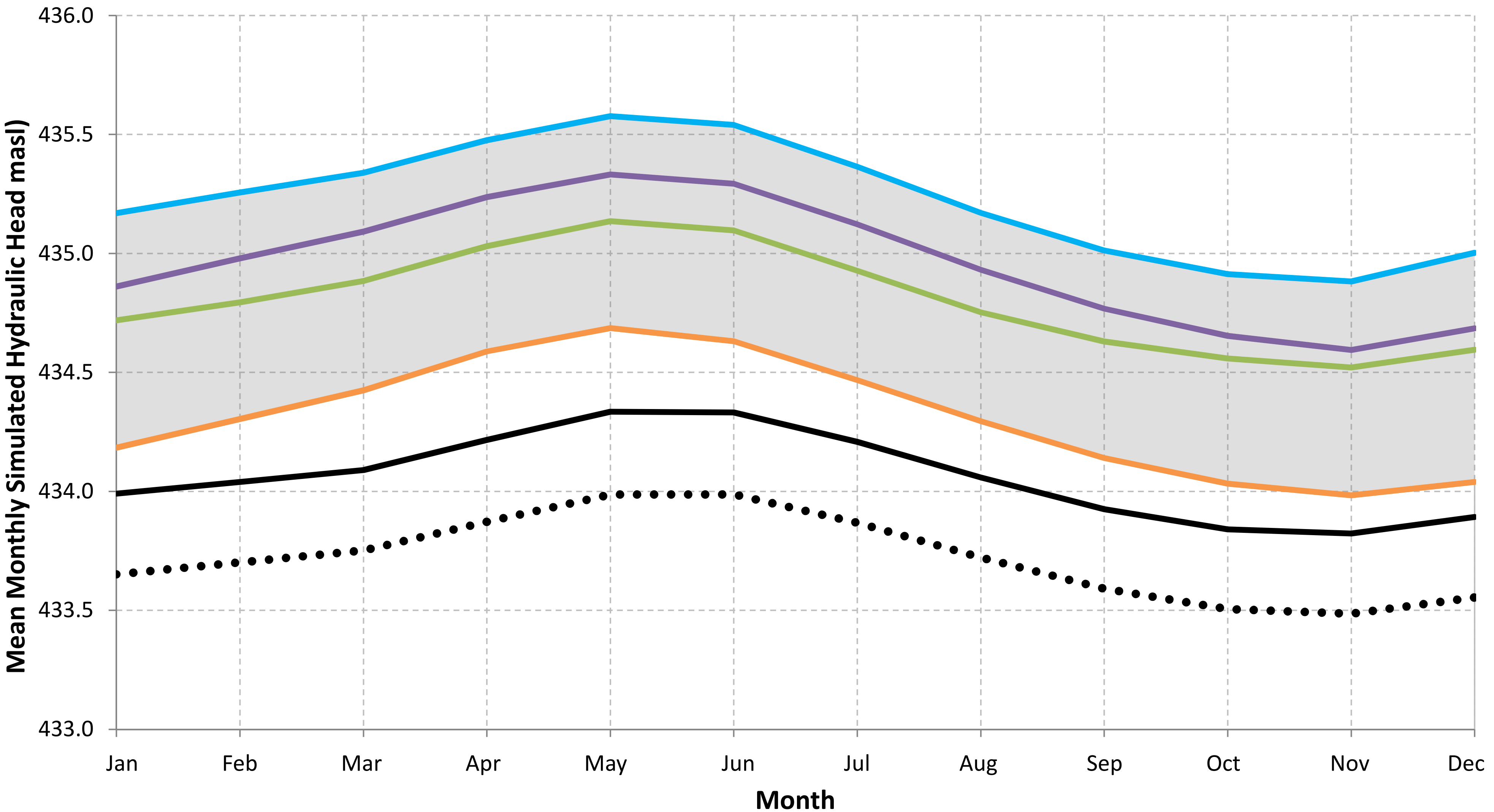
Erin – Mean Monthly Simulated Water Level Variability at Hillsburgh Well 2 – Climate Change Scenarios

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 35



Range of Future Climates
Hillsburgh Well 3 - Historical Climate Variability (NWC Pumping = 207 m^3/day; Scenario 3)
Hillsburgh Well 3 - Historical Climate Variability (NWC Pumping = 1,113 m^3/day; Scenario 4)
Hillsburgh Well 3 - Climate Change 1 (NWC Pumping = 207 m^3/day; Scenario 5a)
Hillsburgh Well 3 - Climate Change 2 (NWC Pumping = 207 m^3/day; Scenario 5b)
Hillsburgh Well 3 - Climate Change 3 (NWC Pumping = 207 m^3/day; Scenario 5c)
Hillsburgh Well 3 - Climate Change 4 (NWC Pumping = 207 m^3/day; Scenario 5d)

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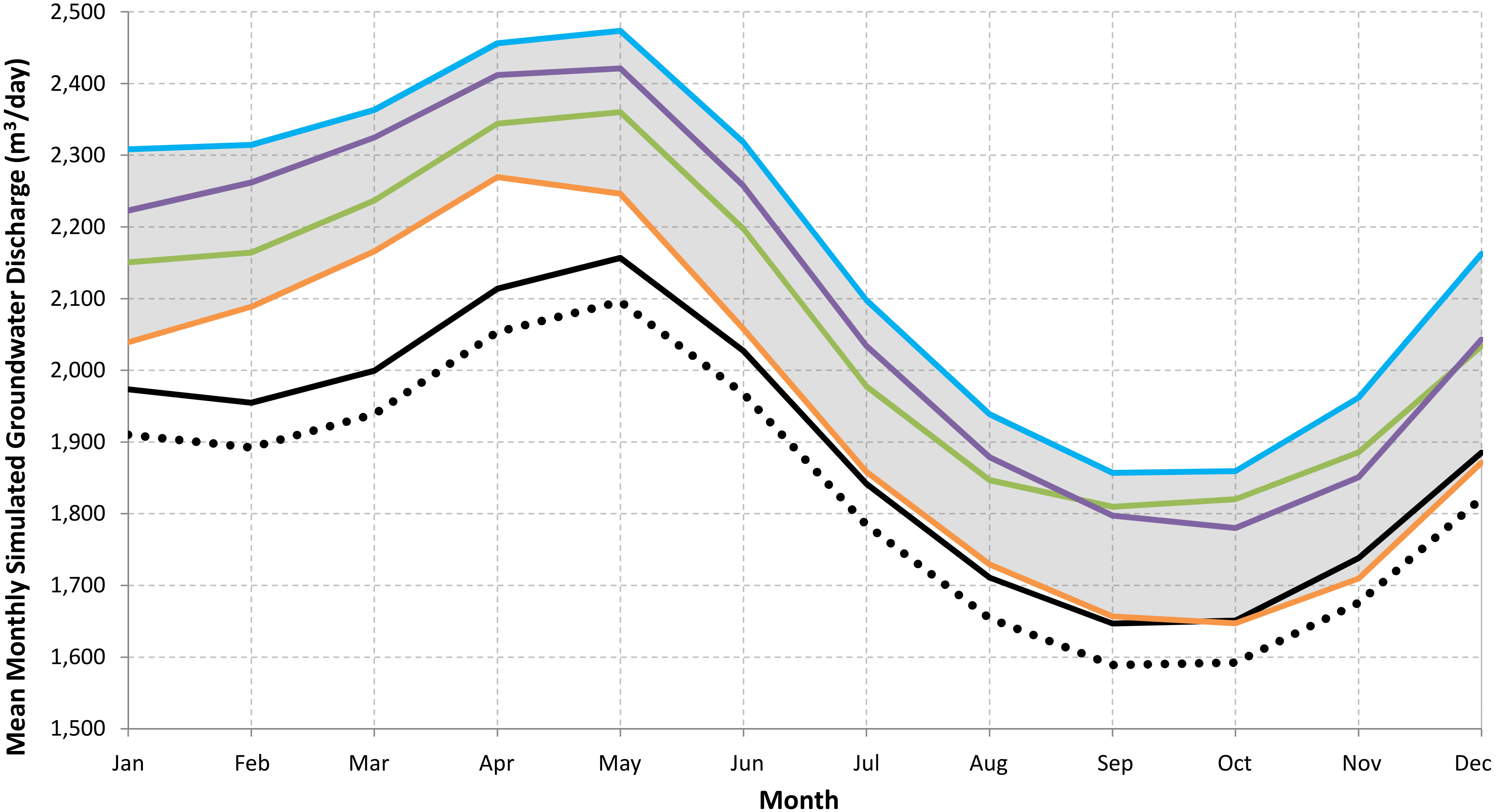
Erin – Mean Monthly Simulated Water Level Variability at Hillsburgh Well 3 – Climate Change Scenarios

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure
36



Range of Future Climates

SW1 - Historical Climate Variability (NWC Pumping = 207 m³/day; Scenario 3)

SW1 - Historical Climate Variability (NWC Pumping = 1,113 m³/day; Scenario 4)

SW1 - Climate Change 1 (NWC Pumping = 207 m³/day; Scenario 5a)

SW1 - Climate Change 2 (NWC Pumping = 207 m³/day; Scenario 5b)

SW1 - Climate Change 3 (NWC Pumping = 207 m³/day; Scenario 5c)

SW1 - Climate Change 4 (NWC Pumping = 207 m³/day; Scenario 5d)

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Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

Erin – Mean Monthly Simulated Groundwater Discharge at SW1 – Climate Change Scenarios

Date:	Project:	Technical:	Reviewer:	Drawn:
11 Dec 2018	26435	J. Melchin	D. Van Vliet	J. Melchin

Figure 37

APPENDIX A
Calibration Dataset and Results

APPENDIX A - CALIBRATION DATASET AND RESULTS

Table A1 Calibration Dataset and Results - Aberfoyle

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
125_Brock_S_Y_Well	569339	4812724	297	296	311.59	313.89	0.26	1.80	Upper Bedrock	N
#2 Brock N.	568379	4813795	n/a	n/a	315.84	314.56	0.11	0.04	Upper Bedrock	N
27_Old_Brock	569089	4813534	299	282	309.41	313.41	5.38	3.36	Lower Bedrock	N
#46 Gilmour	569848	4813550	n/a	n/a	319.56	316.75	n/a	n/a	Upper Bedrock	N
50_Brock_S_I_Well	568947	4813482	299	291	309.68	309.51	n/a	n/a	Lower Bedrock	N
58 Brock S.	569022	4813428	n/a	n/a	311.67	311.52	1.21	4.47	Upper Bedrock	N
7404_Rd_34	568132	4813524	300	298	315.62	314.83	n/a	n/a	Upper Bedrock	N
7425_Rd_34_B_Well	568371	4813669	305	283	310.23	314.91	3.63	0.89	Lower Bedrock	N
8_MapleLeaf_Lane	568715	4813413	303	302	311.74	311.89	n/a	n/a	Upper Bedrock	N
80_Brock_S_W2_Well	569254	4813252	297	260	307.94	312.30	n/a	n/a	Lower Bedrock	N
98_Brock_S_M1_Well	569443	4813056	303	281	309.66	313.86	5.37	2.34	Lower Bedrock	N
67-04699	569118	4813379	300	284	310.60	312.61	n/a	n/a	Upper Bedrock	N
67-08234	568172	4813388	298	285	310.22	313.67	n/a	n/a	Upper Bedrock	N
67-09385	568152	4813754	304	266	315.30	317.55	n/a	n/a	Lower Bedrock	N
Capital_Paving_Asphalt_Pl	567511	4811895	302	281	307.59	309.02	n/a	n/a	Upper Bedrock	N
Fireflow	568454	4812433	299	261	309.86	311.19	1.97	0.74	Lower Bedrock	N
H Well at end of Maple Leaf Ln --	568291	4812752	n/a	n/a	312.94	310.59	n/a	n/a	Upper Bedrock	N
Lane Restaurant	568841	4813123	n/a	n/a	311.71	311.22	n/a	n/a	Upper Bedrock	N
MP8D	568464	4812470	310	309	310.48	310.47	n/a	n/a	Overburden	N

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
MP8S	568464	4812470	310	309	310.51	310.47	n/a	n/a	Overburden	N
MP11D	569736	4813798	317	316	317.91	317.26	n/a	n/a	Overburden	N
MP11S	569736	4813798	318	317	317.79	317.26	n/a	n/a	Overburden	N
MP12D	568954	4812893	310	309	311.60	311.39	0.19	0.12	Overburden	N
MP12S	568954	4812893	311	310	311.55	311.39	0.15	0.12	Overburden	N
MP14D	568750	4812760	309	309	311.51	311.06	n/a	n/a	Overburden	N
MP14S	568750	4812760	311	310	311.50	311.06	n/a	n/a	Overburden	N
MP16D	569148	4813251	310	310	312.16	312.19	n/a	n/a	Overburden	N
MP16S	569148	4813251	312	311	312.25	312.19	n/a	n/a	Overburden	N
MW01A-04	569636	4813476	306	303	317.51	316.39	n/a	n/a	Upper Bedrock	N
MW01B-04	569636	4813476	311	308	317.53	316.40	n/a	n/a	Overburden	N
MW01C-04	569636	4813476	320	317	322.94	316.40	n/a	n/a	Overburden	N
MW02A-07	568946	4812909	283	280	309.41	308.28	7.00	8.86	Lower Bedrock	N
MW02B-07	568946	4812909	292	290	309.79	308.28	n/a	n/a	Lower Bedrock	N
MW02C-07	568946	4812909	300	298	310.81	309.87	2.61	4.59	Upper Bedrock	N
MW02D-07	568940	4812910	304	303	311.49	311.35	0.66	0.11	Overburden	N
MW02E-07	568940	4812910	309	308	311.45	311.35	0.34	0.11	Overburden	N
MW03A-07	568783	4812949	280	277	310.51	311.21	2.64	2.85	Lower Bedrock	N
MW03B-07	568783	4812949	286	284	311.38	311.21	n/a	n/a	Lower Bedrock	N
MW03C-07	568783	4812949	295	293	311.51	311.12	1.88	0.62	Upper Bedrock	N
MW04A-07	569252	4813069	283	280	309.48	309.78	6.11	8.45	Lower Bedrock	N
MW04B-07	569252	4813069	300	298	311.83	313.21	0.35	1.51	Upper Bedrock	N
MW04C-07	569252	4813069	308	306	311.78	313.44	0.01	0.99	Overburden	N
MW06A-08	569344	4814036	283	280	316.18	318.11	1.41	0.71	Lower Bedrock	N
MW06B-08	569344	4814036	299	298	318.44	317.66	0.00	0.02	Upper Bedrock	N
MW07A-08	568805	4813813	288	285	309.90	311.04	5.39	6.26	Lower Bedrock	N

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
MW07B-08	568805	4813813	302	300	311.15	313.36	3.11	2.68	Upper Bedrock	N
MW08A-08	568677	4814244	284	281	317.46	318.61	0.67	0.57	Lower Bedrock	N
MW08B-08	568677	4814244	299	298	317.26	317.41	0.06	0.01	Upper Bedrock	N
MW10A-09	569940	4813642	319	316	319.57	317.31	0.00	0.00	Overburden	N
MW10B-09	569947	4813655	305	302	319.61	317.48	0.02	0.01	Upper Bedrock	N
MW10C-09	569947	4813655	263	260	317.66	318.25	n/a	n/a	Lower Bedrock	N
MW10D-09	569947	4813655	248	245	317.49	318.25	0.61	0.98	Lower Bedrock	N
MW13-10	569080	4812749	287	284	305.02	301.79	14.38	n/a	Lower Bedrock	N
MW14A-11	568360	4813081	283	279	310.26	313.47	3.54	2.19	Lower Bedrock	N
MW14B-11	568360	4813081	297	294	313.66	311.35	0.22	0.04	Upper Bedrock	N
MW14C-11	568360	4813081	303	301	314.26	311.34	0.12	0.03	Upper Bedrock	N
MW15A-12	567775	4812475	282	250	310.43	311.69	0.50	0.18	Lower Bedrock	N
MW15B-12	567770	4812469	301	300	308.26	310.75	n/a	n/a	Upper Bedrock	N
MW16A-12	568750	4811186	262	257	307.03	310.25	0.20	0.10	Lower Bedrock	N
MW16B-12	568747	4811185	290	288	307.44	311.52	n/a	n/a	Upper Bedrock	N
MW17A-12	569495	4811887	275	271	308.08	312.35	2.06	0.79	Lower Bedrock	N
MW17B-12	569493	4811885	301	300	309.47	314.15	n/a	n/a	Upper Bedrock	N
MW18A-12	568760	4812109	261	256	307.82	311.55	3.34	1.37	Lower Bedrock	N
MW18B-12	568758	4812106	297	295	308.05	311.31	n/a	n/a	Upper Bedrock	N
MW-D	568562	4812714	301	294	310.72	310.63	1.13	0.05	Upper Bedrock	N
MW-I	568562	4812714	307	305	310.91	310.63	1.23	0.05	Upper Bedrock	N
MW-S	568562	4812714	297	295	311.10	310.60	0.00	0.03	Overburden	N
Nestle_Farmhouse	569259	4812831	304	292	312.38	312.93	n/a	n/a	Upper Bedrock	N
PCC-D	568445	4813464	303	301	314.20	311.94	0.13	0.10	Upper Bedrock	N
PCC-I	568445	4813464	308	306	313.99	311.50	0.04	0.03	Overburden	N
PCC-S	568445	4813464	312	311	314.16	311.50	0.00	0.03	Overburden	N

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
PW5_Meadows_of_Aberfoyle	569576	4813205	302	266	310.02	315.04	4.72	1.59	Lower Bedrock	N
S Well	569309	4811461	n/a	n/a	308.33	311.55	n/a	n/a	Lower Bedrock	N
TW1-93	568672	4812578	302	302	309.87	311.09	0.36	0.06	Overburden	N
TW1-99	569018	4812829	301	301	311.59	311.90	0.32	1.51	Overburden	N
TW3-80	569056.3	4812800.2	288	285	306.03	299.38	14.52	n/a	Lower Bedrock	N
W Well	569233	4813059	n/a	n/a	311.85	312.98	n/a	n/a	Upper Bedrock	N
TW2-11	568638	4812238	281	255	309.46	311.40	n/a	n/a	Lower Bedrock	N
Lane_House	569018	4813363	298	277	310.05	308.36	5.54	10.79	Upper Bedrock	N
MP4S-04	568999	4812999	311.42	310.81	n/a	n/a	0.19	0.19	Overburden	N
MP4D-04	568999	4812999	310.19	309.75	n/a	n/a	0.19	0.19	Overburden	N
MP6S-04	569030	4813051	310.94	310.33	n/a	n/a	0.08	0.03	Overburden	N
MP6D-04	569030	4813051	309.72	309.11	n/a	n/a	0.11	0.03	Overburden	N
FW1D-09	569777	4813966	244.00	241.00	n/a	n/a	0.42	0.89	Lower Bedrock	N
MW11C-09	570028	4813727	272.10	268.00	n/a	n/a	0.38	0.76	Lower Bedrock	N
MW12C-09	569896	4813760	258.00	253.00	n/a	n/a	0.48	0.96	Lower Bedrock	N
MW9B-09	569779	4813965	297.48	296.11	n/a	n/a	0.02	0.01	Upper Bedrock	N
MW11B-09	570028	4813724	302.63	301.94	n/a	n/a	0.02	0.01	Upper Bedrock	N
MW9A-09	569779	4813963	318.41	315.36	n/a	n/a	0.00	0.01	Overburden	N
MW11A-09	570025	4813725	315.37	313.85	n/a	n/a	0.00	0.01	Overburden	N
MW12A-11	569899	4813760	n/a	n/a	n/a	n/a	0.00	0.01	Overburden	N
n/a	566585	4810364	308.82	303.82	305.13	305.41	n/a	n/a	Overburden	Y
n/a	566436	4810390	309.93	304.93	305.21	305.112	n/a	n/a	Overburden	Y
n/a	566720	4810470	309.82	304.82	305.61	305.901	n/a	n/a	Overburden	Y
n/a	566850	4810320	309.95	304.95	305.84	306.096	n/a	n/a	Overburden	Y
n/a	566991	4811145	310.03	305.03	306.45	306.844	n/a	n/a	Overburden	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
n/a	566984	4811178	310.28	305.28	306.5	306.972	n/a	n/a	Overburden	Y
n/a	566987	4811162	310.31	305.31	306.52	306.816	n/a	n/a	Overburden	Y
n/a	566987	4811162	309.33	304.33	306.57	306.816	n/a	n/a	Overburden	Y
n/a	567128	4811064	311.75	306.75	306.64	307.424	n/a	n/a	Overburden	Y
n/a	567314	4811221	310.79	305.79	306.75	307.286	n/a	n/a	Overburden	Y
n/a	567318	4811201	310.52	305.52	306.76	307.381	n/a	n/a	Overburden	Y
n/a	567262	4811312	308.28	303.28	306.83	307.667	n/a	n/a	Overburden	Y
n/a	567308	4811244	310.26	305.26	306.99	307.37	n/a	n/a	Overburden	Y
n/a	567497	4811427	308.94	303.94	307	307.726	n/a	n/a	Overburden	Y
n/a	566987	4811162	309.16	304.16	307.07	306.816	n/a	n/a	Overburden	Y
n/a	567314	4811221	309.89	304.89	307.12	307.286	n/a	n/a	Overburden	Y
n/a	567680	4811443	311.47	306.47	307.15	308.129	n/a	n/a	Overburden	Y
n/a	567605	4811440	309.74	304.74	307.21	307.806	n/a	n/a	Overburden	Y
n/a	567710	4811492	310.78	305.78	307.34	308.392	n/a	n/a	Overburden	Y
n/a	567726	4811623	312.11	307.11	307.66	308.345	n/a	n/a	Overburden	Y
n/a	567726	4811623	311.88	306.88	307.67	308.345	n/a	n/a	Overburden	Y
n/a	566640	4811326	307.65	302.65	308.72	307.698	n/a	n/a	Overburden	Y
n/a	566720	4811756	311.28	306.28	311.69	308.556	n/a	n/a	Overburden	Y
n/a	566553	4810406	309.03	304.03	305.28	305.385	n/a	n/a	Overburden	Y
n/a	566744	4810530	308.94	303.94	305.85	305.991	n/a	n/a	Overburden	Y
n/a	566640	4810110	312.71	307.71	305.85	305.165	n/a	n/a	Overburden	Y
n/a	566804	4810572	310.14	305.14	305.94	306.219	n/a	n/a	Overburden	Y
n/a	566879	4810152	307.4	302.4	305.96	306.101	n/a	n/a	Overburden	Y
n/a	566750	4810142	305.8	300.8	305.99	306.091	n/a	n/a	Overburden	Y
n/a	566823	4810603	310.15	305.15	306.24	306.307	n/a	n/a	Overburden	Y
n/a	567017	4811031	308.53	303.53	306.31	307.051	n/a	n/a	Overburden	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
n/a	567311	4811129	310.94	305.94	306.49	307.699	n/a	n/a	Overburden	Y
n/a	566940	4810390	310.51	305.51	306.7	306.139	n/a	n/a	Overburden	Y
n/a	567158	4810745	306.6	301.6	307	308.249	n/a	n/a	Overburden	Y
n/a	567775	4811181	310.99	305.99	307.14	308.99	n/a	n/a	Overburden	Y
n/a	566733	4811440	312.32	307.32	307.18	307.75	n/a	n/a	Overburden	Y
n/a	567429	4810589	305.6	300.6	307.41	308.259	n/a	n/a	Overburden	Y
n/a	567314	4811221	309.64	304.64	307.42	307.289	n/a	n/a	Overburden	Y
n/a	566912	4811652	309.19	304.19	307.81	307.725	n/a	n/a	Overburden	Y
n/a	566690	4811747	312.22	307.22	308.12	308.589	n/a	n/a	Overburden	Y
n/a	566716	4811603	310.88	305.88	308.26	307.767	n/a	n/a	Overburden	Y
n/a	566667	4811757	312.32	307.32	308.47	308.711	n/a	n/a	Overburden	Y
n/a	566693	4811583	310.73	305.73	308.5	307.862	n/a	n/a	Overburden	Y
n/a	566571	4811515	310.18	305.18	308.82	308.054	n/a	n/a	Overburden	Y
n/a	566745	4811450	308.52	303.52	308.85	307.753	n/a	n/a	Overburden	Y
6702537	571380	4810889	308.59	303.59	310.39	315.796	n/a	n/a	Overburden	Y
n/a	566957	4812381	311.43	306.43	310.39	310.112	n/a	n/a	Overburden	Y
6703373	568374	4811563	312.57	307.57	313.07	311.228	n/a	n/a	Overburden	Y
n/a	568416	4814373	321.67	316.67	318.21	320.265	n/a	n/a	Overburden	Y
n/a	568332	4814434	322.57	317.57	319.39	321.447	n/a	n/a	Overburden	Y
n/a	568416	4814494	324.07	319.07	319.42	321.622	n/a	n/a	Overburden	Y
n/a	568738	4814705	332.93	327.93	331.33	321.9	n/a	n/a	Overburden	Y
6702674	571500	4810968	299.14	294.14	304.32	315.754	n/a	n/a	Overburden	Y
6702525	568110	4811385	302.38	297.38	305.57	310.963	n/a	n/a	Overburden	Y
6711403	566954	4811184	298.99	293.99	305.87	307.284	n/a	n/a	Overburden	Y
n/a	566994	4811020	298.84	293.84	306.07	306.941	n/a	n/a	Overburden	Y
n/a	567160	4811324	300.8	295.8	306.23	307.655	n/a	n/a	Overburden	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
n/a	566703	4811002	306.41	301.41	306.23	306.884	n/a	n/a	Overburden	Y
6702538	571349	4810824	302.42	297.42	306.29	315.651	n/a	n/a	Overburden	Y
n/a	567435	4811260	301.39	296.39	306.33	307.364	n/a	n/a	Overburden	Y
n/a	566723	4811100	305.45	300.45	306.35	307.457	n/a	n/a	Overburden	Y
n/a	566856	4810865	301.44	296.44	306.56	306.261	n/a	n/a	Overburden	Y
n/a	566945	4811112	300.27	295.27	306.64	306.755	n/a	n/a	Overburden	Y
6703614	570804	4810123	304.75	299.75	306.87	314.21	n/a	n/a	Overburden	Y
n/a	567058	4809760	311.53	306.53	306.97	307.635	n/a	n/a	Overburden	Y
n/a	566985	4811023	300.88	295.88	306.98	306.882	n/a	n/a	Overburden	Y
n/a	566788	4811094	305.15	300.15	307.03	307.569	n/a	n/a	Overburden	Y
n/a	566742	4811279	304.4	299.4	307.06	307.697	n/a	n/a	Overburden	Y
6702326	568032	4810227	305.1	300.1	307.08	309.565	n/a	n/a	Overburden	Y
n/a	567068	4810315	306.83	301.83	307.13	306.263	n/a	n/a	Overburden	Y
n/a	568340	4809542	305.06	300.06	307.14	310.83	n/a	n/a	Overburden	Y
n/a	566765	4811309	305.8	300.8	307.26	307.698	n/a	n/a	Overburden	Y
n/a	568212	4809843	306.89	301.89	307.26	310.621	n/a	n/a	Overburden	Y
n/a	567260	4810328	303.33	298.33	307.27	307.999	n/a	n/a	Overburden	Y
n/a	567102	4811878	311.13	306.13	307.33	309.003	n/a	n/a	Overburden	Y
n/a	567817	4809323	303.82	298.82	307.39	308.994	n/a	n/a	Overburden	Y
n/a	567379	4810979	300.75	295.75	307.43	308.401	n/a	n/a	Overburden	Y
n/a	567639	4810138	307.81	302.81	307.46	308.906	n/a	n/a	Overburden	Y
n/a	568222	4810233	308.06	303.06	307.57	310.17	n/a	n/a	Overburden	Y
n/a	567599	4811606	303.98	298.98	307.76	307.931	n/a	n/a	Overburden	Y
n/a	567612	4811354	301.42	296.42	307.77	307.774	n/a	n/a	Overburden	Y
n/a	566866	4811330	302.75	297.75	307.91	307.701	n/a	n/a	Overburden	Y
n/a	567510	4811567	299.08	294.08	307.94	307.743	n/a	n/a	Overburden	Y

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6709858	571476	4810883	301.4	296.4	308.54	315.519	n/a	n/a	Overburden	Y
n/a	566408	4811545	309.66	304.66	308.65	308.048	n/a	n/a	Overburden	Y
6711419	566472	4811544	308.28	303.28	308.72	308.161	n/a	n/a	Overburden	Y
n/a	566410	4811537	308	303	308.8	308.024	n/a	n/a	Overburden	Y
n/a	566556	4811410	303.91	298.91	308.85	307.783	n/a	n/a	Overburden	Y
n/a	566483	4811776	307.48	302.48	308.93	309.176	n/a	n/a	Overburden	Y
n/a	566910	4811750	305.5	300.5	309.05	308.283	n/a	n/a	Overburden	Y
6704817	571344	4810924	296.99	291.99	309.1	315.999	n/a	n/a	Overburden	Y
6708127	566934	4812403	310.96	306.69	309.91	310.326	n/a	n/a	Overburden	Y
6710043	571313	4811285	302.68	297.68	310.16	317.112	n/a	n/a	Overburden	Y
6706444	568514	4810943	311.41	306.41	310.56	310.457	n/a	n/a	Overburden	Y
6710596	571092	4810988	294.14	289.14	310.57	316.642	n/a	n/a	Overburden	Y
6709780	571147	4810936	291.15	286.15	310.7	316.423	n/a	n/a	Overburden	Y
6711667	571550	4811051	301.08	296.08	310.71	315.92	n/a	n/a	Overburden	Y
6711904	571161	4810840	301.31	296.31	310.75	316.119	n/a	n/a	Overburden	Y
n/a	566756	4811894	311.59	306.59	310.87	309.334	n/a	n/a	Overburden	Y
6702539	571435	4810956	298.44	293.44	311.24	315.891	n/a	n/a	Overburden	Y
6712476	568925	4812654	307.85	302.85	311.24	312.818	n/a	n/a	Overburden	Y
6709672	569076	4813331	312.41	307.41	311.71	312.511	n/a	n/a	Overburden	Y
6712277	570894	4810888	301.92	296.92	311.82	316.587	n/a	n/a	Overburden	Y
6710040	571606	4811618	306.62	301.62	311.9	317.655	n/a	n/a	Overburden	Y
6705095	571306	4811126	299.94	294.94	312.9	316.694	n/a	n/a	Overburden	Y
6704136	571494	4811053	301.96	296.96	313.08	316.079	n/a	n/a	Overburden	Y
6710042	571272	4811260	308.29	303.29	313.36	317.108	n/a	n/a	Overburden	Y
6712255	571732	4811523	304.08	299.08	313.77	317.169	n/a	n/a	Overburden	Y
6702532	571179	4810887	297.79	292.79	314.05	316.224	n/a	n/a	Overburden	Y

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6710443	570891	4810871	298.85	293.85	314.47	316.545	n/a	n/a	Overburden	Y
6712163	571677	4811143	303.62	298.62	314.79	315.905	n/a	n/a	Overburden	Y
6710720	571116	4811018	297.09	292.09	314.98	316.686	n/a	n/a	Overburden	Y
6710494	571727	4811661	312.44	307.44	317.28	317.61	n/a	n/a	Overburden	Y
6702672	571516	4811036	302.25	297.25	318.02	315.962	n/a	n/a	Overburden	Y
6711290	571996	4811693	305.07	300.07	318.59	317.206	n/a	n/a	Overburden	Y
6711984	571962	4811637	303.58	298.58	318.9	317.092	n/a	n/a	Overburden	Y
6702656	570223	4813802	313.89	308.89	319	319.901	n/a	n/a	Overburden	Y
6712487	571865	4811680	305.76	300.76	319.6	317.427	n/a	n/a	Overburden	Y
6710657	567375	4814086	312.44	307.44	319.75	323.751	n/a	n/a	Overburden	Y
n/a	568607	4814561	325.07	320.07	321.1	321.141	n/a	n/a	Overburden	Y
6702535	570569	4809764	312.39	307.39	321.38	313.095	n/a	n/a	Overburden	Y
6702542	570564	4810063	311.52	306.52	321.76	314.159	n/a	n/a	Overburden	Y
6710785	570269	4814216	321.17	316.17	323.36	322.153	n/a	n/a	Overburden	Y
n/a	568617	4814742	329.91	324.91	323.4	322.9	n/a	n/a	Overburden	Y
6702654	570257	4813957	314.66	309.66	323.79	320.91	n/a	n/a	Overburden	Y
n/a	569996	4815301	318.15	313.15	323.84	326.073	n/a	n/a	Overburden	Y
6705984	569665	4815661	324.09	319.09	323.93	324.974	n/a	n/a	Overburden	Y
n/a	570334	4815022	326.02	321.02	324.5	325.927	n/a	n/a	Overburden	Y
n/a	570622	4815502	320.29	315.29	324.64	326.35	n/a	n/a	Overburden	Y
6704730	570693	4814511	320.69	315.69	324.75	324.785	n/a	n/a	Overburden	Y
n/a	570162	4815309	314.85	309.85	325.11	326.125	n/a	n/a	Overburden	Y
n/a	570205	4814901	322.32	317.32	325.56	324.941	n/a	n/a	Overburden	Y
6707382	570654	4814363	324.92	319.92	325.71	323.994	n/a	n/a	Overburden	Y
6703501	570694	4814383	325.58	320.58	325.94	324.168	n/a	n/a	Overburden	Y
n/a	570825	4815022	328.34	323.34	326.06	326.918	n/a	n/a	Overburden	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
n/a	570387	4815749	318.69	313.69	326.21	326.125	n/a	n/a	Overburden	Y
6707995	566454	4814523	320.28	315.28	326.68	328.765	n/a	n/a	Overburden	Y
n/a	570524	4814845	327.82	322.82	327.71	325.931	n/a	n/a	Overburden	Y
6711712	570389	4815590	321.79	316.79	329.06	326.232	n/a	n/a	Overburden	Y
6710354	570568	4814580	324.72	319.72	332.78	324.879	n/a	n/a	Overburden	Y
6704042	569774	4809483	301.51	296.51	303.12	312.338	n/a	n/a	Overburden	Y
6702534	570611	4810062	296.02	291.02	305.45	314.127	n/a	n/a	Overburden	Y
6704693	568214	4809488	294.41	289.41	305.57	310.514	n/a	n/a	Overburden	Y
6706874	569474	4809943	304.25	299.25	306.06	313.43	n/a	n/a	Overburden	Y
6705870	567138	4812055	299.51	294.51	306.75	309.51	n/a	n/a	Overburden	Y
6703852	567734	4811693	303.25	298.25	306.77	308.59	n/a	n/a	Overburden	Y
n/a	567000	4810090	296.97	291.97	307	306.191	n/a	n/a	Overburden	Y
n/a	568803	4809727	306.01	301.01	307.11	311.693	n/a	n/a	Overburden	Y
n/a	568610	4809499	296.16	291.16	307.14	310.859	n/a	n/a	Overburden	Y
6709991	571435	4810814	294.68	289.68	307.25	315.384	n/a	n/a	Overburden	Y
6704038	569614	4809823	306.65	301.65	307.36	313.272	n/a	n/a	Overburden	Y
n/a	568817	4809877	305.21	300.21	307.42	312.016	n/a	n/a	Overburden	Y
n/a	568769	4809970	297.15	292.15	307.46	311.963	n/a	n/a	Overburden	Y
n/a	567200	4810080	303.74	298.74	307.54	306.735	n/a	n/a	Overburden	Y
n/a	567000	4811024	295.54	290.54	307.54	306.984	n/a	n/a	Overburden	Y
n/a	567460	4811180	301.03	296.03	307.68	307.906	n/a	n/a	Overburden	Y
6702526	568622	4810945	297.69	292.69	307.79	311.016	n/a	n/a	Overburden	Y
6707523	568974	4813383	301.73	296.73	307.9	310.633	n/a	n/a	Overburden	Y
6705877	569575	4809782	304.16	299.16	307.95	313.144	n/a	n/a	Overburden	Y
6708315	568693	4813453	303.78	298.78	308.09	312.036	n/a	n/a	Overburden	Y
6711420	566825	4811417	300.5	295.5	308.32	307.718	n/a	n/a	Overburden	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6711905	568960	4810383	299.89	294.89	308.38	312.749	n/a	n/a	Overburden	Y
6704389	569634	4809783	305.72	300.72	308.42	313.198	n/a	n/a	Overburden	Y
6710719	570928	4810921	298.39	293.39	308.47	316.639	n/a	n/a	Overburden	Y
6711008	571323	4811321	301.89	296.89	308.59	317.19	n/a	n/a	Overburden	Y
6707985	569054	4813403	308.06	303.06	308.63	311.902	n/a	n/a	Overburden	Y
6711283	568747	4812709	305.53	300.53	308.77	311.296	n/a	n/a	Overburden	Y
6702533	570683	4810240	297.73	292.73	308.88	314.7	n/a	n/a	Overburden	Y
6709927	571853	4811541	299.73	294.73	309.06	316.977	n/a	n/a	Overburden	Y
6709646	571359	4810949	293.65	288.65	309.15	316.044	n/a	n/a	Overburden	Y
6711908	569586	4809871	305.65	300.65	309.17	313.358	n/a	n/a	Overburden	Y
6702653	569452	4813059	311.76	306.76	309.92	315.002	n/a	n/a	Overburden	Y
6710440	571892	4811504	295.99	290.99	310.31	316.754	n/a	n/a	Overburden	Y
6704325	567154	4812093	300.66	295.66	310.4	309.517	n/a	n/a	Overburden	Y
6702673	571564	4811086	299.81	294.81	310.9	316.008	n/a	n/a	Overburden	Y
6712162	571452	4811385	304.45	299.45	310.99	317.181	n/a	n/a	Overburden	Y
6704046	570604	4810053	299.03	294.03	311.07	314.1	n/a	n/a	Overburden	Y
6702652	569231	4813261	308.9	303.9	311.2	313.284	n/a	n/a	Overburden	Y
6711822	570969	4810622	301.25	296.25	311.22	315.749	n/a	n/a	Overburden	Y
6711985	571656	4811554	303.04	298.04	311.28	317.398	n/a	n/a	Overburden	Y
6702519	568958	4813406	304.41	299.41	311.41	310.701	n/a	n/a	Overburden	Y
6710770	570979	4810976	296.64	291.64	311.57	316.735	n/a	n/a	Overburden	Y
n/a	571139	4811499	299.53	294.53	311.59	317.755	n/a	n/a	Overburden	Y
6703873	569044	4813343	303	298	311.68	311.143	n/a	n/a	Overburden	Y
6707586	569534	4813063	310.86	305.86	312.07	315.568	n/a	n/a	Overburden	Y
6702520	568800	4813486	304.04	299.04	312.31	311.891	n/a	n/a	Overburden	Y
6704957	569227	4813097	306.83	301.83	312.37	312.954	n/a	n/a	Overburden	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6707091	570294	4812123	306.56	301.56	312.48	318.589	n/a	n/a	Overburden	Y
6710415	571754	4811551	304.06	299.06	312.53	317.222	n/a	n/a	Overburden	Y
6709476	569413	4811511	300.87	295.87	312.61	314.188	n/a	n/a	Overburden	Y
6711692	568922	4813430	308.5	303.5	312.9	310.92	n/a	n/a	Overburden	Y
6703850	571494	4811143	300.91	295.91	312.94	316.375	n/a	n/a	Overburden	Y
6711150	568904	4813340	305.74	300.74	313.1	310.802	n/a	n/a	Overburden	Y
6711440	571456	4811452	300.09	295.09	313.13	317.367	n/a	n/a	Overburden	Y
6712223	569431	4811760	306.86	301.86	313.16	313.787	n/a	n/a	Overburden	Y
6702663	571851	4811430	299.09	294.09	313.31	316.572	n/a	n/a	Overburden	Y
6707595	571674	4811183	298.85	293.85	313.38	316.067	n/a	n/a	Overburden	Y
6707588	571574	4811123	300.35	295.35	313.41	316.118	n/a	n/a	Overburden	Y
6702527	569797	4812195	309.4	304.4	313.41	316.891	n/a	n/a	Overburden	Y
6708057	571514	4811043	299.18	294.18	313.44	315.991	n/a	n/a	Overburden	Y
6709100	571545	4811115	301.77	296.77	313.55	316.169	n/a	n/a	Overburden	Y
6704330	569014	4813423	301.61	296.61	313.79	311.397	n/a	n/a	Overburden	Y
6702507	566824	4812988	302.69	297.69	313.91	315.861	n/a	n/a	Overburden	Y
6704401	569454	4812703	298.04	293.04	314.12	314.74	n/a	n/a	Overburden	Y
6704673	567673	4813039	309.65	304.65	314.26	313.465	n/a	n/a	Overburden	Y
n/a	568445	4813462	303.43	298.43	314.28	311.921	n/a	n/a	Overburden	Y
6704397	568954	4813403	305.89	300.89	314.7	310.674	n/a	n/a	Overburden	Y
6702511	568160	4814041	307.85	302.85	314.97	318.679	n/a	n/a	Overburden	Y
6702518	567626	4812895	305.59	300.59	315.07	312.785	n/a	n/a	Overburden	Y
6711149	571502	4811438	300.67	295.67	315.27	317.263	n/a	n/a	Overburden	Y
6704843	566121	4813361	305.07	300.07	315.94	324.668	n/a	n/a	Overburden	Y
6711569	571135	4811051	294.87	289.87	316.08	316.744	n/a	n/a	Overburden	Y
6702645	568170	4814121	309.4	304.4	316.49	319.37	n/a	n/a	Overburden	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6703857	572134	4811763	311.51	306.51	316.53	317.077	n/a	n/a	Overburden	Y
6707509	569114	4814363	305.42	300.42	318.46	318.044	n/a	n/a	Overburden	Y
6702506	567307	4814740	308.77	303.77	318.8	328.474	n/a	n/a	Overburden	Y
6710735	571109	4814142	310	305	319.73	323.401	n/a	n/a	Overburden	Y
6707576	570434	4811983	305.77	300.77	319.75	318.631	n/a	n/a	Overburden	Y
6704395	572184	4813023	304.74	299.74	320.03	320.559	n/a	n/a	Overburden	Y
6707510	569094	4814363	305.37	300.37	320.38	317.99	n/a	n/a	Overburden	Y
6712248	567476	4814168	303.69	298.69	320.64	323.788	n/a	n/a	Overburden	Y
6702659	571610	4813418	308.13	303.13	320.74	321.477	n/a	n/a	Overburden	Y
6705092	570730	4814573	315.42	310.42	320.88	325.164	n/a	n/a	Overburden	Y
6704295	567674	4814563	309.24	304.24	321.48	325.774	n/a	n/a	Overburden	Y
6709773	567562	4814194	302.61	297.61	321.52	323.603	n/a	n/a	Overburden	Y
6703155	571734	4813473	308.12	303.12	322.01	321.759	n/a	n/a	Overburden	Y
6710734	571141	4814193	307.3	302.3	322.16	323.598	n/a	n/a	Overburden	Y
6710250	569383	4811731	309.27	304.27	322.21	313.508	n/a	n/a	Overburden	Y
n/a	569561	4814976	312.03	307.03	322.26	321.792	n/a	n/a	Overburden	Y
6707623	570862	4814453	313.17	308.17	323.1	324.762	n/a	n/a	Overburden	Y
n/a	570434	4815297	316.13	311.13	323.32	326.318	n/a	n/a	Overburden	Y
6705510	570975	4810584	304.74	299.74	324.19	315.622	n/a	n/a	Overburden	Y
6707664	570814	4814483	315.56	310.56	324.33	324.839	n/a	n/a	Overburden	Y
6712161	569796	4815360	310.32	305.32	324.79	324.726	n/a	n/a	Overburden	Y
6704580	571307	4814015	304.91	299.91	324.92	322.763	n/a	n/a	Overburden	Y
n/a	570861	4815176	322.17	317.17	325.49	327.497	n/a	n/a	Overburden	Y
6710980	567254	4814007	310.5	305.5	325.64	323.649	n/a	n/a	Overburden	Y
6703935	570154	4815713	314.56	309.56	326.03	325.953	n/a	n/a	Overburden	Y
n/a	570825	4815656	314.35	309.35	326.15	327.044	n/a	n/a	Overburden	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6703934	570084	4815693	313.98	308.98	326.71	325.865	n/a	n/a	Overburden	Y
6710357	570099	4815643	311.84	306.84	326.76	325.911	n/a	n/a	Overburden	Y
6704466	566674	4814703	309.53	304.53	327.54	329.498	n/a	n/a	Overburden	Y
6703848	566424	4814763	328.71	323.71	329.01	329.839	n/a	n/a	Overburden	Y
6704043	569894	4813453	316.43	311.43	329.14	317.063	n/a	n/a	Overburden	Y
6704767	570492	4815885	317.86	312.86	329.32	326.771	n/a	n/a	Overburden	Y
6703150	566514	4814783	327.58	322.58	330.06	329.896	n/a	n/a	Overburden	Y
6705005	566708	4814830	326.97	321.97	330.37	330.19	n/a	n/a	Overburden	Y
6707984	567254	4815183	329.4	324.4	330.44	330.483	n/a	n/a	Overburden	Y
6702505	567352	4814883	323.68	318.68	331.61	329.317	n/a	n/a	Overburden	Y
6709138	568199	4815620	323.22	318.22	334.06	330.867	n/a	n/a	Overburden	Y
6702544	570559	4809818	294.56	289.56	300.06	313.293	n/a	n/a	Bedrock	Y
6711317	568454	4809354	297.09	292.09	302.15	310.739	n/a	n/a	Bedrock	Y
6702510	567261	4812616	296.88	291.88	304.04	311.768	n/a	n/a	Bedrock	Y
6702543	571138	4810754	293.71	288.71	304.4	315.877	n/a	n/a	Bedrock	Y
6705330	568095	4809837	288.6	283.6	304.98	310.19	n/a	n/a	Bedrock	Y
6703855	570534	4809973	292.06	287.06	305.18	313.857	n/a	n/a	Bedrock	Y
6704041	567724	4811683	294.98	289.98	305.22	308.557	n/a	n/a	Bedrock	Y
6708317	568700	4813342	301.83	296.83	306.51	311.769	n/a	n/a	Bedrock	Y
n/a	567098	4810050	295.26	290.26	307.21	306.549	n/a	n/a	Bedrock	Y
6703151	569034	4813523	300.95	295.95	307.32	312.937	n/a	n/a	Bedrock	Y
6702512	568527	4813668	303.39	298.39	307.8	312.521	n/a	n/a	Bedrock	Y
6705008	567593	4812085	294.47	289.47	307.86	309.488	n/a	n/a	Bedrock	Y
6708493	568928	4813684	303.8	298.8	308.45	313.048	n/a	n/a	Bedrock	Y
6709413	570395	4813932	292.33	287.33	308.49	321.219	n/a	n/a	Bedrock	Y
6702662	571493	4811063	298.35	293.35	308.59	316.108	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6702354	567032	4812124	300.83	295.83	308.88	309.693	n/a	n/a	Bedrock	Y
6707579	568834	4813483	303.61	298.61	308.93	311.592	n/a	n/a	Bedrock	Y
6705773	569305	4811654	300.86	295.86	309.17	313.219	n/a	n/a	Bedrock	Y
6702521	568986	4813391	300.31	295.31	310.07	310.725	n/a	n/a	Bedrock	Y
6703496	569944	4812433	304.5	299.5	310.07	317.793	n/a	n/a	Bedrock	Y
6711545	570823	4810768	299.78	294.78	310.3	316.309	n/a	n/a	Bedrock	Y
6707386	571314	4811043	292.6	287.6	310.31	316.421	n/a	n/a	Bedrock	Y
6702523	569267	4813098	304.69	299.69	310.51	313.418	n/a	n/a	Bedrock	Y
6711281	568817	4812602	301.35	296.35	310.57	311.821	n/a	n/a	Bedrock	Y
6711762	568867	4812703	301.82	296.82	310.73	311.584	n/a	n/a	Bedrock	Y
6707381	568934	4813483	301.94	296.94	310.82	311.378	n/a	n/a	Bedrock	Y
6711879	571584	4811029	296.12	291.12	310.83	315.73	n/a	n/a	Bedrock	Y
6711101	571372	4811391	300.14	295.14	310.85	317.308	n/a	n/a	Bedrock	Y
6703314	566754	4812643	310.73	305.73	310.87	311.432	n/a	n/a	Bedrock	Y
6702522	568903	4813438	302.59	297.59	310.97	310.98	n/a	n/a	Bedrock	Y
6706916	568814	4810343	292.7	287.7	311.05	311.964	n/a	n/a	Bedrock	Y
6702508	567189	4812498	303.56	298.56	311.23	311.229	n/a	n/a	Bedrock	Y
6712002	570371	4812065	304.7	299.7	311.25	318.649	n/a	n/a	Bedrock	Y
6702658	570439	4811943	301.21	296.21	311.6	318.565	n/a	n/a	Bedrock	Y
6707587	569474	4812983	304.83	299.83	311.68	315.024	n/a	n/a	Bedrock	Y
6712021	571020	4810584	299.44	294.44	311.77	315.537	n/a	n/a	Bedrock	Y
6712203	571008	4810662	293.08	288.08	311.81	315.815	n/a	n/a	Bedrock	Y
6708922	571571	4811075	296.96	291.96	311.88	315.944	n/a	n/a	Bedrock	Y
6702509	568391	4813760	304.27	299.27	311.92	314.226	n/a	n/a	Bedrock	Y
6702647	568915	4813584	304.01	299.01	312.13	311.982	n/a	n/a	Bedrock	Y
6708590	569104	4813309	300.78	295.78	312.25	311.892	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6707590	568914	4813503	301.77	296.77	312.34	311.464	n/a	n/a	Bedrock	Y
6706258	568794	4813503	302.26	297.26	312.37	311.961	n/a	n/a	Bedrock	Y
6712204	571027	4810632	294.79	289.79	312.51	315.685	n/a	n/a	Bedrock	Y
6702665	571498	4811003	294.93	289.93	312.72	315.882	n/a	n/a	Bedrock	Y
6711006	571509	4811487	299.36	294.36	313.47	317.4	n/a	n/a	Bedrock	Y
6702529	569838	4812082	305.32	300.32	313.76	316.997	n/a	n/a	Bedrock	Y
6707591	568854	4813543	302.67	297.67	313.95	311.759	n/a	n/a	Bedrock	Y
6703313	571494	4810923	292.31	287.31	314.03	315.598	n/a	n/a	Bedrock	Y
6704790	569069	4813439	300.12	295.12	314.31	312.506	n/a	n/a	Bedrock	Y
6706778	571494	4810983	294.56	289.56	315.3	315.818	n/a	n/a	Bedrock	Y
6707593	568349	4813759	303.88	298.88	315.37	314.625	n/a	n/a	Bedrock	Y
6712276	567448	4814044	300.66	295.66	315.68	323.005	n/a	n/a	Bedrock	Y
6704519	569344	4813343	304.41	299.41	316.06	315.021	n/a	n/a	Bedrock	Y
6711416	567367	4813986	303.92	298.92	316.08	322.948	n/a	n/a	Bedrock	Y
6709634	568293	4814156	305.63	300.63	316.84	318.687	n/a	n/a	Bedrock	Y
6709001	568279	4814202	306.39	301.39	317.12	319.327	n/a	n/a	Bedrock	Y
6710981	567314	4813921	305.26	300.26	318.71	322.663	n/a	n/a	Bedrock	Y
6710777	567237	4813973	310.1	305.1	318.76	323.442	n/a	n/a	Bedrock	Y
6707678	571014	4812283	304.34	299.34	318.78	319.174	n/a	n/a	Bedrock	Y
6704032	569764	4813408	310.79	305.79	318.86	316.841	n/a	n/a	Bedrock	Y
6704534	570134	4813733	302.63	297.63	318.97	319.071	n/a	n/a	Bedrock	Y
6710919	567405	4814099	303.08	298.08	319.19	323.621	n/a	n/a	Bedrock	Y
6710737	567243	4813972	310.22	305.22	319.27	323.408	n/a	n/a	Bedrock	Y
6707517	571494	4813643	304.53	299.53	319.68	321.544	n/a	n/a	Bedrock	Y
6709238	571285	4814060	301.92	296.92	319.86	322.964	n/a	n/a	Bedrock	Y
6710282	571966	4811761	301.74	296.74	320.58	317.476	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6710281	571947	4811801	302.07	297.07	320.84	317.64	n/a	n/a	Bedrock	Y
6704691	569747	4813387	310.26	305.26	321.06	316.813	n/a	n/a	Bedrock	Y
6710353	571902	4811493	294.65	289.65	322.95	316.689	n/a	n/a	Bedrock	Y
6711129	571567	4811505	300.69	295.69	324.75	317.38	n/a	n/a	Bedrock	Y
6702753	569954	4815470	310.18	305.18	324.89	325.606	n/a	n/a	Bedrock	Y
6709879	569832	4815502	309.17	304.17	324.89	325.118	n/a	n/a	Bedrock	Y
6703163	569674	4815763	311.3	306.3	325.15	325.207	n/a	n/a	Bedrock	Y
6703250	570354	4815843	313.58	308.58	328.31	326.471	n/a	n/a	Bedrock	Y
6705404	566840	4814992	308.18	303.18	329.91	330.589	n/a	n/a	Bedrock	Y
6702504	567204	4815026	310.52	305.52	329.93	330.209	n/a	n/a	Bedrock	Y
6702755	571022	4814599	317.36	312.36	330.81	325.663	n/a	n/a	Bedrock	Y
6711016	566645	4815009	307.7	302.7	335.04	330.682	n/a	n/a	Bedrock	Y
6707457	567794	4809923	283.48	278.48	304.11	309.588	n/a	n/a	Bedrock	Y
6702325	567471	4810184	291.26	286.26	304.67	308.296	n/a	n/a	Bedrock	Y
6711087	571421	4811476	297.33	292.33	305.63	317.449	n/a	n/a	Bedrock	Y
6702287	567141	4809885	292.88	287.88	306.55	307.578	n/a	n/a	Bedrock	Y
6703552	567794	4811613	292.76	287.76	306.65	308.956	n/a	n/a	Bedrock	Y
6707762	568554	4810923	291.7	286.7	306.83	310.623	n/a	n/a	Bedrock	Y
6708266	568878	4813528	299.88	294.88	307.58	311.52	n/a	n/a	Bedrock	Y
6710473	571674	4811271	295.59	290.59	308.72	316.374	n/a	n/a	Bedrock	Y
6711745	566845	4811436	295.44	290.44	308.75	307.726	n/a	n/a	Bedrock	Y
6711288	569424	4811792	298.7	293.7	308.99	313.669	n/a	n/a	Bedrock	Y
6705091	565540	4811635	293.07	288.07	309.19	316.522	n/a	n/a	Bedrock	Y
6708578	568587	4813470	301.04	296.04	309.19	311.976	n/a	n/a	Bedrock	Y
6710441	572024	4811656	296.94	291.94	309.59	316.975	n/a	n/a	Bedrock	Y
6702516	568291	4813582	301.32	296.32	310.18	313.969	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6711378	569488	4811604	301.87	296.87	310.73	314.419	n/a	n/a	Bedrock	Y
6711936	568461	4812560	299.03	294.03	310.82	310.453	n/a	n/a	Bedrock	Y
6706256	571574	4811093	295.54	290.54	311.57	315.985	n/a	n/a	Bedrock	Y
6707592	568894	4813443	300.57	295.57	311.9	310.966	n/a	n/a	Bedrock	Y
6705876	565508	4812167	295.59	290.59	312.08	319.658	n/a	n/a	Bedrock	Y
6702528	569943	4812220	299.51	294.51	312.23	317.65	n/a	n/a	Bedrock	Y
6707589	568174	4813523	300.57	295.57	312.68	314.517	n/a	n/a	Bedrock	Y
6710048	570834	4812414	306.26	301.26	313.08	319.491	n/a	n/a	Bedrock	Y
6702671	571516	4811026	293.54	288.54	313.99	315.893	n/a	n/a	Bedrock	Y
6703544	571684	4811203	292.19	287.19	314.11	316.086	n/a	n/a	Bedrock	Y
6711543	567193	4813996	303.22	298.22	316.3	323.751	n/a	n/a	Bedrock	Y
6712390	567251	4813926	308.17	303.17	317.61	322.948	n/a	n/a	Bedrock	Y
6702530	570404	4811875	298.5	293.5	317.88	318.408	n/a	n/a	Bedrock	Y
6707241	569494	4812183	301.87	296.87	318.48	314.565	n/a	n/a	Bedrock	Y
6711000	567250	4813891	306.11	301.11	319.1	322.674	n/a	n/a	Bedrock	Y
6711206	567274	4813957	306.89	301.89	319.26	323.094	n/a	n/a	Bedrock	Y
6704637	572281	4813000	302.27	297.27	320.23	320.236	n/a	n/a	Bedrock	Y
6710452	567234	4814135	300.89	295.89	321.14	324.548	n/a	n/a	Bedrock	Y
6707585	569874	4812423	301.6	296.6	321.73	317.455	n/a	n/a	Bedrock	Y
6710453	567223	4814193	298.63	293.63	321.78	324.959	n/a	n/a	Bedrock	Y
6703384	566564	4814803	307.27	302.27	323.99	329.95	n/a	n/a	Bedrock	Y
6702502	567236	4815011	303.1	298.1	324.05	330.101	n/a	n/a	Bedrock	Y
6712462	569753	4813403	302.96	297.96	324.13	316.807	n/a	n/a	Bedrock	Y
6702500	567136	4814963	304.24	299.24	324.15	330.056	n/a	n/a	Bedrock	Y
n/a	570861	4815146	320.99	315.99	325.11	327.427	n/a	n/a	Bedrock	Y
6703809	567204	4814973	301.14	296.14	325.77	330.031	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6710998	567210	4814155	304.81	299.81	325.94	324.771	n/a	n/a	Bedrock	Y
6702651	570745	4814449	305.97	300.97	326.01	324.552	n/a	n/a	Bedrock	Y
6710122	567268	4814965	303.1	298.1	326.28	329.942	n/a	n/a	Bedrock	Y
6704690	570503	4814793	307.74	302.74	326.57	325.636	n/a	n/a	Bedrock	Y
6702501	566936	4815030	303.33	298.33	328.02	330.542	n/a	n/a	Bedrock	Y
6710455	566870	4814987	306.19	301.19	330.26	330.514	n/a	n/a	Bedrock	Y
6707910	567314	4815423	306.38	301.38	332.38	331.041	n/a	n/a	Bedrock	Y
n/a	569002	4812639	294.91	289.91	303.35	310.506	n/a	n/a	Bedrock	Y
6706771	567214	4812523	293.97	288.97	303.88	311.438	n/a	n/a	Bedrock	Y
6711570	570942	4810908	292.49	287.49	304.95	316.392	n/a	n/a	Bedrock	Y
6711125	570908	4810689	291.97	286.97	307.83	315.569	n/a	n/a	Bedrock	Y
6707223	569454	4811823	297.45	292.45	308.49	313.842	n/a	n/a	Bedrock	Y
6707637	568114	4814103	298.31	293.31	308.74	319.608	n/a	n/a	Bedrock	Y
6711821	570314	4812071	298.68	293.68	308.74	318.381	n/a	n/a	Bedrock	Y
6709781	570746	4810738	294.91	289.91	308.98	315.852	n/a	n/a	Bedrock	Y
6711417	570888	4810595	293.36	288.36	309.52	315.166	n/a	n/a	Bedrock	Y
6704402	571294	4810923	290.25	285.25	309.61	316.057	n/a	n/a	Bedrock	Y
6710853	567288	4814280	293.07	288.07	309.76	325.111	n/a	n/a	Bedrock	Y
6707271	569314	4811663	295.75	290.75	309.97	313.21	n/a	n/a	Bedrock	Y
6702531	570429	4811843	294.55	289.55	310.81	318.133	n/a	n/a	Bedrock	Y
6712401	571536	4811528	295.22	290.22	310.81	317.146	n/a	n/a	Bedrock	Y
6707339	569354	4813163	297.62	292.62	311.41	314.295	n/a	n/a	Bedrock	Y
6712063	570925	4810655	292.55	287.55	311.82	315.384	n/a	n/a	Bedrock	Y
6705880	568383	4813747	296.55	291.55	312.7	314.255	n/a	n/a	Bedrock	Y
6708205	567931	4813572	294.81	289.81	312.86	316.391	n/a	n/a	Bedrock	Y
6710084	571422	4811357	291.48	286.48	313	316.847	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6709102	570456	4811904	296.4	291.4	313.05	318.241	n/a	n/a	Bedrock	Y
6712259	571724	4811484	295.27	290.27	313.19	316.643	n/a	n/a	Bedrock	Y
6708700	570797	4812633	297.24	292.24	314.06	319.498	n/a	n/a	Bedrock	Y
6708415	571811	4811592	295.5	290.5	314.36	316.852	n/a	n/a	Bedrock	Y
6710918	567033	4813999	298.64	293.64	315.59	324.092	n/a	n/a	Bedrock	Y
6706624	570174	4815083	301.67	296.67	316.72	325.531	n/a	n/a	Bedrock	Y
6709101	570866	4812341	299.41	294.41	317.48	319.029	n/a	n/a	Bedrock	Y
6704850	571665	4813240	300.41	295.41	319.09	321.107	n/a	n/a	Bedrock	Y
6711802	567180	4814103	294.29	289.29	319.19	324.263	n/a	n/a	Bedrock	Y
6706667	571914	4812923	298.44	293.44	319.51	320.527	n/a	n/a	Bedrock	Y
6710454	567406	4814209	293.28	288.28	320.64	324.244	n/a	n/a	Bedrock	Y
6711298	567211	4814129	294.26	289.26	322.07	324.335	n/a	n/a	Bedrock	Y
6704962	571036	4814394	304.84	299.84	323.69	324.408	n/a	n/a	Bedrock	Y
6711077	570035	4815041	301.69	296.69	324.31	324.911	n/a	n/a	Bedrock	Y
6704018	570244	4815753	304.13	299.13	325.19	326.129	n/a	n/a	Bedrock	Y
6705873	570262	4815039	302.31	297.31	325.6	325.617	n/a	n/a	Bedrock	Y
6703154	570724	4814433	300.43	295.43	326.81	324.339	n/a	n/a	Bedrock	Y
6703431	568974	4816163	300.68	295.68	331.44	330.584	n/a	n/a	Bedrock	Y
6711488	568133	4815081	303.61	298.61	331.52	327.381	n/a	n/a	Bedrock	Y
6704794	567419	4810108	284.8	279.8	308.88	308.345	n/a	n/a	Bedrock	Y
6707389	568954	4813463	295.41	290.41	310.96	310.05	n/a	n/a	Bedrock	Y
6708407	568633	4813324	293.64	288.64	311.42	312.043	n/a	n/a	Bedrock	Y
6711675	570661	4814445	298.47	293.47	312.43	323.769	n/a	n/a	Bedrock	Y
6710485	571694	4811530	290.17	285.17	313.64	315.172	n/a	n/a	Bedrock	Y
6702517	568366	4813668	293.74	288.74	314.06	314.232	n/a	n/a	Bedrock	Y
6708577	568759	4813444	295.09	290.09	314.64	311.824	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6706980	569494	4814523	296.84	291.84	321.24	318.654	n/a	n/a	Bedrock	Y
6706156	565814	4813543	290.58	285.58	324.8	322.928	n/a	n/a	Bedrock	Y
6712077	568457	4815067	293.44	288.44	325.87	325.653	n/a	n/a	Bedrock	Y
6702650	569098	4813614	292.92	287.92	305.16	314.246	n/a	n/a	Bedrock	Y
6711394	567617	4812179	289.89	284.89	307.55	311.428	n/a	n/a	Bedrock	Y
6707577	569554	4811603	289.24	284.24	307.76	314.047	n/a	n/a	Bedrock	Y
6702327	567655	4811176	286.85	281.85	309.05	310.206	n/a	n/a	Bedrock	Y
6710177	571453	4811389	290.6	285.6	310.38	313.475	n/a	n/a	Bedrock	Y
6712209	570062	4812193	292.66	287.66	311.42	317.176	n/a	n/a	Bedrock	Y
6709785	571760	4811588	291.46	286.46	311.52	313.562	n/a	n/a	Bedrock	Y
6707584	571034	4812283	290.83	285.83	313.37	317.142	n/a	n/a	Bedrock	Y
6702515	568765	4813521	292.32	287.32	315.09	311.821	n/a	n/a	Bedrock	Y
6709499	571027	4812595	292.97	287.97	319.09	317.732	n/a	n/a	Bedrock	Y
6707298	570714	4812063	291.05	286.05	319.63	316.544	n/a	n/a	Bedrock	Y
6702660	571915	4813224	295.22	290.22	320.8	318.574	n/a	n/a	Bedrock	Y
6711280	570156	4815082	297.06	292.06	326.26	324.89	n/a	n/a	Bedrock	Y
6710562	568664	4809522	277.32	272.32	293.66	307.788	n/a	n/a	Bedrock	Y
6706619	567434	4811683	283.01	278.01	305.73	311.808	n/a	n/a	Bedrock	Y
6708234	568219	4813623	291.32	286.32	305.89	315.584	n/a	n/a	Bedrock	Y
6703309	568134	4809933	280.73	275.73	306.18	308.972	n/a	n/a	Bedrock	Y
6703158	567214	4810823	279.3	274.3	306.92	310.434	n/a	n/a	Bedrock	Y
6704719	568191	4809783	280.4	275.4	307.29	308.768	n/a	n/a	Bedrock	Y
6708472	568760	4813465	291.23	286.23	308.83	312.101	n/a	n/a	Bedrock	Y
6711486	571727	4811433	287.39	282.39	309.01	311.3	n/a	n/a	Bedrock	Y
6711282	568661	4812623	285.74	280.74	309.22	311.38	n/a	n/a	Bedrock	Y
6710111	571674	4811436	287.01	282.01	309.4	311.453	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6705029	567317	4812307	283.28	278.28	310.11	313.371	n/a	n/a	Bedrock	Y
6708075	569214	4813223	290.29	285.29	310.12	310.757	n/a	n/a	Bedrock	Y
6712352	567484	4814090	289.79	284.79	313.07	320.797	n/a	n/a	Bedrock	Y
6712370	571787	4811620	292.86	287.86	313.9	311.942	n/a	n/a	Bedrock	Y
6705438	569171	4814467	292.27	287.27	314.15	320.335	n/a	n/a	Bedrock	Y
6710409	567084	4813795	287.24	282.24	314.25	319.408	n/a	n/a	Bedrock	Y
6710484	567278	4814252	287.96	282.96	314.48	321.132	n/a	n/a	Bedrock	Y
6711969	567145	4814090	286.67	281.67	316.09	320.487	n/a	n/a	Bedrock	Y
6711289	568085	4815040	292.19	287.19	320.67	324.026	n/a	n/a	Bedrock	Y
6712112	567399	4814151	287.23	282.23	321.74	320.922	n/a	n/a	Bedrock	Y
6703965	569414	4815543	293.13	288.13	323.65	325.396	n/a	n/a	Bedrock	Y
6711574	568308	4815049	287.6	282.6	325.97	324.256	n/a	n/a	Bedrock	Y
6711126	568443	4815015	287.68	282.68	328	324.331	n/a	n/a	Bedrock	Y
6711204	568392	4815115	287.4	282.4	328.25	324.428	n/a	n/a	Bedrock	Y
6711472	568504	4815648	290.7	285.7	329.01	325.277	n/a	n/a	Bedrock	Y
6711284	568429	4815087	287.49	282.49	329.91	324.418	n/a	n/a	Bedrock	Y
6703535	567884	4810143	266.42	261.42	300.02	309.094	n/a	n/a	Bedrock	Y
6705488	567634	4811560	280.22	275.22	300.46	311.515	n/a	n/a	Bedrock	Y
6711299	567755	4814391	276.5	271.5	300.91	322.136	n/a	n/a	Bedrock	Y
6705566	570354	4812050	289.48	284.48	303.53	315.065	n/a	n/a	Bedrock	Y
6707935	568334	4812943	282.24	277.24	304.85	312.831	n/a	n/a	Bedrock	Y
6708076	568354	4812983	280.72	275.72	305.08	312.885	n/a	n/a	Bedrock	Y
6711724	569957	4811308	278.16	273.16	305.13	311.239	n/a	n/a	Bedrock	Y
6709481	567941	4814561	279.05	274.05	305.5	322.9	n/a	n/a	Bedrock	Y
6708740	569075	4813762	281.21	276.21	306.76	315.415	n/a	n/a	Bedrock	Y
6706620	566474	4812183	274.74	269.74	306.98	313.765	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6709480	568005	4814603	283.21	278.21	307.32	323.101	n/a	n/a	Bedrock	Y
6707797	568974	4812563	278.56	273.56	307.74	311.377	n/a	n/a	Bedrock	Y
6711455	569561	4811898	280.09	275.09	307.86	312.901	n/a	n/a	Bedrock	Y
6703640	568574	4811553	277.35	272.35	308.03	310.696	n/a	n/a	Bedrock	Y
6711801	569167	4812847	277.23	272.23	308.21	308.1	n/a	n/a	Bedrock	Y
6712247	569167	4812847	277.23	272.23	308.21	308.1	n/a	n/a	Bedrock	Y
6704699	569078	4813573	285.18	280.18	308.89	313.758	n/a	n/a	Bedrock	Y
6709784	570964	4810635	281.46	276.46	309.13	309.211	n/a	n/a	Bedrock	Y
6710008	569484	4811644	276.74	271.74	309.17	311.996	n/a	n/a	Bedrock	Y
6703703	571414	4810853	279.93	274.93	309.75	309.378	n/a	n/a	Bedrock	Y
6711723	569656	4811874	281.91	276.91	311.16	313.168	n/a	n/a	Bedrock	Y
6707290	569194	4812803	277.63	272.63	311.24	309.959	n/a	n/a	Bedrock	Y
6707742	568714	4813583	283.63	278.63	311.31	313.547	n/a	n/a	Bedrock	Y
n/a	568860	4812797	274.7	269.7	311.64	310.814	n/a	n/a	Bedrock	Y
6712145	568212	4813479	277.32	272.32	311.92	315.478	n/a	n/a	Bedrock	Y
6703870	568464	4811503	267.19	262.19	312.37	310.593	n/a	n/a	Bedrock	Y
6707384	568734	4813623	286.25	281.25	312.4	313.062	n/a	n/a	Bedrock	Y
6707581	568374	4813103	280.63	275.63	313.71	313.191	n/a	n/a	Bedrock	Y
6711926	567211	4813858	273.63	268.63	313.85	319.68	n/a	n/a	Bedrock	Y
6706705	568074	4813403	278.29	273.29	314.19	315.667	n/a	n/a	Bedrock	Y
6710007	569955	4813426	279.19	274.19	314.25	317.23	n/a	n/a	Bedrock	Y
6707383	568394	4813663	285.73	280.73	314.25	315.676	n/a	n/a	Bedrock	Y
6702655	570187	4813889	281.61	276.61	314.66	320.276	n/a	n/a	Bedrock	Y
6710680	570907	4812719	288.97	283.97	314.83	317.072	n/a	n/a	Bedrock	Y
6709382	571007	4812571	282.84	277.84	315.1	316.667	n/a	n/a	Bedrock	Y
6709384	570809	4812624	288.25	283.25	315.22	316.899	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6706000	568749	4814191	282.8	277.8	315.33	318.886	n/a	n/a	Bedrock	Y
n/a	569037	4812797	277.58	272.58	315.59	301.493	n/a	n/a	Bedrock	Y
6711669	567430	4814174	280.08	275.08	316.56	320.985	n/a	n/a	Bedrock	Y
6711923	567346	4814287	280.55	275.55	316.71	321.258	n/a	n/a	Bedrock	Y
6711270	567649	4814311	276.5	271.5	316.97	321.715	n/a	n/a	Bedrock	Y
6704352	569574	4812903	281.38	276.38	317.52	314.083	n/a	n/a	Bedrock	Y
6709478	570658	4812485	282.39	277.39	317.7	316.571	n/a	n/a	Bedrock	Y
6711473	567264	4814276	275.72	270.72	317.75	321.134	n/a	n/a	Bedrock	Y
6711544	568053	4815021	285.53	280.53	318.68	323.922	n/a	n/a	Bedrock	Y
6712192	567520	4814191	278.54	273.54	318.82	321.142	n/a	n/a	Bedrock	Y
6710341	570868	4812349	281.96	276.96	318.95	316.323	n/a	n/a	Bedrock	Y
6710997	567596	4814247	277.86	272.86	320.24	321.437	n/a	n/a	Bedrock	Y
6702657	570310	4814090	283.09	278.09	320.39	321.644	n/a	n/a	Bedrock	Y
6711713	570175	4812374	280.68	275.68	320.65	316.022	n/a	n/a	Bedrock	Y
6707693	569094	4814363	285.26	280.26	320.68	320.582	n/a	n/a	Bedrock	Y
6712399	568572	4814981	279.26	274.26	320.95	324.38	n/a	n/a	Bedrock	Y
6711439	568593	4814887	285.55	280.55	321.75	324.288	n/a	n/a	Bedrock	Y
6712473	568504	4815044	279.93	274.93	322.37	324.4	n/a	n/a	Bedrock	Y
6703907	570554	4814473	291.13	286.13	325.01	322.891	n/a	n/a	Bedrock	Y
6710952	570141	4815237	277.23	272.23	325.41	324.88	n/a	n/a	Bedrock	Y
6710387	571037	4812996	276.8	271.8	289.66	317.664	n/a	n/a	Bedrock	Y
6709669	569318	4812734	269.33	264.33	295.39	312.193	n/a	n/a	Bedrock	Y
6704969	567832	4813260	271.62	266.62	297.44	316.049	n/a	n/a	Bedrock	Y
6710603	568383	4814775	272.01	267.01	300.63	323.931	n/a	n/a	Bedrock	Y
6710009	569682	4811635	272.96	267.96	304.3	311.735	n/a	n/a	Bedrock	Y
6711474	568333	4813676	269.91	264.91	304.73	316.344	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6708923	570552	4812191	273.69	268.69	306.28	315.527	n/a	n/a	Bedrock	Y
6707273	568954	4812523	266.56	261.56	309.47	311.537	n/a	n/a	Bedrock	Y
6707289	568874	4812723	274.83	269.83	310.42	311.205	n/a	n/a	Bedrock	Y
6706694	570514	4812023	271	266	312	314.908	n/a	n/a	Bedrock	Y
6711997	569519	4813144	269.93	264.93	312.04	313.381	n/a	n/a	Bedrock	Y
6711715	570553	4812185	271.6	266.6	312.37	315.51	n/a	n/a	Bedrock	Y
6712159	569604	4813231	274.12	269.12	312.55	314.346	n/a	n/a	Bedrock	Y
6712321	569694	4811655	272.88	267.88	312.66	311.847	n/a	n/a	Bedrock	Y
n/a	568870	4812485	266.96	261.96	312.85	311.596	n/a	n/a	Bedrock	Y
6709385	568151	4814028	268.73	263.73	315.19	319.384	n/a	n/a	Bedrock	Y
6711113	567229	4814364	274.68	269.68	316.06	321.31	n/a	n/a	Bedrock	Y
6710888	567417	4814097	273.45	268.45	319.81	320.68	n/a	n/a	Bedrock	Y
6710835	570259	4814207	280.02	275.02	320.01	322.183	n/a	n/a	Bedrock	Y
6709498	570997	4812491	276.77	271.77	320.37	316.452	n/a	n/a	Bedrock	Y
6710407	568248	4814779	269.79	264.79	321.03	323.761	n/a	n/a	Bedrock	Y
6712327	568166	4814755	270.14	265.14	321.22	323.609	n/a	n/a	Bedrock	Y
6712119	568471	4814862	277.07	272.07	321.24	324.137	n/a	n/a	Bedrock	Y
6707042	569414	4814423	275.79	270.79	321.81	321.783	n/a	n/a	Bedrock	Y
6708373	570422	4814251	276.25	271.25	321.82	322.348	n/a	n/a	Bedrock	Y
6710654	568635	4814877	269.52	264.52	328.13	324.322	n/a	n/a	Bedrock	Y
6711845	571043	4810933	246.6	241.6	303.69	310.223	n/a	n/a	Bedrock	Y
6708456	568504	4813622	257.84	252.84	303.83	315.281	n/a	n/a	Bedrock	Y
6708457	568528	4813674	258.67	253.67	304.36	315.471	n/a	n/a	Bedrock	Y
6711872	570240	4812553	254.95	249.95	309.59	316.061	n/a	n/a	Bedrock	Y
6712296	569007	4812634	258.98	253.98	310.9	311.195	n/a	n/a	Bedrock	Y
6712227	570996	4812571	253.51	248.51	314.11	316.613	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen /Open Interval Top (masl)	Screen /Open Interval Bottom (masl)	Observed Average Water Level (2009 to 2013 and 2015) (masl)[1]	Simulated Average Water Level (masl)	Observed Drawdown (0 to 3,600 m^3/day) (m)	Simulated Drawdown (0 to 3,600 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6711021	568494	4814422	262.68	257.68	318.46	321.682	n/a	n/a	Bedrock	Y
6708652	570683	4812236	238.12	233.12	314.39	315.805	n/a	n/a	Bedrock	Y
6711771	568413	4814821	248.63	243.63	319.52	324.015	n/a	n/a	Bedrock	Y
6712093	568506	4814893	251.34	246.34	321.15	324.203	n/a	n/a	Bedrock	Y

n/a information not available
WWIS – Water Well Information System
Masl – meters above sea level
[1] Observed water levels for WWIS wells represent values collected over different time periods and potentially under different regional pumping conditions

TABLE A2 Calibration Dataset and Results - Erin

Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
TW1-88	568376	4847829	410.80	393.60	423.1	425.85	6.40	7.49	Bedrock	N
MW05A-05	568339	4847771	410.56	404.47	423.78	425.63	4.08	4.02	Bedrock	N
MW06A-05	568741	4847572	411.72	408.67	422.18	420.75	0.68	0.94	Bedrock	N
MW11A-08	568784	4848063	411.80	407.23	426.9	426.09	n/a	n/a	Bedrock	N
MW12A-08	569279	4847593	407.90	404.86	424.85	416.94	n/a	n/a	Bedrock	N
D3	568160	4847870	418.72	410.80	425	428.78	1.67	1.96	Bedrock	N
D8	568759	4848313	412.32	390.07	427.3	428.69	0.44	0.85	Bedrock	N
D15	569038	4848475	408.35	406.83	427.38	428.59	n/a	n/a	Bedrock	N
D24A	567878	4847889	409.61	400.16	425.82	429.45	1.82	1.59	Bedrock	N
D24B	567891	4847804	410.93	399.04	425.2	429.13	1.72	1.61	Bedrock	N
D26A	568405	4847251	n/a	n/a	420.22	419.57	1.45	0.96	Bedrock	N
D26B	568348	4847311	398.50	396.06	420.22	420.55	n/a	n/a	Bedrock	N
D32	569198	4847127	404.50	390.18	413.45	412.51	0.10	0.15	Bedrock	N
D36B	569195	4847350	399.28	384.48	424.08	414.21	0.32	0.21	Bedrock	N
MW02-00	568432	4847705	428.07	426.66	428.29	429.56	0.00	0.06	Overburden	N
MW03A-00	568370	4847686	426.88	426.63	428.42	428.52	0.00	0.00	Overburden	N
MW03B-00	568370	4847686	428.13	427.94	428.31	428.52	0.00	0.00	Overburden	N
MW05B-05	568350	4847778	420.68	418.85	428.58	430.50	0.00	0.06	Overburden	N
MW06B-05	568741	4847574	426.63	425.10	428.33	429.38	0.00	0.11	Overburden	N
MW11B-08	568784	4848062	423.38	420.33	428.62	432.22	n/a	n/a	Overburden	N
MW12B-08	569281	4847591	434.26	431.22	431.7	431.37	n/a	n/a	Overburden	N
TW1-99	568515	4847847	422.48	420.04	428.53	431.55	0.00	0.10	Overburden	N
D7B	568370	4848313	n/a	n/a	435.5	435.90	0.00	0.01	Overburden	N
D26C	568329	4847305	n/a	n/a	434.72	425.03	n/a	n/a	Overburden	N

Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
D36A	569178	4847335	n/a	n/a	435.06	426.30	0.00	-0.17	Overburden	N
6706674	571064	4846323	390.4	385.4	400.64	403.25	n/a	n/a	Bedrock	Y
6708665	568535	4846462	362.7	357.7	405.58	414.58	n/a	n/a	Bedrock	Y
6706591	569414	4847123	368.3	363.3	405.81	412.47	n/a	n/a	Bedrock	Y
6700710	569479	4846990	395.4	390.4	406.27	410.79	n/a	n/a	Bedrock	Y
6707233	569614	4846473	354.6	349.6	406.85	409.18	n/a	n/a	Bedrock	Y
6704921	569432	4847165	376.4	371.4	408.06	412.75	n/a	n/a	Bedrock	Y
6707351	570014	4848173	401.9	396.9	408.42	419.77	n/a	n/a	Bedrock	Y
6703622	570164	4845973	369.1	364.1	408.57	406.37	n/a	n/a	Bedrock	Y
6703617	568634	4846553	368.7	363.7	409.34	414.27	n/a	n/a	Bedrock	Y
6709574	569889	4845983	366.2	361.2	409.49	407.54	n/a	n/a	Bedrock	Y
6710155	567703	4845330	378.4	373.4	409.56	411.08	n/a	n/a	Bedrock	Y
6703960	568374	4847373	400.2	395.2	409.84	421.09	n/a	n/a	Bedrock	Y
6704991	569250	4847091	394.9	389.9	410.15	412.07	n/a	n/a	Bedrock	Y
6703808	569314	4846833	381.3	376.3	410.16	411.16	n/a	n/a	Bedrock	Y
6706588	569714	4846323	365.9	360.9	410.45	408.46	n/a	n/a	Bedrock	Y
6708632	569510	4847139	373.0	368.0	410.51	412.39	n/a	n/a	Bedrock	Y
6708725	570195	4845854	366.6	361.6	410.52	406.32	n/a	n/a	Bedrock	Y
6705561	568973	4846730	382.6	377.6	410.79	412.72	n/a	n/a	Bedrock	Y
6703704	569414	4847043	381.4	376.4	411.02	411.88	n/a	n/a	Bedrock	Y
6700677	567765	4846419	402.1	397.1	411.94	418.99	n/a	n/a	Bedrock	Y
6700676	568648	4847067	409.2	404.2	412.14	415.51	n/a	n/a	Bedrock	Y
6711066	570000	4846184	371.4	366.4	412.16	407.02	n/a	n/a	Bedrock	Y
6710535	570297	4845535	378.5	373.5	412.6	405.98	n/a	n/a	Bedrock	Y
6706403	569464	4846623	386.9	381.9	412.67	409.76	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6700711	569451	4847061	381.8	376.8	412.85	411.91	n/a	n/a	Bedrock	Y
6708631	569481	4847149	372.7	367.7	413.01	412.52	n/a	n/a	Bedrock	Y
6703621	569284	4847193	375.2	370.2	413.2	413.35	n/a	n/a	Bedrock	Y
6700708	570707	4845652	381.0	376.0	413.24	404.32	n/a	n/a	Bedrock	Y
6712435	571353	4846608	384.4	379.4	413.38	403.99	n/a	n/a	Bedrock	Y
6707864	569414	4847273	372.8	367.8	413.49	413.69	n/a	n/a	Bedrock	Y
6703647	570014	4846093	371.3	366.3	413.81	406.96	n/a	n/a	Bedrock	Y
6710528	567720	4846248	392.2	387.2	413.81	417.63	n/a	n/a	Bedrock	Y
6712437	569781	4846039	361.2	356.2	413.91	408.04	n/a	n/a	Bedrock	Y
6703623	569324	4847243	373.7	368.7	414.21	413.64	n/a	n/a	Bedrock	Y
6710144	570236	4845456	370.5	365.5	414.22	406.14	n/a	n/a	Bedrock	Y
6703186	571114	4846523	409.3	404.3	414.33	404.40	n/a	n/a	Overburden	Y
6700679	568013	4847639	411.4	406.4	414.36	426.81	n/a	n/a	Bedrock	Y
6704458	566589	4845848	404.4	399.4	414.36	419.96	n/a	n/a	Bedrock	Y
6710566	566595	4845926	393.6	388.6	414.47	421.09	n/a	n/a	Bedrock	Y
6705648	570168	4847799	398.1	393.1	414.72	416.38	n/a	n/a	Bedrock	Y
6710547	570538	4845437	392.9	387.9	415.14	405.21	n/a	n/a	Bedrock	Y
6709043	570486	4845481	392.7	387.7	415.31	405.47	n/a	n/a	Bedrock	Y
6700655	568538	4844747	376.7	371.7	415.6	407.89	n/a	n/a	Bedrock	Y
6705975	569454	4847483	370.6	365.6	415.61	415.55	n/a	n/a	Bedrock	Y
6707356	569214	4845823	387.4	382.4	415.63	410.46	n/a	n/a	Bedrock	Y
6707429	569214	4846473	372.4	367.4	415.96	411.08	n/a	n/a	Bedrock	Y
6710800	569858	4846123	369.4	364.4	415.97	407.69	n/a	n/a	Bedrock	Y
6709713	567678	4846188	394.5	389.5	416.1	417.22	n/a	n/a	Bedrock	Y
6705147	569413	4844769	393.8	388.8	416.14	406.92	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6711236	570697	4847263	392.6	387.6	416.17	410.96	n/a	n/a	Bedrock	Y
6706342	569414	4847323	374.8	369.8	416.18	414.13	n/a	n/a	Bedrock	Y
6700657	567894	4845359	382.4	377.4	416.54	411.57	n/a	n/a	Bedrock	Y
6707555	567714	4845423	412.0	407.0	416.96	411.86	n/a	n/a	Bedrock	Y
6708433	567375	4846783	404.9	399.9	417	424.53	n/a	n/a	Bedrock	Y
6707831	567814	4845023	372.2	367.2	417.03	409.34	n/a	n/a	Bedrock	Y
6710326	566893	4846209	370.1	365.1	417.03	422.00	n/a	n/a	Bedrock	Y
6708353	571002	4848734	391.0	386.0	417.12	418.08	n/a	n/a	Bedrock	Y
6707564	571314	4848423	401.9	396.9	417.18	415.87	n/a	n/a	Bedrock	Y
6704164	568984	4845323	397.0	392.0	417.46	410.30	n/a	n/a	Bedrock	Y
6700656	568126	4844868	391.3	386.3	417.55	408.61	n/a	n/a	Bedrock	Y
6700658	567559	4846306	383.0	378.0	417.58	419.05	n/a	n/a	Bedrock	Y
6705643	567414	4846123	390.2	385.2	417.72	417.73	n/a	n/a	Bedrock	Y
6711073	569502	4846342	395.0	390.0	417.99	409.48	n/a	n/a	Bedrock	Y
6709053	567547	4846423	397.9	392.9	418.1	420.52	n/a	n/a	Bedrock	Y
6705908	566934	4846163	390.4	385.4	418.28	420.88	n/a	n/a	Bedrock	Y
6705623	567464	4846463	400.5	395.5	418.33	421.20	n/a	n/a	Bedrock	Y
6710544	571205	4848518	395.2	390.2	418.36	416.62	n/a	n/a	Bedrock	Y
6704175	569614	4848173	387.8	382.8	418.43	422.21	n/a	n/a	Bedrock	Y
6705150	568086	4846287	388.7	383.7	418.49	416.01	n/a	n/a	Bedrock	Y
6700675	570019	4845838	386.0	381.0	418.54	407.07	n/a	n/a	Bedrock	Y
6707836	566864	4847223	406.0	401.0	418.68	431.28	n/a	n/a	Bedrock	Y
6707559	569914	4848073	382.1	377.1	418.79	419.50	n/a	n/a	Bedrock	Y
6708163	567412	4846538	402.1	397.1	418.8	422.13	n/a	n/a	Bedrock	Y
6709026	567531	4846382	398.5	393.5	418.96	420.15	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6709566	569134	4844963	395.4	390.4	419.03	408.65	n/a	n/a	Bedrock	Y
6708168	567387	4846730	403.2	398.2	419.09	424.02	n/a	n/a	Bedrock	Y
6704176	569589	4848198	388.3	383.3	419.11	422.66	n/a	n/a	Bedrock	Y
6706651	567314	4846773	404.2	399.2	419.18	424.80	n/a	n/a	Bedrock	Y
6704455	567454	4847003	405.6	400.6	419.67	425.28	n/a	n/a	Bedrock	Y
6700709	570961	4846631	387.7	382.7	419.67	405.69	n/a	n/a	Bedrock	Y
6705479	567314	4846703	403.0	398.0	419.7	424.31	n/a	n/a	Bedrock	Y
6704704	571576	4848191	394.7	389.7	419.9	413.78	n/a	n/a	Bedrock	Y
6700660	566787	4846065	397.7	392.7	420.04	421.30	n/a	n/a	Bedrock	Y
6711773	567421	4846972	401.3	396.3	420.18	425.33	n/a	n/a	Bedrock	Y
6708432	567594	4846933	405.8	400.8	420.21	423.14	n/a	n/a	Bedrock	Y
6708719	567424	4846743	404.3	399.3	420.26	423.91	n/a	n/a	Bedrock	Y
6704432	566714	4845848	410.3	405.3	420.34	419.15	n/a	n/a	Bedrock	Y
6710223	567335	4846650	403.9	398.9	420.46	423.75	n/a	n/a	Bedrock	Y
6711808	569345	4846461	377.9	372.9	420.51	410.41	n/a	n/a	Bedrock	Y
6704447	567064	4845848	398.0	393.0	420.58	417.00	n/a	n/a	Bedrock	Y
6707572	567864	4845673	393.4	388.4	420.62	413.77	n/a	n/a	Bedrock	Y
6712044	569347	4844923	394.7	389.7	420.63	407.76	n/a	n/a	Bedrock	Y
6706395	567364	4846573	404.9	399.9	420.68	422.87	n/a	n/a	Bedrock	Y
6704910	570868	4846925	383.9	378.9	420.73	407.96	n/a	n/a	Bedrock	Y
6709530	569027	4848418	405.9	400.9	420.75	428.09	n/a	n/a	Bedrock	Y
6704182	569054	4845123	388.9	383.9	420.9	409.70	n/a	n/a	Bedrock	Y
6704988	567377	4846689	404.9	399.9	420.92	423.88	n/a	n/a	Bedrock	Y
6710218	567214	4846583	404.6	399.6	421	423.80	n/a	n/a	Bedrock	Y
6708722	567235	4846710	405.3	400.3	421.07	424.81	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6709533	569032	4848393	414.8	409.8	421.19	427.87	n/a	n/a	Bedrock	Y
6705146	569719	4848033	403.4	398.4	421.24	420.30	n/a	n/a	Bedrock	Y
6709532	569027	4848442	411.9	406.9	421.25	428.36	n/a	n/a	Bedrock	Y
6706583	569214	4848473	413.9	408.9	421.28	427.56	n/a	n/a	Bedrock	Y
6707852	567164	4846823	407.6	402.6	421.35	426.11	n/a	n/a	Bedrock	Y
6710548	569791	4848098	403.4	398.4	421.75	420.50	n/a	n/a	Bedrock	Y
6707143	569764	4848123	405.1	400.1	421.79	420.95	n/a	n/a	Bedrock	Y
6709595	569834	4847973	405.4	400.4	421.84	418.89	n/a	n/a	Bedrock	Y
6704171	569634	4848173	404.7	399.7	421.85	422.21	n/a	n/a	Bedrock	Y
6710567	567154	4846831	409.3	404.3	421.99	426.24	n/a	n/a	Bedrock	Y
6710551	569634	4847672	406.3	401.3	422.01	417.28	n/a	n/a	Bedrock	Y
6707151	568414	4845723	393.7	388.7	422.19	413.10	n/a	n/a	Bedrock	Y
6709602	569745	4848059	405.3	400.3	422.31	420.42	n/a	n/a	Bedrock	Y
6706590	568614	4845323	395.2	390.2	422.92	411.39	n/a	n/a	Bedrock	Y
6708080	569664	4848123	398.5	393.5	423.2	421.53	n/a	n/a	Bedrock	Y
6706286	569574	4848223	399.5	394.5	423.36	423.03	n/a	n/a	Bedrock	Y
6707144	569664	4848273	407.3	402.3	423.63	422.99	n/a	n/a	Bedrock	Y
6710154	567876	4847308	401.4	396.4	423.65	424.37	n/a	n/a	Bedrock	Y
6710572	567085	4846863	406.5	401.5	423.68	426.95	n/a	n/a	Bedrock	Y
6710530	566954	4846933	408.5	403.5	423.85	428.34	n/a	n/a	Bedrock	Y
6709709	566879	4846853	411.0	406.0	424.18	428.20	n/a	n/a	Bedrock	Y
6704115	568764	4847223	411.1	406.1	424.49	415.23	n/a	n/a	Bedrock	Y
6709886	569405	4848417	412.5	407.5	424.59	425.92	n/a	n/a	Bedrock	Y
6700712	569004	4848354	399.3	394.3	424.68	427.61	n/a	n/a	Bedrock	Y
6703357	570184	4848273	401.0	396.0	424.99	419.49	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6705148	569795	4848098	411.4	406.4	425.1	420.50	n/a	n/a	Bedrock	Y
6709212	570116	4848219	396.4	391.4	425.15	419.44	n/a	n/a	Bedrock	Y
6708146	567881	4847890	405.2	400.2	425.37	429.44	n/a	n/a	Bedrock	Y
6711507	570228	4849191	382.5	377.5	425.39	428.30	n/a	n/a	Bedrock	Y
6706041	569314	4848473	418.8	413.8	425.42	426.99	n/a	n/a	Bedrock	Y
6705612	568840	4848356	395.6	390.6	425.47	428.59	n/a	n/a	Bedrock	Y
6709065	570567	4848720	403.2	398.2	425.63	420.90	n/a	n/a	Bedrock	Y
6704542	569434	4848483	413.8	408.8	426.07	426.37	n/a	n/a	Bedrock	Y
6707156	569814	4848273	405.2	400.2	426.12	422.06	n/a	n/a	Bedrock	Y
6710148	569082	4848616	377.3	372.3	426.22	429.55	n/a	n/a	Bedrock	Y
6703520	566584	4847283	401.5	396.5	426.32	434.04	n/a	n/a	Bedrock	Y
6703518	569004	4848873	381.5	376.5	426.66	432.37	n/a	n/a	Bedrock	Y
6709578	568859	4848859	389.2	384.2	426.83	433.08	n/a	n/a	Bedrock	Y
6705647	570514	4848673	407.2	402.2	426.89	420.79	n/a	n/a	Bedrock	Y
6706911	569064	4848723	418.4	413.4	427.63	430.68	n/a	n/a	Bedrock	Y
6710156	570480	4848893	415.9	410.9	427.78	423.48	n/a	n/a	Bedrock	Y
6700771	570664	4849203	416.1	411.1	427.79	425.77	n/a	n/a	Bedrock	Y
6700739	570583	4848804	415.2	410.2	428.07	421.65	n/a	n/a	Bedrock	Y
6700746	569464	4848468	408.0	403.0	428.15	426.01	n/a	n/a	Bedrock	Y
6708720	568791	4848303	395.1	390.1	428.19	428.38	n/a	n/a	Bedrock	Y
6700713	569185	4848623	415.5	410.5	428.22	429.11	n/a	n/a	Bedrock	Y
6703528	568634	4848703	384.7	379.7	428.4	433.10	n/a	n/a	Bedrock	Y
6706594	570714	4848973	412.7	407.7	428.49	422.67	n/a	n/a	Bedrock	Y
6710228	568207	4847890	414.7	409.7	429.31	427.31	n/a	n/a	Bedrock	Y
6711625	571312	4849051	406.2	401.2	429.57	419.55	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6712043	566646	4847156	404.9	399.9	429.7	432.28	n/a	n/a	Bedrock	Y
6710162	567449	4848214	410.7	405.7	429.79	437.17	n/a	n/a	Bedrock	Y
6704913	568918	4849017	364.8	359.8	430.24	434.23	n/a	n/a	Bedrock	Y
6708616	568719	4849027	415.1	410.1	430.36	435.31	n/a	n/a	Bedrock	Y
6707054	570814	4849023	411.7	406.7	430.75	422.41	n/a	n/a	Bedrock	Y
6703149	569034	4849223	403.3	398.3	430.8	435.23	n/a	n/a	Bedrock	Y
6711075	568765	4848930	384.1	379.1	430.94	434.40	n/a	n/a	Bedrock	Y
6710235	568896	4848874	406.2	401.2	431.28	432.96	n/a	n/a	Bedrock	Y
6708365	568793	4848858	405.3	400.3	431.34	433.40	n/a	n/a	Bedrock	Y
6709042	568731	4849270	401.1	396.1	431.46	437.95	n/a	n/a	Bedrock	Y
6707358	568714	4848823	408.5	403.5	431.46	433.54	n/a	n/a	Bedrock	Y
6709050	568646	4848767	385.8	380.8	431.56	433.63	n/a	n/a	Bedrock	Y
6700740	568722	4849233	406.5	401.5	431.68	437.67	n/a	n/a	Bedrock	Y
6707821	568814	4849473	429.3	424.3	432.07	443.42	n/a	n/a	Overburden	Y
6703077	569084	4848213	412.8	407.8	432.12	425.80	n/a	n/a	Bedrock	Y
6708174	568803	4848861	416.5	411.5	432.19	433.31	n/a	n/a	Bedrock	Y
6709537	567566	4848063	410.5	405.5	432.3	434.45	n/a	n/a	Bedrock	Y
6704915	568749	4849470	404.1	399.1	432.39	439.80	n/a	n/a	Bedrock	Y
6710806	568559	4848525	415.6	410.6	432.41	431.90	n/a	n/a	Bedrock	Y
6706282	568764	4849423	422.7	417.7	432.43	439.23	n/a	n/a	Bedrock	Y
6700742	568801	4849079	413.5	408.5	432.49	435.20	n/a	n/a	Bedrock	Y
6704716	568914	4849033	394.1	389.1	432.49	434.29	n/a	n/a	Bedrock	Y
6709156	568808	4849283	394.8	389.8	432.51	437.44	n/a	n/a	Bedrock	Y
6709207	567608	4848229	392.8	387.8	432.55	435.89	n/a	n/a	Bedrock	Y
6709548	567785	4848113	410.7	405.7	432.63	432.60	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6707813	568814	4849473	417.8	412.8	432.68	439.41	n/a	n/a	Bedrock	Y
6708153	569289	4847274	378.8	373.8	432.81	413.98	n/a	n/a	Bedrock	Y
6708360	568714	4849447	419.6	414.6	432.87	439.92	n/a	n/a	Bedrock	Y
6709702	567034	4847593	425.1	420.1	432.87	434.28	n/a	n/a	Bedrock	Y
6708388	568233	4848077	405.6	400.6	432.88	429.42	n/a	n/a	Bedrock	Y
6708347	568847	4849569	416.2	411.2	433.19	440.15	n/a	n/a	Bedrock	Y
6708346	568642	4848787	407.9	402.9	433.31	433.65	n/a	n/a	Bedrock	Y
6700738	568722	4849243	403.6	398.6	433.64	437.77	n/a	n/a	Bedrock	Y
6707860	568914	4849723	415.9	410.9	433.68	441.16	n/a	n/a	Bedrock	Y
6709157	568786	4849305	417.5	412.5	433.86	437.83	n/a	n/a	Bedrock	Y
6708154	568752	4849492	432.5	427.5	434.32	444.86	n/a	n/a	Overburden	Y
6708625	568732	4849358	427.0	422.0	434.33	443.02	n/a	n/a	Overburden	Y
6708413	568828	4849519	416.3	411.3	434.65	439.81	n/a	n/a	Bedrock	Y
6709888	568876	4849608	419.1	414.1	434.87	440.33	n/a	n/a	Bedrock	Y
6704918	568725	4849314	422.5	417.5	435.02	438.53	n/a	n/a	Bedrock	Y
6711499	570182	4849736	410.2	405.2	435.72	434.39	n/a	n/a	Bedrock	Y
6705153	569302	4847515	394.2	389.2	435.72	415.21	n/a	n/a	Bedrock	Y
6703896	568514	4848713	400.2	395.2	435.78	433.87	n/a	n/a	Bedrock	Y
6712436	568623	4849076	415.0	410.0	436.1	436.80	n/a	n/a	Bedrock	Y
6704469	568174	4849553	390.6	385.6	436.36	444.28	n/a	n/a	Bedrock	Y
6707731	566614	4848423	396.3	391.3	436.59	445.32	n/a	n/a	Bedrock	Y
6700741	568764	4849146	420.3	415.3	436.75	436.38	n/a	n/a	Bedrock	Y
6707861	568664	4848923	409.6	404.6	436.82	434.84	n/a	n/a	Bedrock	Y
6706900	568564	4848773	389.7	384.7	437.27	434.15	n/a	n/a	Bedrock	Y
6707558	568814	4849723	408.1	403.1	438.42	441.80	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6708148	569542	4850082	411.8	406.8	439.05	440.72	n/a	n/a	Bedrock	Y
6710805	570293.3	4849525	406.3	401.3	439.84	431.53	n/a	n/a	Bedrock	Y
6707164	568564.3	4848823	422.8	417.8	440.63	434.39	n/a	n/a	Bedrock	Y
6706584	568814.3	4849373	394.6	389.6	441.5	438.28	n/a	n/a	Bedrock	Y
6708389	567929.3	4848635	412.8	407.8	441.99	437.64	n/a	n/a	Bedrock	Y
6709580	566837.3	4848885	424.7	419.7	442.5	447.87	n/a	n/a	Bedrock	Y
6707858	568614.3	4849323	422.0	417.0	443.05	439.51	n/a	n/a	Bedrock	Y
6710531	566141.3	4848004	418.4	413.4	443.2	443.66	n/a	n/a	Bedrock	Y
6708826	568676.3	4849428	440.4	435.4	443.75	445.20	n/a	n/a	Overburden	Y
6704718	567064.3	4849503	385.7	380.7	444.03	451.00	n/a	n/a	Bedrock	Y
6703364	568294.3	4849423	406.7	401.7	444.77	442.39	n/a	n/a	Bedrock	Y
6708396	570346.3	4848685	404.4	399.4	444.91	422.35	n/a	n/a	Bedrock	Y
6709726	566740.3	4848952	420.4	415.4	445.69	448.98	n/a	n/a	Bedrock	Y
6703961	567144.3	4849103	425.5	420.5	447.09	447.62	n/a	n/a	Bedrock	Y
6705915	567864.3	4849643	418.3	413.3	448.1	447.42	n/a	n/a	Bedrock	Y
6709502	568399.3	4849055	452.6	447.6	448.48	444.56	n/a	n/a	Overburden	Y
6705909	568614.3	4849343	412.2	407.2	450.12	439.69	n/a	n/a	Bedrock	Y
6703169	567474.3	4850243	426.3	421.3	450.97	454.46	n/a	n/a	Bedrock	Y
6705933	568514.3	4849213	429.4	424.4	453.39	444.89	n/a	n/a	Overburden	Y
6708663	566580.3	4849279	-112.6	-117.6	454.56	449.94	n/a	n/a	Bedrock	Y
6705633	567564.3	4850323	427.6	422.6	456	454.57	n/a	n/a	Bedrock	Y
1700164	565046.3	4851813	412.1	407.1	459.38	468.64	n/a	n/a	Bedrock	Y
1700172	565445.3	4852268	405.0	400.0	461.84	469.78	n/a	n/a	Bedrock	Y
6700640	565813.3	4846073	404.6	399.6	426.14	426.67	n/a	n/a	Bedrock	Y
6700641	564344.3	4847545	404.0	399.0	443.3	443.36	n/a	n/a	Bedrock	Y

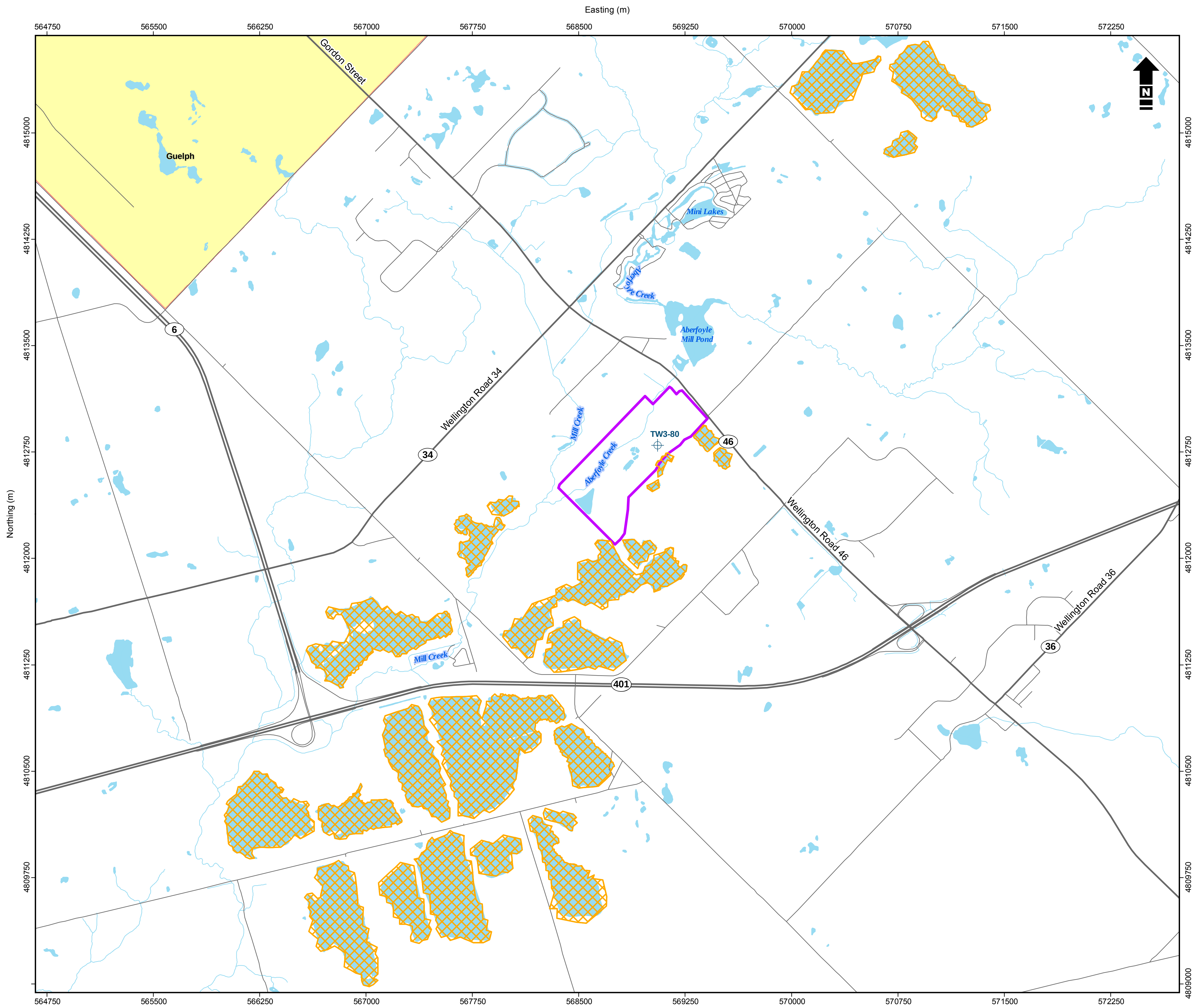
Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6700642	563881.3	4847890	414.9	409.9	444.62	449.33	n/a	n/a	Overburden	Y
6700659	566250.3	4845950	390.0	385.0	418.27	423.45	n/a	n/a	Bedrock	Y
6700680	565311.3	4848647	419.0	414.0	454.22	452.09	n/a	n/a	Bedrock	Y
6700681	565157.3	4850516	408.2	403.2	460.24	463.26	n/a	n/a	Bedrock	Y
6700715	565859.3	4850112	409.4	404.4	463.28	459.92	n/a	n/a	Bedrock	Y
6700716	566175.3	4849703	429.4	424.4	458.96	456.76	n/a	n/a	Bedrock	Y
6700743	567632.3	4851670	434.3	429.3	454.95	461.66	n/a	n/a	Bedrock	Y
6700744	567203.3	4850833	429.5	424.5	455.47	459.32	n/a	n/a	Bedrock	Y
6700745	566981.3	4852503	421.0	416.0	460	467.34	n/a	n/a	Bedrock	Y
6700747	565321.3	4851775	403.6	398.6	464.22	468.17	n/a	n/a	Bedrock	Y
6700773	567955.3	4851858	421.8	416.8	454.26	460.91	n/a	n/a	Bedrock	Y
6703203	567564.3	4851973	404.5	399.5	459.04	463.10	n/a	n/a	Bedrock	Y
6704116	566354.3	4845803	390.3	385.3	424.23	421.02	n/a	n/a	Bedrock	Y
6704424	566064.3	4845973	404.9	399.9	428.94	424.71	n/a	n/a	Bedrock	Y
6704723	566314.3	4851523	390.2	385.2	466.02	465.26	n/a	n/a	Bedrock	Y
6704905	566645.3	4845263	388.3	383.3	420.29	415.69	n/a	n/a	Bedrock	Y
6705292	569160.3	4851037	421.1	416.1	441.9	449.56	n/a	n/a	Bedrock	Y
6705636	564751.3	4851073	404.9	399.9	474.87	465.93	n/a	n/a	Bedrock	Y
6705651	569064.3	4851203	418.8	413.8	444.56	451.24	n/a	n/a	Bedrock	Y
6705992	565614.3	4852373	419.2	414.2	464.12	470.02	n/a	n/a	Bedrock	Y
6706037	564994.3	4849543	419.7	414.7	463.65	458.75	n/a	n/a	Bedrock	Y
6706280	568514.3	4851073	419.7	414.7	450.93	453.83	n/a	n/a	Bedrock	Y
6706917	566364.3	4845623	394.2	389.2	416.7	418.70	n/a	n/a	Bedrock	Y
6707158	565714.3	4847773	380.6	375.6	442.29	443.10	n/a	n/a	Bedrock	Y
6707159	566164.3	4849373	393.8	388.8	459.55	454.63	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6707352	566614.3	4850023	424.7	419.7	457.27	456.91	n/a	n/a	Bedrock	Y
6707355	565564.3	4846473	405.4	400.4	431.85	431.37	n/a	n/a	Bedrock	Y
6707430	565614.3	4847523	410.1	405.1	448.34	441.47	n/a	n/a	Bedrock	Y
6707560	566014.3	4845923	395.8	390.8	422.57	424.53	n/a	n/a	Bedrock	Y
6707561	568064.3	4851723	438.9	433.9	458.37	474.28	n/a	n/a	Overburden	Y
6707773	565314.3	4847173	389.5	384.5	444.23	438.99	n/a	n/a	Bedrock	Y
6707819	567014.3	4845023	400.6	395.6	408.64	411.86	n/a	n/a	Bedrock	Y
6707822	564364.3	4847173	386.7	381.7	441.02	440.18	n/a	n/a	Bedrock	Y
6708157	567474.3	4844928	391.5	386.5	404.05	407.90	n/a	n/a	Bedrock	Y
6708352	565637.3	4848328	414.3	409.3	449.23	448.52	n/a	n/a	Bedrock	Y
6708361	567663.3	4852044	408.4	403.4	455.75	462.96	n/a	n/a	Bedrock	Y
6708485	564282.3	4849595	393.9	388.9	451.82	458.60	n/a	n/a	Bedrock	Y
6708605	566441.3	4845353	398.2	393.2	416.62	417.22	n/a	n/a	Bedrock	Y
6708810	568727.3	4851931	431.3	426.3	449.54	456.94	n/a	n/a	Bedrock	Y
6708813	566764.3	4850893	406.8	401.8	466.37	461.14	n/a	n/a	Bedrock	Y
6709022	565901.3	4851735	428.9	423.9	466.4	466.07	n/a	n/a	Bedrock	Y
6709034	565457.3	4847352	385.8	380.8	441.3	440.27	n/a	n/a	Bedrock	Y
6709048	565230.3	4847040	369.2	364.2	423.13	437.65	n/a	n/a	Bedrock	Y
6709218	564239.3	4850302	422.4	417.4	465.09	475.73	n/a	n/a	Overburden	Y
6709339	565376.3	4849091	431.7	426.7	469.27	456.42	n/a	n/a	Bedrock	Y
6709340	564272.3	4847648	410.1	405.1	445.79	444.25	n/a	n/a	Bedrock	Y
6709534	566308.3	4851112	401.7	396.7	459.4	463.56	n/a	n/a	Bedrock	Y
6709547	567166.3	4850473	429.4	424.4	458.27	457.40	n/a	n/a	Bedrock	Y
6709550	567300.3	4850524	430.7	425.7	455.73	457.15	n/a	n/a	Bedrock	Y
6709710	565525.3	4846488	407.9	402.9	432.88	431.77	n/a	n/a	Bedrock	Y

Well Name	Easting	Northing	Screen/ Open Interval Top (masl)	Screen/ Open Interval Bottom (masl)	Estimated Observed Water Level (0 m^3/day) (masl)[1]	Simulated Average Water Level (0 m^3/day) (masl)	Estimated Observed Drawdown (0 to 890 m^3/day) (m)	Simulated Drawdown (0 to 890 m^3/day) (m)	Interpreted Aquifer System	WWIS Target from Tier Three Assessment (Y/N)
6709893	565049.3	4847570	412.1	407.1	449.39	443.19	n/a	n/a	Bedrock	Y
6709978	564506.3	4847273	393.4	388.4	441.98	441.01	n/a	n/a	Bedrock	Y
6710065	564146.3	4850498	427.5	422.5	469.29	476.52	n/a	n/a	Overburden	Y
6710067	565468.3	4848429	416.5	411.5	458	449.81	n/a	n/a	Bedrock	Y
6710546	564434.3	4850584	423.7	418.7	466	464.08	n/a	n/a	Bedrock	Y
6710799	568444.3	4851098	432.9	427.9	451.16	454.48	n/a	n/a	Bedrock	Y
6711062	566306.3	4845341	400.5	395.5	420.22	417.98	n/a	n/a	Bedrock	Y
6711071	565510.3	4847164	396.0	391.0	436.92	438.27	n/a	n/a	Bedrock	Y
6711385	566022.3	4846371	385.8	380.8	429.01	428.27	n/a	n/a	Bedrock	Y
6711710	565084.3	4848643	416.0	411.0	450.78	452.29	n/a	n/a	Bedrock	Y
6711782	569686.3	4850657	402.2	397.2	447.44	444.42	n/a	n/a	Bedrock	Y
6712042	566148.3	4845576	404.0	399.0	419.21	420.52	n/a	n/a	Bedrock	Y
6712152	567648.3	4851940	405.2	400.2	461.75	462.60	n/a	n/a	Bedrock	Y
6712423	566797.3	4845155	403.2	398.2	412.25	414.15	n/a	n/a	Bedrock	Y
6712438	567279.3	4844805	391.2	386.2	406.22	407.99	n/a	n/a	Bedrock	Y

n/a information not available
WWIS – Water Well Information System
Masl – meters above sea level
[1] Observed water levels for WWIS wells represent values collected over different time periods and potentially under different regional pumping conditions

APPENDIX B
Hydraulic Conductivity Updates



Nestlé Waters Canada Property Boundary
Community
Water Body
Watercourse
Highway
Road
Production Well

Conductivity Zone Update

$Kx = 1x10^{-1}$ m/s
$Ky = 1x10^{-1}$ m/s

Reference: Contains information licensed under the Open Government Licence – Ontario and information made available under the copyright © of Grand River Conservation Authority Open Data Licence v3.0. Service Layer Credits:

1:27,500 metres
290 0 290 580
NAD 1983 UTM Zone 17N

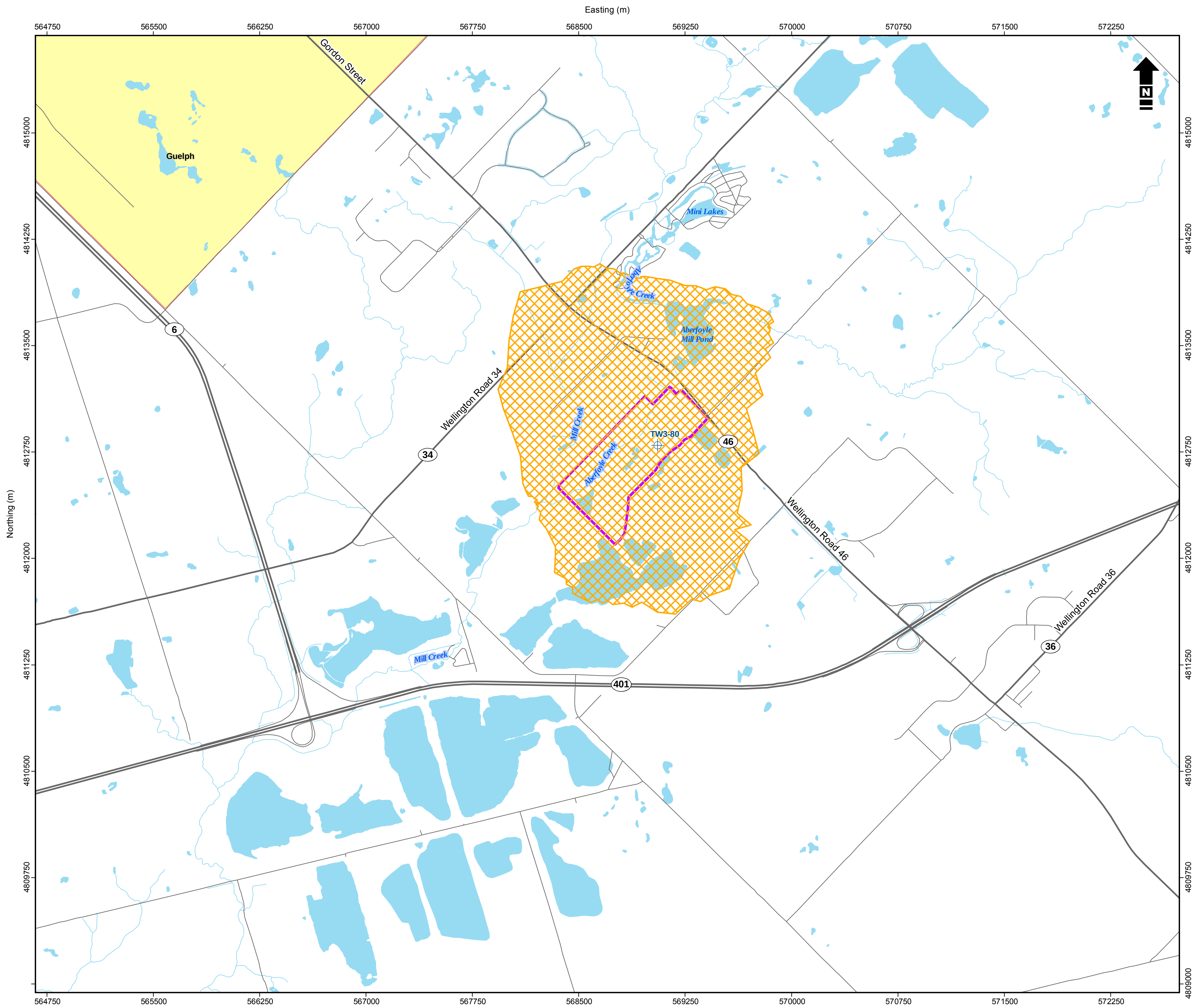
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfoyle - Hydraulic Conductivity Updates Coarser Grained Overburden Deposits (Layer 1 and 2)

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

Figure B1



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1:27,500 metres

290 0 290 580

NAD 1983 UTM Zone 17N

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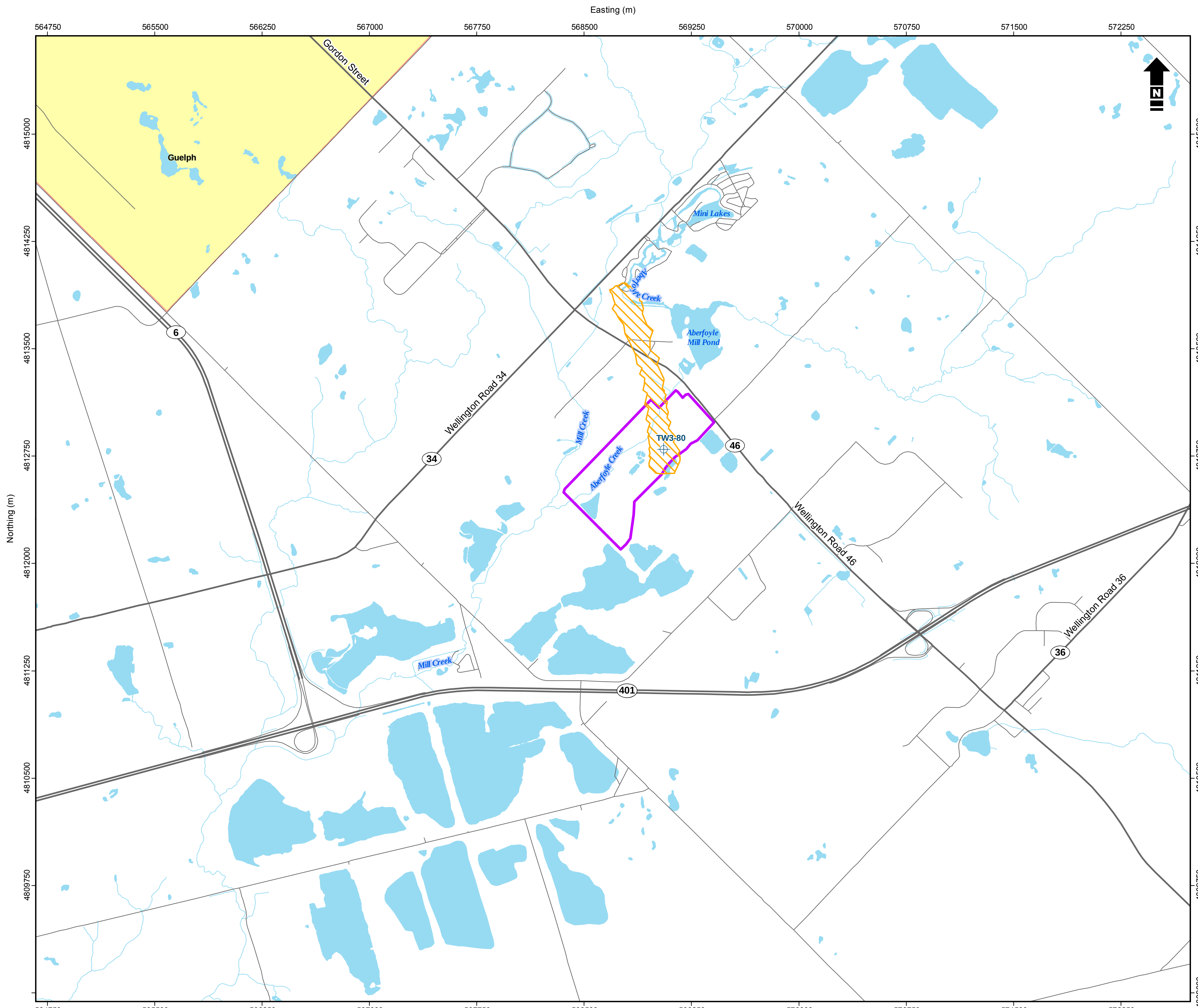
City of Guelph

Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfoyle - Hydraulic Conductivity Updates Finer-Grained Overburden Deposits (Layer 3)

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

Figure B2



- Nestlé Waters Canada Property Boundary
- Community
- Water Body
- Watercourse
- Highway
- Road
- Production Well

Conductivity Zone Update

- Ky = $3x10^{-7}$ m/s

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1:27,500 metres
290 0 290 580
NAD 1983 UTM Zone 17N

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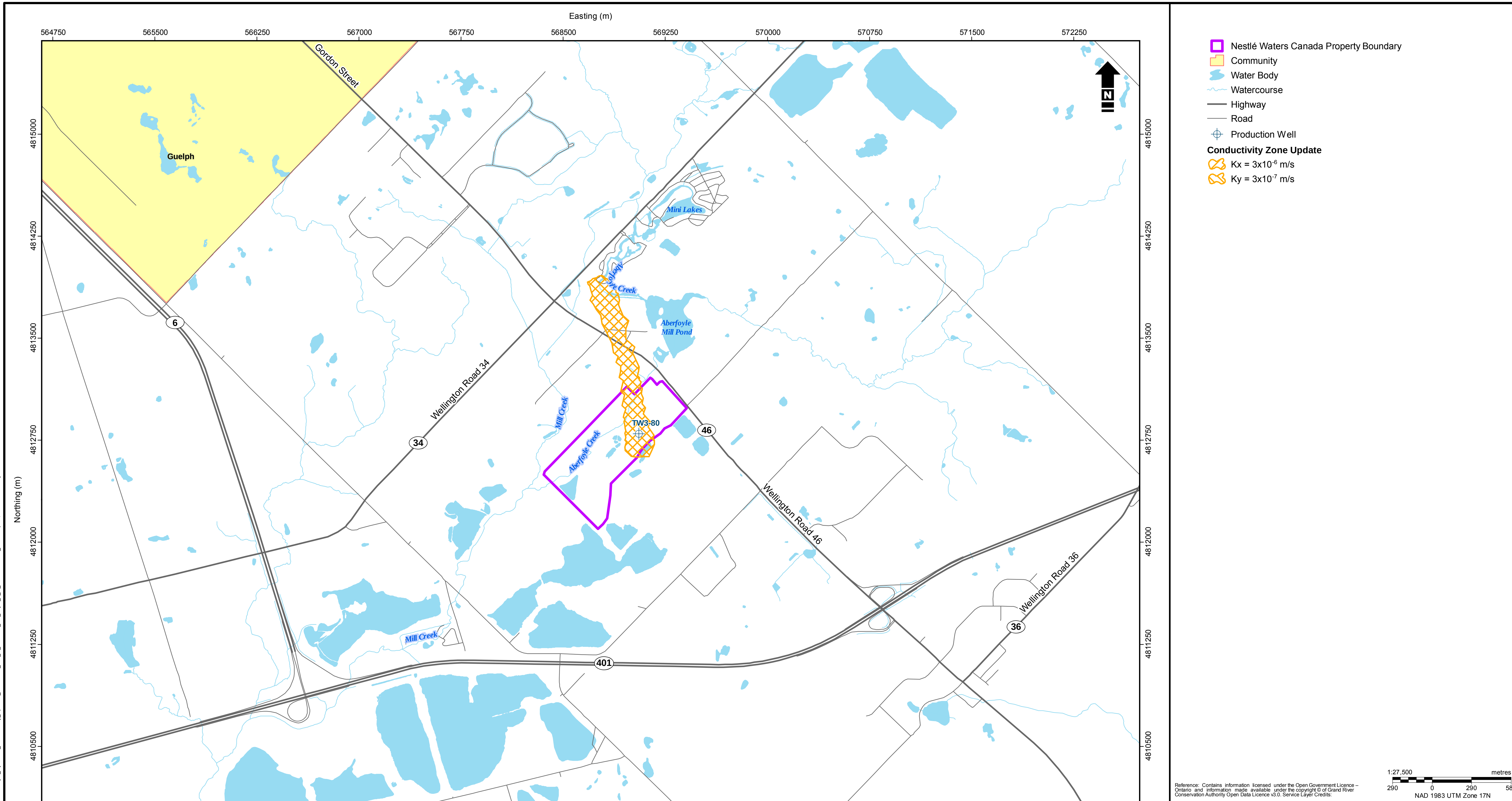
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfoyle - Hydraulic Conductivity Updates Guelph Fm and Reformatory Quarry Mbr. of Eramosa Fm. (Layer 5 and 6)

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

Figure B3



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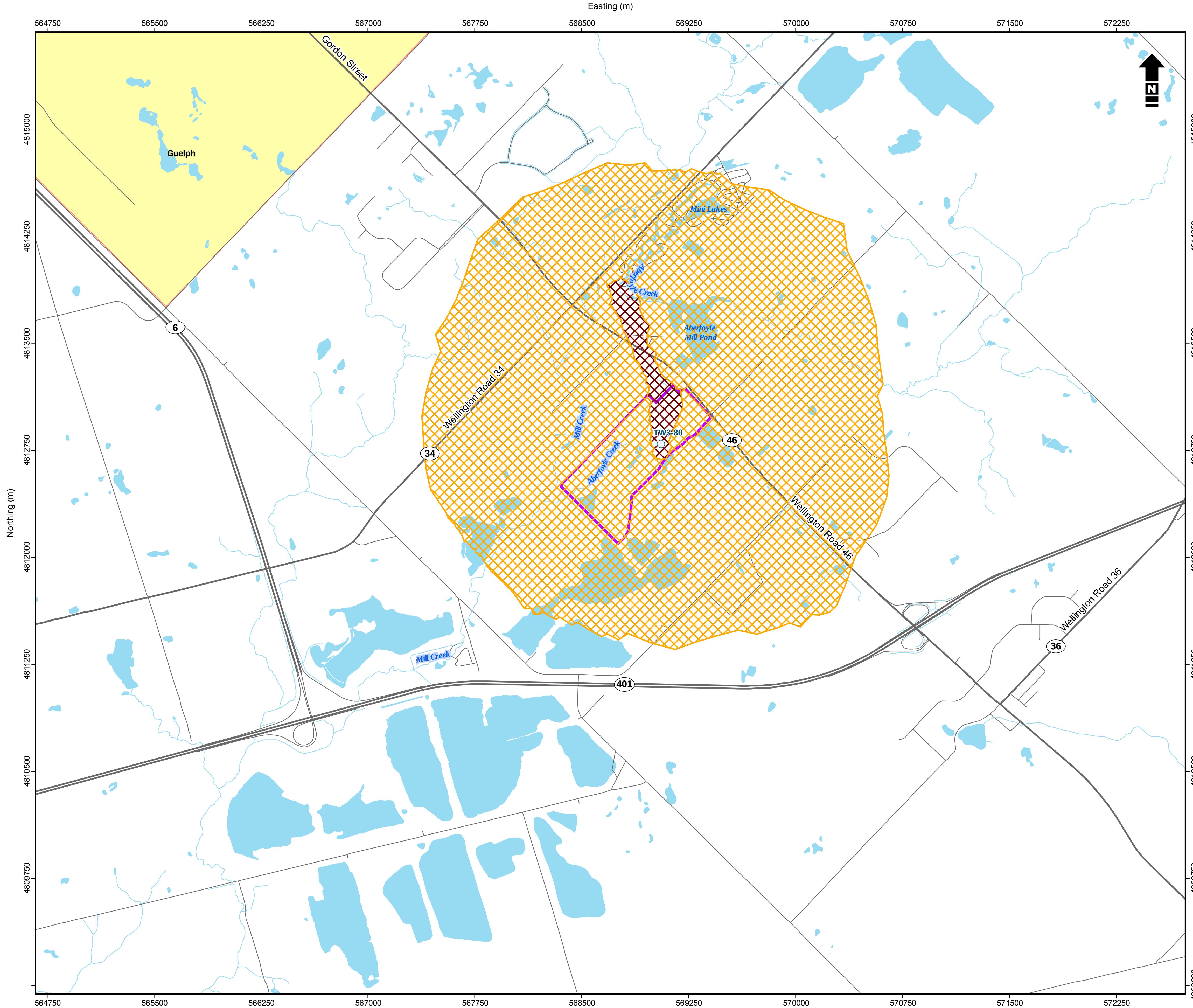
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfoyle - Hydraulic Conductivity Updates Vinemount Mbr. of Eramosa Fm. (Layers 7 to 9)

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

Figure
B4



Nestlé Waters Canada Property Boundary
Community
Water Body
Watercourse
Highway
Road
Production Well

Conductivity Zone Update

Zone 1

Kx = $8x10^{-8}$ m/s
Ky = $1.3x10^{-9}$ m/s

Zone 2

Kx = $1x10^{-3}$ m/s
Ky = $1x10^{-4}$ m/s

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1:27,500 metres
290 0 290 580
NAD 1983 UTM Zone 17N

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City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfoyle - Hydraulic Conductivity Updates Goat Island Fm. (Layers 10)

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

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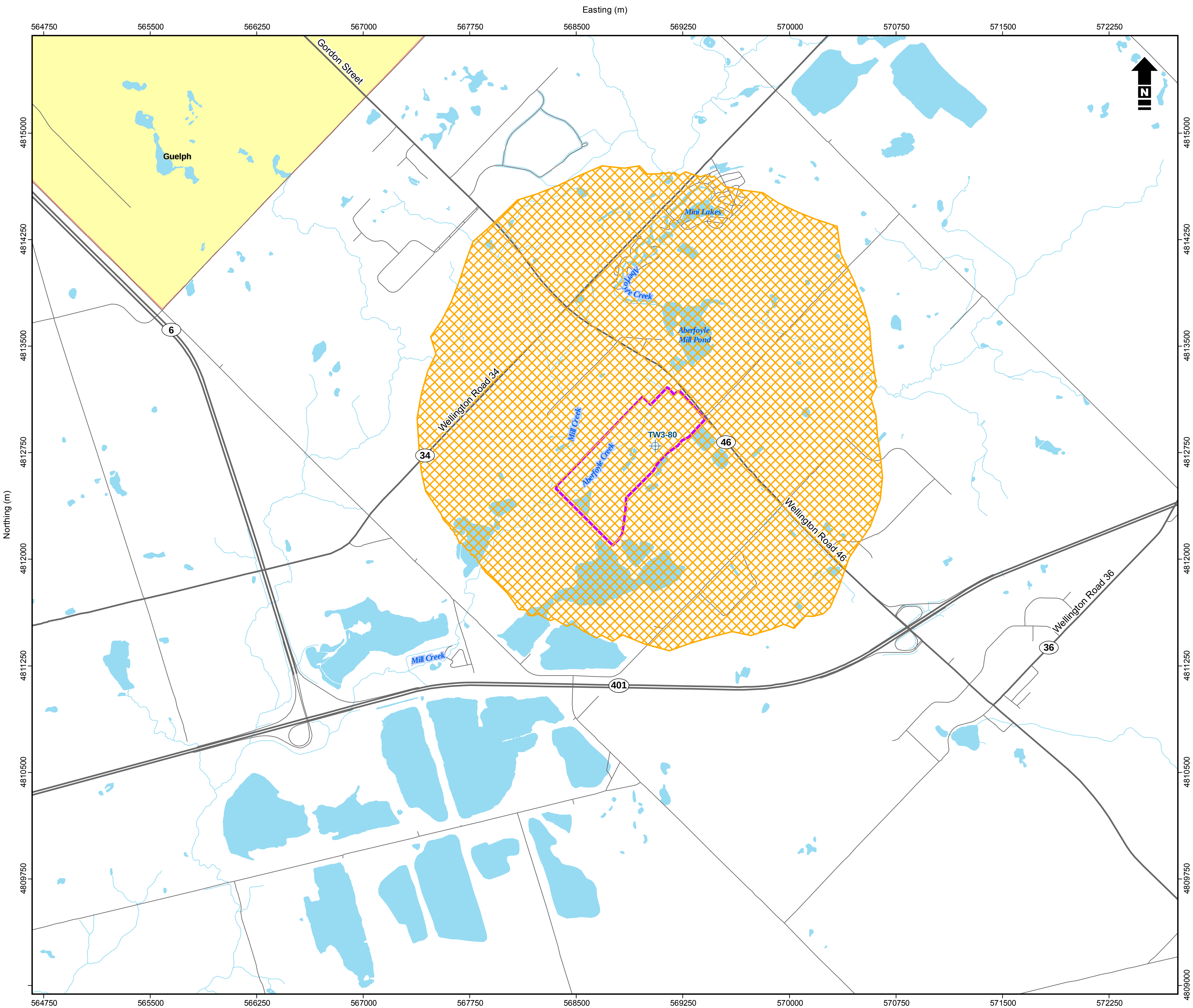
Figure
B5



Nestlé Waters Canada Property Boundary
Community
Water Body
Watercourse
Highway
Road
Production Well

Conductivity Zone Update

$Kx = 1x10^{-7}$ m/s
$Ky = 1x10^{-8}$ m/s

1:27,500 metres
290 0 290 580
NAD 1983 UTM Zone 17N

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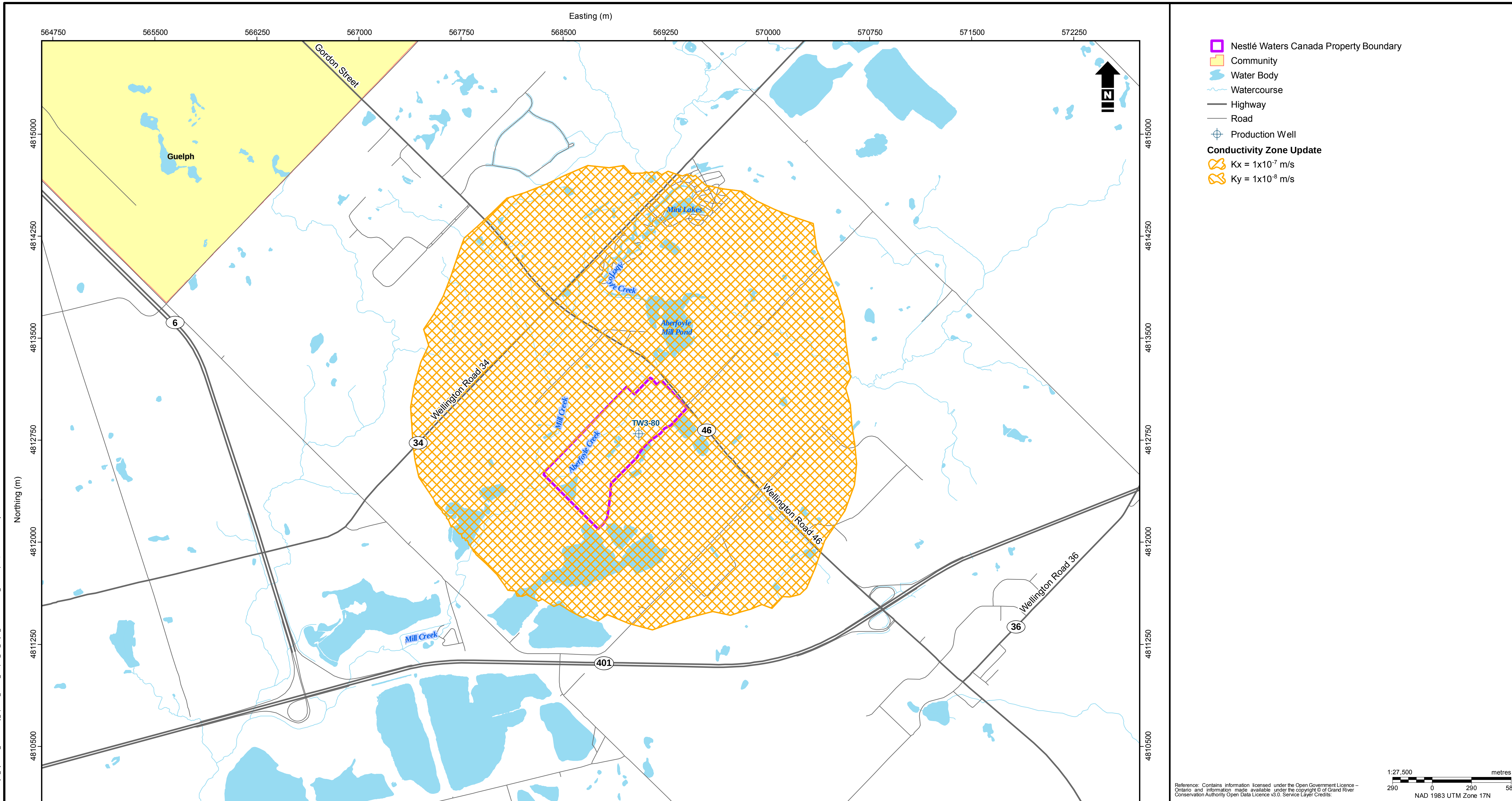
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfoyle - Hydraulic Conductivity Updates Upper and Lower Gasport Fm. (Layers 11 and 13)

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

Figure B6



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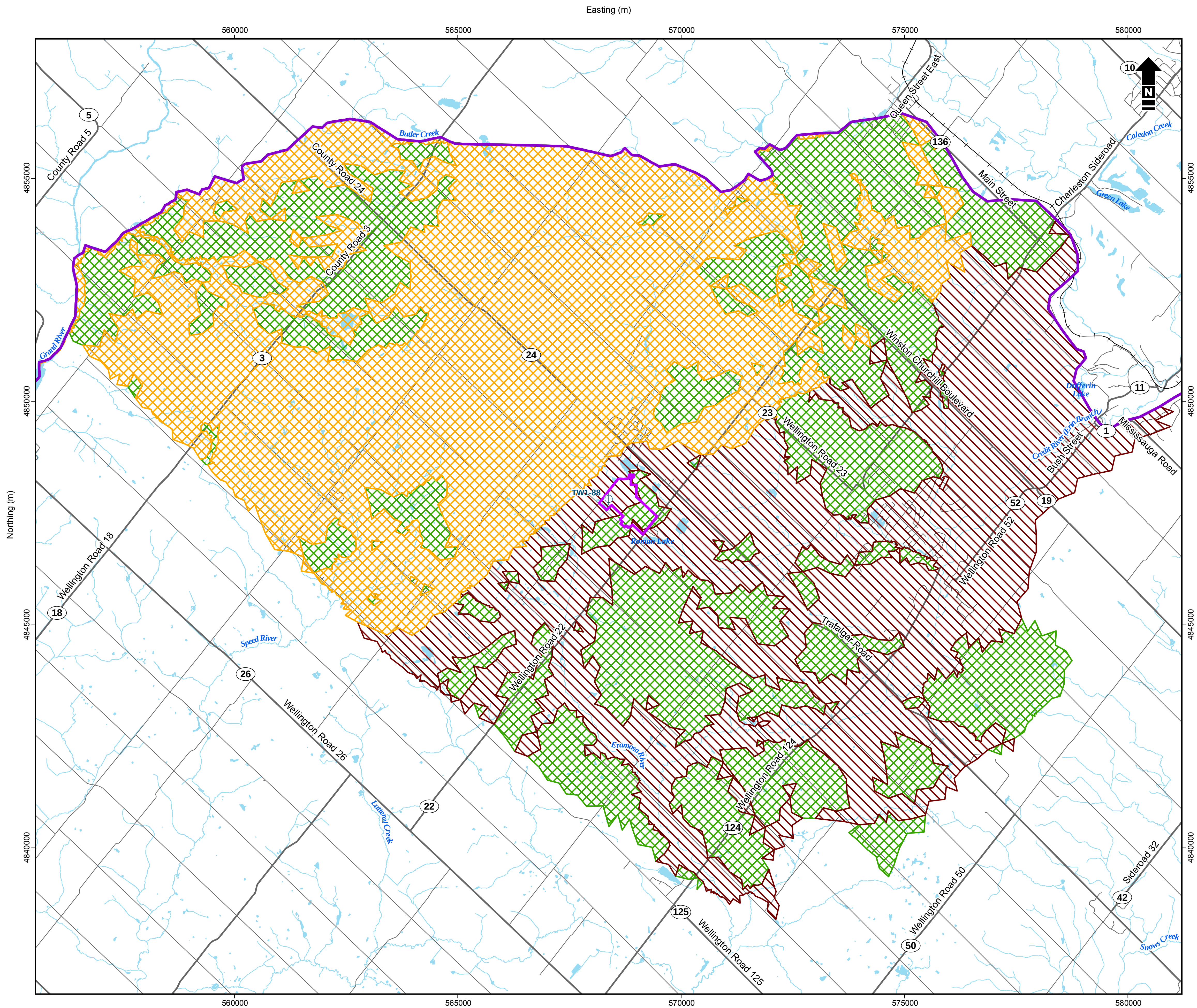
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Aberfoyle - Hydraulic Conductivity Updates Middle Gasport Fm. (Layers 12)

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

Figure B7



- Nestlé Waters Canada Property Boundary
- Tier Three Model Boundary
- Water Body
- Watercourse
- Highway
- Road
- Industry Road
- Railway
- Production Well

Conductivity Zone Update

Zone 1

- $K_x = 1 \times 10^{-4}$ m/s
- $K_y = 1 \times 10^{-5}$ m/s

Zone 2

- $K_y = 1 \times 10^{-5}$ to 5×10^{-5} m/s

Zone 3

- $K_x = 5 \times 10^{-6}$ m/s
- $K_y = 5 \times 10^{-7}$ m/s

1:87,500 metres
900 0 900 1,800
NAD 1983 UTM Zone 17N

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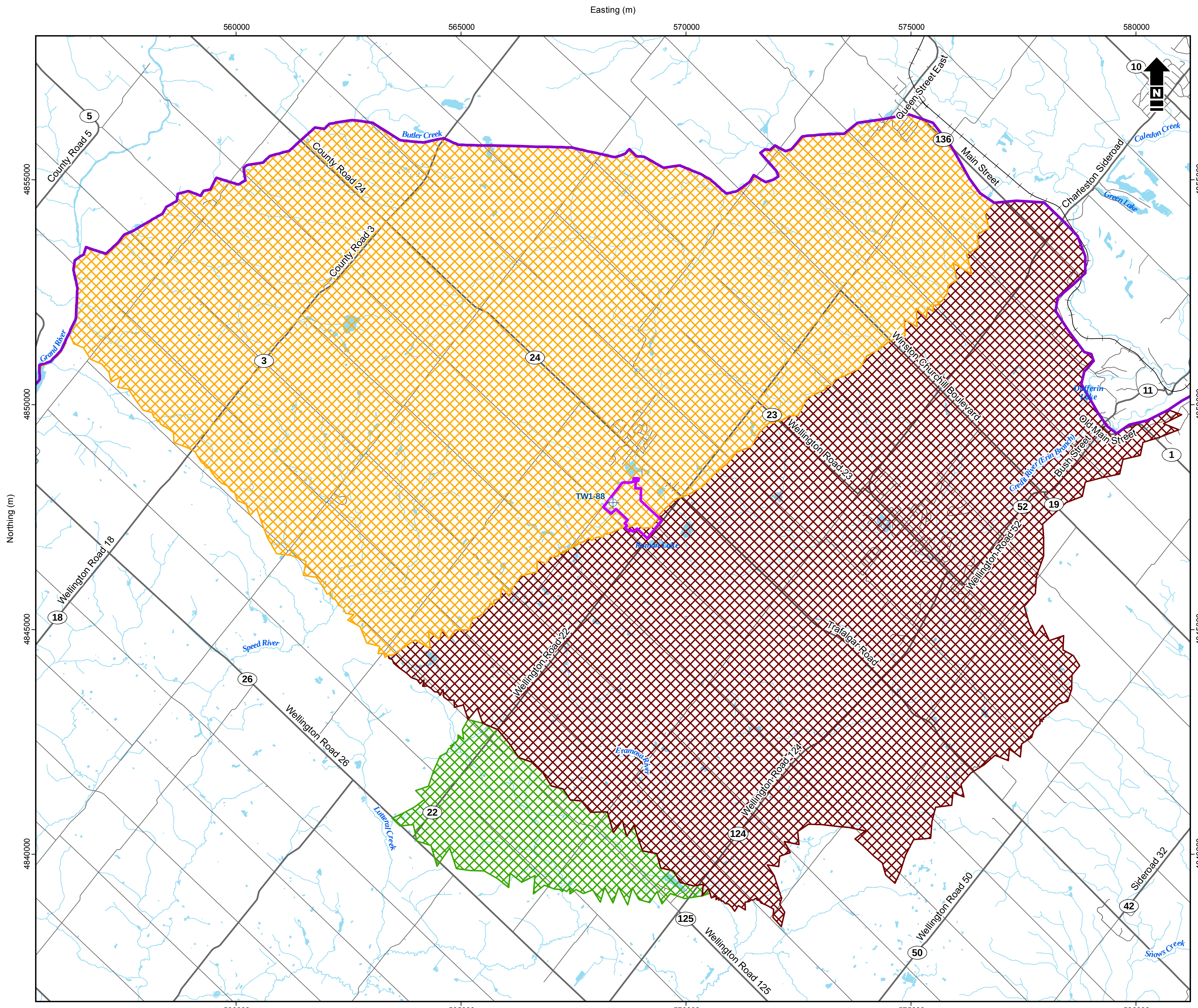
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Erin Hydraulic Conductivity Updates Coarser-Grained Overburden Deposits (Layer 1 and 2)

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

Figure B8



Nestlé Waters Canada Property Boundary
Tier Three Model Boundary
Water Body
Watercourse
Highway
Road
Industry Road
Railway
Production Well

Conductivity Zone Update

Zone 1

$K_x = 6 \times 10^{-8}$ m/s

$K_y = 6 \times 10^{-9}$ m/s

Zone 2

$K_x = 5 \times 10^{-6}$ m/s

$K_y = 5 \times 10^{-7}$ m/s

Zone 3

$K_x = 1 \times 10^{-5}$ m/s

$K_y = 5 \times 10^{-6}$ m/s

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1:87,500 metres
900 0 900 1,800
NAD 1983 UTM Zone 17N

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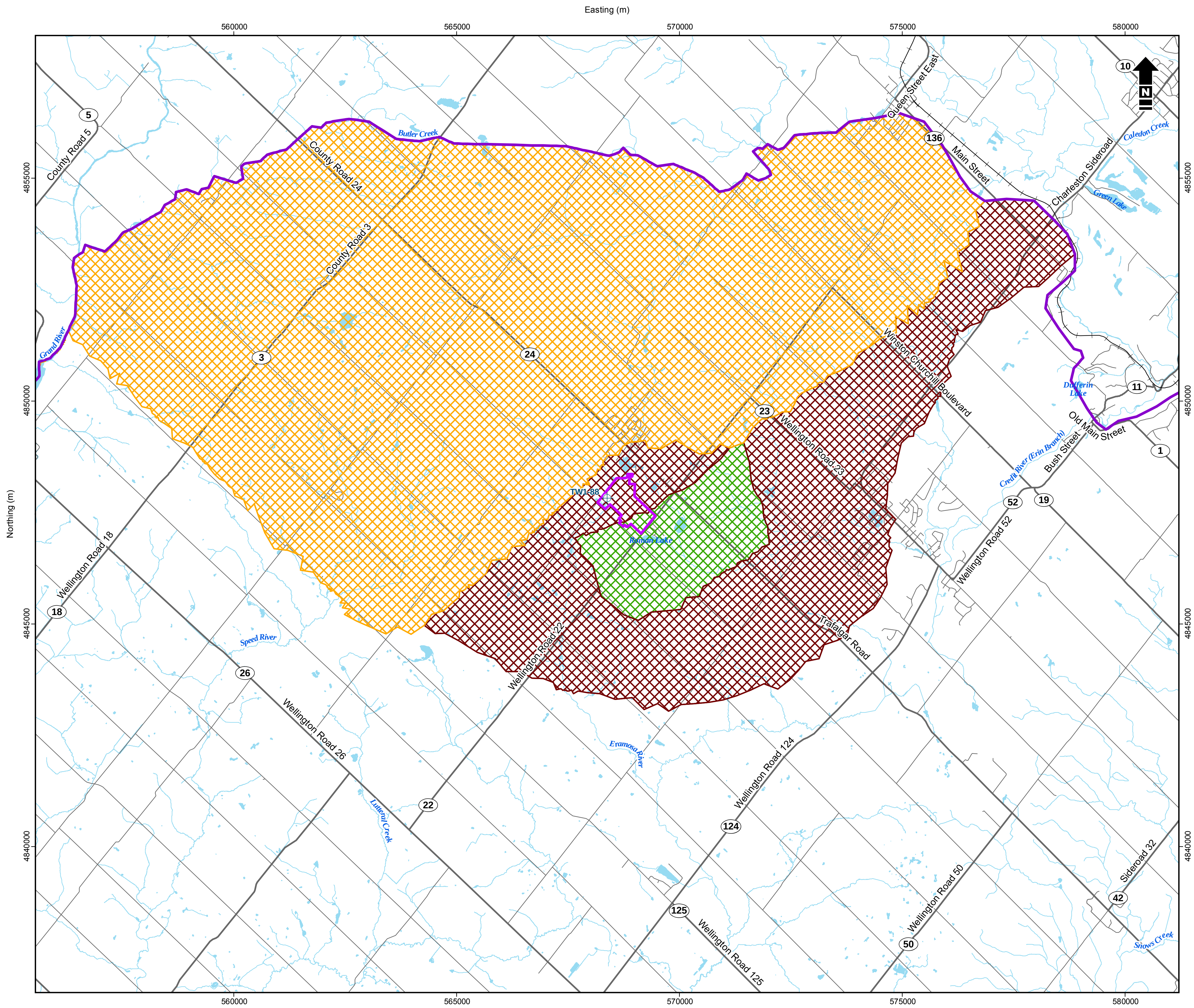
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Erin Hydraulic Conductivity Updates Finer-Grained Overburden Deposits (Layer 3)

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

Figure B9



Nestlé Waters Canada Property Boundary
Tier Three Model Boundary
Water Body
Watercourse
Highway
Road
Industry Road
Railway
Production Well

Conductivity Zone Update

Zone 1

Kx = $1x10^{-5}$ m/s
Ky = $1x10^{-6}$ m/s

Zone 2

Kx = $6x10^{-5}$ m/s
Ky = $6x10^{-6}$ m/s

Zone 3

Kx = $5x10^{-4}$ m/s
Ky = $5x10^{-5}$ m/s

1:87,500 metres
900 0 900 1,800
NAD 1983 UTM Zone 17N

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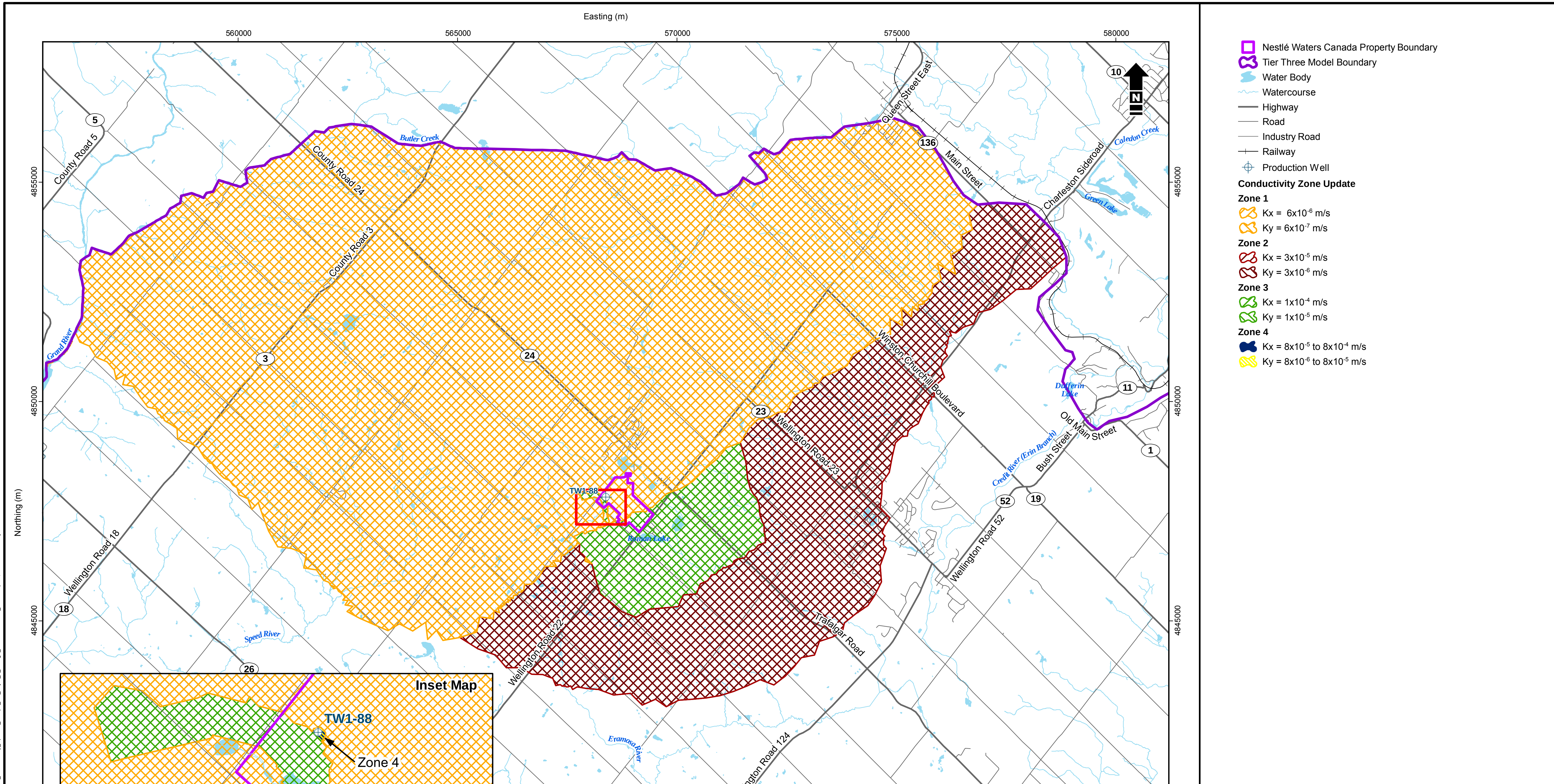
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Erin Hydraulic Conductivity Updates Contact Zone (Layer 4)

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

Figure B10



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Service Layer Credits:

1:87,500 metres
900 0 900 1,800
NAD 1983 UTM Zone 17N

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City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

Erin Hydraulic Conductivity Updates Guelph Fm. (Layer 5 through 10)

Date:	Project:	Submitter:	Reviewer:
September 2018	26435	J. Melchin	D. Van Vliet

Figure B11

APPENDIX N

Well Interference Protocol

WELL PROTECTION AGREEMENT

THIS AGREEMENT is made as of March 18, 2009 between The Corporation of the Township of Puslinch (the "**Township**") and Nestlé Waters Canada, a division of Nestlé Canada Inc. ("**NWC**")

RECITAL:

The parties wish to set out in this Agreement the procedure and terms on which complaints, if any, that may be raised by the Well Owners about their wells being affected by the NWC Operations may be received, investigated and, if found to be caused by NWC's operations, remedied by NWC.

FOR GOOD AND VALUABLE CONSIDERATION the receipt and sufficiency of which is acknowledged, the parties agree as follows:

1. **Definitions**

In this Agreement, unless the context otherwise requires:

"**Agreement**" means this agreement as it may be amended from time to time.

"**Business Day**" means any day except Saturday, Sunday or a statutory holiday in the Province of Ontario.

"**Committee**" has the meaning given to it in Section 2.

"**Contractor**" means a contractor engaged as contemplated under Section (1).

"**GRCA**" means the Grand River Conservation Authority.

"**including**" means to include without limitation.

"**NWC Operations**" means the present and future operations by NWC of NWC's production water wells in or about the Township of Puslinch, County of Wellington, Ontario.

"**Well Owner**" means such owners from time to time who have a water supply well within the Well Protection Area.

"**Well Protection Area**" means such area of influence as may be agreed to between the Township and NWC relating to the NWC Operations within the Township of Puslinch.

2. **Well Protection Committee**

(1) The parties shall establish a committee called the "Well Protection Committee" (the "**Committee**") comprising 5 members, being: 2 members appointed by NWC (each, a

"**NWC Member**"); 2 members appointed by the Township (each, a "**Township Member**"); and, 1 member appointed by the GRCA who is a member of GRCA's board of directors (the "**GRCA Member**"). The members shall be appointed for a term of up to 4 years and may be re-appointed.

(2) The Committee shall meet monthly unless otherwise determined by it. A quorum for a meeting shall be constituted by the attendance of at least: (a) 1 NWC Member; and (b) 1 Township Member, and (c) a GRCA Member. Members of the Committee may participate by telephone or by web-based or video conference call or other electronic means (and as a result be deemed to be in attendance) at a meeting of the Committee.

(3) Decisions of the Committee shall require the approval of a majority of those in attendance at a meeting at which a quorum is constituted.

(4) The Committee at its meetings shall review any water use or private water well issues relating to the NWC Operations. A long-term meeting schedule shall be decided on by the Committee.

(5) The Committee shall keep an active log of all correspondence and arrange for minutes to be prepared of each meeting.

(6) Any Member of the Committee may call a meeting of the Committee on 10 days' prior written notice to the other Members. Such notice shall set out the reason for the meeting and include any relevant documents or information.

3. **Well Owners**

(1) NWC shall prepare and deliver to the Committee a list of the addresses of all current Well Owners. NWC will update such list from time to time as it learns of changes relating to the Well Owners.

(2) NWC shall send a package, approved by the Committee, to each Well Owner consisting of: a letter to the Well Owner describing this Agreement; a copy of this Agreement; a laminated card outlining the process to follow in case of a claim or problem; contact information; and, such other information as may be approved by the Committee.

(3) If an owner of a water well located in the Township of Puslinch but outside of the well protection area (the "**Applicant**") wishes to be treated as a Well Owner, such Well Owner may request this in writing to the Committee. The Committee will review the request. If the Committee, based on scientific evidence, believes that the Applicant may be affected by the NWC Operations, the Committee may, in its absolute discretion, decide to deem the Applicant to be a "Well Owner" despite being outside of the well protection area. In any event, the Committee will inform the Applicant of the Committee's decision. The Committee's decision shall be final.

4. **Well Data Assessment**

(1) NWC at its expense will arrange for a residential, agricultural or commercial well assessment to be conducted with respect to each well of each Well Owner and for owners of properties in the Township of Puslinch within the well protection area. The data assessment may include: well location, type of casing and other well construction details, well depth, water level, depth of pump intake, condition of well and pump, history of water quantity and quality issues, source aquifer and municipal address. In conducting the assessment, account will be taken of public information, information from the owner and, where appropriate, from actual testing of the well in question.

(2) NWC shall seek permission to access the well, but no formal written site access agreement will be required by NWC. The Township will not expect payment by NWC to the land owner for site access to provide these services. If access to the well is limited or denied by the Well Owner, then the assessment will still be conducted to the extent possible, but the parties acknowledge that the assessment may be incomplete.

5. **Well Contractors**

(1) NWC shall enter into a contractual arrangement with up to two (2) professional licensed well contractors to provide the services contemplated of contractors under this Agreement on a 7-day-a-week basis.

(2) NWC shall deliver to each Contractor a list of the addresses of the Well Owners and a description, including a map of the well protection area and provide updates to each Contractor such list as necessary from time to time.

6. **Well Owner Complaints**

(1) If a Well Owner in good faith believes that the quantity or quality of the water from its well located within the well protection area is being adversely affected by the NWC Operations, then the following procedure shall be followed:

(a) the Well Owner shall contact, as soon as possible, one of the Contractors;

(b) such Contractor, at NWC's cost, will respond to all calls within 24 hours; and

(c) the Contractor will deliver 5 cases of bottled water (consisting of at least 60 litres in total) to the Well Owner at NWC's cost within 24 hours after the Well Owner's call.

(2) The Contractor will attempt to determine the cause of the problem.

(3) If the Contractor determines that the cause is a mechanical issue or otherwise unrelated to NWC's Operations (a "**Non-NWC Failure**"), then the Contractor will issue a written report to that effect and deliver it to the Well Owner with a copy to the Committee and NWC. There will be no further action by NWC, and no charge to the well owner.

(4) If, however, the Contractor does not determine that it is a Non-NWC Failure, then, NWC, at NWC's cost, and to the extent reasonably possible, within 24 hours after receiving the Contractor's report shall: inform the Committee; take all reasonable steps to arrange for an alternative water supply; and, arrange for a scientific study to be made.

(5) The scientific study shall include a written report, prepared in a timely manner, which summarizes all relevant information regarding the problem, its cause, and recommendations regarding possible mitigation. The report must be signed and stamped by a Professional Geoscientist (P.Geo.) or Professional Engineer (P.Eng.) licensed in the Province of Ontario.

(6) NWC shall promptly deliver a copy of the scientific study to the Committee. If such report concludes that the issue was materially caused by the NWC Operations, then NWC shall so inform the Committee and remedy the problem.

(7) If, however, such scientific report concludes that the problem was not materially caused by the NWC Operations, then no further action will be required of NWC.

(8) If the Well Owner disputes the conclusion of the scientific report, then the Well Owner shall promptly notify in writing the Committee of its dispute. Within 5 Business Days after receiving such notice and after giving each of the Contractor, NWC and the Well Owner similar opportunities to present their position (or such longer period as may be determined by the Committee to be required), the Committee shall determine whether NWC materially caused the problem. If the Committee finds that NWC did so, then NWC at its cost shall remedy the problem.

(9) If, however, the Committee finds that it is a Non-NWC Failure, the Committee will send a copy of its decision to the Well Owner and no further action will be required.

(10) If the Well Owner limits or denies access to the Contractor or to the consultant engaged to do the scientific study contemplated above, then NWC shall not be responsible to remedy the problem raised by the Well Owner. Such access includes, as necessary or appropriate, such tests as may be required or appropriate to assist in determining the cause of the water problem (such as collecting water samples or conducting pumping tests).

7. **Term**

This Agreement shall remain in full force until NWC is no longer carrying on the NWC Operations or the Township and NWC agree in writing to terminate this Agreement (whichever occurs earlier).

8. **Notices**

(1) Any notice required or permitted to be given by either party under this Agreement to the other shall be in writing and shall be delivered or sent by registered mail (except during a postal disruption or threatened postal disruption) or fax to the applicable address set out below:

(a) in the case of the Township, to:

The Township of Puslinch
7404 Wellington Road 34, R. R. # 3,
Guelph Ontario
N1H 6H9
Attention: CAO / Clerk-Treasurer
Fax No.: 519.763.5846

(b) in the case of NWC, to:

Mr. Mark Evans, Senior Vice-President & General Counsel,
Nestle Waters Canada, a division of Nestle Canada Inc.
101 Brock Road,
Guelph, ON
N1H-6H9
Fax No.: 519.763.8156

(2) Any notice delivered shall be deemed to have been validly and effectively given on the day of such delivery. Any notice sent by registered mail shall be deemed to have been validly and effectively given on the third Business Day following the date of mailing. Any notice sent by fax shall be deemed to have been validly and effectively given on the day the fax is sent if sent before 4:00 p.m. but if after 4:00 p.m., then on the next Business Day after it was sent.

(3) Either party may from time to time by notice to the other change its address for service under this Agreement.

9. **General**

(1) Each party shall do such further things and execute such further documents as may be reasonably required by the other party to more fully implement the intent of this Agreement.

(2) This Agreement shall ensure to the benefit of, and bind, the parties to it and their respective successors and permitted assigns provided that the Township shall not assign this Agreement (other than to a successor municipality) without the prior written consent of NWC, which consent shall not be unreasonably withheld.

(3) A waiver of any default, breach or non-compliance under this Agreement is not effective unless in writing and signed by the party to be bound by the waiver. No waiver will be inferred from or implied by any failure to act or delay in acting by a party in respect of any default, breach or non-observance or by anything done or omitted to be done by the other party. The waiver by a party of any default, breach or non-compliance under this Agreement will not operate as a waiver of that party's rights under this Agreement in respect of any continuing or subsequent default, breach or non-observance (whether of the same or any other nature).

(4) No amendment of this Agreement will be effective unless made in writing and signed by the parties.

(5) This Agreement is in addition to, and does not replace, or supersede, any rights a Well Owner may have at law or in equity, including under municipal, provincial or federal statutes or regulations.

(6) Despite anything else in this Agreement: this Agreement shall be solely for the benefit of the Township and NWC; and, no Well Owner is a party to this Agreement and no Well Owner shall have any rights under this Agreement including as a third party beneficiary.

10. **Interpretation**

(1) This Agreement constitutes the entire agreement between the parties with respect to the subject matter of it and cancels and supersedes any prior agreements, undertakings, declarations or representations, written or verbal in respect of it.

(2) Any provision of this Agreement that is prohibited or unenforceable in any jurisdiction will, as to that jurisdiction, be ineffective to the extent of such prohibition or unenforceability and will be severed from the balance of this Agreement, all without affecting the remaining provisions of this Agreement or affecting the validity or enforceability of such provision in any other jurisdiction.

(3) The division of this Agreement into Sections, the insertion of headings, and the provision of any table of contents, are for convenience of reference only and will not affect the construction or interpretation of this Agreement.

(4) Unless the context requires otherwise, words importing the singular include the plural and *vice versa* and words importing gender include all genders.

(5) This Agreement will be governed by and construed in accordance with the laws of the Province of Ontario and the laws of Canada applicable in that Province.

(6) This Agreement may be executed by fax or in counterpart, or both.

The parties have executed and deliver this Agreement as of the date first written above.

THE CORPORATION OF TOWNSHIP OF PUSLINCH

By: ______________________________
Name: Brad Whitcombe
Title: Mayor

By: ______________________________
Name: Brenda Law
Title: CAO/Clerk-Treasurer

We have authority to bind the Corporation.

NESTLÉ WATERS CANADA, a division of NESTLÉ CANADA INC.

By: ______________________________
Name: GAIL COSMAN
Title: PRESIDENT

By: ______________________________
Name: MICHEL MCARTHUR
Title: SUPPLY CHAIN DIRECTOR

I/We have authority to bind the Corporation

PRIVATE WELL INTERFERENCE COMPLAINTS RESOLUTION AGREEMENT

THIS AGREEMENT is made as of ____________, 20__ (the “**Effective Date**”) between the Corporation of the Township of Puslinch (the "**Township**") and Nestlé Waters Canada, a division of Nestlé Canada Inc. ("**NWC**").

RECITAL:

The parties wish to set out in this Agreement the procedure and terms on which complaints, if any, that may be raised by the Well Owners about their wells being affected by NWC Operations may be received, investigated and, if found to be caused by NWC Operations, remedied by NWC.

FOR GOOD AND VALUABLE CONSIDERATION the receipt and sufficiency of which is acknowledged, the parties agree as follows:

1. Key Definitions

In this Agreement, unless the context otherwise requires:

(1) "**Agreement**" means this Private Well Interference Complaints Resolution Agreement as it may be amended from time to time.

(2) "**Business Day**" means any day except Saturday, Sunday or a statutory holiday in the Province of Ontario.

(3) "**Committee**" has the meaning given to it in Section 2(1).

(4) "**Contractor**" has the meaning given to it in Section 5(1).

(5) "**GRCA**" means the Grand River Conservation Authority.

(6) “**including**” means to include without limitation.

(7) "**NWC Operations**" means the present and future operations by NWC of NWC's production water wells in the Township of Puslinch, County of Wellington, Ontario.

(8) “**PTTW**” means a Permit to Take Water under the *Ontario Water Resources Act* and any applicable regulations, which is applicable to at least part of the Potential Well Interference Area.

(9) "**Well Owner**" means such owners from time to time who have a water supply well within the Potential Well Interference Area.

(10) "**Potential Well Interference Area**" means the area defined in the attached **Schedule A**.

2. Well Protection Committee

(1) The parties shall establish a committee called the "Well Protection Committee" (the "**Committee**") comprised of five members (the "**Members**") being: (a) two members appointed by NWC (each, a "**NWC Member**"); (b) one member appointed by the Township (each, a "**Township Member**"); (c) one member appointed by the GRCA who is a member of GRCA's board of directors or professional staff (the "**GRCA Member**") and one member appointed by the Ministry of Environment, Conservation, and Parks (the "**MECP**"). The Members should, to the extent reasonably possible, have a strong technical understanding of hydrogeology.

(2) The Committee shall meet quarterly unless otherwise determined by the Committee that an additional meeting is required. A quorum for a meeting shall be constituted by the attendance of at least: (a) one NWC Member; and (b) one Township Member. Members may participate by telephone or by web-based or video conference call or other electronic means (and as a result be deemed to be in attendance) at a meeting of the Committee.

(3) Decisions of the Committee shall require the approval of a majority of those in attendance at a meeting at which a quorum is constituted, subject to the jurisdiction of the MECP, where applicable.

(4) At meetings of the Committee, the Committee may review and discuss any outstanding Complaints (defined in Section 6 below) related to NWC Operations.

(5) The Committee may, if it determines it relevant and beneficial to do so, keep an active log of all correspondence and arrange for minutes to be prepared of each meeting.

(6) Any Member may call a meeting of the Committee on ten days' prior written notice to the other Members. Such notice shall set out the reason for the meeting and include any relevant documents or information.

3. Well Owners

(1) At the Committee's reasonable request, NWC shall prepare and deliver to the Committee a list of the addresses of all current Well Owners. At the Committee's reasonable request, NWC, with the assistance of the Township, will update such list from time to time to reflect changes relating to the Well Owners.

(2) NWC shall make commercially reasonable efforts to, within sixty (60) days of receiving a new PTTW or a renewal of an existing PTTW, send a package to each then-current Well Owner consisting of: (a) a letter to the Well Owner describing this Agreement; (b) a copy of this Agreement; (c) a laminated card outlining the process to follow in case of a claim or problem; (d) contact information; and (e) such other information as may be approved by the Committee,

4. Private Well Survey

(1) As part of its periodic applications for and renewals of its relevant PTTWs, where required by the permitting process, NWC will, at its expense, arrange for a well survey to be

conducted with respect to each Well Owner's well. The assessment may include: well location, type of casing and other well construction details, well depth, water level, depth of pump intake, condition of well and pump, history of water quantity and quality issues, source aquifer and municipal address. In conducting the assessment, account will be taken of public information, information from the Well Owners and, where appropriate, from actual testing of the well in question.

(2) NWC shall seek permission to access the well, but no formal written site access agreement will be required by NWC, and NWC shall not be required to pay for access rights. If access to the well is limited or denied by the Well Owners, then the assessment will still be conducted to the extent possible, but the parties acknowledge that the assessment may be incomplete.

5. Use of Independent Well Contractors

(1) NWC shall enter into a contractual arrangement with up to two professional licensed well contractors (a "**Contractor**") to provide, if necessary, the services contemplated of Contractors under this Agreement on a seven day-a-week basis.

(2) NWC shall deliver to each Contractor a list of the addresses of the Well Owners and a description, including a map, of the Potential Well Interference Area and provide updates of such list to each Contractor as necessary from time to time.

(3) NWC shall also deliver to each Well Owner the contact information for one or more Contractors.

6. Well Owner Complaints

(1) If a Well Owner in good faith believes that the quantity or quality of the water from its well located within the Potential Well Interference Area is being adversely affected by NWC Operations (a "**Complaint**"), then the following procedure shall be followed:

(a) the Well Owner shall contact, as soon as possible, one of the Contractors, who will subsequently notify NWC, to ensure NWC is immediately aware of the issue;

(b) such Contractor, at NWC's cost, will respond to all calls within 24 hours; and

(c) the Contractor will deliver five (5) cases of bottled water (consisting of at least 60 litres in total) to the Well Owner at NWC's cost within 24 hours after the Well Owner's call.

(2) NWC will instruct the Contractor to investigate the cause of the Complaint as soon as reasonably possible. NWC will continue to provide a suitable alternate water supply to the Well Owner while the Contractor investigates.

(3) If the Contractor determines that the cause of the Complaint is a mechanical issue or otherwise unrelated to NWC Operations (a "**Non-NWC Failure**"), then the Contractor will issue a written report to that effect and deliver it to the Well Owner with a copy to the Committee, the Township and NWC. There will be no further action by NWC.

(4) If, however, the Contractor does determine that the water from the well has been adversely affected, and does not determine that the Complaint is a Non-NWC Failure, then, NWC, at NWC's cost, shall: (a) take all reasonable steps to arrange for an alternative water supply; and (b) arrange for a qualified independent consultant (which may in appropriate circumstances be the Contractor) to undertake a scientific study of the Complaint. To the extent reasonably possible, NWC shall take the foregoing steps within twenty-four (24) hours after receiving the Contractor's report.

(5) The scientific study shall be documented in a written report (the "**Report**"), prepared in a timely manner and shall summarize all relevant information regarding the Complaint, its cause, and recommendations regarding possible mitigation. The Report must be signed and stamped by a Professional Geoscientist (P.Geo.) or Professional Engineer (P.Eng.) licensed in the Province of Ontario.

(6) NWC shall promptly deliver a copy of the Report to the Well Owner.

(7) If the Report concludes that the Complaint was caused by NWC Operations, then NWC shall so inform the Committee and the Well Owner and NWC shall also promptly provide a copy of the Report to the appropriate Manager of the MECP. Subject to Section 6(8) below, NWC shall promptly take all reasonable steps to remedy the Complaint and shall promptly report the details and results of such remedial action to the Committee, the Well Owner and the Manager of the MECP.

(8) If the Report concludes that the Complaint was not caused by NWC Operations, then NWC shall promptly inform the Committee and the Well Owner of that conclusion in writing and no further action will be required of NWC.

(9) Any complaints, whether caused by NWC or not, shall be logged by NWC and form part of its annual reporting requirements.

(10) If the Well Owner limits or denies access to the Contractor or to the consultant engaged to do the scientific study contemplated above, then NWC shall not be responsible for remedying the Complaint raised by the Well Owner. Such access includes, as necessary or appropriate, such tests as may be required or appropriate to assist in determining the cause of the Complaint. The MECP shall be so notified.

(11) In managing any Complaints, NWC shall comply with the terms of its applicable PTTWs.

7. Term

This Agreement shall commence on the Effective Date and, unless terminated earlier pursuant to the terms of this Agreement, shall remain in effect until NWC ceases to have any valid PTTWs applicable to the Potential Well Interference Area, at which point this Agreement shall immediately expire automatically. Notwithstanding the foregoing, either party may terminate this Agreement at any time, without cause or penalty, upon not less than six (6) months' prior written notice to the other party.

8. Notices

(1) Any notice required or permitted to be given by either party under this Agreement to the other shall be in writing and shall be delivered or sent by registered mail (except during a postal disruption or threatened postal disruption) or fax or email to the applicable address set out below:

(a) in the case of the Township, to:

The Corporation of the Township of Puslinch
7404 Wellington Road 34
Puslinch, ON
N0B 2J0
Attention: Karen Landry
Tel: (519) 763-1226 ext. 214
Fax: (519) 763-5846
E-mail: KLandry@puslinch.ca

(b) in the case of NWC, to:

Natural Resource Manager, Nestlé Waters Canada
Nestlé Waters Canada, a division of Nestlé Canada Inc.
101 Brock Road,
Puslinch, ON
N0B 2J0
No: 519-767-6422

And

General Counsel
Nestlé Canada Inc.
25 Sheppard Avenue West,
North York, ON
M2N 6S8
No: 1-416-218-2816

(2) The contact information for the Manager of the MECP is:

Dan Dobrin, Manager
Ontario Ministry of the Environment, Conservation, and Parks, Section 34.1
Ontario Water Resources Act, R.S.O. 1990
12th Floor
119 King St W
Hamilton ON L8P 4Y7
Fax: (905) 521-7820

(3) Any notice delivered shall be deemed to have been validly and effectively given on the day of such delivery. Any notice sent by registered mail shall be deemed to have been validly and effectively given on the third Business Day following the date of mailing. Any notice sent by fax or email shall be deemed to have been validly and effectively given on the day the fax or email is sent if sent before 4:00 p.m. but if after 4:00 p.m., then on the next Business Day after it was sent.

(4) Either party may from time to time by notice to the other change its address for service under this Agreement.

9. General

(1) The parties agree to cooperate in the implementation of this Agreement with the intent that good faith complaints from Well Owners should be addressed promptly, fairly and reasonably on their merits. Each party shall do such further things and execute such further documents as may be reasonably required by the other party to more tally implement the intent of this Agreement.

(2) This Agreement shall enure to the benefit of, and bind, the parties to it and their respective successors and permitted assigns provided that the Township shall not assign this Agreement (other than to a successor municipality) without the prior consent of NWC, which consent shall not be unreasonably withheld.

(3) A waiver of any default, breach or non-compliance under this Agreement is not effective unless in writing and signed by the party to be bound by the waiver. No waiver will be inferred from or implied by any failure to act or delay in acting by a party in respect of any default, breach or non-observance or by anything done or omitted to be done by the other party. The waiver by a party of any default, breach or non-compliance under this Agreement will not operate as a waiver of that party's rights under this Agreement in respect of any continuing or subsequent default, breach or non-observance (whether of the same or any other nature).

(4) No amendment of this Agreement will be effective unless made in writing and signed by the parties.

(5) This Agreement is in addition to, and does not replace, or supersede, any rights a Well Owner may have at law or in equity, including under municipal, provincial or federal statutes regulations.

(6) Despite anything else in this Agreement, this Agreement shall be solely for the benefit of the Township and NWC and no Well Owner is a party to this Agreement and no Well Owner shall have any rights under this Agreement including as a third party beneficiary.

10. Interpretation

(1) This Agreement constitutes the entire agreement between the parties with respect to the subject matter of it and cancels and supersedes any prior agreements, undertakings, declarations or representations, written or verbal in respect of it.

(2) Any provision of this Agreement that is prohibited or unenforceable in any jurisdiction will, as to that jurisdiction, be ineffective to the extent of such prohibition or unenforceability and will be severed from the balance of this Agreement, all without affecting the remaining provisions of this Agreement or affecting the validity or enforceability of such provision in any other jurisdiction.

(3) The division of this Agreement into Sections, the insertion of headings, and the provision of any table of contents, are for convenience of reference only and will not affect the construction or interpretation of this Agreement.

(4) Unless the context requires otherwise, words importing the singular include the plural and vice versa and words importing gender include all genders.

(5) This Agreement will be governed by and construed in accordance with the laws of the Province of Ontario and the laws of Canada applicable in that Province.

(6) This Agreement may be executed by fax or in counterpart, or both.

The parties have executed and deliver this Agreement as of the date first written above.

THE CORPORATION OF THE TOWNSHIP OF PUSLINCH

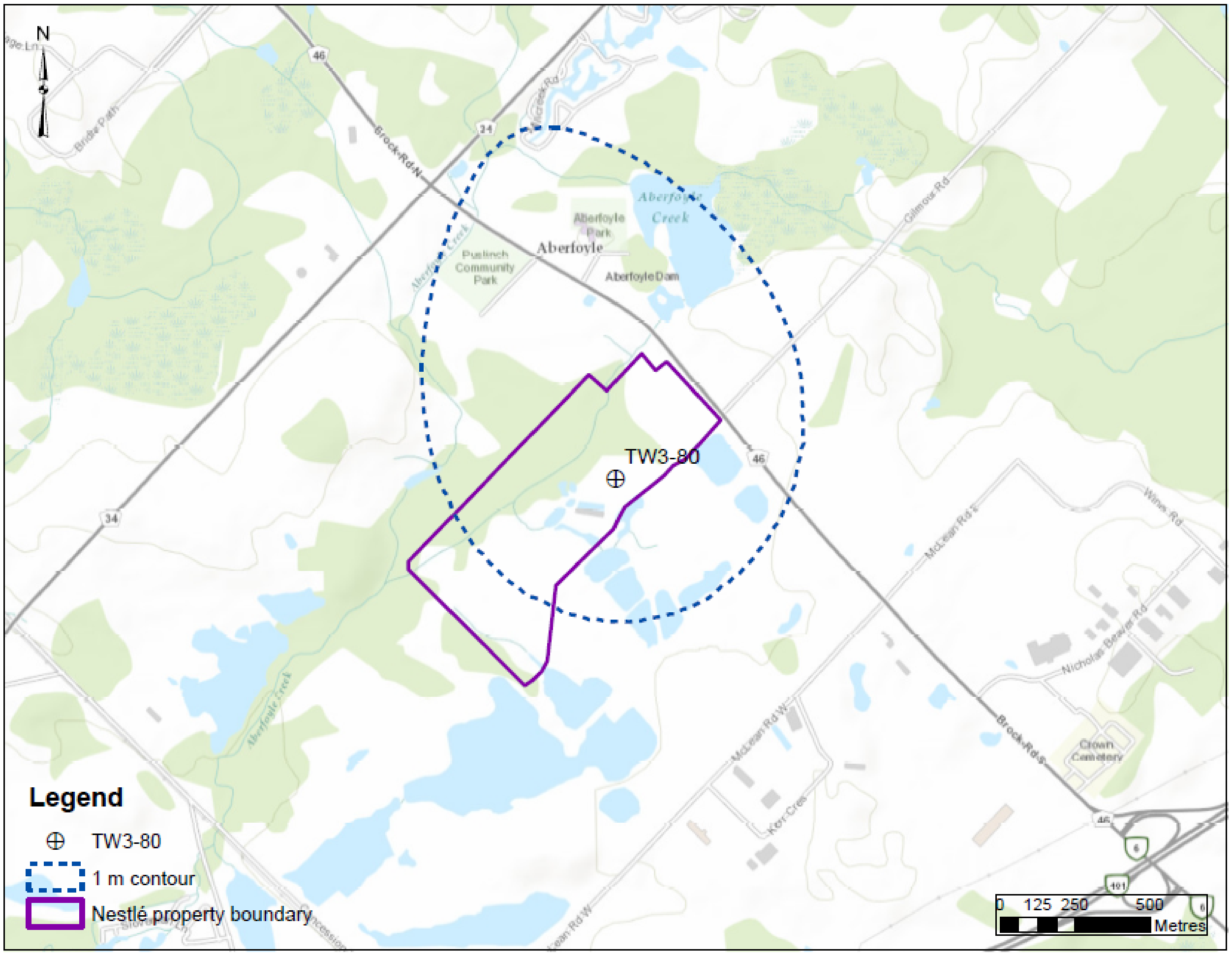
By: ___________________________________
Name:
Title:
Date:
I have the authority to bind the corporation.

NESTLÉ WATERS CANADA, A DIVISION OF NESTLÉ CANADA INC.

By: __________________________________
Name:
Title:
Date:
I have the authority to bind the corporation.

Schedule A

<u>Potential Well Interference Area</u>



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