Appendix E

Hydrogeological Studies

Appendix E.1

Test Well Drilling and Testing Hydrogeologic Report
(Groundwater Science Corp., February 2020)

Groundwater
Science Corp.

Unit 2, 465 Kingscourt Drive,
Waterloo, ON N2K 3R5
Phone: (519) 746-6916
groundwaterscience.ca

Town of Erin Water Supply EA
New Water Supply Source Investigation
Test Well Drilling and Testing
Hydrogeologic Report

Prepared For:

Corporation of the Town of Erin
5684 Trafalgar Rd.
Hillsburgh, Ontario
N0B 1Z0

February 2020

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1.0 INTRODUCTION

This report provides a technical summary of hydrogeological work and assessment undertaken in support of the Corporation of the Town of Erin (Town) Urban Centre Water Servicing Municipal Class Environmental Assessment (Class EA). The Class EA was initiated in May 2015 and is administered on behalf of the Town by Triton Engineering Services Limited (Triton). Triton is preparing the Project File Report for the Class EA, this hydrogeologic assessment is intended as an appendix to the Project File Report.

The Class EA was initiated to evaluate potential solutions to address water supply and storage deficiencies identified for both existing development and future growth scenarios for the two urban centres of Hillsburgh and Erin Village, as identified in the Servicing and Settlement Master Plan (SSMP) that was completed by B.M. Ross and Associates in August 2014 for the Town. Since that time An Urban Centre Wastewater Servicing Schedule C Municipal Class EA has been completed, which determined the population representing full build-out of the future growth community based on the assimilative capacity of the West Credit River.

We note that total water supply needs, as identified through the Class EA planning process, relate to longer term development projections. Actual development, and therefore water supply capacity need, will occur incrementally in stages over the planning period. That timing will also be influenced by other infrastructure construction timing (such as wastewater treatment and services).

Therefore the development of new water supply sources (wells) is also expected to be incremental, as needed, over the planning period. This assessment is intended to satisfy current need, as related to existing factors such as system redundancy, in addition to initial future development expectations. Given the uncertainties regarding individual well capacity, the hydrogeological work program was intended to meet minimum initial requirements for each community, as opposed to a fixed water supply volume representing the full build-out requirements.

The minimum initial water supply targets (maximum daily demand) were 1,615 cubic meters per day (m^3/d) for Hillsburgh (18.7 litres per second over 24 hours), and, 2,457 m^3/d (28.4 L/s over 24 hours) for Erin Village, which correspond to the population growth forecast to year 2031 as outlined in the Growth Management Strategy.

1.1 INVESTIGATION BACKGROUND

A Terms of Reference (TOR) and work plan for the hydrogeological component of the Class EA was prepared in April 2015 by Blackport Hydrogeology Inc. (BHI). The TOR identified the need for new water supply wells to address Town water supply deficiencies. As part of the TOR, the following criteria were developed to guide the process of locating suitable exploratory test well locations:

- ➢ Wells should be located outside of the existing Well Head Protection Areas (WHPAs) to minimize the potential for mutual interference.
- ➢ Locations should be selected where a reasonable level of natural protection from surface sources of contamination can be provided.

- In general, wells should be located away from known or potential sources of contamination and/or poor groundwater quality.
- Areas where the existing well yield information shows limited promise for higher yielding wells (<500 m^3/day) should be given a low priority.
- Where possible, wells should be located in relatively close proximity to the existing distribution system.
- Each new well should be capable of producing at least 1,000 m^3/day.

At that time a three stage work plan was developed, consisting of:

- Stage 1 – assessment of water supply options;
- Stage 2 – investigate new water sources; and,
- Stage 3 – develop new water sources.

Stages 1 and 2 correspond to the exploratory test well program needed to choose locations for construction and testing of new municipal water supply wells. Stage 3 of the work plan corresponds to the successful construction and testing of new municipal water supply source wells to provide additional supply capacity and redundancy for the Town's municipal drinking water systems.

This report provides a summary of work completed regarding Stages 1 and 2 of the work plan, and includes recommended locations for Stage 3. Separate reports are provided for the two new municipal water supply source wells constructed as part of this Class EA.

1.2 INVESTIGATION SUMMARY

BHI completed Stage 1 of the April 2015 work plan and provided recommendations regarding initial Stage 2 work. A summary of the Stage 1 findings is provided in **Section 2** of this report.

Recommended Stage 2 investigations at that time included the testing of one existing municipal owned well in Hillsburgh, and, drilling and testing of one exploratory test well on municipally owned land in Erin Village. This work was initiated in late 2015 and completed in November 2017 under the direction of BHI, in conjunction Groundwater Science Corp (GSC) and Triton. The results of the initial investigations are provided in **Section 3** of this report.

Based on the results of the initial Stage 2 investigations, it was determined that additional exploratory test well drilling and testing was required. That work was authorized by the Town in April 2018 and completed by GSC, in conjunction with Triton, by March 2019. The results of that work are summarized in **Section 3** of this report.

Stage 3 work, which included the construction and testing of municipal water supply source wells in both Hillsburgh and Erin Village, was authorized by the Town in June 2019 and completed by February 2020. As noted, separate reports are provided for each municipal supply well, to be included as appendices to the Project File Report and to be used in support of expected future Permit To Take Water applications for both locations.

1.3 REPORT STRUCTURE

This report provides a general summary of geologic and hydrogeologic conditions, and, results of the BHI Stage 1 investigations in **Section 2**.

The geologic and hydrogeologic setting description within the study area is based primarily on the SSMP reporting because the SSMP study area more closely matches the Class EA study area, as compared to other available summaries. For example, although Source Protection assessments and reports are more recent and may more closely match Source Protection computer model structures, the summaries provided are generalized and deal with the entire Credit River watershed, therefore do not provide the “local” scale information that is available from the SSMP.

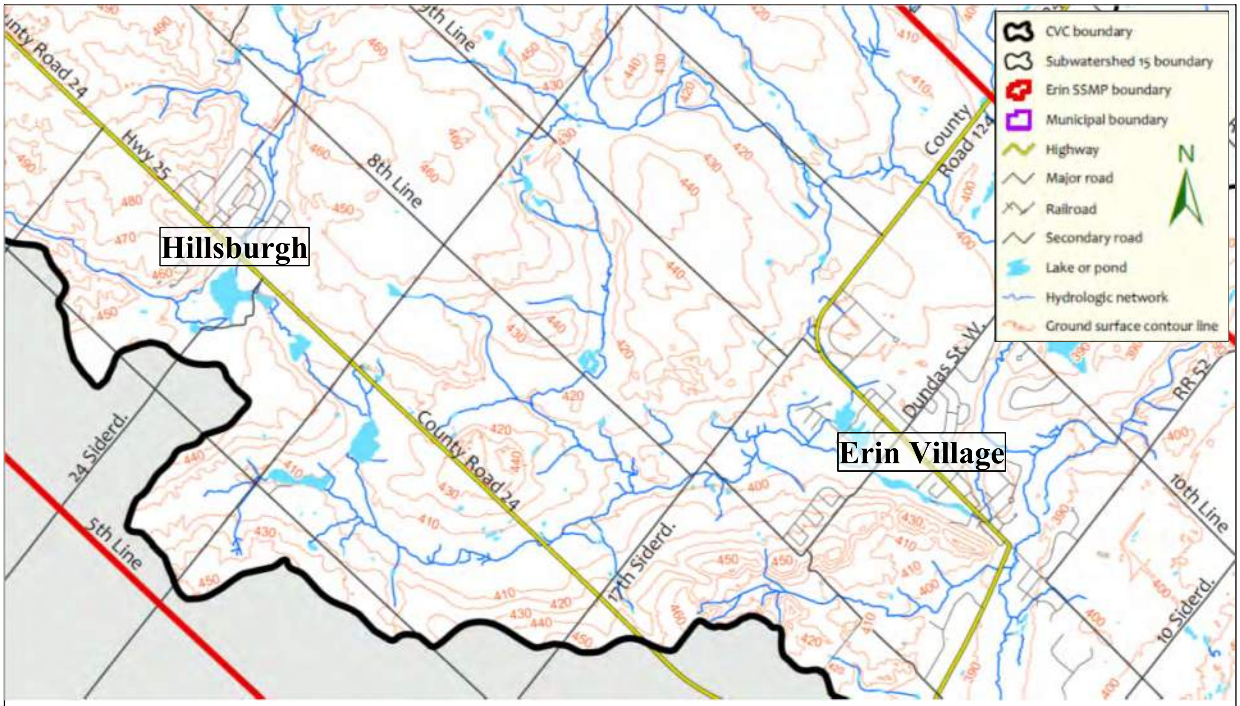
Stage 2 investigations, and exploratory well drilling and testing results, for the communities of Hillsburgh and Erin Village are summarized in **Section 3**. This represents the field work completed to implement the Class EA work plan.

The overall conclusions resulting from the Stage 2 exploratory well drilling and testing, and, recommendations for Stage 3 work, are provided in **Section 4**.

2.0 HYDROGEOLOGIC CONDITIONS

2.1 PHYSICAL SETTING

The study area is located within the West Credit River subwatershed. **Figure 1**, modified from the *Erin Servicing and Settlement Master Plan Phase 1 - Environmental Component Report – Existing Conditions Report* (May 2011; Credit Valley Conservation, Aquafor Beech Inc., Blackport Hydrogeology Inc.), shows general topographic contour elevations, in metres above sea level (mASL), and, surface water system in the study area.



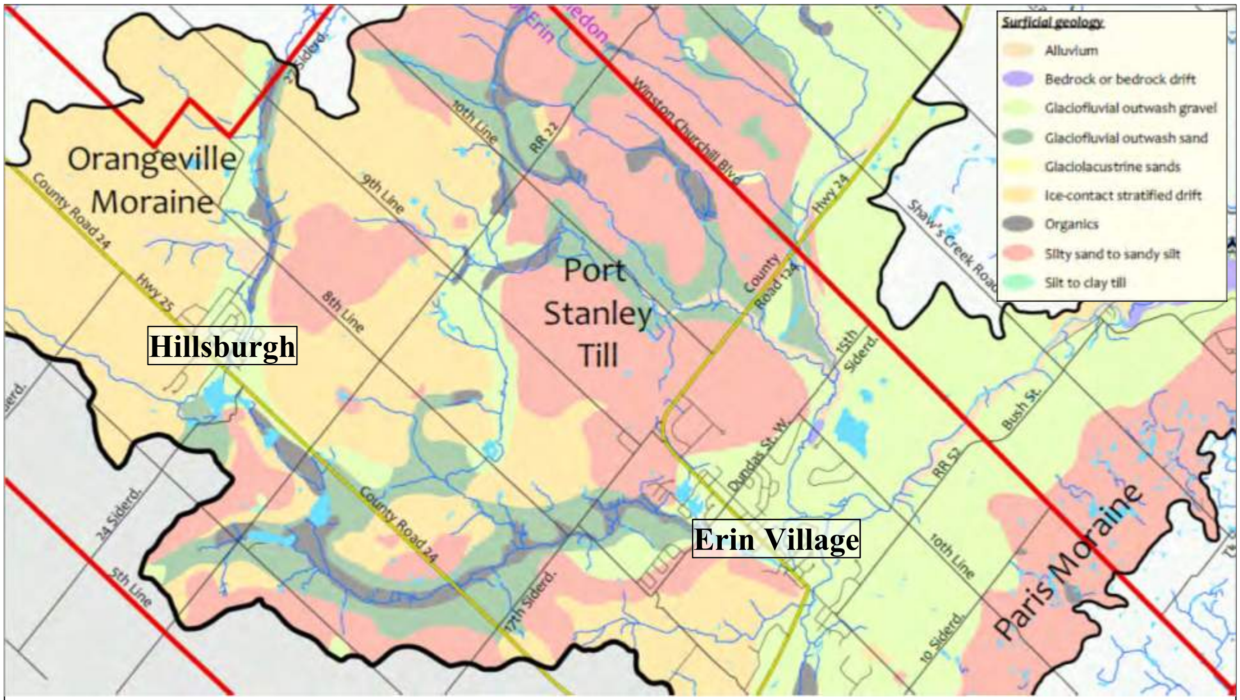
Source: Figure 2.1.1, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 1: Physical Setting

2.2 SURFICIAL GEOLOGY

The surficial geology of the study area is shown in **Figure 2**. As described in the SSMP environmental component report:

> *The surficial geology is a mapping of surface geological features which resulted from the last period of glaciation depositing geologic material in different forms (e.g., till sheets,glacial outwash). The surficial geology has been mapped in detail by Karrow (1968) andCowan (1976) and presented in Figure 2.1.2. The surficial geology, combined with topographic relief is important in determining areas of major groundwater recharge and discharge throughout the subwatershed and local study area. The surficial geology will typically provide a good indication of the most permeable ground surface and therefore the area of greatest potential for groundwater recharge. It will not provide sufficient information to determine how deep this water will move and where it will discharge.*



Source: Figure 2.1.2, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 2: Surficial Geology

The following comments highlight the relevant characteristics of the surficial geology of the West Credit River subwatershed, as adapted from the West Credit Subwatershed Study, Phase 1 Characterization report (CVC 1998a):

- *The surficial geology is characterized by five main geologic units representing three types of geologic conditions. Two units are tills of similar characteristics, two units are glacial outwash sands, and one unit is ice-contact sand and gravel.*
- *The two major till units present, are the Port Stanley Till and the Wentworth Till, both described as sandy silt tills. The Port Stanley Till is present throughout much of the central portion of the subwatershed. The Wentworth Till is present in the southeastern portion of the subwatershed as part of the Paris Moraine. These units typically have a moderately low infiltration rate, especially in the Port Stanley Till. The Wentworth Till however, because of the hummocky nature of the ground surface of the Paris Moraine, has a greater recharge as more water is "trapped" in depressions and will continually infiltrate to the water table.*
- *The major upland area in the western portion of the subwatershed (Hillsburgh Sandhills) is comprised of ice-contact sand and gravel with some till present. Ice-contact sand and gravel is deposited at the edge of a melting glacier. Much of this area is part of the Orangeville Moraine, which is also quite hummocky. This unit provides a significant potential for groundwater recharge, given the highly permeable nature of the geologic material, the high relief, and the hummocky terrain minimizing*

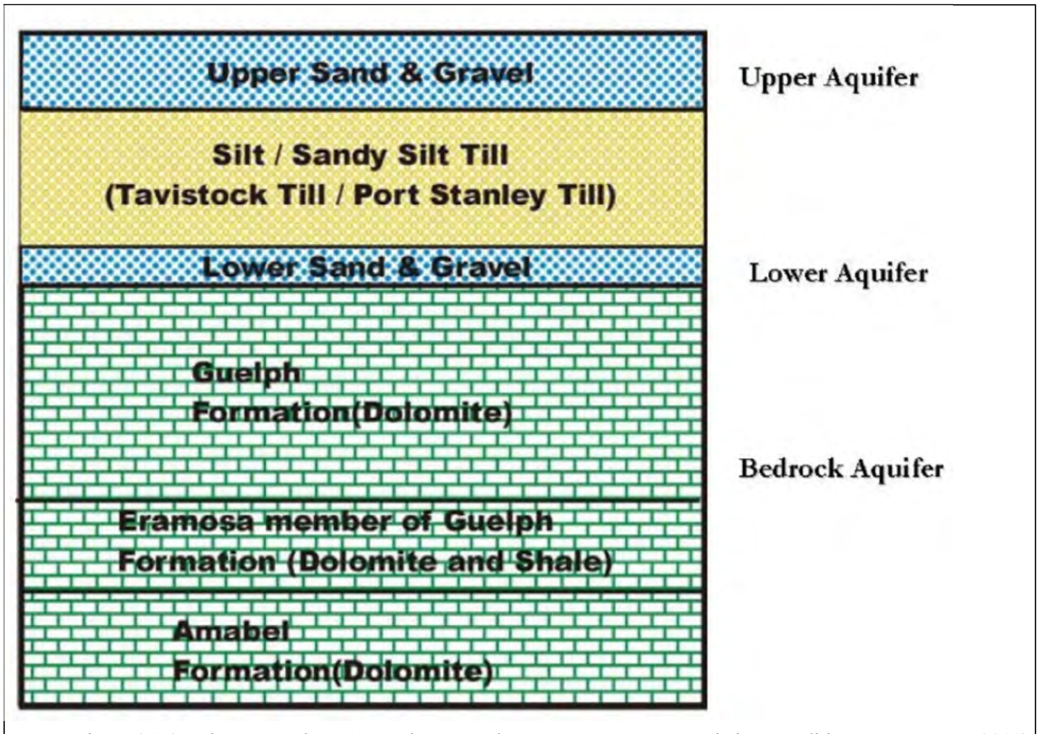
runoff. The West Credit River cuts through this area creating a low relief valley, providing considerable opportunity for groundwater to discharge to this portion of the river.

- *Extensive glaciofluvial outwash sands are present between the two major till units. The lower portion of the West Credit River flows through these outwash sands. Numerous gravel pits are located within this unit.*

2.3 SUBSURFACE GEOLOGY

A generalized conceptual model of the subsurface geology in the study area is shown in **Figure 3**. As described in the SSMP environmental component report:

> *The subsurface geology of the West Credit River subwatershed is comprised of a variable thickness of glacier deposited material, as a result of numerous ice advances and retreats 10,000 to 70,000 years ago. Underlying this material is bedrock consisting primarily of dolostone. As part of the West Credit Subwatershed Study (CVC 1998a) and the Town of Erin Groundwater Management Study (Blackport Hydrogeology Inc. 2005) the subsurface geology within the study area was interpreted using water well records on file with the Ministry of Environment (MOE).*
>
> *Figure 2.1.3 shows the interpreted conceptual geologic model for the study area as developed from the Quaternary geology interpretation by Cowan, (1976) and the interpretation of the water well records (Blackport Hydrogeology Inc. 2005).*



Source: Figure 2.1.3, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011).

Figure 3: Conceptual Geologic Model

As noted in the SSMP report, the geologic units vary in thickness, and may not be continuous in extent through the study area.

The upper sand and gravel layer is comprised of permeable surficial geologic units, primarily associated with kame moraine, till moraine, or ice contact sand and gravel deposits of the Orangeville Moraine and the Paris Moraine. These deposits are not continuous across the study area, however are associated with areas of higher relief. The permeable surficial sand and gravel is associated with higher recharge and contributes significantly to the volume of local recharge.

The till sequence consists primarily of the two major till deposits identified in this area; the Port Stanley Till; and, the Wentworth Till. Both are described as sandy silt tills. The till units can occur at ground surface, or underlie the upper sand and gravel layer. The till units are interpreted to have a moderate to low permeability and can act as aquitards where present in sufficient thickness.

Underlying the till units, and immediately above bedrock, discontinuous sand and gravel (glaciofluvial) deposits are reported. These deposits may occur at surface in low lying areas (e.g. river valleys), especially in areas where the overburden is thin. The lower sand and gravel units can be hydraulically connected to the upper bedrock, and where connected the sand/gravel/bedrock system can act as one aquifer unit.

The municipal water systems and majority of private residential wells obtain water from the Silurian dolostone (dolomite) bedrock aquifer system. The overall bedrock aquifer system consists of the Guelph Formation, basal Eramosa Member of the Guelph Formation, and the underlying sequence characterized as the (unsubdivided) Amabel Formation.

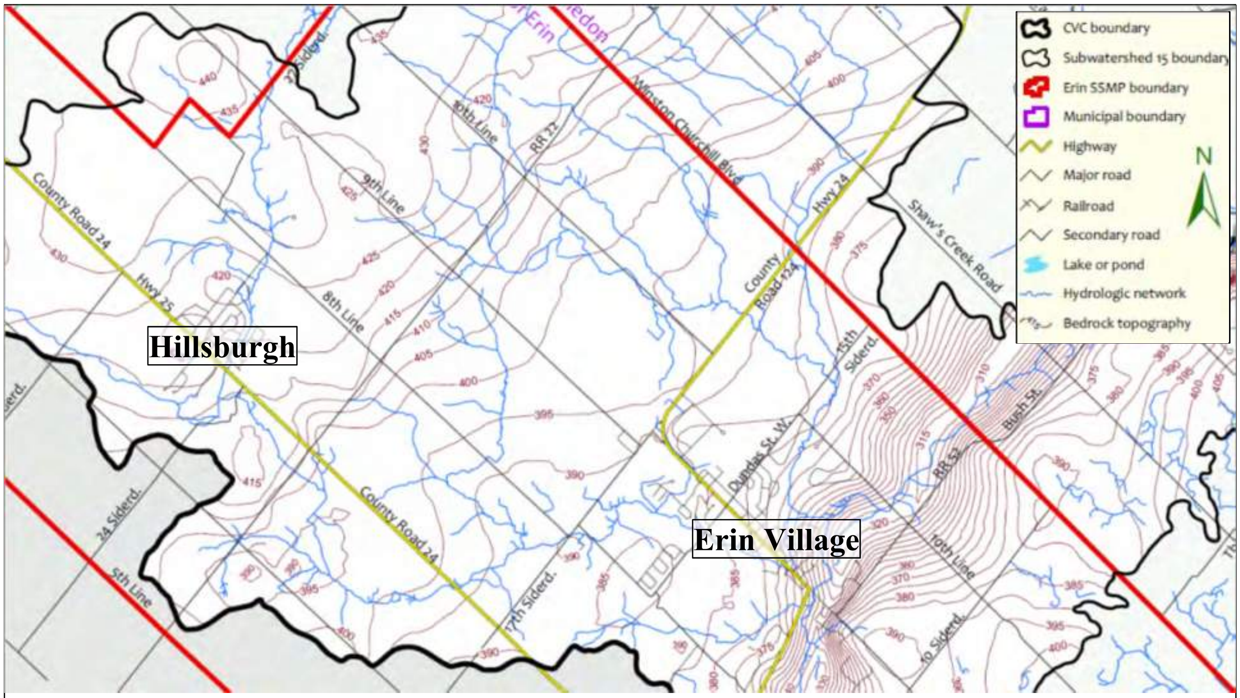
We note that the stratigraphic characterization and nomenclature of the Silurian bedrock sequence has been revised by the Ontario Geologic Survey (e.g. Brunton and Brintnell, 2001). However for simplicity and consistency with the SSMP and published Source Protection reporting, in this report we will utilize the previous formation references. For example, for this study the former nomenclature can be more directly “correlated” to the generalized descriptions within water well records in this area. For comparative purposes, the Guelph Formation reference used in this report is consistent with the new revised characterization. The Eramosa Member of the Guelph Formation is now generally categorized as the Eramosa Formation The former (unsubdivided) Amabel Formation would include the current Goat Island Formation (as present), the Gasport Formation (thickest and primary aquifer sequence) and any underlying thinner dolostone sequence (Rochester/Irondequoit) that may be present. The dolostone sequence is underlain by shale units that form the base of the bedrock aquifer system.

The Guelph Formation is described as *a cream and brown, porous fine to medium crystalline dolomite* (SSMP, May 2011). The Guelph Formation is a major water bearing unit where present. The upper portion of the Guelph Formation is typically fractured and can produce a considerable quantity of water. Many private wells within the Hillsburgh area are constructed in the upper Guelph Formation. Based on geologic mapping and water well record descriptions, the Guelph Formation is not continuous over the study area. The Guelph Formation appears to be present in the Hillsburgh area but largely absent in the Erin Village area.

The Eramosa member of the Guelph Formation is described as *more massive bedded and consists of dolomite interbedded with shale* (SSMP, May 2011). This unit typically does not produce much water, compared to the Guelph and Amabel formations. The Eramosa member, where present, can act as a confining layer for the deeper bedrock.

The Amabel Formation is described as a *gray to blue-gray medium crystalline dolomite* (SSMP, May 2011). The Amabel Formation is also capable of producing substantial quantities of water, typically from major fracture zones reported at depth. Much of the water produced from the municipal wells for Erin Village and Hillsburgh is produced from the Amabel Formation, however few wells penetrate the full formation thickness.

The interpreted bedrock topography (contours in mASL) within the study area is shown in **Figure 4**.



Source: Figure 2.1.6, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

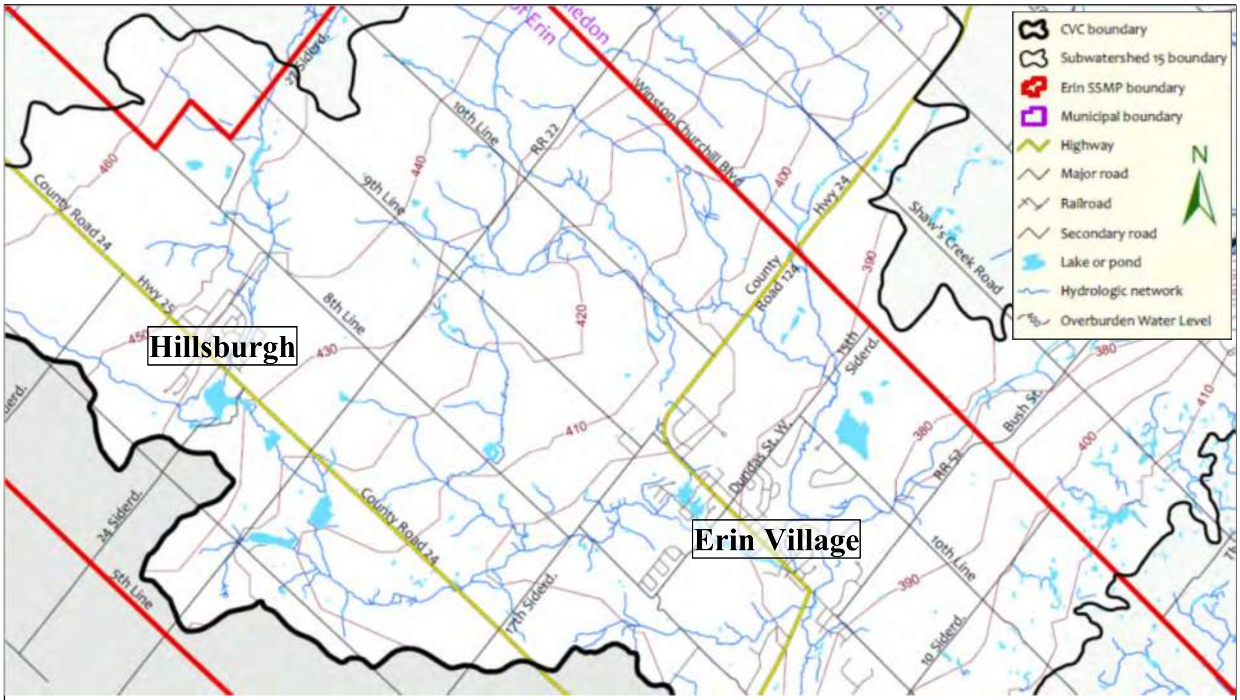
Figure 4: Bedrock Topography

As described in the SSMP environmental component report:

> *Bedrock topography (Figure 2.1.6) indicates a bedrock high north of Hillsburgh with regional topographic slope towards the main branch of the West Credit River at Erin Village. There is a deep bedrock valley present in the downstream portion of the subwatershed that extends almost to Erin Village. This deep bedrock valley controls deeper groundwater flow to the east of Erin Village…*

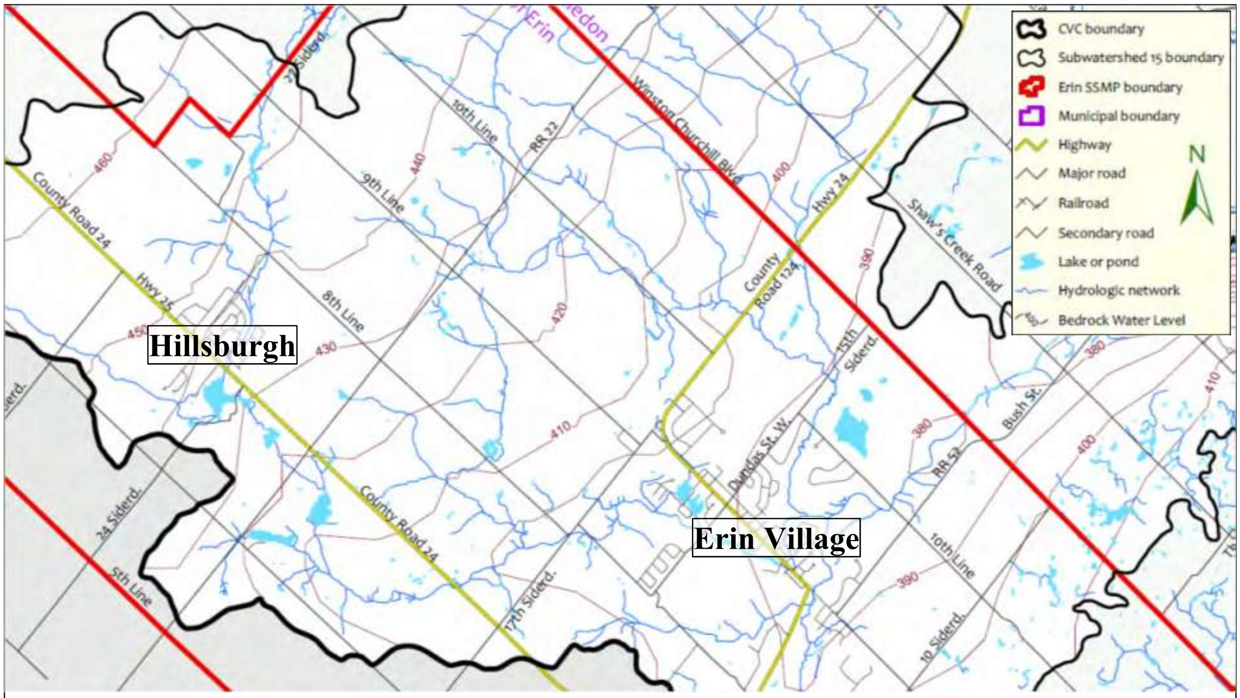
2.4 GROUNDWATER FLOW

The following discussion of regional groundwater flow is provided to provide general context to the hydrogeologic understanding that forms the basis of this assessment. More detailed analysis is provided within Source Protection studies and/or localized assessments, however the descriptions as provided in the SSMP reporting provide a reasonable regional analysis for the purposes of this report. The interpreted shallow (water table) groundwater flow system is shown in **Figure 5**. The interpreted deeper bedrock aquifer system is shown in **Figure 6**.



Source: Figure 2.1.7, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 5: Water Table Contours



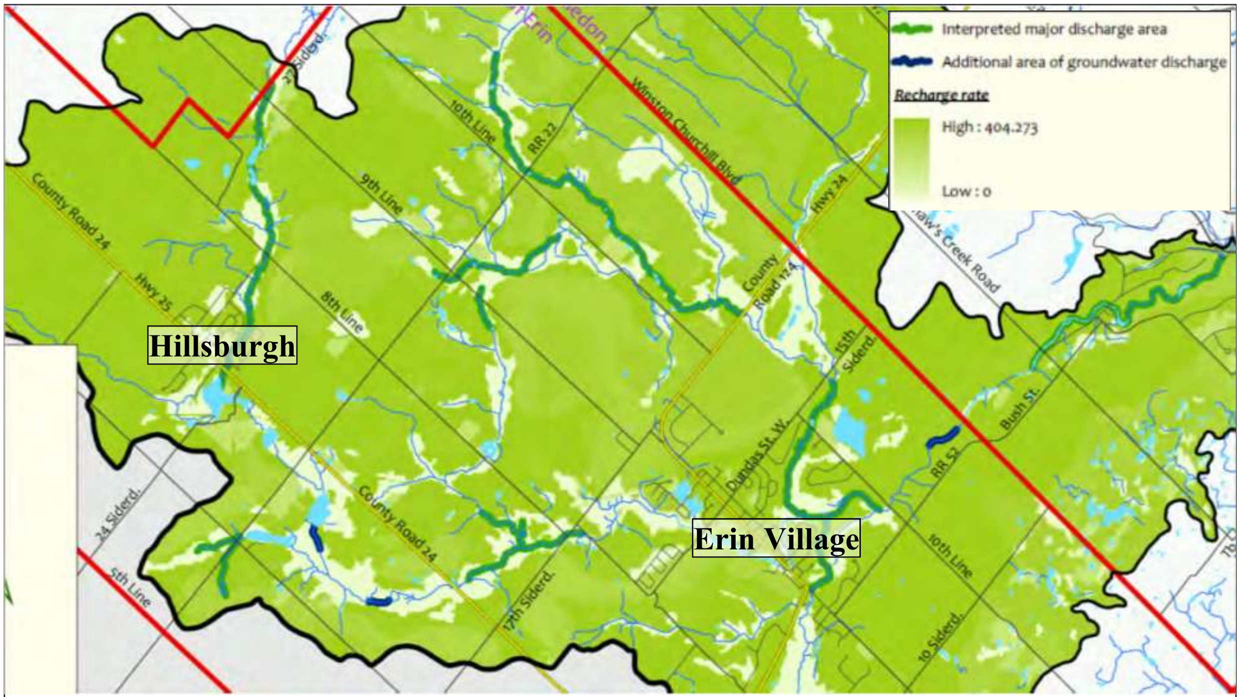
Source: Figure 2.1.8, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 6: Bedrock Water Levels

Both the regional water table and bedrock groundwater contours generally follow topographic relief. As shown, similar overall patterns of flow occur, and, groundwater elevations can be similar in both the shallow and deep systems. Regional flow is generally northwest to southeast within the study area. Near Erin Village local groundwater flow is directed eastward, controlled to a large extent by the elevation of the deep bedrock valley.

2.5 GROUNDWATER RECHARGE AND DISCHARGE

Generalized regional groundwater recharge and discharge conditions within the study area, as reported by the SSMP, is shown in **Figure 7**.



Source: Figure 2.1.6, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 7 : Groundwater Recharge and Discharge

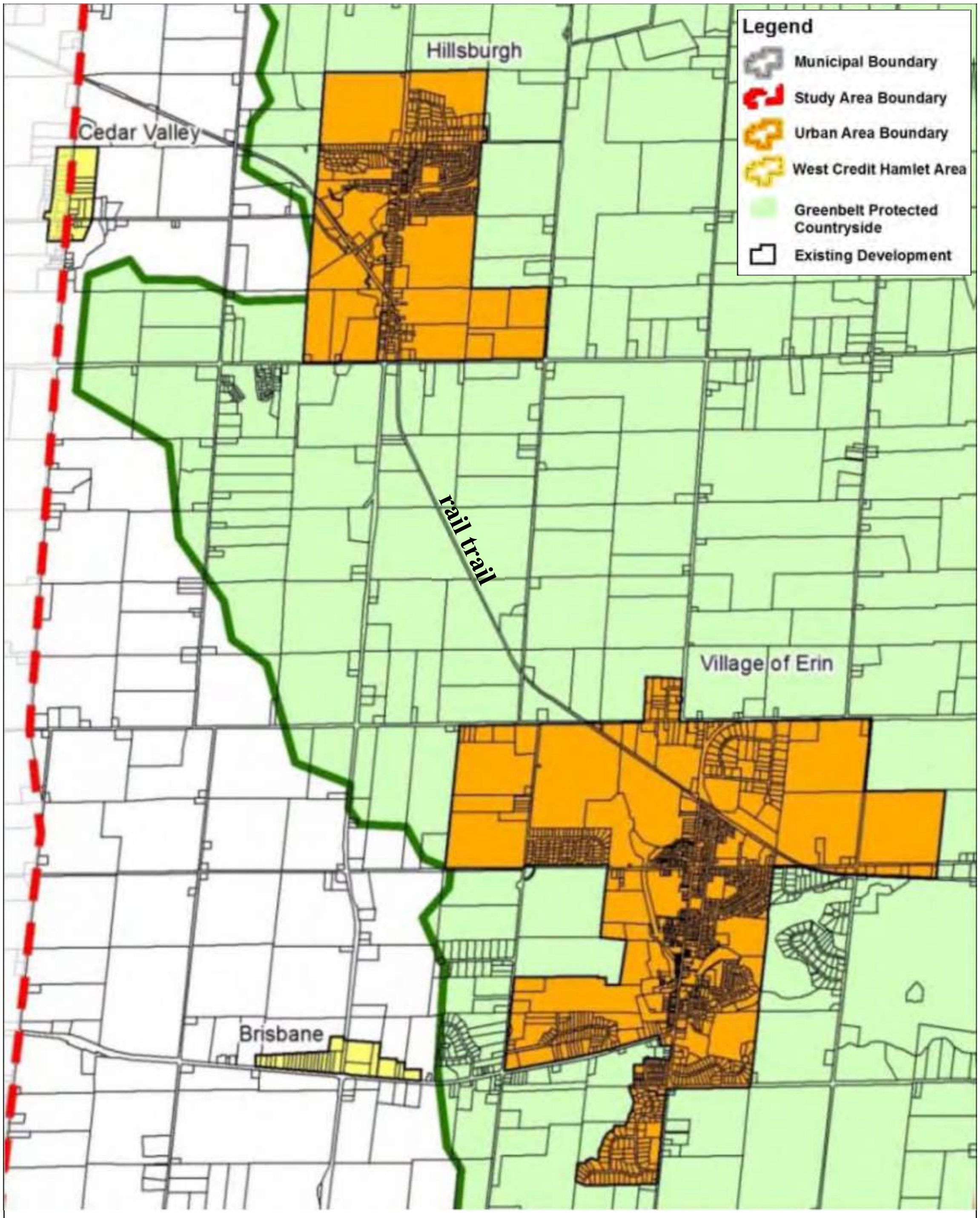
As shown, much of the area is characterized as having relatively high recharge rates. This recharge supports both local and regional flow systems. Where surface water systems associated with the West Credit, or other natural environment features (e.g. ponds, wetlands, etc.) intercept the water table, groundwater discharge to surface occurs. Groundwater discharge can also be a result of regional flow systems from both the overburden and bedrock.

Additional specific information regarding discharge conditions within the West Credit water shed is available through Subwatershed studies, Source Protection studies and local (site specific) assessments. Please refer to those assessments for additional detail.

2.6 GROUNDWATER USAGE

As noted in the SSMP reporting, groundwater uses within the study area include municipal drinking water supply, private (e.g. residential) water supply, commercial water taking, aquaculture, agricultural, industrial, institutional and commercial uses.

The following general overview of groundwater usage within the study area is summarized from the SSMP reporting. **Figure 8** shows the approximate urban area boundaries for the communities of Hillsburgh and Erin Village.



Source: Figure 2-4, Town of Erin Servicing and Settlement Master Plan Final Report, August 2014 (not to scale)

Figure 8: Urban Boundaries

The Town provides municipal water supply within portions of the urban boundaries of both Hillsburgh and Erin Village, however the water distribution system does not extend to all properties within the two communities.

2.9.1 Private Water Supply

Private residences outside of the urban boundaries, and residences inside the urban boundaries that are not connected to the municipal water supply system, rely on private wells for water supply. Based on previous reviews (including available water well records), the majority of private wells obtain water from the bedrock aquifer system. Private wells are also completed in the overburden aquifer systems, either as drilled wells at depth (e.g. accessing deeper aquifer layers) or as shallow dug or bored wells within the water table system. We note that the water well record database does not necessarily include all private water supply wells that may exist within the study area.

Other private water taking occurs for agricultural, institutional, commercial and industrial purposes. Please refer to the SSMP and Source Protection reporting for a more detailed analysis of those uses.

2.9.2 Municipal Water Supply - Hillsburgh

The location of existing and former municipal water supply wells, and the approximate current extent of water distribution system within Hillsburgh is shown on **Figure 9**.

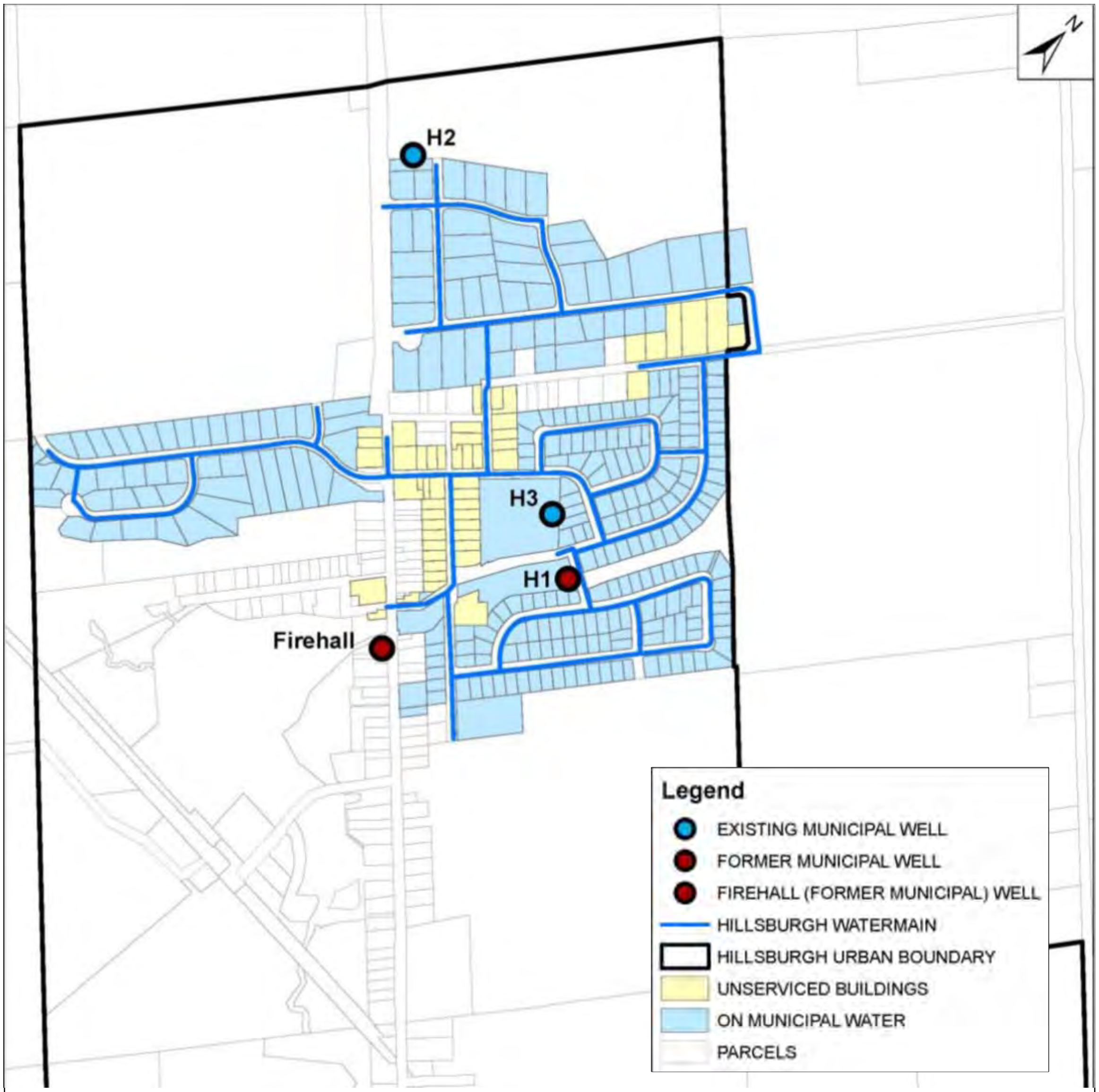
The original municipal water supply well in Hillsburgh, Well H1 (original Glendevon well), was drilled in 1968 at a location adjacent to the West Credit River. Well H1 was completed in bedrock to a total depth of 37.2 m. Bedrock was encountered at 17.4 m. The rated water supply capacity of well H1 was approximately 588 m^3/day. The well was used until 1995, and was abandoned due to apparent iron bacteria problems and the frequency of rehabilitation (reconditioning of the well) to maintain performance.

Well H2 (Hillsburgh Heights well) was drilled in September 1988 at the northern edge of the current developed area. Well H2 was completed in bedrock to a total depth of 88 m. Bedrock was encountered at 16 m, and the primary water bearing zones were reported at 85 to 88 m depth. Well H2 is currently approved for water taking up to 982 m^3/day and has been in operation since 1992.

Well H3 (referenced as the Glendevon, or, Victoria Park well) is located at Victoria Park, approximately 150 metres north of the original Glendevon pumphouse. Well H3 replaced well H1, and was drilled in May 1996. Well H3 was completed in bedrock to a total depth of 57.9 m. Bedrock was encountered at 58 m, and the primary water bearing zones were reported at 37.5 and 52.5 m depth. Well H2 is currently approved for water taking up to 655 m^3/day.

Although Well H3 (and original Well H1) are located near the West Credit River, testing at both wells indicated that Well H3 is not hydraulically connected to the surface water system, and, the well is not considered GUDI (Groundwater Under the Direct Influence of surface water).

One additional municipally owned water supply well, known as the Firehall Well, was drilled in May 1989 to assess the potential for municipal water supply and for use as supply well for fire services. The Firehall Well was completed in bedrock to a total depth of 62 m. Bedrock was encountered at 13 m and the main water bearing zones were reported at 58 to 61 m. After construction the well was tested at a rate of 821 m^3/day, but was interpreted to have a potential capacity in the range of 1,400 to 1,600 m^3/day. The well was not tested any further, or used for as part of the municipal water supply system due to the availability of Well H3 (and ease of connection of Well H3 to the existing Glendevon treatment and storage facility). The Firehall Well currently provides water for fire services.

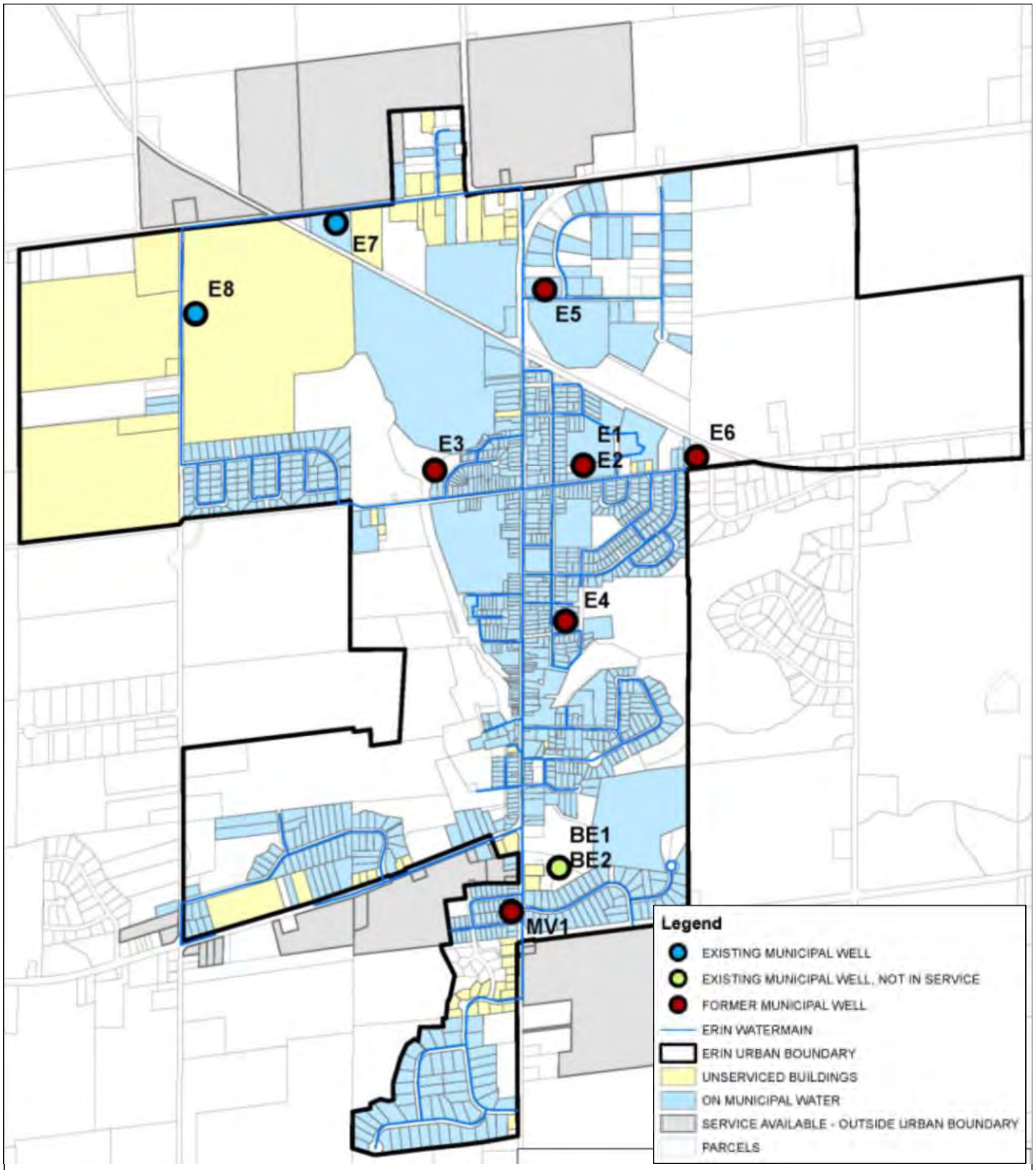


Source: Figure 7-5, Town of Erin Servicing and Settlement Master Plan Final Report, August 2014 (not to scale)

Figure 9: Hillsburgh Water Supply System

2.9.3 Municipal Water Supply – Erin Village

The location of existing and former municipal water supply wells, and the approximate current extent of water distribution system within Erin Village is shown on **Figure 10**.



Source: Figure 7-5, Town of Erin Servicing and Settlement Master Plan Final Report, August 2014 (not to scale)

Figure 10: Erin Village Water Supply System

The first wells for municipal use in the Village of Erin, Well E1 and E2, were constructed in 1954 and 1955 respectively. Both wells were completed in the upper bedrock in an area of shallow permeable overburden. While initial water supply capacity was high (±2,300 m^3/day), by 1984 the well capacity had declined significantly (±850 m^3/day). Due to water quality and potablity issues, and the availability of new municipal supply wells, Well E1 and Well E2 were taken out of service in 1984.

To supplement the municipal supply Well E3 was constructed in 1976. The well drilling program included 4 test wells extending into bedrock, one of which was completed as

Well E3. However the well was screened from approximately 7.9 to 9.1 m depth, within a sand and gravel unit that occurred directly above bedrock. It appears that a bored well (Well E3A) was also installed in an upper sand unit. Both wells had limited capacity. It was noted in 1984 that the bored well was not used and Well E3 was used at the time only for emergencies under a temporary PTTW to meet peak demands. At that time it was concluded the amount of water available did not justify the installation of permanent pumping and treatment facilities at Well E3.

Well E4 was brought into service in 1976, however it appears the well was constructed at an earlier date and few details are available regarding the well. In 1976 Well E4 was rehabilitated to yield about 590 m^3/day, however the yield was subsequently reported to quickly decline. It appears the well was only used for a short time before being abandoned due to water quality issues and well performance.

Well E5 was drilled in June 1980 within an industrial subdivision in the north end of Erin Village and brought into operation in July 1984. The well was completed in bedrock to a total depth of 38 m. Bedrock was encountered at 6 m and potential water bearing zones reported at 17 and 38 m. Well E5 was reported to sustain a rate of over 1,900 m^3/day. In 1992 elevated concentrations of trichloroethylene (TCE) were found in the well and the well was shut down. It was ultimately determined that control of TCE migration to the Well E5 was not feasible, and the well was officially abandoned in 2007.

Well E6 was drilled in December 1985 and was completed in bedrock to a total depth of 36 m. Bedrock was encountered at 8.3 m. Initial testing indicated that the well could produce a continuous yield of about 490 m^3/day, however there was considerable drawdown in the well. The well was never developed for use as a municipal well and rather than being abandoned, the well is currently part of the Provincial Groundwater Monitoring Network.

Well E7 was drilled in January 1986 and has been in production since the early 1990's. The well was completed in bedrock at a total depth of 42 m. Bedrock was encountered at 10.7 m. The well was originally artesian, flowing at a rate of about 657 m^3/day. Well E7 was originally tested at a rate of 1,961 m^3/day, with drawdown stabilized at 10 m below ground surface. In October 2004, to address potential GUDI concerns, the well casing was extended to 19.1 m depth. Assessments completed at that time indicated only a 7% loss in well yield as a result of extending the casing into the upper bedrock. Most water of the water production is interpreted to be from the lower portion of the bedrock. No hydraulic connection to surface sources of water was found. Well E7 is currently approved for water taking up to 2,160 m^3/day.

Well E8 was drilled in December 1991and has been in production since 1993. The well is completed in bedrock at a total depth of 46 m. Bedrock was encountered at 6.6 m and water bearing zones reported from 9.8 to 15.5 m depth, and, from 18.9 to 46 m depth. The upper bedrock zone was sealed (pressure grouted) to a depth of 16.8 m to minimize potential connection to surface water. The well is artesian, flowing at an estimated rate of 1,600 m^3/day and with a static level about 6.4 m above ground surface at the time of construction. Well E8 was originally tested at a rate of 2,620 m^3/day, with a total drawdown of 16.7 m. Testing in 1992 and 1993 indicated there was no direct connection or impact of groundwater discharge to the West Credit River or adjacent wetlands. Well E8 is currently approved for water taking up to 1,968 m^3/day.

The Town also owns two non-operational municipal water supply wells, originally installed for the Bel-Erin subdivision (Bel-Erin Wells), referenced as BE1 and BE2. The wells were drilled in July 1991 and December 1990, and completed in the unconfined overburden sand and gravel outwash deposit aquifer near the West Credit River. The wells are also along the edge of the buried bedrock valley identified in that area. Well screen depths at BE1 and BE2 are 11.3 to 13.4 m, and 12.5 to 16.2 m. Rated well capacities are limited. The wells were permitted for to pump on an alternating basis with a combined total maximum taking of 655 m^3/day. An assessment completed in 2001 indicated that the wells were not GUDI under the operational pumping rates at that time (which were lower than the permitted rates), however it was concluded that chemically assisted filtration would likely be required in order to use the wells for a municipal supply. Since that time the wells have been non-operational as they would require an upgrade to the treatment system for municipal use.

2.7 WELL HEAD PROTECTION AREAS

Selected mapping from the *Approved Source Protection Plan: CTC Source Protection Region* (July 28, 2015) report, showing reported Well Head Protection Area (WHPA) and Significant Groundwater Quality Threat Areas for each of the current Town municipal water supply wells is included in **Appendix A** for reference.

2.8 STAGE 1 REVIEW FINDINGS

Based on the overall setting and existing Town water supply system, as outlined in **Sections 2.1** to **2.7** of this report, it was determined that new municipal exploratory test wells should be completed in the bedrock aquifer systems, while meeting to the extent possible, the general Class EA TOR criteria for locating test well locations, as follows:

- Wells should be located outside of the existing Well Head Protection Areas (WHPAs) to minimize the potential for mutual interference.
- Locations should be selected where a reasonable level of natural protection from surface sources of contamination can be provided.
- In general, wells should be located away from known or potential sources of contamination and/or poor groundwater quality.
- Areas where the existing well yield information shows limited promise for higher yielding wells (<500 m^3/day) should be given a low priority.
- Where possible, wells should be located in relatively close proximity to the existing distribution system.
- Each new well should be capable of producing at least 1,000 m^3/day.

As part of the Stage 1 assessment a review was completed by BHI of existing higher producing wells in the areas of both Erin Village and Hillsburgh to determine common patterns and provide drilling target focus. The review included information sources available to the Town, primarily through previous water supply assessments completed for existing and proposed development (e.g. Gulia Subdivision and nearby Mountainview Subdivision, Mattamy/Solmar proposed development, Cal-Erin Golf Course, commercial water bottling assessments, etc.) and Ministry of the Environment Conservation and Parks (MECP) water well records. **Table 1** provides a summary of relevant information.

Well	Reported Yield (m3/day)	Bedrock		Well Drilled To		Water Bearing Zones	
		Depth (m)	Elevation (mASL)	Depth (m)	Elevation (mASL)	Depth (m)	Elevation (mASL)
Hillsburgh Firehall	1,363 to 1,635	13.0	423	61.0	375	58-61	378-375
Gulia Subdivision	1,635 to 2,180	6.4	394.6	42.6	358.4	39.6-42.1	361.4-358.4
Nestlé TW1	927+	19.5	413.5	39.0	394.0	25.3-31.4	401.6-407.7
Danone	818	14.6	388.4	53.6	349.4	49.7-51.8	353.6-351.2
H3	545	16.1	421.9	57.9	380.1	51.8-53.3	386.2-384.7
H2	818	51.2	423.8	87.8	387.2	85.3-87.8	389.7-387.2
Works yard	327	39.3	400.7	61.5	378.5	60	380
E2	1,908	8.5	386.5	20.1	374.5	13.7-20.1	381.3-374.9
E3(A)	327	9.1	383.9	15.8	377.4	7.6-9.0	385.4-384
E3	327	9.1	383.9	40.8	352.2	33.5-35.0	359.5-358
E4	491	N/A	N/A	N/A	N/A	N/A	N/A
E5	1,635	4.5	393.5	37.8	360.2	20.7/23.8	377.3/374.2
E6	491	6.1	388.9	36.0	359	23.6/34.0	371.4/361
Mountainview	327	16.4	373.6	29.6	360.4	27.4-29.6	362.6-360.4
E7	1,799	10.0	390	43.0	357	15.0-42.0*	385-358
E8	1,635	6.6	391.4	46.0	352	18.9-46.0	379.1-352
Cal Erin	818	7.9	398.4	55.4	350.6	27/43/58	379/363/348
Mattamy5	1,090+	7.6	402.4	48.1	361.9	27.4/36.5	382.6/373.5
Mattamy4	1,090+	10.5	404 .5	52.1	362.9	30.7/38.4	384.3/376.6

* Geophysical testing indicated most of the water came from deeper zones

Table 1 – Summary of High Yield Wells In The Erin Village and Hillsburgh Areas

The primary pattern noted is the elevation of the reported water bearing (high transmissivity) zones, two main zones are reported in the bedrock, referenced here as upper and lower zones. Note that some wells listed in **Table 1** obtain water from both the upper and lower zones.

Bedrock in the Erin Village and Hillsburgh area includes several bedrock units with varying water supply capacity. The uppermost bedrock is the Guelph Formation, which forms an unconfined regional aquifer system of varying capacity. Below the Guelph Formation is the Eramosa Member (now Formation), which is made up of several layers, including the Reformatory Quarry Member and the Vinemount Member. Although the Vinemount Member can act as an aquitard at the base of the Eramosa Formation, limiting the vertical movement of water to depth, the overlying Reformatory Quarry Member can be weathered and fractured enough to produce significant amounts of water. Below the Eramosa Formation is the Amabel Formation, of which lower zones (currently classified as the Gasport Formation) form an extensive regional confined aquifer system, with high water production zones.

The upper bedrock production zone identified in Table 2 occurs at approximately 380 mASL (±10 m), and likely corresponds to the Eramosa Formation (possibly the Reformatory Quarry Member) and/or overlying Guelph Formation.

The lower bedrock production zone identified in Table 2 occurs at an elevation of 355 mASL (±10 m), and likely corresponds to the lower Amabel (Gasport) Formation. The relative position of the Eramosa Formation (above) can form a “protective” layer, limiting local vertical water movement and reducing potential connections to shallow groundwater systems and/or surface water features.

The primary target for new Erin Village and Hillsburgh water supply wells would be the lower Amabel (Gasport) Formation zone, based on the potential high capacity and overlying protective layer(s). However, the upper zone as encountered may also assist in providing adequate supply.

In conjunction with the Town it was determined that the water supply search will first examine least costly potential new source or drilling locations, based on factors that include:

- Existing municipally owned wells that may be underutilized (to reduce drilling costs);
- Other existing wells that may be available to the Municipality (to reduce drilling costs);
- Proximity to the existing water supply system infrastructure (to reduce connection costs);
- Land ownership and drilling access, with Municipal lands being given priority;
- Location with respect to surface water features (to reduce potential GUDI issues), and, Watershed divides (to avoid inter-basin transfer issues);
- Location relative to existing municipal and private wells (to reduce potential interference issues); and,
- Source water protection considerations such as potential WHPA direction and overlap, known areas of groundwater contamination, former landfill site locations, etc.

2.9 RECOMMENDED EXPLORATORY TESTING LOCATIONS

The Stage 1 assessment identified the main drilling target as the deeper bedrock zone, corresponding to the base of the Amabel Formation. There is no "preferred" area of the community (i.e., Hillsburgh and/or Erin Village) where the deeper zone is known to have higher production capacity. However, historical trichloroethylene (TCE) contamination and Source Protection issues related to the existing industrial area at the north end of Erin Village would preclude that immediate area from the drilling program. Former (now closed) landfill areas occur in or near both Hillsburgh and Erin villages, which are potential sources of contamination. An extensive river and tributary system flows through both communities and reservoir/ponds are present in both villages. In addition, geologic conditions, including areas of extensive sand and gravel at surface, may lead some areas to be more susceptible to influence from shallow groundwater or surface water features.

Through consideration of the above noted items and the review of existing high producing wells, the potential drilling sites were identified for Stage 2 investigations. The locations of the potential exploratory test well drilling and testing sites in Erin Village and Hillsburgh are presented on **Figure 11** and **Figure 12**, respectively.

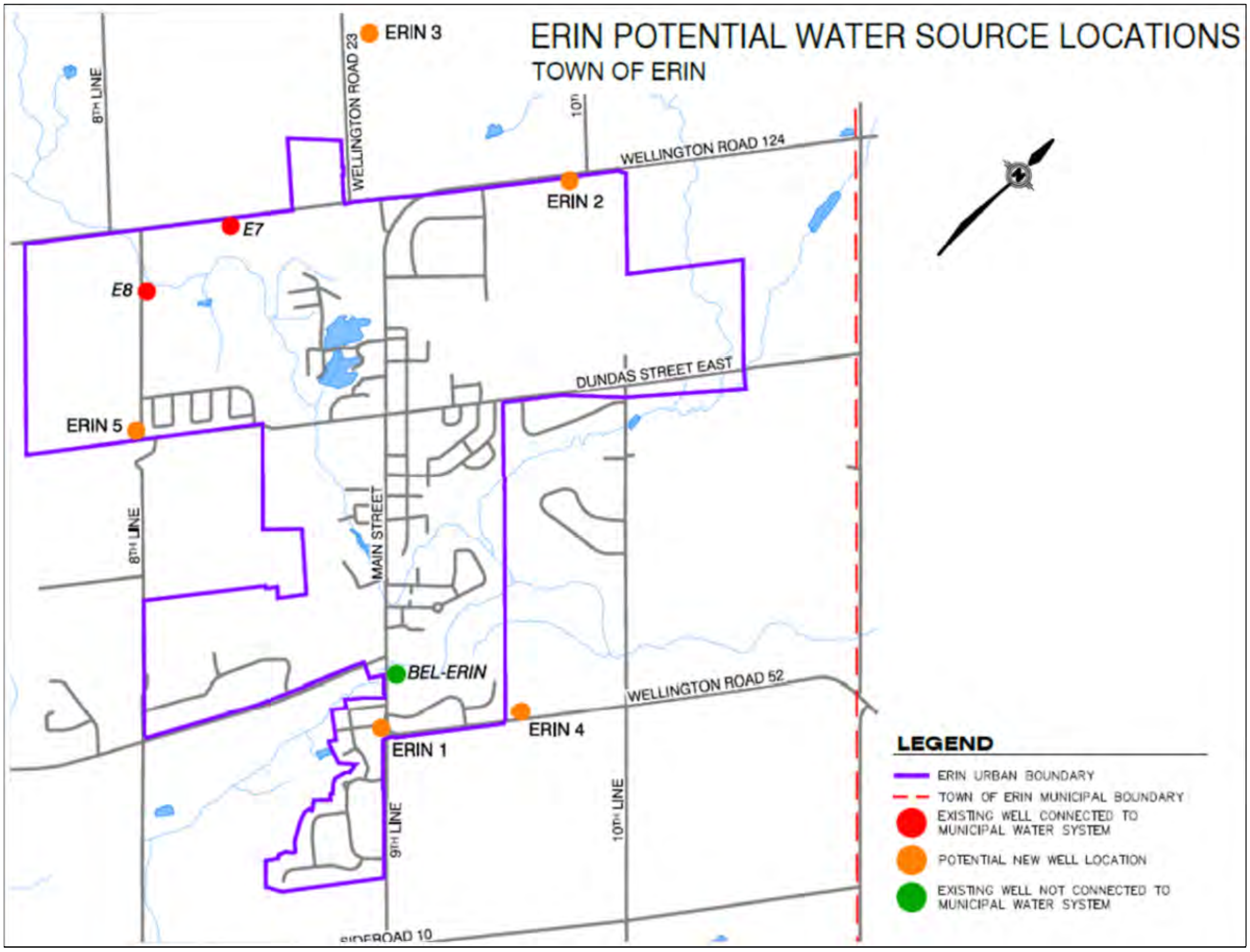


Figure 11 : Potential Erin Village Drilling and Testing Areas

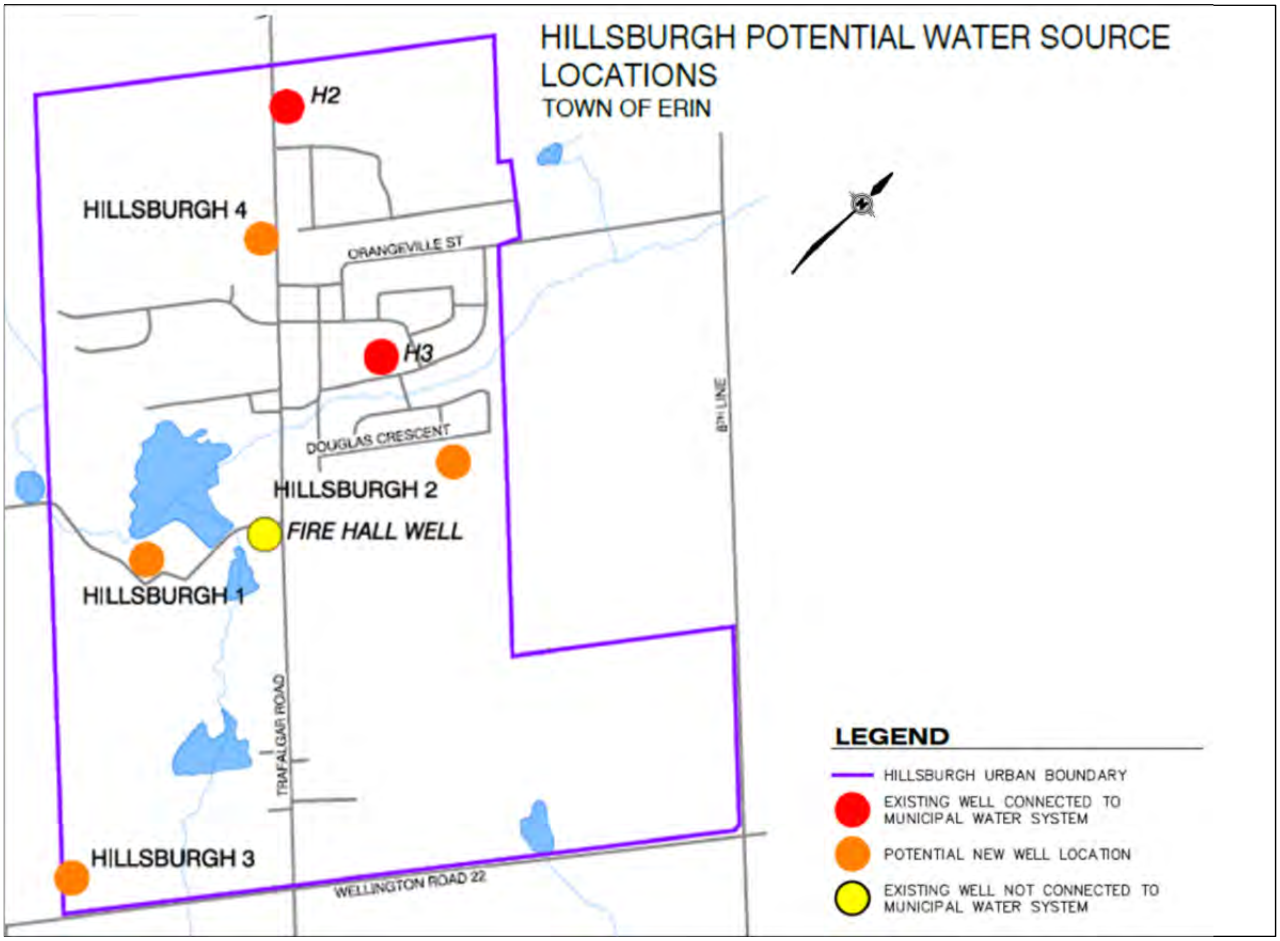


Figure 12 : Potential Hillsburgh Drilling and Testing Areas

The test sites include the following locations:

Erin Village

- Location 1 (Erin 1, Kenneth Ave well site), Town lands, site of former Mountainview Well, adjacent to existing watermain and in close proximity to the former Gulia high production well (now abandoned).
- Location 2 (Erin 2, TW1 and TW2 site), Solmar lands (former Mattamy Homes Lands) proposed for development.
- Location 3, (Erin 3, TW3 site), Tavares lands/Erin North site (Wellington Road 23).
- Location 4 (Erin 4), southeast corner of Erin Village (Wellington Road 52).
- Location 5 (Erin 5), 8th Line/Dundas Street West.

Hillsburgh

- Firehall Well (existing Town well identified for further testing), located adjacent to existing watermain.

- Location 1 (Hillsburgh 1, TW01-18 site), Nestlé Canada lands, located approximately 830 m from the existing watermain infrastructure at the intersection of Trafalgar Road and Mill/George Street, and approximately 690 m from watermain on Spruce Street.
- Location 2 (Hillsburgh 2, TW4 site), Tavares lands proposed for development, located approximately 100 m from the watermain infrastructure on Douglas Crescent.
- Location 3 (Hillsburgh 3), Thomasfield Homes Lands, Wellington Road 22.
- Location 4 (Hillsburgh 4), North of Upper Canada Drive.

Additional details and selection rational are summarized in the following sections of this report.

2.9.1 Mountainview (Erin 1)

The former Mountainview Well site is located on municipally owned land at the corner of Kenneth Ave and 9tth Line that provides easy access and has close proximity to the existing Erin water supply distribution system, and, the former (high production) Gulia Well. The Mountainview Well was a moderately producing bedrock well drilled in 1957 to a depth of 29.6 m, just above the lower bedrock water production zone. The Mountainview Well was decommissioned in 2008 (no longer exists).

The Gulia Well was a high production bedrock well drilled in 1990 (enlarged in 1991) to a depth of 42.6 m, into the lower bedrock production zone. Testing over the period of 1990 to 1997 confirmed the large capacity of the Gulia Well and the reported results indicated little potential for interference with local private wells or surface water systems. The Gulia Well was also decommissioned in 2008 and no longer exists.

A new exploratory test well would be necessary to assess the local aquifer capacity at this location.

2.9.2 Solmar/Former Mattamy Homes Lands, Wellington Road 124 (Erin 2)

This proposed test well site is located within an area of future expected development, referenced as the Solmar (former Mattamy Homes) Lands. This site was selected for new exploratory test well drilling based on the following considerations:

- Located within the Credit Valley Watershed.
- Located within lands that are relatively close to the existing municipal water supply infrastructure.
- Located in an area that provides some spacing relative to existing municipal wells and identified capture areas.
- Known to have two existing upper bedrock zone test wells present, constructed in 2006, reported to have moderate capacity (possible potential for high capacity).
- Located in an area that is reported to have a reasonable thickness of (protective) till above bedrock.
- Located in an area with few private wells.

One potential issue related to Erin 2 is the presence of known TCE contamination to the southwest and proximity to industrial areas. It appears that sufficient separation distance from known and potential sources of contamination could be provided within the overall development area; however, this may increase distance from the existing water supply system. In addition, a well at Erin 2 would result in all three water supply sources at the north end of the distribution system, which is not optimal from an engineering or water resources standpoint.

An existing (older) test well can be tested to provide an initial assessment of local aquifer capacity and guide further assessment if warranted.

2.9.3 Tavares Lands, Wellington Road 23 (Erin 3)

This original site chosen was selected for new exploratory test well drilling based on the following considerations:

- Located within the Credit Valley Watershed.
- Located within lands that are relatively close to existing municipal water supply infrastructure.
- Located in an area that provides some spacing relative to existing municipal wells and identified capture areas.
- Located in an area that is reported to have a thick layer of (protective) till above bedrock.
- Located in an area with few private wells.

Potential issues related this site are similar to the Solmar Lands, however the separation distance from the existing wells is reduced compared to the Solmar Lands.

A new exploratory test well would be necessary to assess the local aquifer capacity at this location.

2.9.4 Wellington Road 52 (Erin 4)

This site is located at the southeast corner of Erin Village. This site was selected for new exploratory test well drilling based on the following considerations:

- Located within the Credit Valley Watershed.
- Located within lands that are relatively close to existing municipal water supply infrastructure.
- Located in an area that provides good spacing relative to existing municipal wells and identified capture areas.
- Located in an area with few private wells.
- Existing wells on a nearby Halton Crushed Stone (aggregate extraction) site have been permitted for larger scale water taking, indicating water supply potential in this area.

The overburden at this location is reported to consist of permeable sand and gravel, which may result in increased potential connection to shallow groundwater or surface water systems. This site is also the closest to the future site of the recommended Sewage Treatment Plant and discharge location to the West Credit River between 10th Line and Winston Churchill Boulevard.

A new exploratory test well may be necessary to assess the local aquifer capacity at this location. Existing Halton Crushed Stone wells could also be assessed, however that site is further away from municipal water supply infrastructure.

2.9.5 8th Line/Dundas (Erin 5)

This site is located at the southwest end of Dundas Street and was selected for new exploratory test well drilling based on the following considerations:

- Located within the Credit Valley Watershed;
- Located within lands that are relatively close to existing municipal water supply infrastructure.
- Located in an area that provides some spacing relative to existing municipal wells and identified capture areas.

This site was identified as a potential small target area that is close to the existing water supply system that has some separation distance from the closed landfill located on the west side of the river south of Dundas Street. Groundwater flow is reported to be from the southwest, similar to existing well E8, and the expected WHPA can be expected to extend in a similar direction (e.g. away from the former landfill). There are more private wells in this area as compared to other potential drilling locations identified above.

A new exploratory test well would be necessary to assess the local aquifer capacity at this location.

2.9.6 Firehall Well (Hillsburgh)

The Firehall Well was selected as the first priority to test in Hillsburgh because it is an existing municipally owned well located in close proximity of the water distribution system, and because of the well's reported high capacity when it was initially drilled in 1989 and subsequently tested. The drilling reports indicated that most of the water was obtained from a zone near the bottom of the well. The reported primary water producing zone is located at a depth well below most local private wells. The original testing at the time of construction indicated that there was limited connection from the Firehall Well to the shallow groundwater system, and local private wells (bedrock and overburden).

Since the time of construction, the Firehall Well has experienced relatively low usage, primarily used to supply the Emergency Response Station with potable water and for emergency filling of tanker trucks for firefighting purposes.

2.9.7 Nestlé (Hillsburgh 1)

Nestlé Waters Canada (NWC) approached the Town to offer assistance with the Class EA study, through access to lands for testing and assistance with test well drilling for a possible future water supply well. The original site chosen as a possible testing site is located on the eastern portion of NWC lands. One major benefit of drilling and testing on NWC lands is the availability of NWC's extensive existing monitoring network with a long-term historical data base. The existing network and information could significantly enhance the ability of the Town to monitor the effects of drilling and testing a well, and may reduce the costs associated with that monitoring.

This site was selected for new exploratory test well drilling based on the following considerations:

- Located within the Credit Valley Watershed.
- Located relatively close to approved development and existing municipal water supply infrastructure, with potential connection via the Station Street Dam reconstruction work expected in the near future.
- Located in an area providing good spacing relative to existing municipal wells and identified capture areas.
- Located in an area with few private wells; and,
- Chosen within the property to maximize separation distance from the existing Nestlé Canada well.

Although the NWC site is closer to surface water features than the other proposed potential well sites in Hillsburgh, based on the target depth, known overlying till unit and potential presence of the Eramosa Formation, a deep source at this location is expected to provide separation from the influence of the shallow (overburden) groundwater system and surface water.

A new exploratory test well would be necessary to assess the local aquifer capacity at this location.

2.9.8 Tavares Lands, Currie Drive (Hillsburgh 2)

This site is located within an area of future expected development, referenced as the Tavares Lands, and was selected new exploratory test well drilling based on the following considerations:

- Located within the Credit Valley Watershed;
- Located within lands that are close to existing municipal water supply infrastructure;
- Located in an area that provides spacing relative to existing municipal wells and identified capture areas;
- Located in an area with few private wells.

A new exploratory test well would be necessary to assess the local aquifer capacity at this location.

2.9.9 Thomasfield Homes, Wellington Road 22 (Hillsburgh 3)

This site is located within an area of future potential development, referenced as the Thomasfield Homes Lands. A potential drilling area at the site was identified based on ground surface elevation (to minimize drilling depth) and potential connection route to the existing water supply system, as well as the following considerations:

- Located within the Credit Valley Watershed.
- Located in an area that provides good spacing relative to existing municipal wells and identified capture areas.

This location is further from existing municipal water supply infrastructure than the Nestlé and Tavares Lands and is in the vicinity of a larger number of private wells.

A new exploratory test well would be necessary to assess the local aquifer capacity at this location.

2.9.10 North of Upper Canada Drive (Hillsburgh 4)

This site is located within an area of future potential development and was selected based on the following considerations:

- Located within the Credit Valley Watershed.
- Located within lands that are close to existing municipal water supply infrastructure.
- Located in an area with relatively fewer private wells.

One issue identified for this site is the proximity to existing well H2, which is known to have a natural presence of lead. Therefore, there is a concern that a well at this location could experience the same issue. Additionally, drilling locations closest to the water supply infrastructure would likely result in relatively close spacing of the three Hillsburgh water supply wells, and, surface water features.

A new exploratory test well would be necessary to assess the local aquifer capacity at this location.

2.10 DRILLING AND TESTING PROGRAM IMPLEMENTATION

Based on the Stage 1 findings the Town authorized an initial Stage 2 drilling and testing program at the Firehall Well and the Mountainview (Erin 1). This work was initiated in late 2015 and completed by November 2017. The initial drilling and testing results are summarized in **Section 3** of this report.

As a result of the initial Stage 2 investigations, it was determined that additional Stage 2 exploratory test well drilling and testing was required and selection of additional exploratory test well drilling and testing areas was completed. That work was authorized by the Town in April 2018 and completed by March 2019. The additional drilling and testing results are summarized in **Section 3** of this report.

Water quality samples were obtained at select locations during testing. The sample results were compared to current Ontario Drinking Water Quality Standards (ODWQS) listed in Ontario Regulation 169/03 under the Safe Drinking Water Act (2002), and, according to historical Aesthetic Objective and Operational Guidelines (e.g. as listed in the *Technical Support Document for Ontario Drinking-water Quality Standards, Objectives and Guidelines*, Revised June 2006) that can assist in assessing treatment options for municipal water supplies.

3.0 EXPLORATORY TEST WELL DRILLING AND TESTING

3.1 TEST WELL DRILLING AND ASSESSMENT SUMMARY

The initial goal of the water supply assessment was to establish two new municipal water supply wells, one in Erin village and one in Hillsburgh, to meet the minimum initial supply requirements of the future growth forecast and improve system redundancy. Timing and sequence of well construction and testing program was related to factors such as: the stepwise staging of budget available for the assessment; access to individual sites for drilling and monitoring; timing of work completed by others that provided information to be considered by the Water Supply EA; time required for approvals related to testing; and, the timing of the construction and testing activities themselves.

Two existing Test Wells (one in Erin village and one in Hillsburgh) were assessed as part of the program, in order to potentially reduce drilling and construction costs by utilizing existing infrastructure. Existing wells were assessed by short or long term pumping, and, geophysical inspection (as needed).

Short term well development and/or pump testing was limited to less than 50,000 litres per day and involved monitoring the test well in addition to any nearby monitoring wells (or surface water features) for which immediate access was available. Long term testing included appropriate approvals, such as: a Permit to Take Water from the MECP; additional review and consultation with Credit Valley Conservation (CVC) regarding discharge location and groundwater and surface water monitoring requirements; a private well survey; and, monitoring of local private wells

The construction and development of the new (nominal) 152 mm diameter Exploratory Test Wells provides a preliminary assessment of the potential capacity of the chosen investigation sites through the drilling process and some short-term testing. The Exploratory Test Well drilling does not include any long-term pumping or significant removal of water from the well.

If the initial Exploratory Test Well capacity is deemed favourable, the next step would include the construction of a (nominal) 254 mm diameter (larger, potential municipal) well, and a long-term pump test to confirm capacity, assess water quality and assess impacts to the surrounding groundwater system and private water supplies.

Testing of the existing Hillsburgh Fire Hall Well commenced in July 2016. As described later in this report, this testing was unsuccessful. Subsequently, in August 2018 Nestlé Canada initiated a well drilling and testing program on their lands (Hillsburgh 1 location) as part of their ongoing monitoring program, and, to assist the Town of Erin with the Water Supply EA investigations in Hillsburgh. As described later in this report, the Nestlé test well capacity was limited. Based on the identified capacity and uncertainty related to the timing of a potential connection to the existing water supply system from the Nestlé site, an exploratory well drilling and testing program was initiated at the Hillsburgh 2 location (Tavares Lands, Currie Drive) in December 2018.

Exploratory drilling activities at the Erin 1 location (former Mountainview Well site) in Erin village commenced in October 2017. As described later in this report, the resulting well has limited capacity. Based on those results an exploratory testing and drilling program was initiated at the Erin 2 (Solmar Lands) and Erin 3 (Tavares Lands) locations.

The results of the drilling and testing programs for each of the target areas are described in **Sections 3.2** to **3.11** of this report.

3.2 MOUNTAINVIEW (ERIN 1)

The former Mountainview Subdivision Well site on Kenneth Avenue was the first priority of the test drilling activities because the site is owned by the Town (which facilitates access and reduces potential costs), and the potential aquifer capacity as identified at the former Gulia Well.

A drilling tender was awarded for the Kenneth Avenue Test Well in November 2016. The tender specified a nominal 152 mm diameter test well be drilled to a target depth of 37 m, which coincides with the main water production zone of the former Gulia Well, which was located approximately 500 m southeast of the Kenneth Avenue Test Well.

Based on concerns expressed by a local landowner, and consultations with the MECP, it was determined that during the drilling and testing period monitoring should occur on the Sivercreek Aquaculture site to ensure that springs contributing to the fish farm water supply were not affected. In addition, MECP indicated that the daily volume of water removed during the drilling process (e.g. during well development) must be measured and remain less than 50,000 litres per day (otherwise a PTTW would be required).

After MECP and landowner consultations, access was obtained and water level monitoring initiated at the Silvercreek Aquiculture site (Spring 1 and Spring 3) on October 18, 2017. Monitoring was also initiated at two water table observation wells and one private bedrock well located between the drill site and the Silvercreek Aquiculture site. The Kenneth Ave Test Well was drilled and initial well development completed by Keith Lang Water Well Drilling Inc. on November 6, 2017. Additional test well development and testing occurred on November 10, 2017.

The well record for the Kenneth Ave Well, and monitoring results, are included in **Appendix B** of this report. The drilling and testing results are summarized as follows:

- clay till overburden extends to bedrock, encountered at a depth of 21.6 m below ground surface;
- brown to grey limestone (dolostone), interpreted to be the (former) Amabel Formation, encountered to a depth of 33.2 m;
- shale (base of bedrock aquifer) encountered from 33.2 to 37.2 m depth;
- well casing installed to 21.9 m depth, open hole from 21.9 to 27.2 m;
- water producing zones (e.g. fractures) encountered at depths of 22.9 and 24.7 m;
- static level measured to be 1.7 m below ground surface;
- development pumping at consecutive 50 minute step rates of 4.0 L/s and 5.7 L/s resulted in drawdown of 10.4 and 23.2 m respectively;
- final water levels during test were below the well casing;
- average specific capacity for the well calculated to be 0.32 L/s/m; and,
- no water level changes observed over the well drilling and testing periods at any of the locations monitored (springs, water table observation wells, private bedrock well).

Water production zones at the well were identified within the relatively shallow bedrock, however not encountered at depth. The overall capacity of the well is limited, potentially in the range of 3 L/s (assuming an operationally sustainable drawdown of 10 m), which corresponds to approximately 259 m^3/d. Therefore the well as constructed is considered very marginal with respect to the identified water supply needs.

Based on the results of the Kenneth Avenue Test Well further testing and exploratory drilling at the Erin 2 site was completed.

3.3 SOLMAR LANDS, WELLINGTON ROAD 124 (ERIN 2)

The existing well, identified as TW1 for this study, located at the north end of the Solmar (former Mattamy Homes) Lands was identified as the second priority of the testing program based on location, reported historical testing results, and potential to reduce program drilling costs. The investigation results (including well records and testing records) for the Erin 2 site are included in **Appendix C** of this report.

TW1 is a nominal 152 mm diameter well drilled in May 2006 to the base of the (former) Amabel Formation, which was encountered at approximately 50.3 m below ground surface. TW1 was step tested in 2006 at reported consecutive rates of 3.8, 7.6 and 11.4 L/s with a final drawdown of approximately 10 m. Based on the 2006 results an average specific capacity of 1.5 L/s/min was identified. The 2006 test indicated that production rates on the order of 11.4 L/s (985 m^3/d) could be anticipated at an operationally sustainable drawdown of 10 m. The results showed potential given that a larger diameter well can be expected to have slightly higher production rates. However, it is noted that at 10 m drawdown the water level in the well approaches the bottom of casing. Additional testing was required to assess the current condition and pumping capacity.

Updated testing at TW1 was initiated by Ontario Water Well Services Inc. (OWWS) on December 29, 2017. The well was pumped for 122 minutes at a rate of 2.3 L/s and a final drawdown of 3.4 m was measured. Basic water quality samples were obtained at that time. Subsequent video inspection of the well indicated a significant encrustation and accumulation of naturally occurring biofilm (likely related to the well sitting unused since 2006) within the open hole. Based on the 2017 results the specific capacity of the well had declined to 0.88 L/s/m, which assuming an operationally sustainable drawdown of 10 m would result in production rates on the order of 8.8 L/s (758 m^3/d). Water quality results indicate elevated sodium and chloride concentrations were present, which may indicate surficial connection (e.g. road salting impacts). In addition, elevated concentrations of iron and manganese were also noted.

These results were considered marginal with respect to the identified water supply needs. Based on the 2017 testing results it was determined that a new nominal 152 mm diameter exploratory test well (TW2) was required to further assess the water supply potential of the Solmar Site. This work was authorized in May 2018.

TW2 was drilled and developed by Keith Lang Well Drilling Inc. on July 17, 2018. At that time TW1 was also flushed (air lifted) until the discharge water was relatively clear. The drilling results are summarized as follows:

- clay till overburden extends to bedrock, encountered at a depth of 17.6 m below ground surface;

- brown to grey limestone (dolostone), interpreted to be the (former) Amabel Formation, encountered to a depth of 50.3 m;
- shale (base of bedrock aquifer) encountered from 50.3 to 51.8 m depth;
- well casing installed to 19.2 m depth, open hole from 19.2 to 51.8 m;
- two water producing zones (e.g. fractures) encountered at depths of 28 to 29 m, and, 43 to 43.6 m;
- projected pumping rate of 11.4 L/s at 10 m drawdown.

Video well inspection, flow profiling and step testing at TW1 and TW2 was completed by Lotowater Technical Services Inc. on January 15 and 16, 2019. Basic water quality at TW2 was also sampled at that time. The test results are summarized as follows:

- TW1 specific capacity after rehabilitation of 0.75 L/s/m;
- TW1 video inspection indicates some remaining biofilm accumulation, identifies potential water production zones at depths of 19 m, 37.7 to 38.4 m, and, 40.9 to 43.5 m;
- TW1 flow profiling indicates the water producing zones at about 34 m (moderate), and, from 39 to 44 m (major production zone);
- TW2 specific capacity of 1.24 L/s/m, projected potential pumping rate of 12.2 L/s assuming 10 m drawdown (equates to 1,069 m3/d);
- TW2 video inspection indicates some biofilm presence, identifies potential water production zones at depths of 29 m and 44 m below ground surface;
- TW2 flow profiling indicates the water producing zones from 28 to 30 m (moderate), and, from 40 to 42 m (major production zone);
- TW2 water quality results similar water quality as observed at TW1 (possible road salt impacts), however iron and manganese concentrations are reduced; and,
- Pumping TW1 at 10 L/s resulted in a drawdown of 10.4 m at TW1 and 4.6 m at TW2 (separation distance of approximately 10 m).

Rehabilitation efforts to date at TW1 have not restored the well to the original reported capacity. The projected capacity at TW2 is at the lower end of water supply needs identified for this assessment. Based on the historical and drilling and testing it appears there may be some water supply potential at the Solmar testing site, however results to date indicate individual well capacities are limited.

Additional testing may be appropriate in the future to determine if, for example, combined pumping at TW1 and TW2, or exploratory test wells at other well locations at the Solmar property, would result in more appropriate production rates.

Based on the results of the Solmar test wells, further testing and exploratory drilling at the Erin 3 site was completed.

3.4 TAVARES LANDS, WELLINGTON ROAD 23 (ERIN 3)

A nominal 152 mm diameter exploratory test well, referenced as TW3, was drilled and developed by Keith Lang Well Drilling Inc. on December 12, 2018. The investigation results (including well record and testing records) for the Erin 3 site are included in **Appendix D** of this report.

The drilling results are summarized as follows:

- clay till overburden extends to bedrock, encountered at a depth of 40.5 m below ground surface;
- brown to grey limestone (dolostone), interpreted to be the (former) Amabel Formation, encountered to a depth of 82.0 m;
- shale (base of bedrock aquifer) encountered from 82.0 to 84.4 m depth;
- well casing installed to 41.8 m depth, open hole from 41.8 to 84.4 m; and,
- two significant water producing zones (e.g. fractures) encountered at depths of 51.8 m, and, 73.8 m.

Video well inspection, flow profiling and step testing at TW3 was completed by Lotowater Technical Services Inc. on January 22 and 28, 2019. At that time a water quality sample was obtained. The test results are summarized as follows:

- TW3 video inspection and flow profiling indicates water production zones at depths of 56.7 m (10% of inflow), 66.1 m (15% of inflow), and 73.2 m (70% of inflow);
- TW3 step testing results in a specific capacity of 3.15 L/s/m;
- projected potential pumping rate of 31.5 L/s (2,722 m3/d) based on an assumed operationally sustainable drawdown of 10 m; and,
- overall good water quality results are noted, however slightly elevated sulfate is present (at concentrations below drinking water guidelines), sodium and chloride are present at relatively low concentrations.

Based on the drilling and testing results a decision was made to proceed to the municipal well construction and testing stage at the Erin 3 site.

3.5 WELLINGTON ROAD 52 (ERIN 4)

Based on the successful results obtained at the Erin 3 location, no additional test drilling was completed. Future water supply investigations, if required, can be completed to assess potential water supply capacity of the Erin 4 site.

3.6 8TH LINE/DUNDAS (ERIN 5)

Based on the successful results obtained at the Erin 3 location, no additional test drilling was completed. Future water supply investigations, if required, can be completed to assess potential water supply capacity of the Erin 5 site.

3.7 FIREHALL WELL (HILLSBURGH)

In order to assess the full capacity of the Firehall Well, planning and arrangements for a pumping test were initiated in late 2015. The prepatory work included: obtaining a Category 2 (Temporary) PTTW from MECP; consultation with CVC regarding monitoring requirements; and, selection of a pump test contractor. Prior to the test a private water well survey was conducted to satisfy conditions of the PTTW and obtain further information on local private water supply wells.

The investigation documentation and results (including well record, copy of the PTTW, private well survey, and pump test monitoring results) for the Hillsburgh Firehall Well are included in **Appendix E** of this report.

The pump test was completed in July 2016. During the test, the pumping capacity of the well varied unexpectedly; at high pumping rates the well produced significant amounts of sediment; and, a response was observed at a number of private wells and monitoring points completed in both the overburden and bedrock (upper and lower bedrock zones).

Due to the unexpected results of the pumping test, a video flow log of the well was then completed by OWWS to help determine the source of the sediment and identify the main water production zone. The video log indicated that the main water production zone is in the uppermost bedrock, near the well casing/bedrock contact. This is also the source of the sediment that is noted in the well water at high pumping rates and drawdowns. The lowermost zone was shown to have limited water production.

As a result of the pump test and video inspection, the Firehall Well is not recommended for use as a municipal supply.

Based on the drilling and testing results a decision was made by the Town to review well construction and testing completed by Nestlé Waters Canada (NWC) at the Hillsburgh 1 site prior to advancing any further exploratory test wells in the Hillsburgh area.

3.8 NESTLÉ LANDS (HILLSBURGH 1)

NWC, as part of an initiative to expand their monitoring network, completed a drilling program within the former Morette Furniture site (15 Station Street). As part of that work NWC also drilled and tested a deep well adjacent to the new monitoring wells. The deep well was completed, in part, to provide a preliminary assessment of the potential for a new water supply source for Town, and thereby assist the Class EA. NWC has shared drilling and testing results with the Town of Erin, those results are summarized below.

The nominal 152 mm diameter test well (TW01-18) was completed by SD Hopper Drilling, under the direction of Golder Associates on behalf of NWC, on August 9, 2018. The drilling results are summarized as follows:

- silty to sandy gravel, and, silty sand Till with gravel extends to bedrock, encountered at a depth of 21.6 m below ground surface;
- well casing installed to 23.6 m depth;
- well was advanced to a depth of 82.6 m below ground surface, well completed as an open hole in rock (from 23.6 to 82.6 m); and,
- an aquitard separating upper and lower aquifer zones was encountered from 43.9 to 47.5 m below ground surface.

Based on the known stratigraphy in the area, the "aquitard" described by Golder is assumed to be the Vinemount Member (Eramosa Formation) separating the Guelph Formation upper aquifer and the former unsubdivided Amabel Formation lower aquifer. Subsequent testing was completed on the lower aquifer zone using an inflatable packer installed within the aquitard zone, and a summary report was provided to the Town of Erin on September 6, 2018. The report indicates two short term constant rate tests, as well as a step test, was completed at rates up to 11 L/s. A non-pumping ("static") level of 10.7 m below ground surface and maximum pumping drawdown on the order of 24 m was reported. Based on the results a specific capacity of 0.48 L/s/m was estimated. Golder Associates projected a lower zone potential production rate of 15.8 L/s (1,365 m^3/day) assuming a total drawdown of 33.2 m (to the top of the aquitard zone).

For comparison with other testing results obtained as part of the Class EA, a revised projection based on an assumed operationally sustainable drawdown of 10 m projected a potential pumping rate of 4.8 L/s (413 m^3/day). Based on the revised projection, the NWC lower zone as tested would not meet the identified water supply needs.

We note that NWC subsequently converted the original test well to monitoring well by installing a nominal 102 mm diameter steel casing (liner) to 47.6 m below ground surface (bottom of aquitard), and, a nominal 51 mm diameter PVC well screen (in the lower zone) and riser pipe to surface. The monitoring well is screened from 68.6 to 74.7 m depth, with a sand pack from 67.1 to 75.6 m depth. A bentonite seal was installed both below and above the sand pack. The annular space between the original well casing and smaller diameter steel liner was also sealed, using cement.

Based on the TW01-18 testing results, a decision was made to proceed to additional exploratory test well drilling at the Hillsburgh 2 site.

3.9 TAVARES LANDS, CURRIE DRIVE (HILLSBURGH 2)

A nominal 152 mm diameter exploratory test well, referenced as TW4, was drilled and developed by Keith Lang Well Drilling Inc. on December 30, 2018. The investigation results (including well record and testing records) for the Hillsburgh 2 site are included in **Appendix F** of this report.

The drilling results are summarized as follows:

- till overburden extends to a depth of 4.6 m below ground surface;
- sand and gravel overburden encountered from 4.6 to 17.7 m below ground surface;
- highly fractured bedrock encountered from 17.7 to 21.9 m below ground surface
- brown limestone (dolostone), assumed to be Guelph Formation, encountered from 17.7 to 44.2 m depth;
- grey limestone (dolostone), assumed to be former Amabel Formation, encountered from 44.2 to 93.9 m depth;
- shale (base of bedrock aquifer) encountered from 93.9 to 97.5 m depth;
- well casing installed to 20.7 m depth, open hole from 20.7 to 97.5 m; and,
- two significant water producing zones (e.g. fractures) encountered at depths of 21.3 m, and, 86.3 m.

Video well inspection, flow profiling and step testing at TW4 was completed by Lotowater Technical Services Inc. on January 22, 2019. General water quality sampling was also completed at that time. The test results are summarized as follows:

- TW4 video inspection indicates numerous potential water production zones at depths of 20.8 to 22.6 m (cavern, fractures, vuggs), 24.9 m (fracture), 30.6 to 34 m (fractures, vuggs), and, 76.7 to 82.6 m (cavern, fractures, vuggs) below ground surface;
- flow profiling was inconclusive, with no vertical flow velocities recorded below the pump;
- measured total well depth of 88.5 m, and rock rubble observed at bottom of well;
- TW4 open hole step testing at rates up to 9.5 L/s resulted in 0.8 m drawdown;

- estimated open hole specific capacity of 12.13 L/s/m;
- much of the water produced by the open hole appears to be from the upper highly fractured Guelph Formation;
- projected potential open pumping rate of 121.3 L/s (10,481 m3/d) based on an assumed operationally sustainable drawdown of 10 m (however projection is very tentative and based on limited data); and,
- generally good water quality results are noted, however elevated hydrogen sulphide is present along with elevated iron and manganese, sodium and chloride are at moderate concentrations which may indicate some surficial connection may be present as the water quality is expected to be representative of the upper zone (predominantly).

The initial drilling and testing results indicated a highly productive well as constructed. However based on the presence of sand and gravel to surface and highly fractured upper bedrock some concerns with the well as constructed were identified related to connection to surface. It was decided to utilize a packer to test the capacity of the lower zone (only) in order to assess the capacity of the deep bedrock aquifer.

A short term test of the lower aquifer zone was completed by Keith Lang Drilling Inc. on May 3, 2019. General water quality samples were obtained during the test. An inflatable packer was set to approximately 30.5 to 31.5 m below ground surface and the lower zone pumped at rates of 3.4 and 7.2 L/s. Based on the results a lower zone specific capacity of 1.75 L/s/m was estimated, and a projected pumping rate of 17.5 L/s based on an assumed operationally sustainable drawdown of 10 m. The results are interpreted to be relatively conservative based on the video inspection identification of major water production zones at depth and due to limitations with the packer and pumping configuration.

Water quality results from the lower zone at TW4 are somewhat similar as compared to the open hole results, however based on the pumping time there may be residual characteristics from the upper zone due to the flow of water from the upper to lower zones over time. Sodium, chloride, iron and manganese concentrations are slightly lower than observed from the open hole samples, however sulfate concentrations are slightly higher (but below drinking water guidelines).

Based on the drilling and testing results a decision was made to proceed to the municipal well construction and testing stage at the Hillsburgh 2 site.

3.10 THOMASFIELD HOMES, WELLINGTON ROAD 22 (HILLSBURGH 3)

Based on the successful results obtained at the Hillsburgh 2 location, no additional test drilling was completed. Future water supply investigations, if required, can be completed to assess potential water supply capacity of the Hillsburgh 3 site.

3.11 NORTH OF UPPER CANADA DRIVE (HILLSBURGH 4)

Based on the successful results obtained at the Hillsburgh 2 location, no additional test drilling was completed. Future water supply investigations, if required, can be completed to assess potential water supply capacity of the Hillsburgh 4 site.

3.12 TEST COMPARISON

A comparison of testing results is provided in Table 2.

Well	Step	Pumping Rate (Q) L/s	Drawdown (Sw) (m)	Specific Capacity (Sw/Q)		Projected Pumping Rate Drawdown = 10 m (L/s)
				Step (L/s/m)	Average (L/s/m)	
2018 Nestle		3.2	6.60	0.48	0.48	4.8
		4.8	9.70	0.49		
		7.4	14.70	0.50		
		10.7	24.80	0.43		
		11	23.00	0.48		
2006 Solmar TW1 Testing	1	3.8	1.95	1.95	1.50	15.0
	2	7.6	5.38	1.41		
	3	11.4	10.04	1.14		
Solmar TW1	3	3	5.80	0.52	0.75	7.5
	2	6.5	8.31	0.78		
	1	10	10.37	0.96		
Solmar TW2	1	3	2.67	1.12	1.24	12.4
	2	6.5	4.86	1.34		
	3	10	8.00	1.25		
Erin North TW3	2	4.5	1.37	3.28	3.15	31.5
	1	6	1.99	3.02		
Currie Dr TW4	1	3.5	0.31	11.29	12.13	121.3
	2	6	0.47	12.77		
	3	9.5	0.77	12.34		
TW4 Lower Zone	1	3.4	2.00	1.70	1.75	17.5
	2	7.2	4.00	1.80		
Note:	Nestle data estimated from report provided September 6, 2019 Unless noted tests were completed in 2019					

Table 2: Testing Comparison

The comparison is also shown graphically in Figure 13. As illustrated, exploratory test wells TW3 (Erin Village) and TW4 (Hillsburgh) have the highest potential for water supply capacity, and the potential to provide water at rates that meet the initial water supply targets in each community.

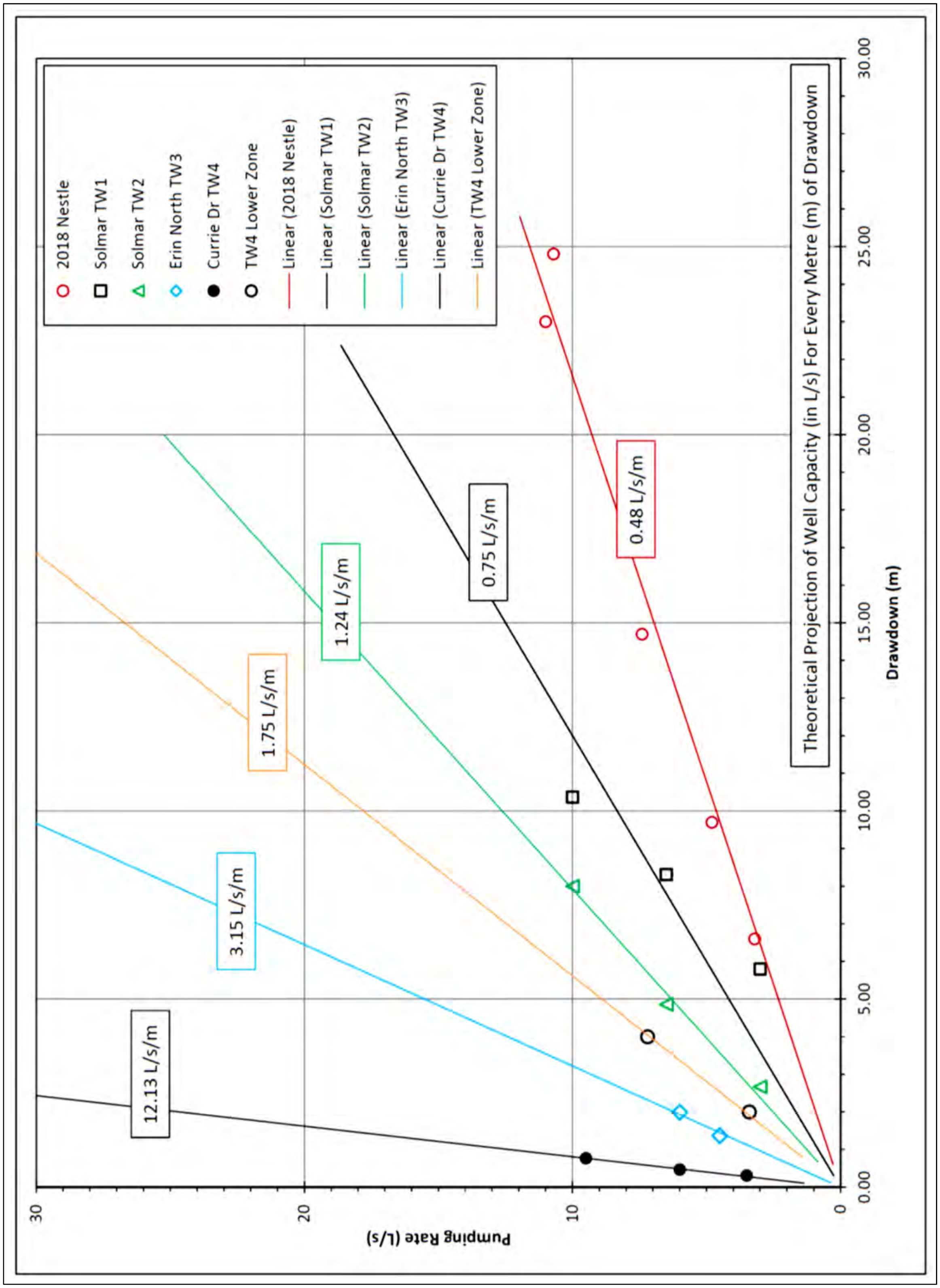


Figure 13: Step Test Comparison

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

Based on the results of the Stage 1 and Stage 2 Class EA investigations, including exploratory test well drilling and testing program implemented to date, sites Ein 3 (TW3) and Hillsburgh 2 (TW4) show favorable aquifer conditions for Municipal Well construction and testing as part of Stage 3 investigations.

4.2 RECOMMENDATIONS

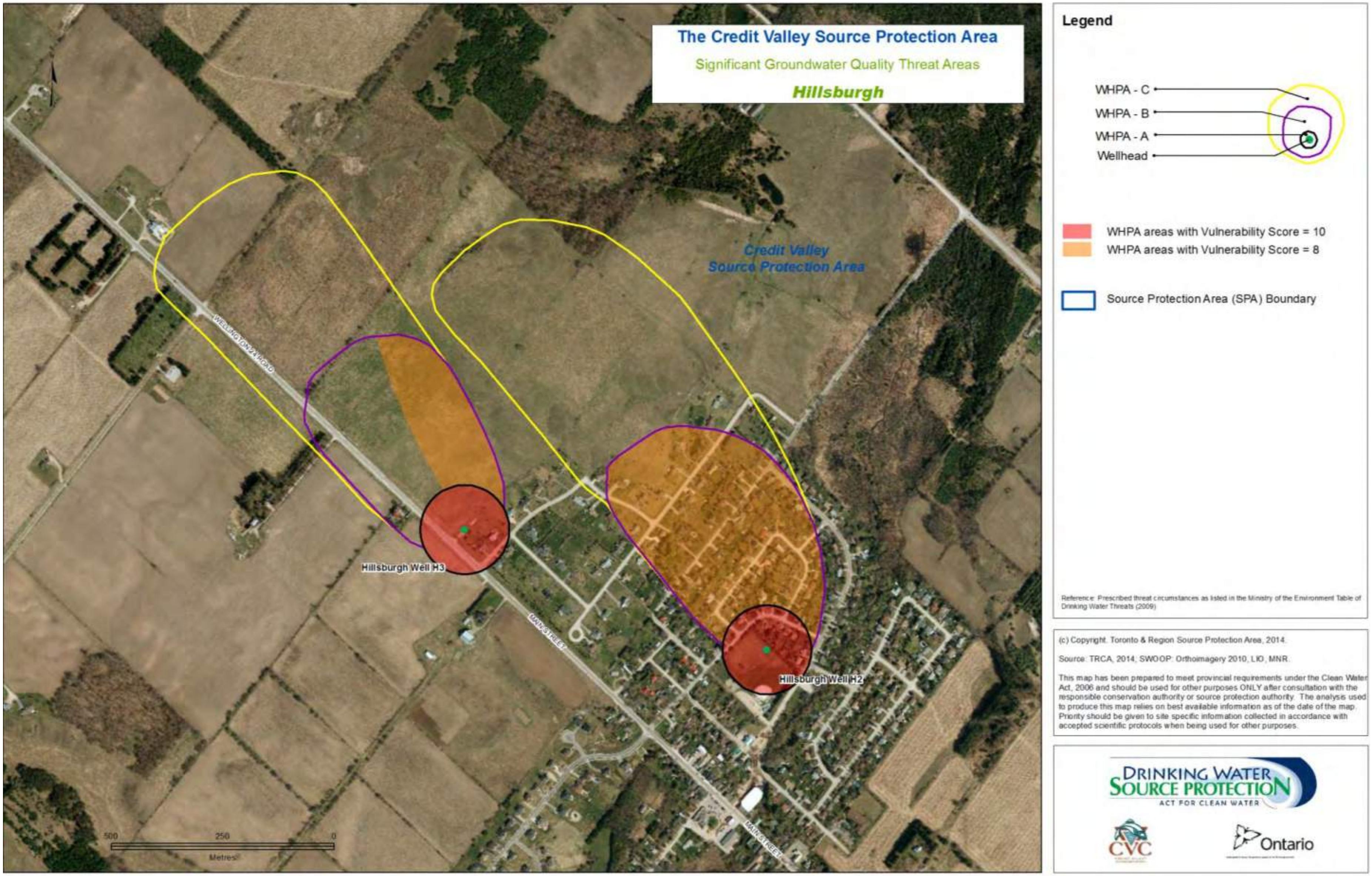
Therefore, based on the findings to date, it is recommended, in conjunction with the Town and Triton, that Stage 3 work, including Municipal Well construction and testing, be completed at the Ein 3 (TW3) and Hillsburgh 2 (TW4) sites.

Groundwater Science Corp.

Andrew Pentney, P.Geo.
Senior Hydrogeologist

Appendix A

WHPA Mapping



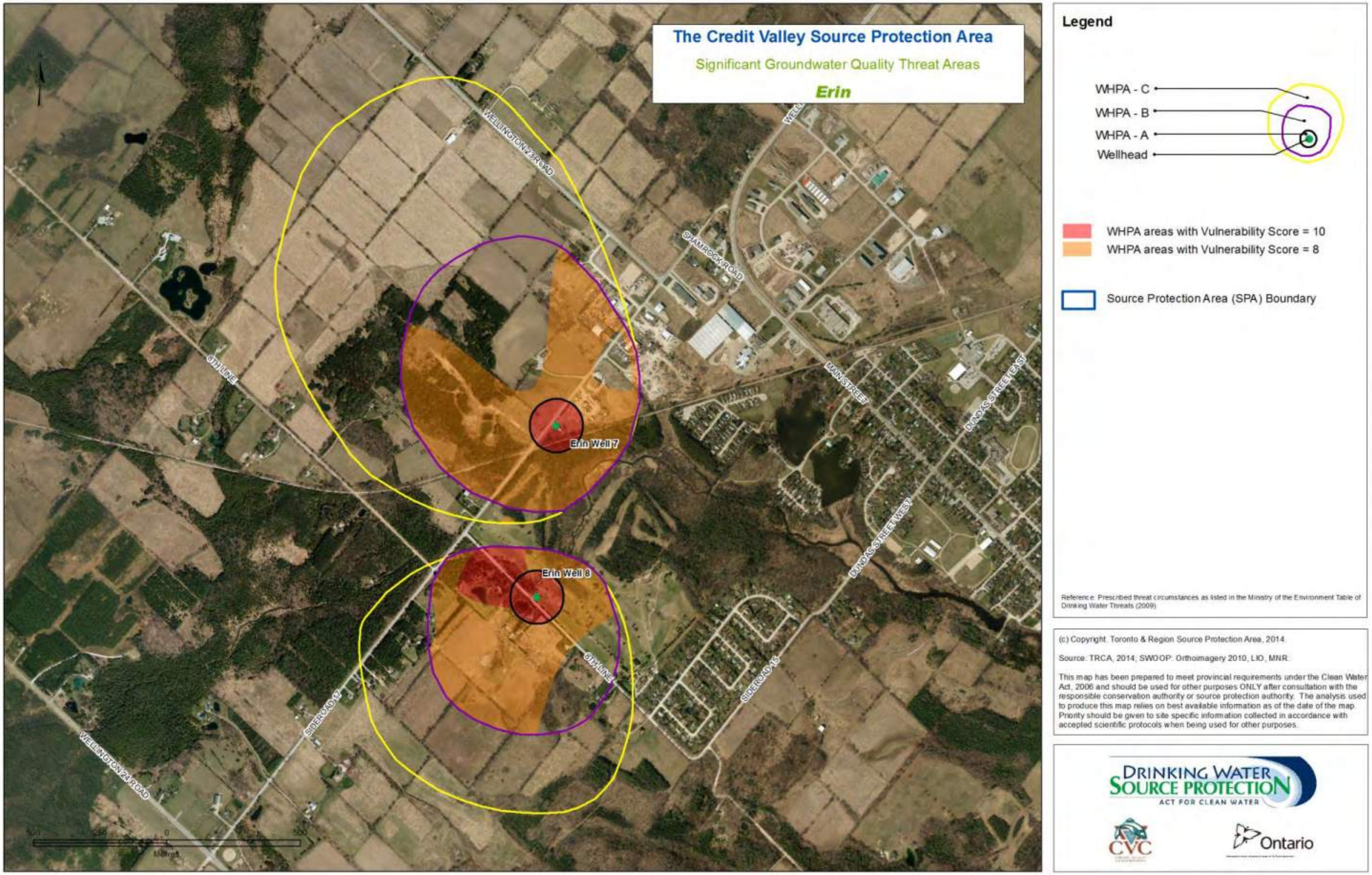
Reference: Prescribed threat circumstances as listed in the Ministry of the Environment Table of Drinking Water Threats (2009)

(c) Copyright: Toronto & Region Source Protection Area, 2014.

Source: TRCA, 2014; SWOOP: Orthoimagery 2010, LIO, MNR.

This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.

Map 1.4: Hillsburgh – Significant Groundwater Quality Threat Areas

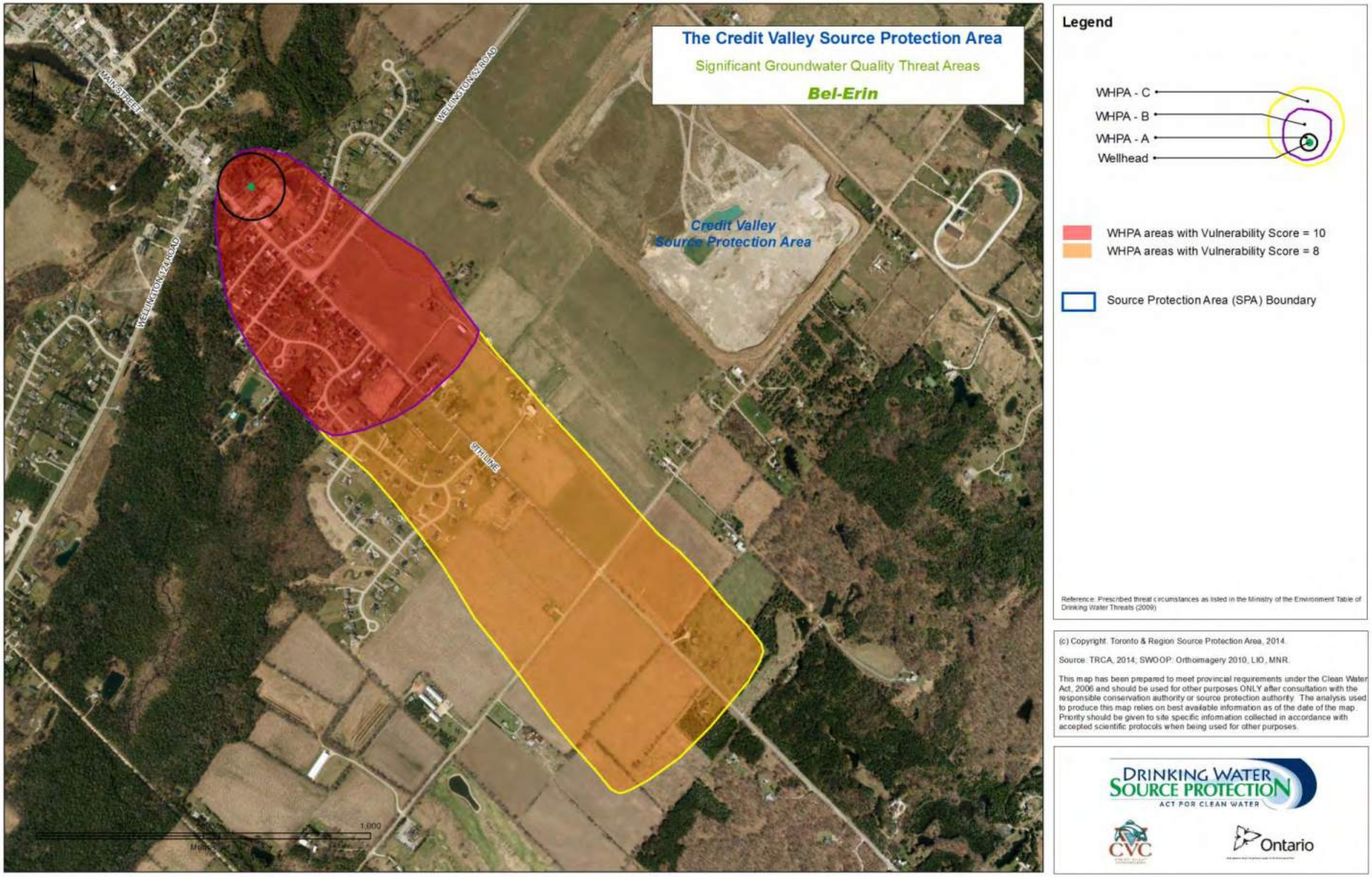


Reference: Prescribed threat circumstances as listed in the Ministry of the Environment Table of Drinking Water Threats (2009)

Source: TRCA, 2014; SWOOP: Orthoimagery 2010, LIO, MNR.

This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.

Map 1.5: Erin – Significant Groundwater Quality Threat Areas



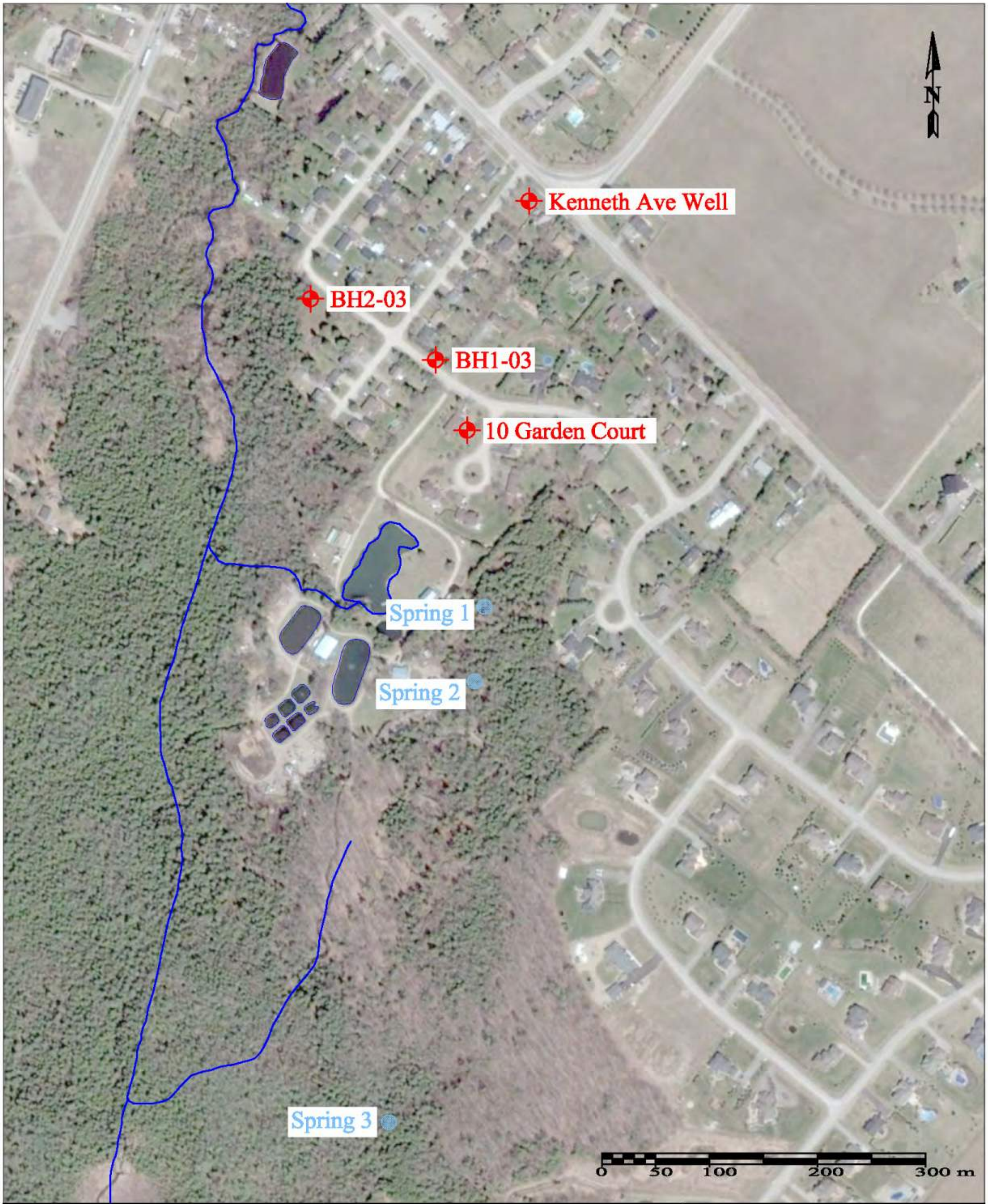
Reference: Prescribed threat circumstances as listed in the Ministry of the Environment Table of Drinking Water Threats (2009)

Source: TRCA, 2014; SWOOP: Orthoimagery 2010, LIO, MNR.

This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.

Map 1.6: Bel-Erin – Significant Groundwater Quality Threat Areas

Appendix B
Mountainview (Erin 1)
Drilling and Testing Results



Drilling and monitoring locations as shown

— surface water (pond, creek)

— mapped wetlands

modified from: OBM mapping
UNDER LICENSE, WITHOUT PREJUDICE OR ENDORSEMENT, FROM THE QUEEN'S PRINTER OF ONTARIO, 2005

February 2020
Scale: as shown

Groundwater Science Corp.

Monitoring Locations

Town of Erin Water Supply EA
Kenneth Ave Welll

Ontario Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
21940
Tag#:A 219403

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Well Owner's Information

First Name / Last Name / Organization: TOWN OF ERIN WATER WORKS
E-mail Address:
☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name): 5684 WELLINGTON RD RR#2
Municipality: HILLSBURGH
Province: ONT
Postal Code: N0B1Z0
Telephone No. (inc. area code):

Well Location

Address of Well Location (Street Number/Name):
Township: ERIN
Lot: 13
Concession: 9
County/District/Municipality: WELLINTON
City/Town/Village:
Province: **Ontario**
Postal Code:
UTM Coordinates Zone: NAD 83 17
Easting: 576087
Northing: 4846002
Municipal Plan and Sublot Number:
Other:

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	Depth (m/ft) To
BROWN	CLAY & STONES			0	12ft
GRAY	SILTY CLAY & STONES			12ft	28ft
GRAY	CLAY & STONES			28ft	71ft
BROWN	LIMESTONE			71ft	87ft
GRAY	LIMESTONE			87ft	109ft
GRAY	SHALE			109ft	122ft

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	72ft	BENTONITE SLURRY 110gal	

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): 100ft
Pumping rate (l/min / GPM): 90gpm
Duration of pumping: 1 hrs + 25 min
Final water level end of pumping (m/ft): 86ft
If flowing give rate (l/min / GPM):
Recommended pump depth (m/ft): 100ft
Recommended pump rate (l/min / GPM): 90gpm
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	8ft		
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	

TO BE TESTED BY OTHERS

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
6¼	steel	.188	0	72ft
6in	open hole		72ft	122ft

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

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

Water Details

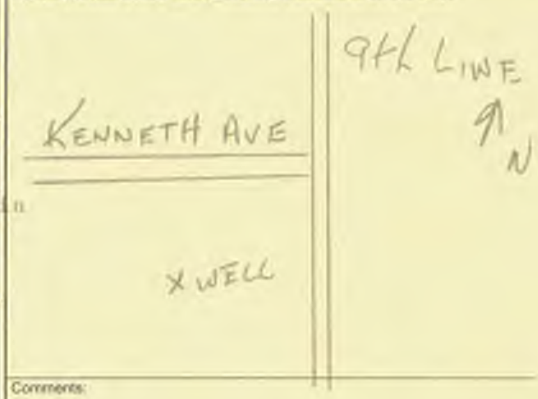
Water found at Depth 75ft (m/ft) ☐ Gas; Kind of Water: ☑ Fresh ☐ Untested ☐ Other, specify
Water found at Depth 81ft (m/ft) ☐ Gas; Kind of Water: ☑ Fresh ☐ Untested ☐ Other, specify
Water found at Depth (m/ft) ☐ Gas; Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	72ft	8.75in
72ft	122ft	6in

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor: KEITH LANG WELL DRILLING INC
Well Contractor's Licence No.: 7154
Business Address (Street Number/Name): 251 ELDON ST GODERICH
Municipality:
Province: ONT
Postal Code: N7A3B9
Business E-mail Address:
Bus. Telephone No. (inc. area code):
Name of Well Technician (Last Name, First Name): KEITH LANG
Well Technician's Licence No.: T446
Signature of Technician and/or Contractor: K. Lang
Date Submitted: Y Y Y Y M M D D

Well owner's information package delivered: ☐ Yes ☒ No
Date Package Delivered: Y Y Y Y M M D D
Date Work Completed: 2017 1113

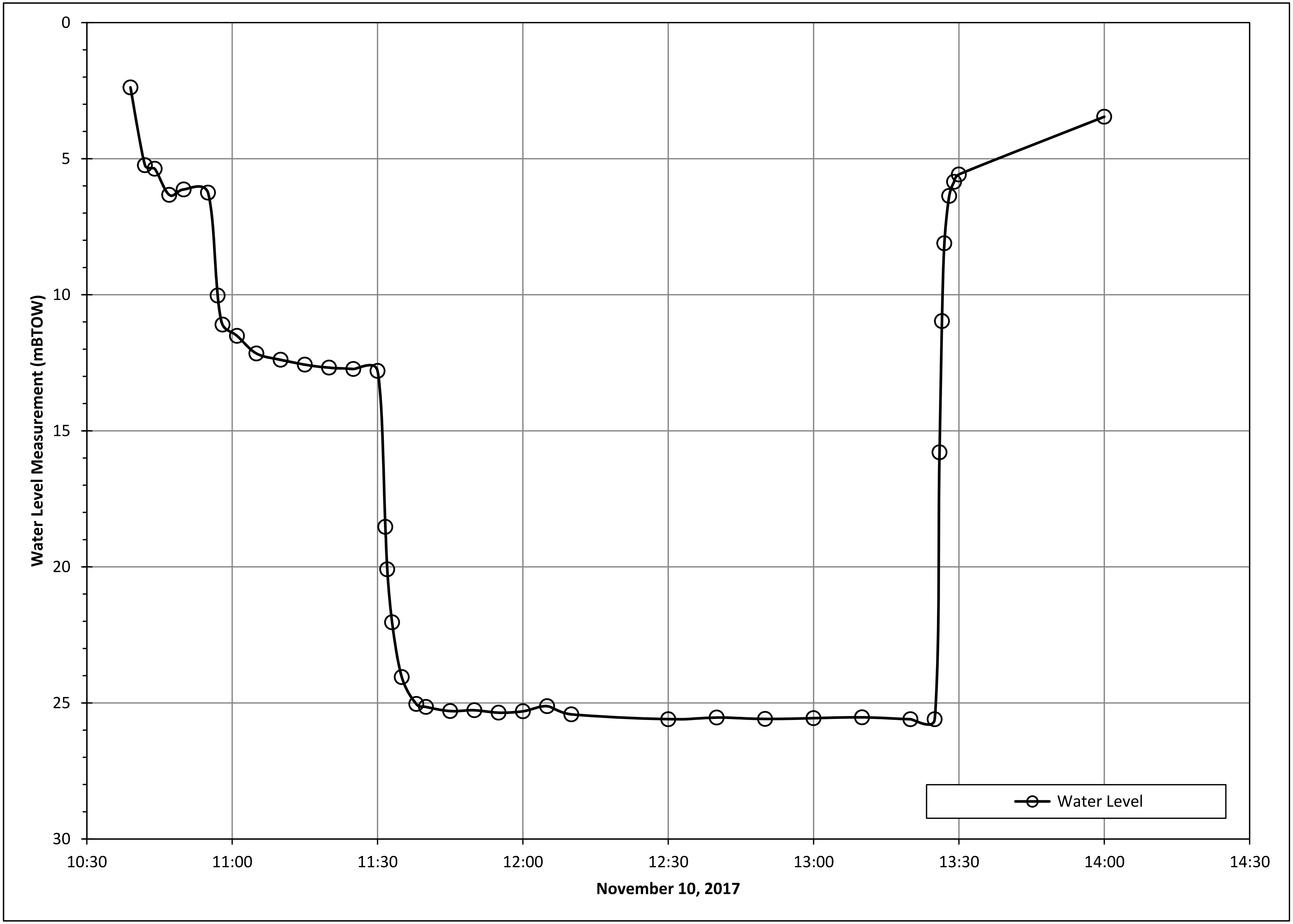
Ministry Use Only
Audit No. Z270834
Received

0506E (2014/11)

Contractor's Copy

Time 10-Nov-17	Water Level (mBTOW)	Test Contractor: Keith Lang Drilling	Discharge point: roadside ditch, south side of 9th Line at Kenneth Ave, flows northwest
10:00:00	2.39	SU = 0.56 mAGS	TD = 36.22 mBTOW

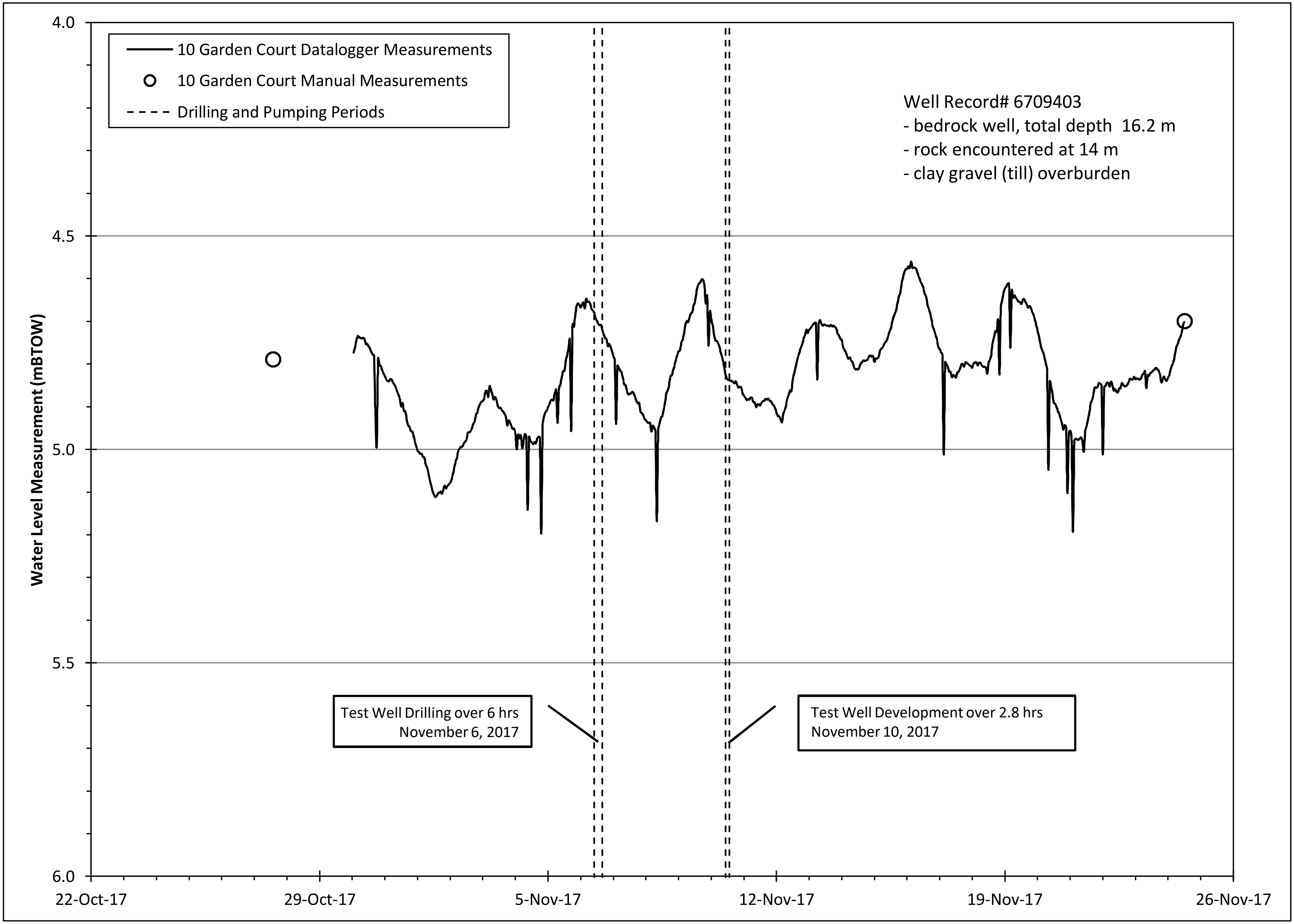
Time 13-Nov-17	Elapsed (min)	Water Level (ftBTORef)	Water Level (mBTOW)	DD (m)	Rate (US GPM)	Totalizer (US Gal)	Event / Comment
							pump set at approx 103 ft BTOW
10:39:00	static	10.00	2.38			747,008	temp Ref = 0.67 mAGS
10:39:45	0.0						pumping start
10:42:00	2.3	19.40	5.24	2.86			
10:44:00	4.3	19.80	5.37	2.99	33.86		
10:47:00	7.3	22.95	6.33	3.95			discharge clear
10:50:00	10.3	22.30	6.13	3.75		747,374	
10:55:00	15.3	22.70	6.25	3.87		747,540	set rate at 60 GPM
10:57:00	17.3	35.10	10.03	7.65			
10:58:00	18.3	38.60	11.1	8.72	64.6		
11:01:00	21.3	39.95	11.51	9.13	63.63		
11:05:00	25.3	42.10	12.16	9.78	63.63		discharge clear
11:10:00	30.3	42.85	12.39	10.01			
11:15:00	35.3	43.45	12.57	10.19			
11:20:00	40.3	43.80	12.68	10.3	62.9		
11:25:00	45.3	43.95	12.73	10.35	62.66		average Step 1 rate (L/s): 3.99
11:30:00	50.3	44.20	12.8	10.42	62.42		increase rate to 102.8 GPM
11:31:37	51.9	63.00	18.53	16.15			
11:32:00	52.3	68.10	20.09	17.71	97.23		
11:33:00	53.3	74.50	22.04	19.66			discharge cloudy
11:35:00	55.3	81.10	24.05	21.67	92.87		
11:38:00	58.3	84.35	25.04	22.66	91.3		
11:40:00	60.3	84.70	25.15	22.77	90.45		
11:45:00	65.3	85.20	25.3	22.92	89.7		
11:50:00	70.3	85.10	25.27	22.89	89.6		
11:55:00	75.3	85.40	25.36	22.98	89.49		no flow in discharge ditch past
12:00:00	80.3	85.25	25.31	22.93	89.49		house #5390 (all water infiltrates)
12:05:00	85.3	84.60	25.12	22.74	90.58		
12:10:00	90.3	85.60	25.42	23.04	89.85		
12:30:00	110.3	86.20	25.6	23.22	89.97		
12:40:00	120.3	86.00	25.54	23.16	89.73		
12:50:00	130.3	86.15	25.59	23.21	89.6		
13:00:00	140.3	86.05	25.56	23.18	89.37		Available Drawdown (m): 29.0
13:10:00	150.3	85.95	25.53	23.15	89.61		
13:20:00	160.3	86.20	25.6	23.22	89.24		average Step 2 rate (L/s): 5.71
13:25:00	165.3	86.20	25.6	23.22		760,075	
13:25:32	165.8					760,098	stop pumping (no check valve
13:26:00	166.3	54.00	15.79	13.41			at pump, discharge valve closed)
13:26:30	166.8	38.20	10.97	8.59			
13:27:00	167.3	28.80	8.11	5.73			Total Pumped (L): 49,551
13:28:00	168.3	23.10	6.37	3.99			
13:29:00	169.3	21.40	5.85	3.47			
13:30:00	170.3	20.50	5.58	3.2			pump removal
14:00:00	200.3	11.35	3.46	1.08			reading from TOW



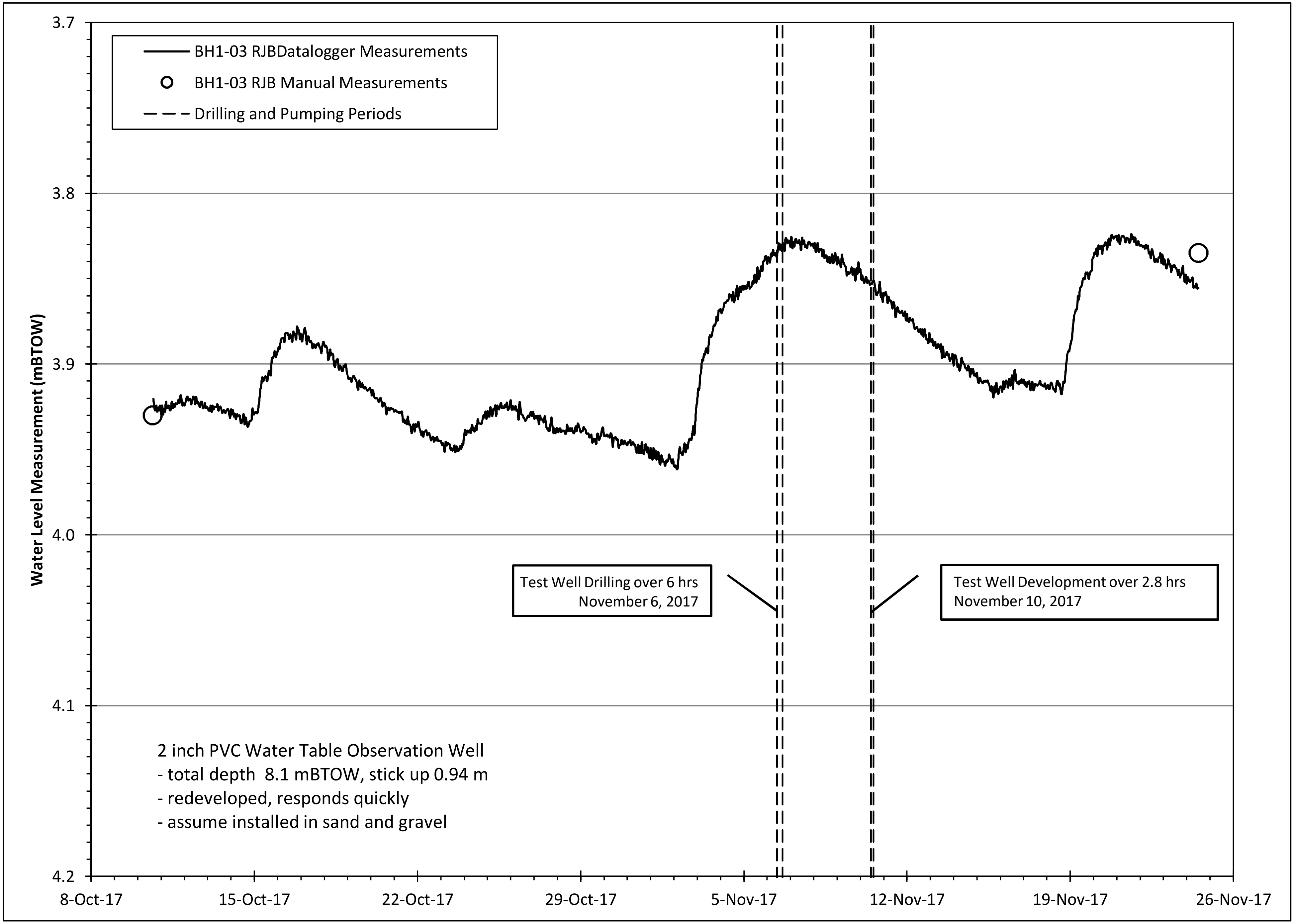
Town of Erin
Water Supply EA

Kenneth Ave Well Step Test Hydrograph

Groundwater Science Corp
Hydrogeological Assessment



Kenneth Ave Drilling and Testing
Private Well Hydrograph



Test Well Drilling over 6 hrs
November 6, 2017

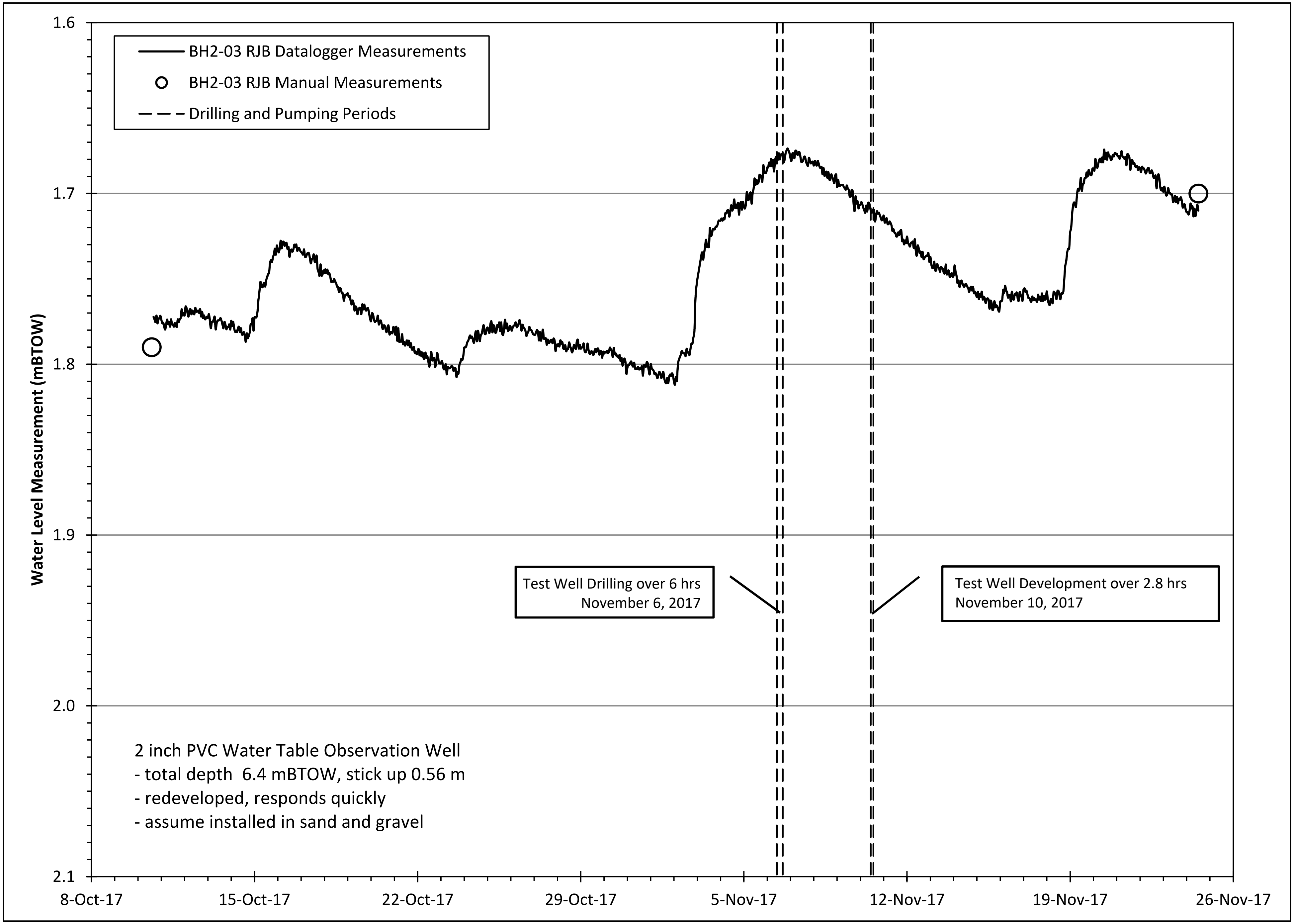
Test Well Development over 2.8 hrs
November 10, 2017

2 inch PVC Water Table Observation Well
- total depth 8.1 mBTOW, stick up 0.94 m
- redeveloped, responds quickly
- assume installed in sand and gravel

Town of Erin
Water Supply EA

Kenneth Ave Drilling and Testing
BH1-03 Hydrograph

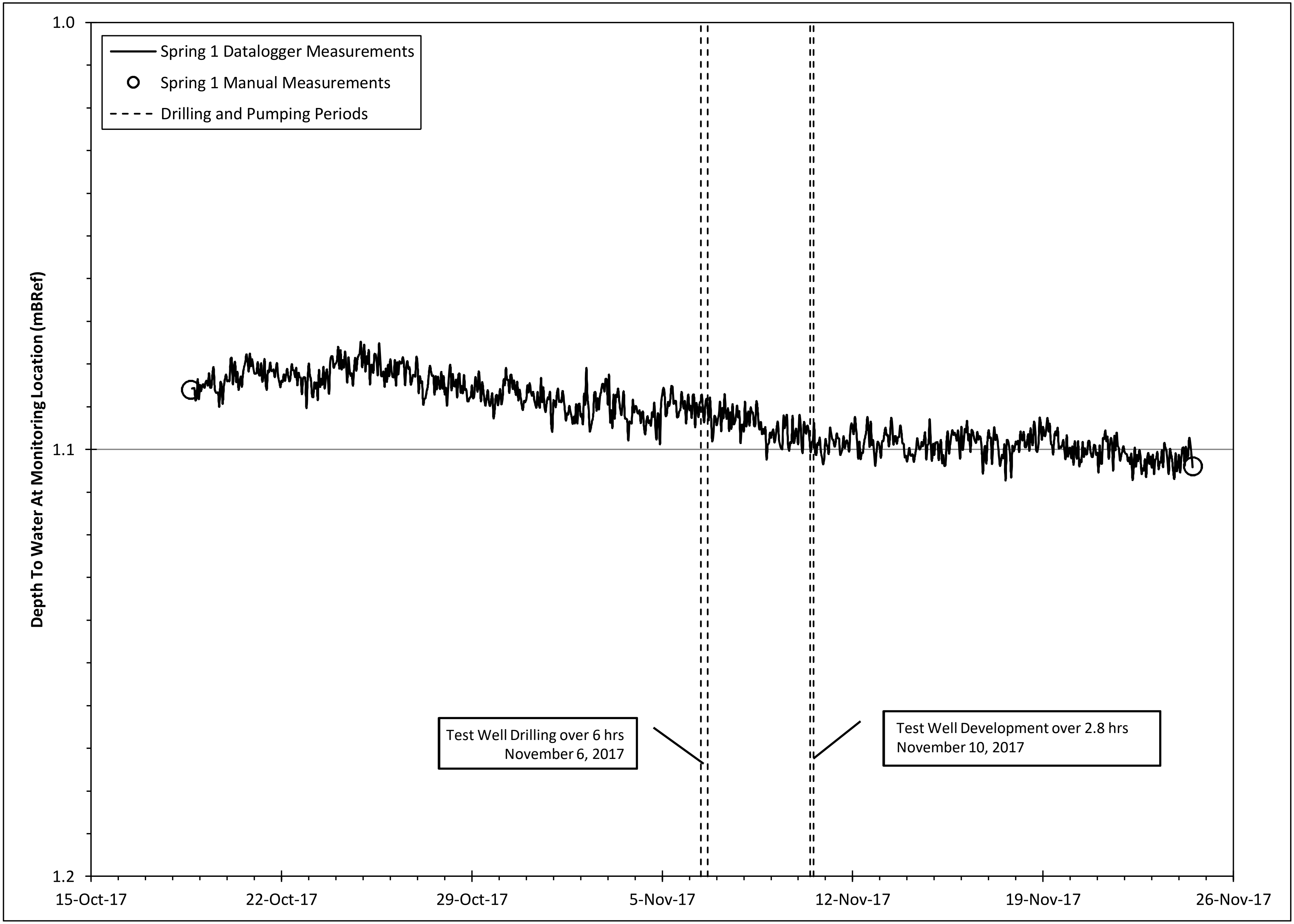
Groundwater Science Corp
Hydrogeological Investigation



Town of Erin
Water Supply EA

Kenneth Ave Well Drilling and Testing
BH2-03 Hydrograph

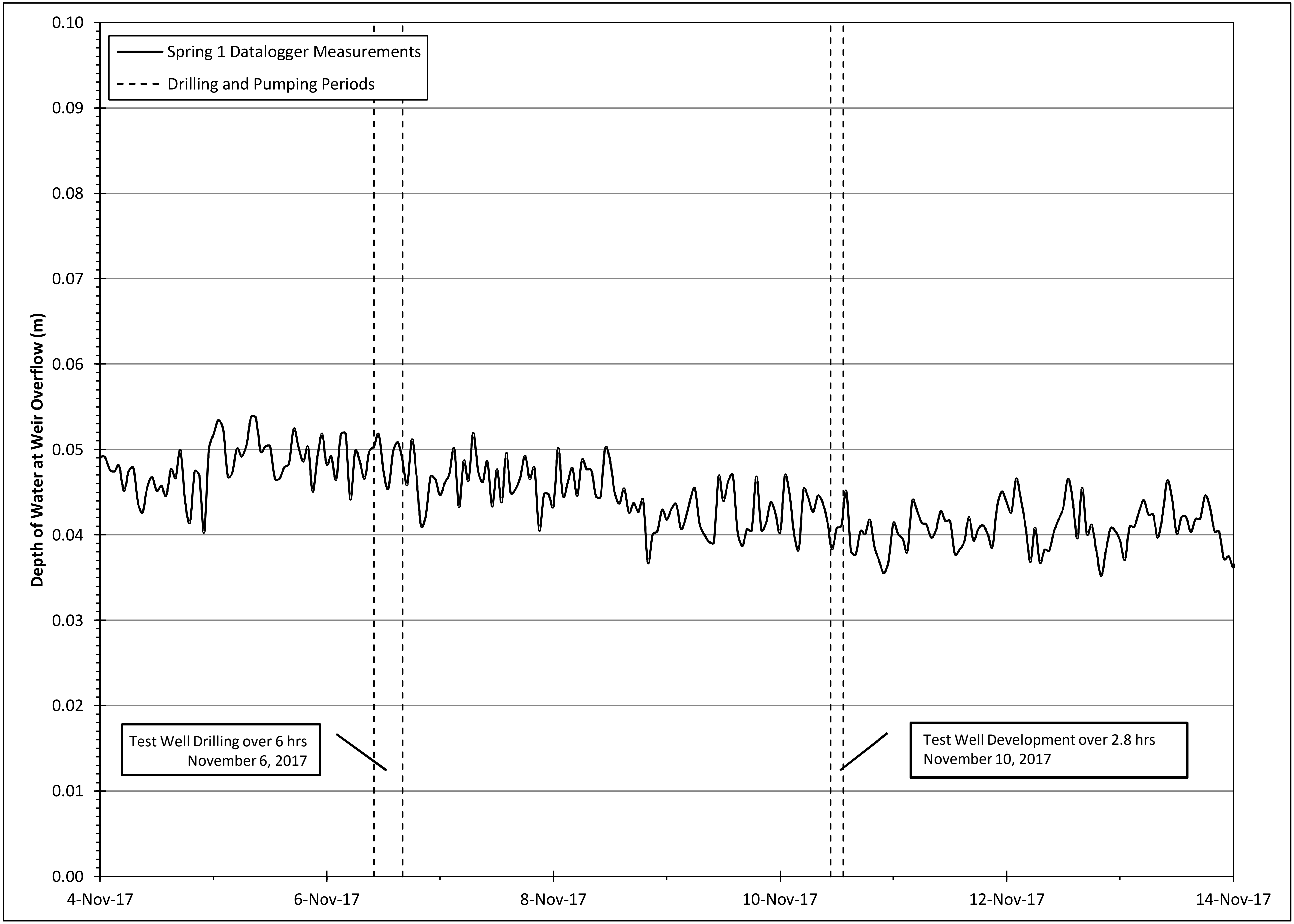
Groundwater Science Corp
Hydrogeologic Assessment



Town of Erin
Water Supplly EA

Kenneth Ave Well Drilling and Testing
Spring 1 Monitoring Hydrograph

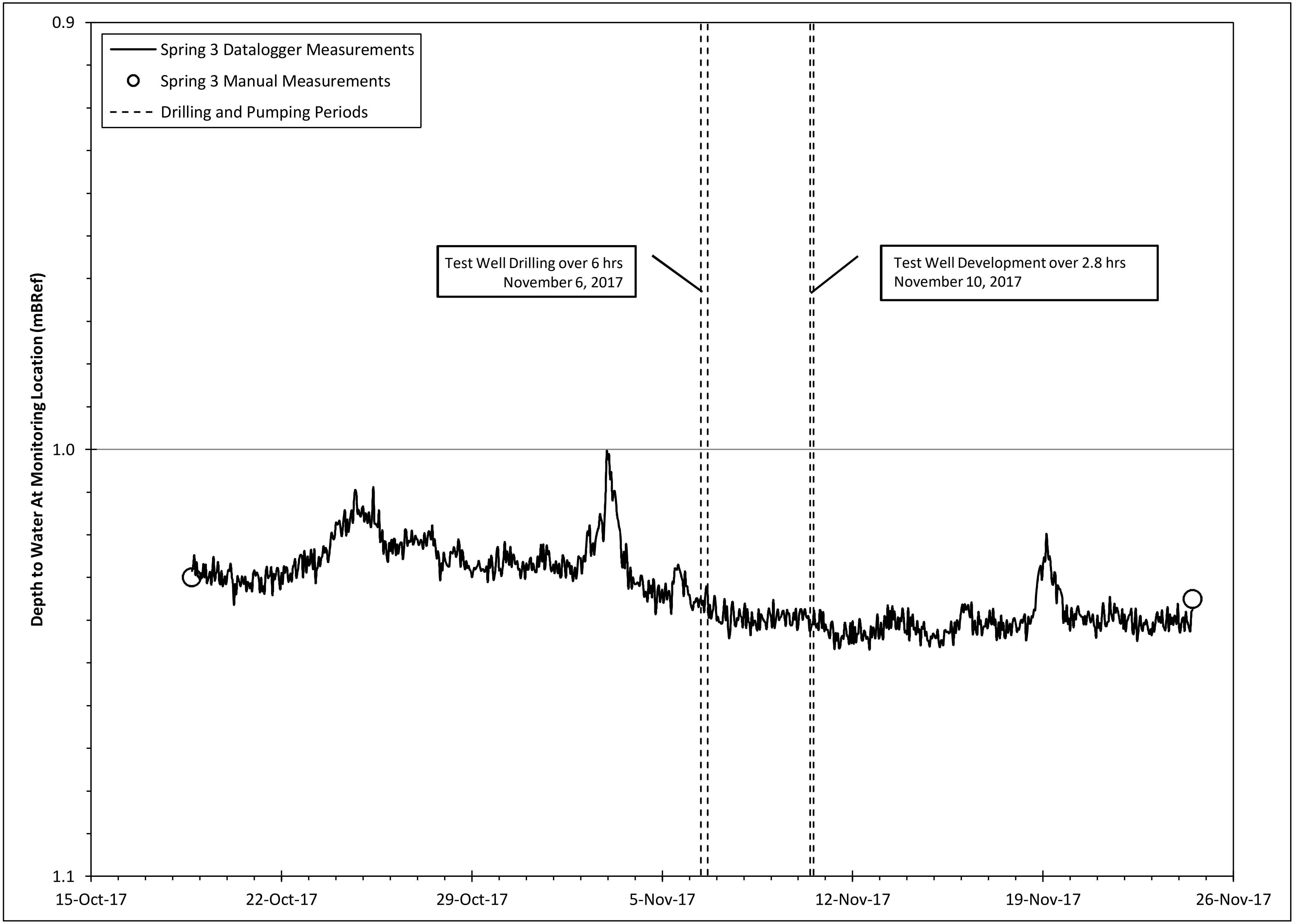
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

Kenneth Ave Well Drilling and Testing
Spring 1 Depth At Weir

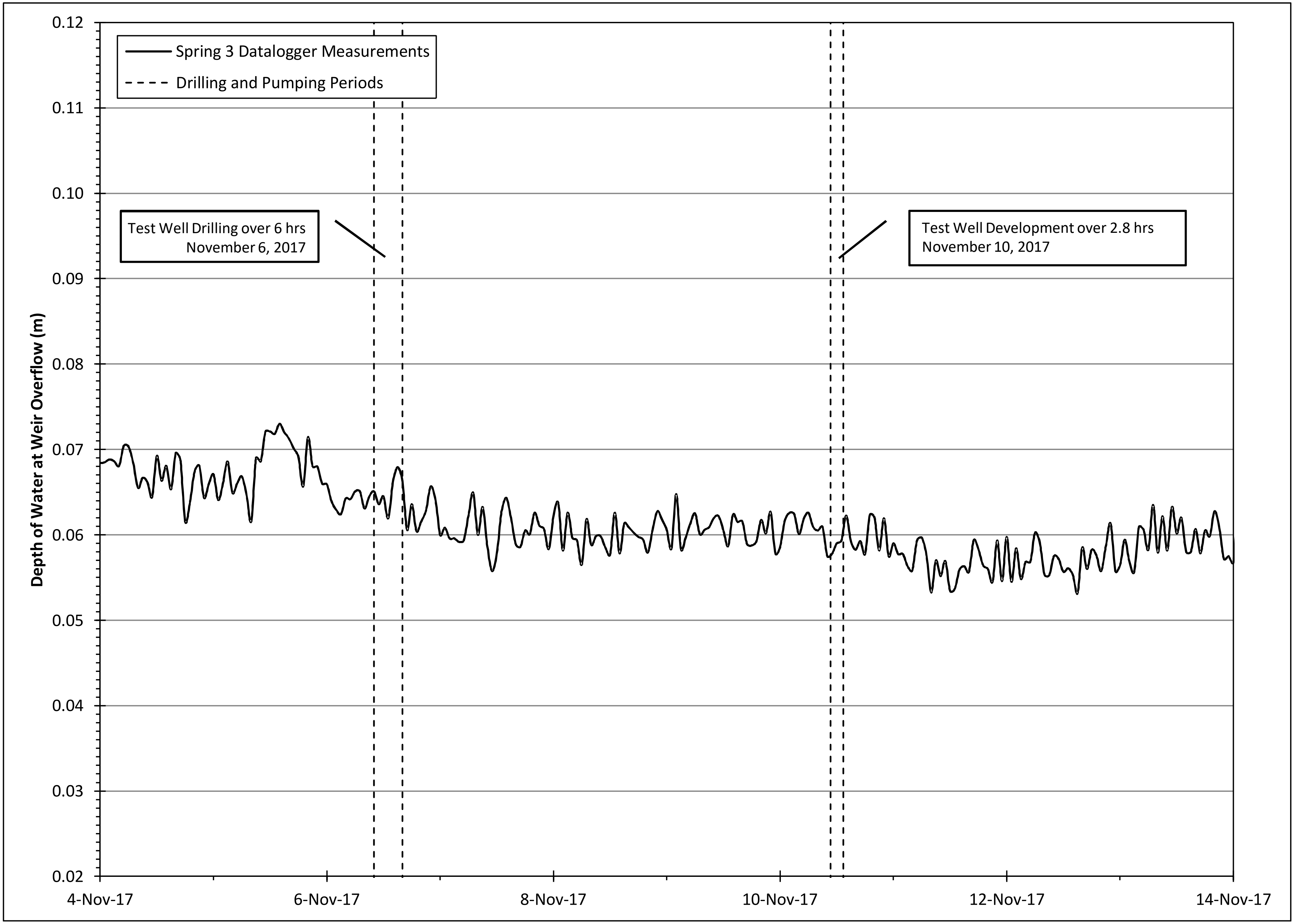
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supplly EA

Kenneth Ave Well Drilling and Testing
Spring 3 Monitoring Hydrograph

Groundwater Science Corp
Hydrogeological Assessment



Kenneth Ave Drilling and Testing
Spring 3 Depth At Weir

Appendix C

Solmar Lands (Erin 2)

Drilling and Testing Results

Ontario Ministry of the Environment

Well Tag Number A 032501

#AO 32501

Well Record

Regulation 903 Ontario Water Resources Act

page ___ of ___

Instructions for Completing Form

- For use in the **Province of Ontario** only. This document is a permanent **legal** document. Please retain for future reference.
- All Sections **must** be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- **All metre measurements shall be reported to 1/10th of a metre.**
- Please print clearly in blue or black ink only.

Ministry Use Only

MUN ___ CON ___ LOT ___

Well Owner's Information and Location of Well Information

[redacted]

WELLINGTON | ERIN | 16 | 10

RR#/Street Number/Name | City/Town/Village | Site/Compartment/Block/Tract etc.

GPS Reading NAD 83 Zone 17 Easting 574601 Northing 4848972 | Unit Make/Model MAGELEN | Mode of Operation: UTM ☐ Undifferentiated ☒ Averaged ☐ Differentiated, specify

Log of Overburden and Bedrock Materials (see instructions)

General Colour	Most common material	Other Materials	General Description	Depth Metres From	Depth Metres To
BROWN	CLAY & STONES	SILTY		0	36ft
GRAY	CLAY & STONES			36ft	57ft
BROWN	LIMESTONE			57ft	85ft
GRAY	LIMESTONE			85ft	165ft
GRAY	SHALE			165ft	171ft

Hole Diameter

Depth Metres From	Depth Metres To	Diameter Centimetres
0	62ft	8.75in
62ft	171ft	6in

Water Record

Water found at Metres	Kind of Water
101ft	☒ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:
126ft	☒ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:
___ m	☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

After test of well yield, water was
☒ Clear and sediment free
☐ Other, specify

Chlorinated ☒ Yes ☐ No

Construction Record

Inside diam centimetres	Material	Wall thickness centimetres	Depth Metres From	Depth Metres To
Casing				
6¼	☒ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	.188	0	62ft
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
Screen				
Outside diam	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	Slot No.		
No Casing or Screen				
	☒ Open hole		62ft	171ft

Test of Well Yield

Pumping test method WELL TO BE PUMPED BY ENG

Pump intake set at - (metres)

Pumping rate - (litres/min)

Duration of pumping ___ hrs + ___ min

Final water level end of pumping ___ metres

Recommended pump type. ☐ Shallow ☐ Deep

Recommended pump depth. ___ metres

Recommended pump rate. (litres/min)

If flowing give rate - (litres/min)

If pumping discontinued, give reason.

Draw Down Time min	Draw Down Water Level Metres	Recovery Time min	Recovery Water Level Metres
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	

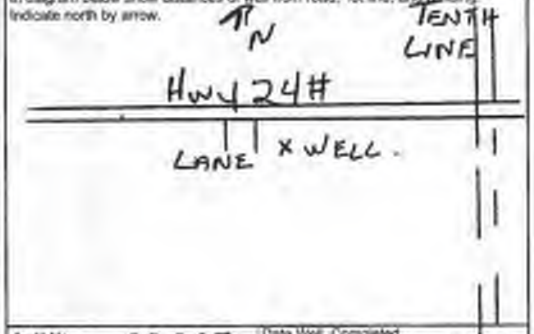
Plugging and Sealing Record

☒ Annular space ☐ Abandonment

Depth set at - Metres From	Depth set at - Metres To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
0	62ft	BENSEAL BENTONITE SLURRY	

Location of Well

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



Method of Construction

☐ Cable Tool ☐ Rotary (air) ☐ Diamond ☐ Digging
☒ Rotary (conventional) ☐ Air percussion ☐ Jetting ☐ Other
☐ Rotary (reverse) ☐ Boring ☐ Driving

Water Use

☒ Domestic ☐ Industrial ☐ Public Supply ☐ Other
☐ Stock ☐ Commercial ☐ Not used
☐ Irrigation ☐ Municipal ☐ Cooling & air conditioning

Final Status of Well

☒ Water Supply ☐ Recharge well ☐ Unfinished ☐ Abandoned, (Other)
☐ Observation well ☐ Abandoned, insufficient supply ☐ Dewatering
☐ Test Hole ☐ Abandoned, poor quality ☐ Replacement well

Audit No. Z 48445

Date Well Completed YYYY 2006 MM 5 DD 26

Was the well owner's information package delivered? ☐ Yes ☒ No

Date Delivered YYYY ___ MM ___ DD ___

Well Contractor/Technician Information

Name of Well Contractor: KEITH LANG WELL DRILLING INC

Well Contractor's Licence No. 7154

Business Address (street name, number, city etc.): 251 ELDON ST GODERICH ONT

Name of Well Technician (last name, first name): KEITH LANG

Well Technician's Licence No. T 446

Signature of Technician/Contractor X Keith Lang.

Date Submitted YYYY ___ MM ___ DD ___

Ministry Use Only

Data Source

Contractor 7154

Date Received JUN 23 2006

Date of Inspection YYYY ___ MM ___ DD ___

Remarks

Well Record Number

Solmar TW1

0506E (09/03) Contractor's Copy ☐ Ministry's Copy ☐ Well Owner's Copy ☐

Cette formule est disponible en français

ONTARIO WATER WELL SERVICES INC.
R.R. #1 Mono Centre, Orangeville, Ontario L9W 2Y8

Page 1 of 2
PERFORMANCE TEST

Site: Erin / Solmar ; Data for Well # Solmar
Client: Town of Erin
r From PW
; Pumping Well # Solmar

Time Data
Pump on: Date 12/29 Time 9:30
Pump off: Date 12/29 Time 11:30
Duration of test
Pumping 2hrs Recovery 15min

Water Level Data
Static level 10.32 m
Measuring point T.O.C.
Height of M.P.

Discharge Data
How Q measured mag meter
Orifice/Wier size ____ by ____
Comments on Q:

Comments & Observations

Date	Clock Time	Elapsed Time	Water Level	Draw Down	Recovery	Q IGPM	Q Adjustment Elapsed Time	Down / Up	Am'nt IPGM	Baro meter	☀ ☁ 🌧 ❄
Dec29/17	09:25	0	10.32								
	09:30	0	10.32								
		0.5	12.24			30					→ Q cloudy
		1	12.44								
		1.5	12.45								
		2	12.455								
		2.5	12.39								
		3	12.385			30	stable				
		4	12.43			30	Stable.				→ Q dirty
		5	12.46								
		6	12.48								
		7	12.515								
		8	12.565			30	stable				
		10	12.63								
		12	12.655			30	stable				
		15	12.69								→ Q clearing
		20	12.825			30	stable				
		25	12.86								
	11:00	30	12.91								
		35	12.98								
		40	13.07			30	stable				
		50	13.18								
	10:30	60	13.225			30	stable				
		70	13.395								
		80	13.47								
	11:00	90	13.55								

Page 1 of 2
Well #

Page 2 of

ONTARIO WATER WELL SERVICES INC.
R.R. #1 Mono Centre, Orangeville, Ontario L9W 2Y8

PERFORMAN

Erin / Solmar
Town of Erin
;

Data for Well # Solmar
r From PW
Pumping Well # Solmar

Time Data
on: Date 12/29 Time 9:30
off: Date 12/29 Time 11:30
on of test
ng 2 hr Recovery 15 min

Water Level Data
Static level
Measuring point
Height of M.P.

Discharge Data
How Q measured
Orifice/Wier size by
Comments on Q

C
Obs

te	Clock Time	Elapsed Time	Water Level	Draw Down	Recovery	Q IGPM	Q Adjustment			Baro meter	C
							Elapsed Time	Down / Up	Am'nt IPGM		
9/17	11:15	105	13.62			30					→Q
	11:32	122	13.72								
		.5			12.26	0	0				
		1			12.13						
		1.5			12.06						
		2			12.02						
		3			12.0						
		5			11.94						
		7			11.90						
		10			11.84						
		15			11.765						

ALS		Sample ID				SOLMAR TEST WELL WWR #6715778
2/17/2020		ALS ID				L2039987-1
L2039987		Date Sampled				12/29/2017 11:30:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water
Colour, Apparent	CU	2	-	5	-	11
Conductivity	umhos/cm	3	-	-	-	1500
Hardness (as CaCO3)	mg/L	10	-	-	100	406 *
pH	pH units	0.1	-	6.5-8.5	-	7.85
Total Dissolved Solids	mg/L	20	-	500	-	968 *
Turbidity	NTU	0.1	-	5	-	10.4
Alkalinity, Total (as CaCO3)	mg/L	10	-	-	500	249
Ammonia, Total (as N)	mg/L	0.02	-	-	-	0.05
Bromide (Br)	mg/L	0.5	-	-	-	<0.50 *
Chloride (Cl)	mg/L	2.5	-	250	-	392 *
Fluoride (F)	mg/L	0.1	1.5	-	-	<0.10 *
Nitrate (as N)	mg/L	0.1	10	-	-	0.17 *
Nitrite (as N)	mg/L	0.05	1	-	-	<0.050 *
Total Kjeldahl Nitrogen	mg/L	0.15	-	-	-	<0.15
Orthophosphate-Dissolved (as P)	mg/L	0.003	-	-	-	<0.0030
Sulfate (SO4)	mg/L	1.5	-	500	-	50.2 *
Sulphide (as S)	mg/L	0.02	-	0.05	-	<0.020
Sulphide (as H2S)	mg/L	0.021	-	0.05	-	<0.021
Dissolved Organic Carbon	mg/L	1	-	5	-	<1.0
Aluminum (Al)-Total	mg/L	0.005	-	-	0.1	<0.0050
Antimony (Sb)-Total	mg/L	0.0001	0.006	-	-	0.00037
Arsenic (As)-Total	mg/L	0.0001	0.01	-	-	0.00501
Barium (Ba)-Total	mg/L	0.0002	1	-	-	0.174
Beryllium (Be)-Total	mg/L	0.0001	-	-	-	<0.00010
Bismuth (Bi)-Total	mg/L	0.00005	-	-	-	<0.000050
Boron (B)-Total	mg/L	0.01	5	-	-	<0.010
Cadmium (Cd)-Total	mg/L	0.000005	0.005	-	-	0.0000734
Calcium (Ca)-Total	mg/L	0.5	-	-	-	101
Cesium (Cs)-Total	mg/L	0.00001	-	-	-	<0.000010
Chromium (Cr)-Total	mg/L	0.0005	0.05	-	-	<0.00050
Cobalt (Co)-Total	mg/L	0.0001	-	-	-	0.00495
Copper (Cu)-Total	mg/L	0.001	-	1	-	0.002
Iron (Fe)-Total	mg/L	0.05	-	0.3	-	0.955
Lead (Pb)-Total	mg/L	0.00005	0.01	-	-	0.00529
Lithium (Li)-Total	mg/L	0.001	-	-	-	0.0036
Magnesium (Mg)-Total	mg/L	0.05	-	-	-	37.5
Manganese (Mn)-Total	mg/L	0.0005	-	0.05	-	0.266
Molybdenum (Mo)-Total	mg/L	0.00005	-	-	-	0.00823
Nickel (Ni)-Total	mg/L	0.0005	-	-	-	0.0171
Phosphorus (P)-Total	mg/L	0.05	-	-	-	<0.050
Potassium (K)-Total	mg/L	0.05	-	-	-	1.49
Rubidium (Rb)-Total	mg/L	0.0002	-	-	-	0.00126
Selenium (Se)-Total	mg/L	0.00005	0.05	-	-	0.000079
Silicon (Si)-Total	mg/L	0.1	-	-	-	7.06
Silver (Ag)-Total	mg/L	0.00005	-	-	-	<0.000050
Sodium (Na)-Total	mg/L	5	20	200	-	202 *
Strontium (Sr)-Total	mg/L	0.001	-	-	-	0.221
Sulfur (S)-Total	mg/L	0.5	-	-	-	18.2
Tellurium (Te)-Total	mg/L	0.0002	-	-	-	<0.00020
Thallium (Tl)-Total	mg/L	0.00001	-	-	-	0.000255
Thorium (Th)-Total	mg/L	0.0001	-	-	-	<0.00010
Tin (Sn)-Total	mg/L	0.0001	-	-	-	<0.00010
Titanium (Ti)-Total	mg/L	0.0003	-	-	-	<0.00030
Tungsten (W)-Total	mg/L	0.0001	-	-	-	<0.00010
Uranium (U)-Total	mg/L	0.00001	0.02	-	-	0.000913
Vanadium (V)-Total	mg/L	0.0005	-	-	-	<0.00050
Zinc (Zn)-Total	mg/L	0.003	-	5	-	0.0764
Zirconium (Zr)-Total	mg/L	0.0003	-	-	-	<0.00030
* = Result Qualified	**Color Key:**	Within Guideline	Exceeds Guideline			

Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON Drinking Water Standards, Objectives and Guidelines

TW1 Water Quality Analysis December 2017

TABLE 4

VARIABLE RATE PERFORMANCE TEST

Post-Rehabilitation

Lotowater TECHNICAL SERVICES INC.

Well Name: Solmar TW1
Project Number: 148-003
Client: Town of Erin (GSC)
Date: January 15, 2018
Technician Name: Craig Lawson
Pump: Grundfos 230S200-2 (5hp)
Water Level Device: LTS water level meter
Pump Inlet: 19.8 m
Water Level Reference: Top of casing (0.47m above ground)
Flow Measuring Device: 4" McCrometer Impeller
Test Note: TD = 49.30m, Base of 150mm diameter casing 19.51mbtc

Time *hr:min*	Elapsed Time *min*	Level *mbtc*	Drawdown *m*	Flow *L/s*	Note
11:00	0	9.25	0.00	11.0	Start Step 1
11:01	1			10.0	
11:02	2			10.0	
11:03	3	17.77	8.52	10.0	
11:04	4	17.83	8.58	10.0	
11:05	5	17.89	8.64	10.0	
11:06	6	17.98	8.73	10.0	
11:08	8	18.13	8.88	10.0	
11:10	10			10.0	
11:12	12	18.29	9.04	10.0	
11:15	15	18.42	9.17	10.0	
11:20	20	18.51	9.26	10.0	
11:25	25	18.79	9.54	10.0	
11:30	30	18.88	9.63	10.0	
11:40	40	19.14	9.89	10.0	
11:50	50	19.45	10.20	10.0	
12:00	60	19.62	10.37	10.0	
12:01	1	17.39	8.14	6.5	Start Step 2
12:02	2	17.30	8.05	6.5	
12:03	3	17.07	7.82	6.5	10 psi
12:04	4	17.05	7.80	6.5	
12:05	5	17.02	7.77	6.5	
12:06	6	17.03	7.78	6.5	
12:08	8	17.05	7.80	6.5	
12:10	10	17.07	7.82	6.5	
12:12	12	17.08	7.83	6.5	
12:15	15	17.11	7.86	6.5	
12:20	20	17.18	7.93	6.5	
12:25	25	17.22	7.97	6.5	
12:30	30	17.26	8.01	6.5	
12:40	40	17.34	8.09	6.5	
12:50	50	17.45	8.20	6.5	
13:00	60	17.56	8.31	6.5	
12:01	1	15.41	6.16	3.0	Start Step 3
12:02	2	15.39	6.14	3.0	
12:03	3	15.33	6.08	3.0	
12:04	4	15.30	6.05	3.0	
12:05	5	15.28	6.03	3.0	
12:06	6	15.26	6.01	3.0	
12:08	8	15.24	5.99	3.0	

TABLE 4

VARIABLE RATE PERFORMANCE TEST

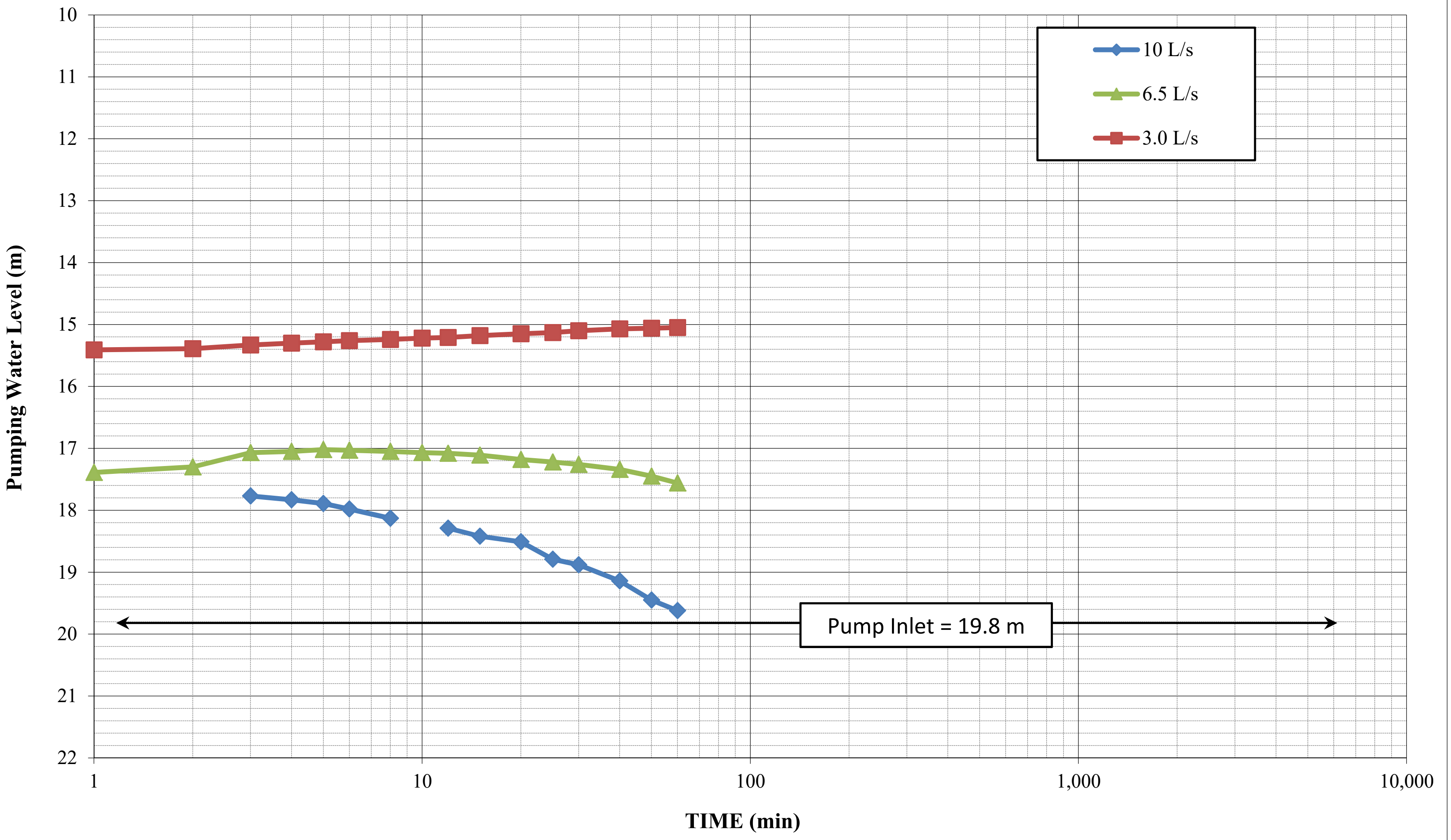
Post-Rehabilitation

Lotowater TECHNICAL SERVICES INC.

Well Name:	Solmar TW1	**Project Number:**	148-003
Client:	Town of Erin (GSC)	**Date:**	January 15, 2018
Technician Name:	Craig Lawson	**Pump:**	Grundfos 230S200-2 (5hp)
Water Level Device:	LTS water level meter	**Pump Inlet:**	19.8 m
Water Level Reference:	Top of casing (0.47m above ground)	**Flow Measuring Device:**	4" McCrometer Impeller

Test Note: TD = 49.30m, Base of 150mm diameter casing 19.51mbtc

Time *hr:min*	**Elapsed Time** *min*	**Level** *mbtc*	**Drawdown** *m*	**Flow** *L/s*	**Note**
12:10	10	15.22	5.97	3.0	
12:12	12	15.21	5.96	3.0	
12:15	15	15.18	5.93	3.0	
12:20	20	15.15	5.90	3.0	
12:25	25	15.13	5.88	3.0	
12:30	30	15.10	5.85	3.0	
12:40	40	15.07	5.82	3.0	
12:50	50	15.06	5.81	3.0	
13:00	60	15.05	5.80	3.0	



Notes:

Test Date = January 15, 2019

All water levels are referenced from top of well casing

Top of casing = 0.47 m above ground surface

Base of well casing = 19.51m

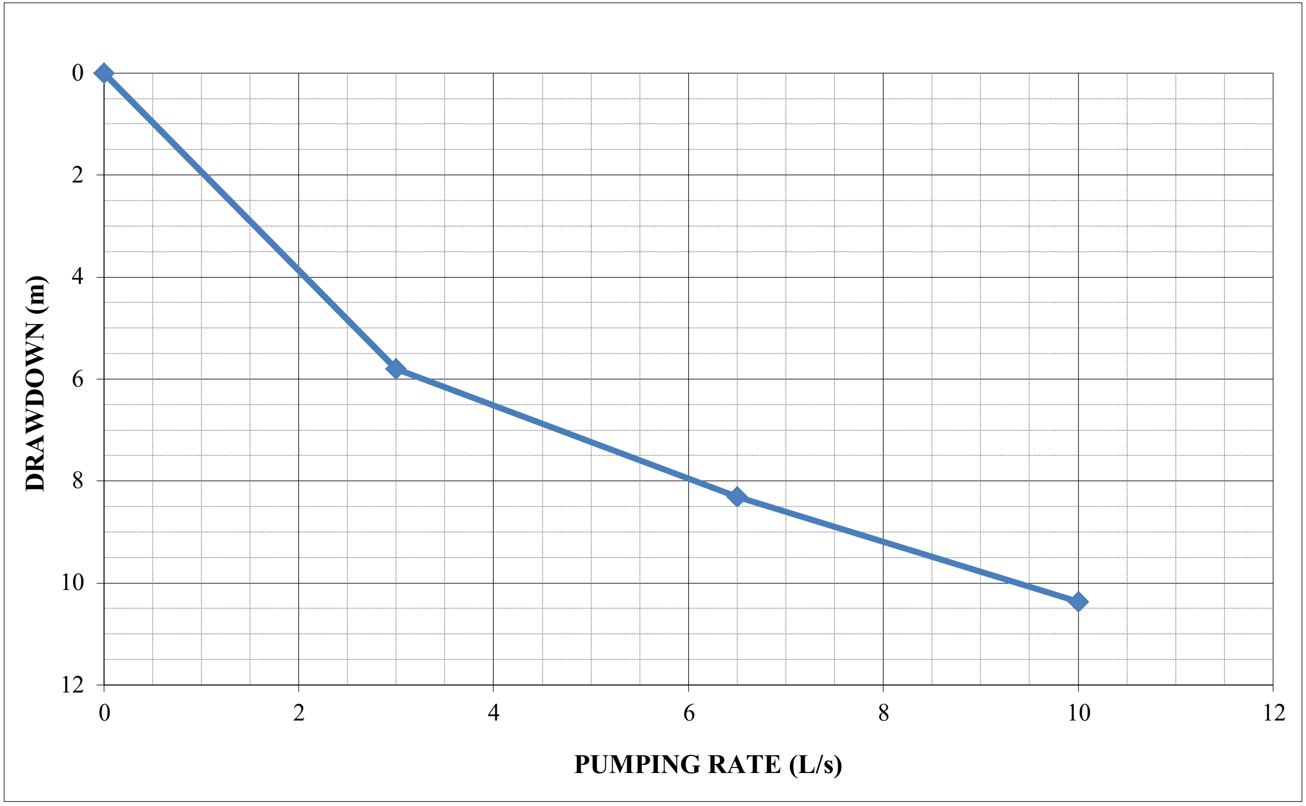
Township of Erin

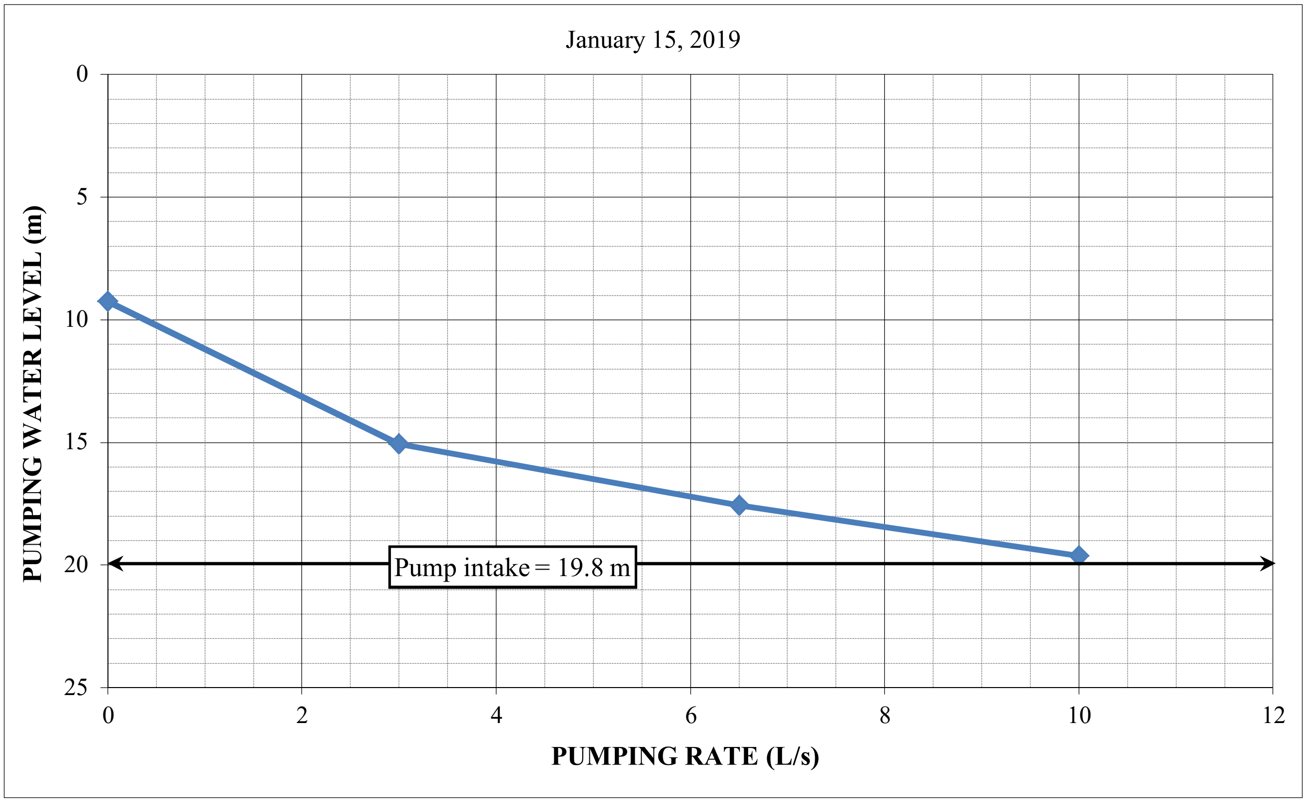
Solmar TW1

Comparison of Variable Rate Tests

Lotowater Technical Services Inc. **Figure 1A**

Reference: 148-003 15/01/2019





Notes:

Test Date = January 15, 2019

All water levels are referenced from top of well casing

Top of casing = 0.47 m above ground surface

Base of well casing = 19.51m

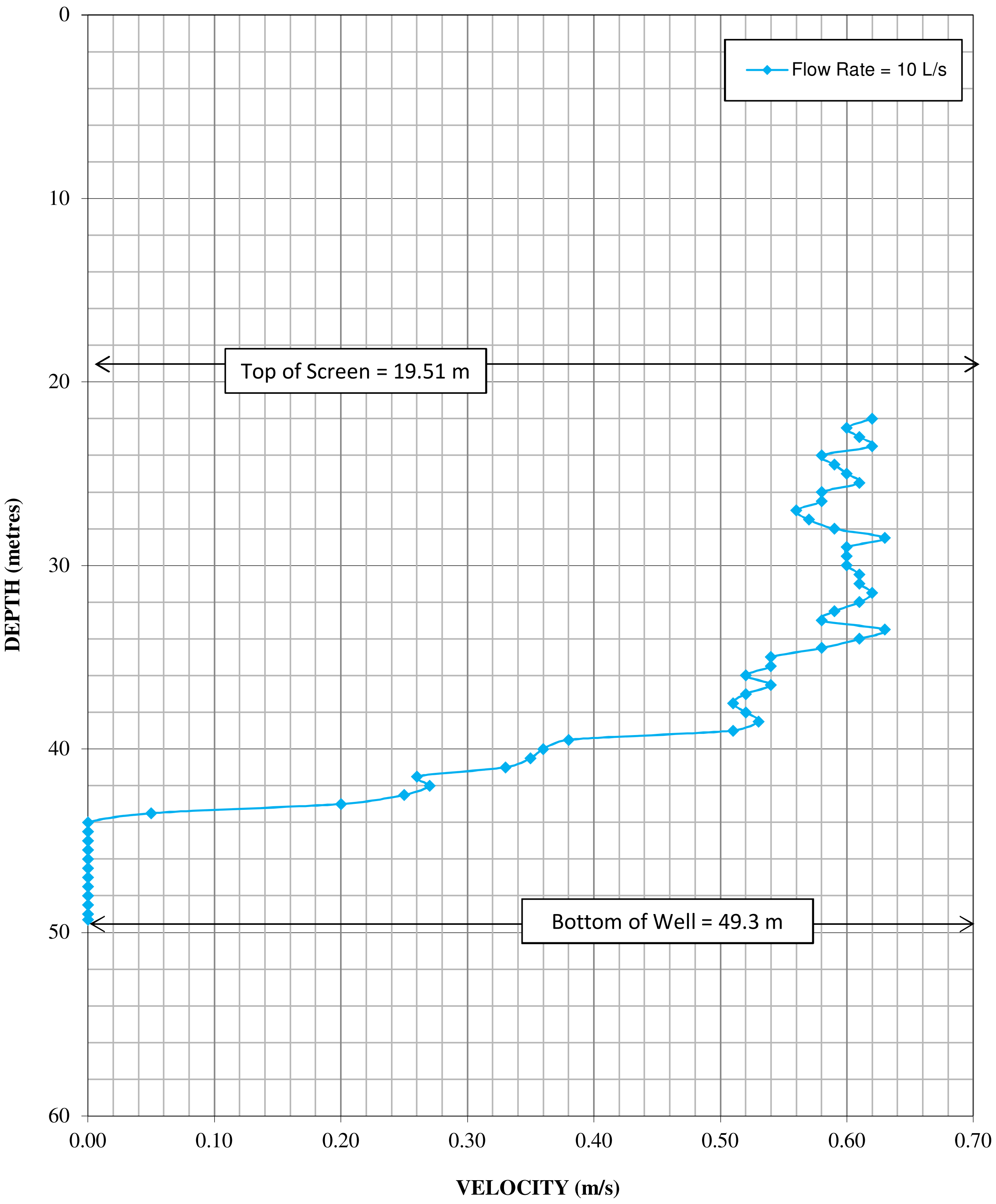
Township of Erin

Solmar TW1

Comparison of Variable Rate Tests

Lotowater Technical Services Inc. **Figure 1A**

Reference: 148-003 15/01/2019



Notes:
Test Date = January 15, 2019
All water levels are referenced from top of well casing
Top of casing = 0.47 m above ground surface

Township of Erin

Solmar TW1

Flow Profile

Lotowater Technical Services Inc. **Figure 2**
Reference: 148-003 15/01/2019

Ontario | Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
219470 Tag#:A219470

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
TOWN OF ERIN			

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
	ERIN	17	10

County/District/Municipality	City/Town/Village	Province	Postal Code
WELLINGTON		Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 8 3	17	574608	4848974		

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
BROWN	CLAY & STONES			0	35ft
GRAY	CLAY & STONES			35ft	58ft
BROWN	LIMESTONE			58ft	87ft
GRAY	LIMESTONE			87ft	165ft
GRAY	SHALE			165ft	170ft

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	63ft	BENTONITE SLURRY	70 GAL

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	.188	0	63ft
6in	open hole		63ft	170ft

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 92-95ft (m/ft) ☐ Gas | Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify
Water found at Depth 141-143ft (m/ft) ☐ Gas | Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter *(cm/in)*
-0	63ft	8.75in
63ft	170ft	6in

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
KEITH LANG WELL DRILLING INC	7154

Business Address (Street Number/Name)	Municipality
251 ELDON ST GODERICH	

Province	Postal Code	Business E-mail Address
ONT	N7A3R9	

Bus. Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)
	KEITH LANG

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
T446	K. Lang	Y Y Y Y M M D D

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)

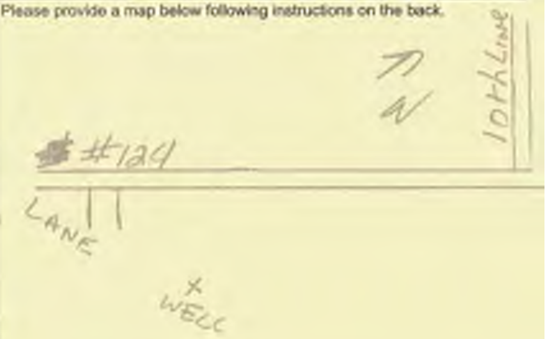
Well production (l/min / GPM) 150 gPM

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	40.5ft		
1		1	
2	Pump test	2	
3		3	
4		4	
5		5	
10		10	
15		15	
20	Done By	20	
25		25	
30	Others	30	
40		40	
50		50	
60		60	

Map of Well Location

Please provide a map below following instructions on the back.



Solmar TW2

Comments:

Well owner's information package delivered	Date Package Delivered
☒ Yes ☐ No	Y Y Y Y M M D D
	Date Work Completed 20180717

Ministry Use Only

Audit No. Z287031

Received

0506E (2014/11)

Contractor's Copy

VARIABLE RATE PERFORMANCE TEST

Lotowater
TECHNICAL SERVICES INC.

Well Name: Solmar TW2

Project Number: 148-003

Client: Town of Erin (GSC)

Date: 16/01/2018

Technician Name: Craig Lawson

Pump: Grundfos 230S200-2 (5hp)

Water Level Device: LTS water level meter

Pump Inlet: 19.8 m

Water Level Reference: Top of casing (0.47 m agl)

Flow Measuring Device: 4" McCrometer Impeller

Test Note: TD = 50.3 mbtc, Base of 150 mm diameter casing 19.4 mbtc

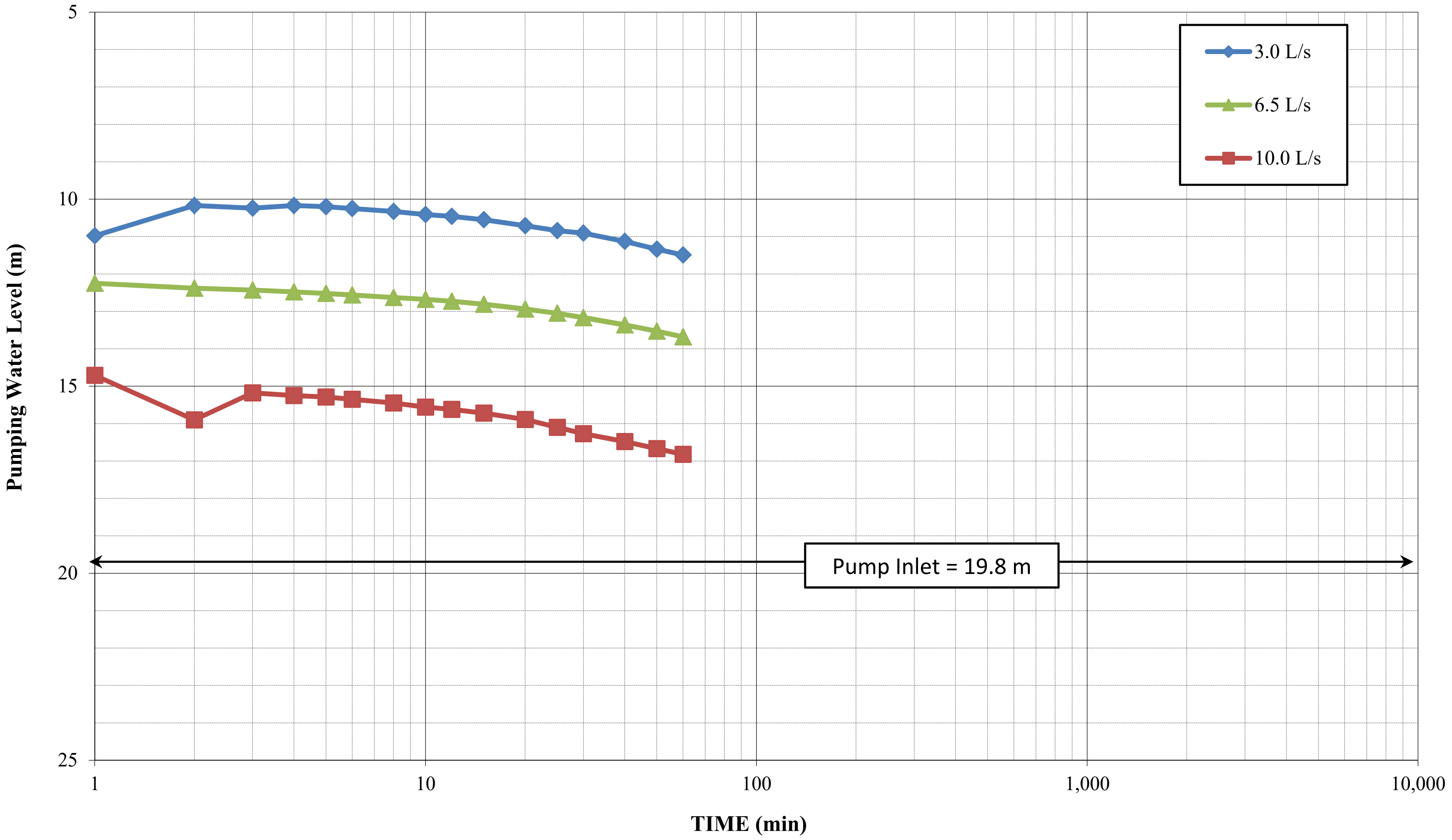
Time *hr:min*	**Elapsed Time** *min*	**Level** *mbtc*	**Drawdown** *m*	**Flow** *L/s*	**Note**
0:00	0	8.82	0.00	3.0	Start Step 1
0:01	1	10.98	2.16	3.0	
0:02	2	10.17	1.35	3.0	
0:03	3	10.24	1.42	3.0	
0:04	4	10.17	1.35	3.0	
0:05	5	10.20	1.38	3.0	
0:06	6	10.25	1.43	3.0	
0:08	8	10.33	1.51	3.0	
0:10	10	10.41	1.59	3.0	
0:12	12	10.46	1.64	3.0	
0:15	15	10.55	1.73	3.0	
0:20	20	10.71	1.89	3.0	
0:25	25	10.84	2.02	3.0	
0:30	30	10.91	2.09	3.0	
0:40	40	11.13	2.31	3.0	
0:50	50	11.34	2.52	3.0	
1:00	60	11.49	2.67	3.0	
1:01	1	12.25	3.43	6.5	Start Step 2
1:02	2	12.38	3.56	6.5	
1:03	3	12.43	3.61	6.5	
1:04	4	12.48	3.66	6.5	
1:05	5	12.52	3.70	6.5	
1:06	6	12.56	3.74	6.5	
1:08	8	12.63	3.81	6.5	
1:10	10	12.68	3.86	6.5	
1:12	12	12.73	3.91	6.5	
1:15	15	12.81	3.99	6.5	
1:20	20	12.94	4.12	6.5	
1:25	25	13.05	4.23	6.5	
1:30	30	13.17	4.35	6.5	
1:40	40	13.36	4.54	6.5	
1:50	50	13.53	4.71	6.5	
2:00	60	13.68	4.86	6.5	

VARIABLE RATE PERFORMANCE TEST

Lotowater TECHNICAL SERVICES INC.

Well Name: Solmar TW2
Project Number: 148-003
Client: Town of Erin (GSC)
Date: 16/01/2018
Technician Name: Craig Lawson
Pump: Grundfos 230S200-2 (5hp)
Water Level Device: LTS water level meter
Pump Inlet: 19.8 m
Water Level Reference: Top of casing (0.47 m agl)
Flow Measuring Device: 4" McCrometer Impeller
Test Note: TD = 50.3 mbtc, Base of 150 mm diameter casing 19.4 mbtc

Time *hr:min*	Elapsed Time *min*	Level *mbtc*	Drawdown *m*	Flow *L/s*	Note
2:01	1	14.71	5.89	10.0	Start Step 3
2:02	2	15.90	7.08	10.0	
2:03	3	15.18	6.36	10.0	
2:04	4	15.25	6.43	10.0	
2:05	5	15.29	6.47	10.0	
2:06	6	15.35	6.53	10.0	
2:08	8	15.45	6.63	10.0	
2:10	10	15.56	6.74	10.0	
2:12	12	15.62	6.80	10.0	
2:15	15	15.72	6.90	10.0	
2:20	20	15.89	7.07	10.0	
2:25	25	16.10	7.28	10.0	
2:30	30	16.27	7.45	10.0	
2:40	40	16.48	7.66	10.0	
2:50	50	16.67	7.85	10.0	
3:00	60	16.82	8.00	10.0	



Notes:

Test Date = January 16, 2019

All water levels are referenced from top of well casing

Top of casing = 0.47 m above ground surface

Base of well casing = 19.4 m

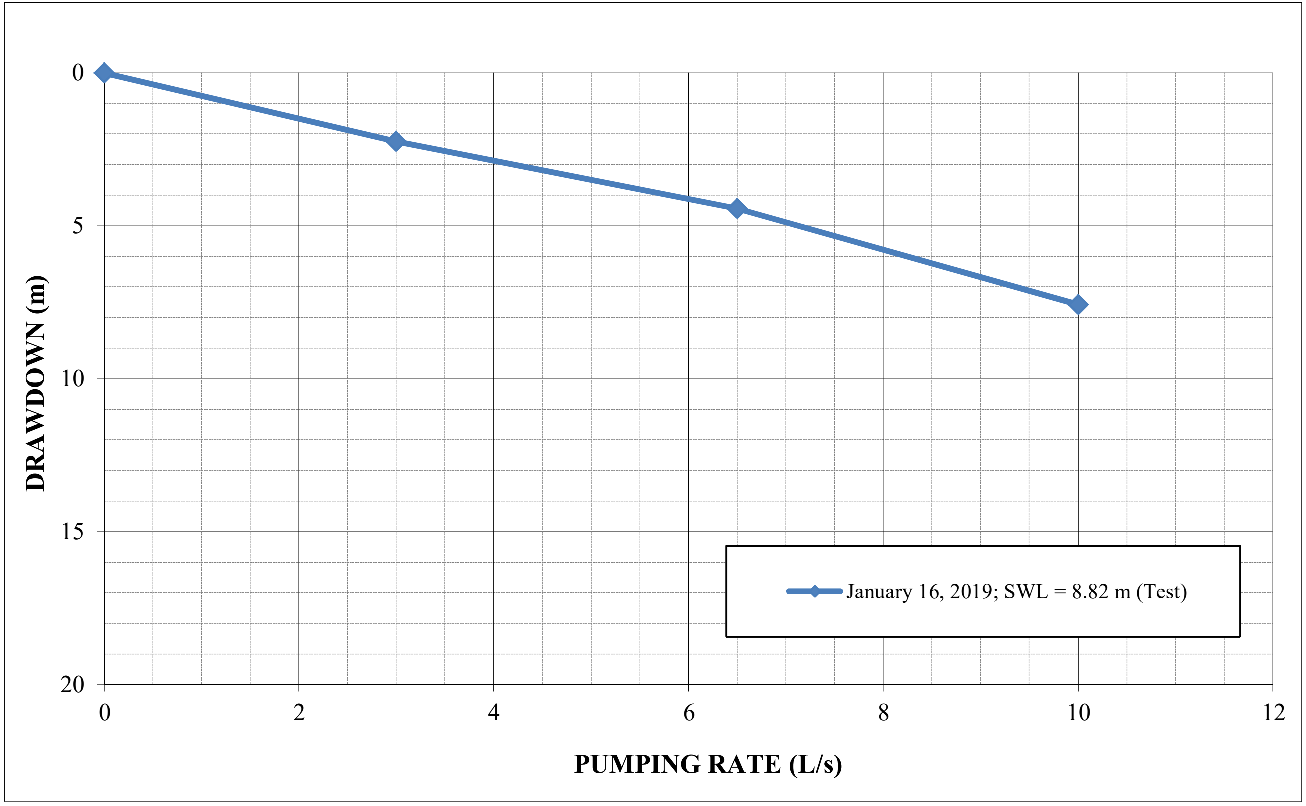
Township of Erin

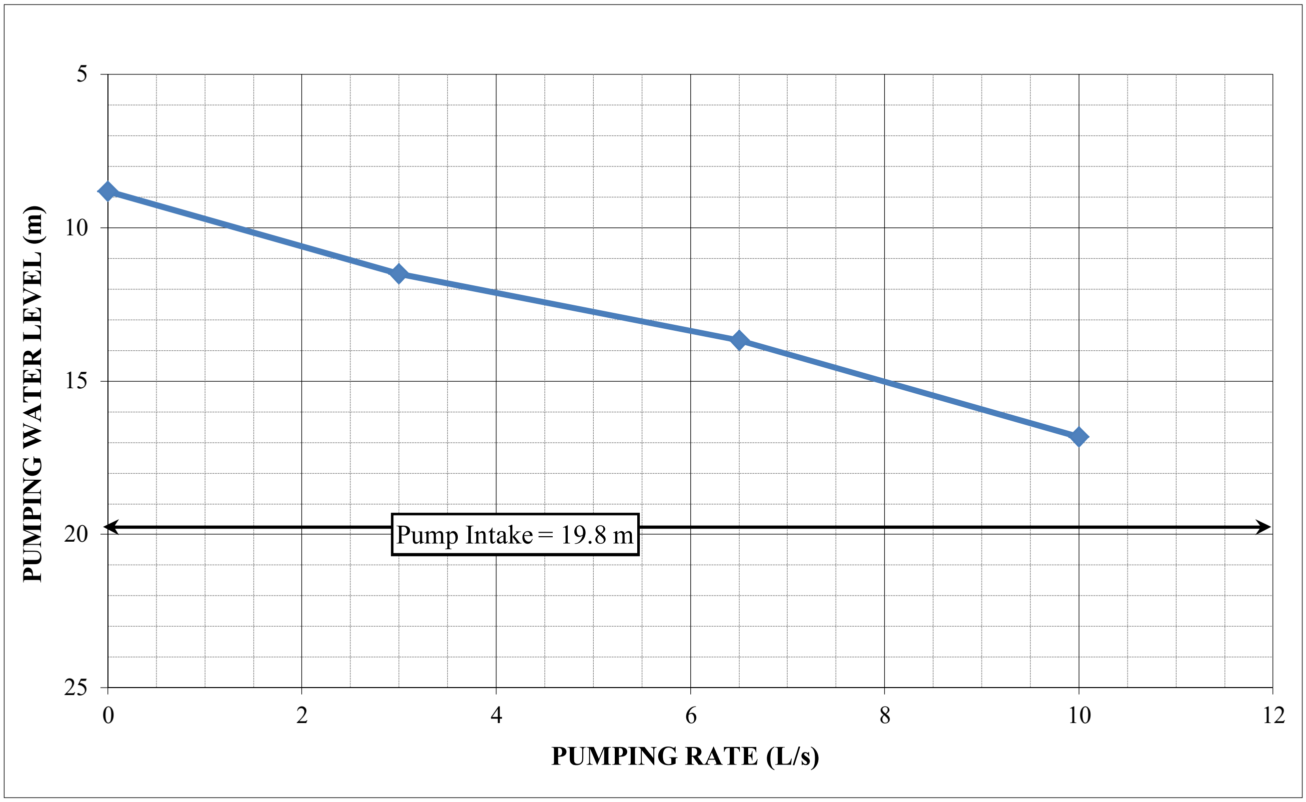
Solmar TW2

Comparison of Variable Rate Tests

Lotowater Technical Services Inc. **Figure 1A**

Reference: 148-003 17/01/2019





Notes:

Test Date = January 16, 2019
All water levels are referenced from top of well casing
Top of casing = 0.47 m above ground surface
Base of well casing = 19.4 m

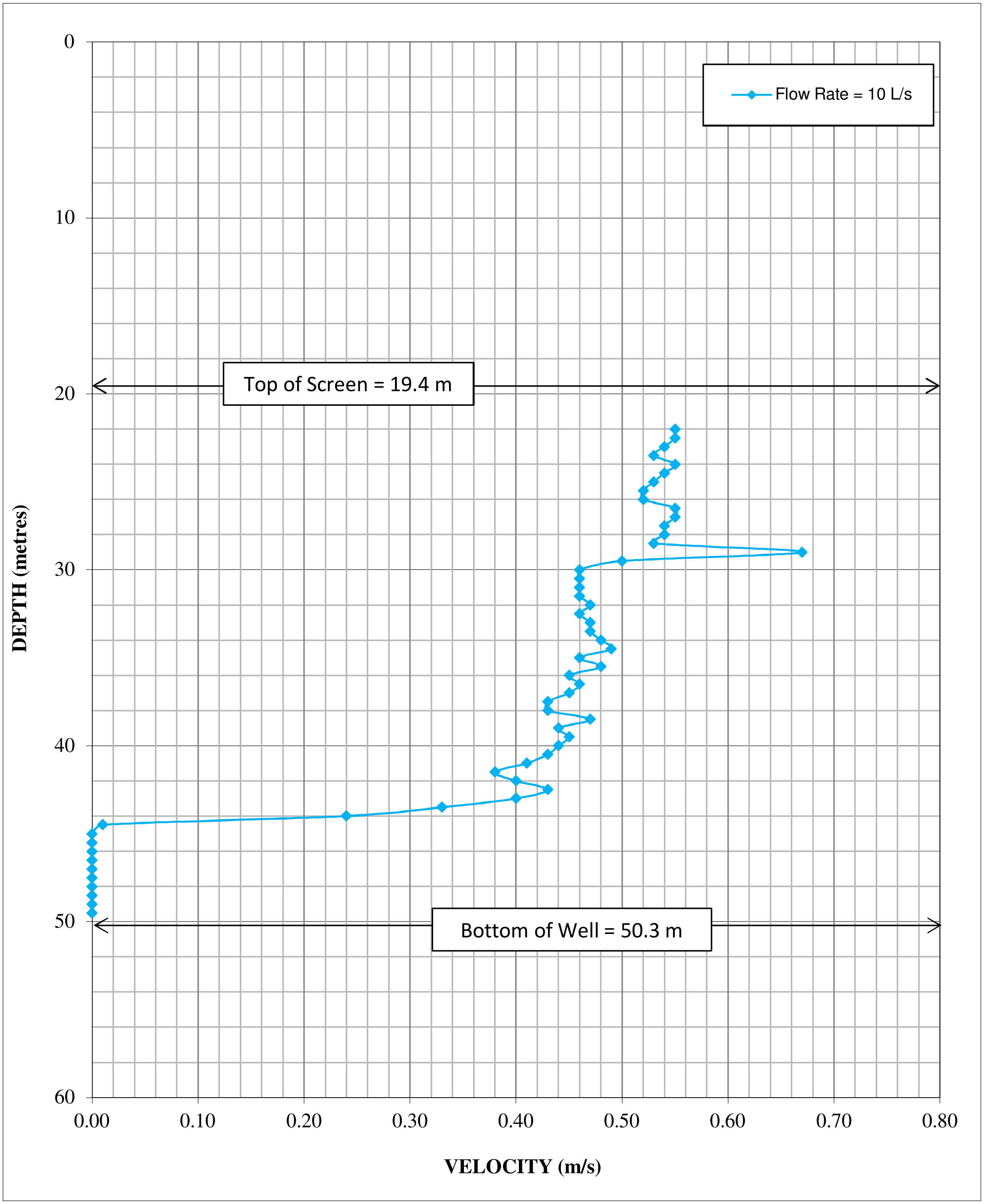
Township of Erin

Solmar TW2

Comparison of Variable Rate Tests

Lotowater Technical Services Inc. **Figure 1A**

Reference: 148-003 17/01/2019



Notes:
Test Date = January 16, 2019
All water levels are referenced from top of well casing
Top of casing = 0.47 m above ground surface

Township of Erin

Solmar TW2

Flow Profile

Lotowater Technical Services Inc. **Figure 2**
Reference: 148-003 17/01/2019

TABLE 1

TOWNSHIP OF ERIN

Solmar TW 2
Static Video Summary
2019/01/15

Elapsed Time (h:min)	Depth (ft below MP)	Depth (m below MP)	Comments
0:00	2.8'	0.9	Below top of casing
0:00	3.1'	0.9	Casing joint
0:03	23.1'	7.0	Casing joint
0:04	29.4'	9.0	Static water level
0:07	43'	13.1	Casing joint
0:09	56.6'	17.3	Increase in turbidity
0:10	63.3'	19.3	Bottom of casing
0:12	75.6'	23.0	Vugs
0:13	82.2'	25.1	Horizontal ring feature, biofilm
0:14	95.2'	29.0	Horizontal ring feature, flow in
0:17	112.2'	34.2	Fractures with biofilm fouling
0:20	126.2'	38.5	Horizontal ring feature, biofilm
0:20	128.7'	39.2	Vugs
0:20	131.1'	40.0	Fractures
0:21	133.5'	40.7	Vugs
0:21	138.7'	42.3	Vugs
0:22	140.8'	42.9	Vugs
0:22	144.2'	44.0	Horizontal ring feature, PWPZ
0:24	154.6'	47.1	Vugs
0:26	165'	50.3	Bottom of well, biofilm accumulation
0:33	144.8'	44.1	Horizontal ring feature, possible flow out
0:44	139.1'	42.4	Vugs
0:46	131.6'	40.1	Verticial ring feature
0:47	128.6'	39.2	Vugs with sediment
0:48	126.8'	38.6	Horizontal ring feature
0:51	113'	34.4	Biofilm fouling
0:56	95.8'	29.2	Horizontal ring feature, flow in
1:03	63.8'	19.4	Bottom of casing
1:04	63.6'	19.4	Casing joint
1:08	43.9'	13.4	Water level (TW1 pumping @ 10 L/s)
1:09	43.6'	13.3	Casing joint
1:12	23.6'	7.2	Casing joint
1:15	3.7'	1.1	Casing joint
1:15	3'	0.9	Below top of casing

Video survey conducted by Rodney Secor

Notes: Measuring point (MP) is top of casing which is 0.47 m above ground surface
PWPZ = Possible water producing zone

ALS		Sample ID				SOLMAR TW2
2/17/2020		ALS ID				L2221323-1
L2221323		Date Sampled				1/16/2019 2:00:00 PM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water
Colour, Apparent	CU	2	-	5	-	2.7
Conductivity	umhos/cm	3	-	-	-	1870
pH	pH units	0.1	-	6.5-8.5	-	7.5
Redox Potential	mV	-1000	-	-	-	233 *
Total Dissolved Solids	mg/L	20	-	500	-	1070 *
Turbidity	NTU	0.1	-	5	-	0.85
Alkalinity, Bicarbonate (as CaCO3)	mg/L	10	-	-	-	272
Alkalinity, Carbonate (as CaCO3)	mg/L	10	-	-	-	<10
Alkalinity, Hydroxide (as CaCO3)	mg/L	10	-	-	-	<10
Alkalinity, Total (as CaCO3)	mg/L	10	-	-	500	272
Ammonia, Total (as N)	mg/L	0.02	-	-	-	0.034
Bromide (Br)	mg/L	0.5	-	-	-	<0.50 *
Chloride (Cl)	mg/L	2.5	-	250	-	470 *
Computed Conductivity	uS/cm	n/a	-	-	-	1730
Conductivity % Difference	%	n/a	-	-	-	-7.6
Fluoride (F)	mg/L	0.1	1.5	-	-	0.10 *
Hardness (as CaCO3)	mg/L	n/a	-	-	-	464
Ion Balance	%	n/a	-	-	-	102
Langelier Index		n/a	-	-	-	0.4
Nitrate (as N)	mg/L	0.1	10	-	-	0.10 *
Nitrite (as N)	mg/L	0.05	1	-	-	<0.050 *
Saturation pH	pH	n/a	-	-	-	7.05
Orthophosphate-Dissolved (as P)	mg/L	0.003	-	-	-	<0.0030
TDS (Calculated)	mg/L	n/a	-	-	-	1080
Sulfate (SO4)	mg/L	1.5	-	500	-	53.7 *
Sulphide (as S)	mg/L	0.018	-	0.05	-	<0.018
Sulphide (as H2S)	mg/L	0.019	-	0.05	-	<0.019
Anion Sum	me/L	n/a	-	-	-	18.9
Cation Sum	me/L	n/a	-	-	-	19.3
Cation - Anion Balance	%	n/a	-	-	-	1.1
Cyanide, Total	mg/L	0.002	-	-	-	<0.0020
Dissolved Carbon Filtration Location		n/a	-	-	-	LAB
Dissolved Organic Carbon	mg/L	0.5	-	5	-	0.89
Silica Total	mg/L	0.21	-	-	-	16.7
E. Coli	CFU/100mL	0	0	-	-	0
Total Coliform Background	CFU/100mL	0	-	-	-	1
Total Coliforms	CFU/100mL	0	0	-	-	0
Sodium Adsorption Ratio	SAR	0.1	-	-	-	4.62
Aluminum (Al)-Total	mg/L	0.01	-	-	0.1	<0.010
Antimony (Sb)-Total	mg/L	0.0001	0.006	-	-	0.00024
Arsenic (As)-Total	mg/L	0.0001	0.01	-	-	0.00119
Barium (Ba)-Total	mg/L	0.0002	1	-	-	0.177
Beryllium (Be)-Total	mg/L	0.0001	-	-	-	<0.00010
Bismuth (Bi)-Total	mg/L	0.00005	-	-	-	<0.000050
Boron (B)-Total	mg/L	0.01	5	-	-	0.01
Cadmium (Cd)-Total	mg/L	0.00001	0.005	-	-	0.000034
Calcium (Ca)-Total	mg/L	0.5	-	-	-	115
Cesium (Cs)-Total	mg/L	0.00001	-	-	-	0.00001
Chromium (Cr)-Total	mg/L	0.0005	0.05	-	-	<0.00050
Cobalt (Co)-Total	mg/L	0.0001	-	-	-	0.00012
Copper (Cu)-Total	mg/L	0.001	-	1	-	0.0089
Iron (Fe)-Total	mg/L	0.05	-	0.3	-	0.076
Lead (Pb)-Total	mg/L	0.0001	0.01	-	-	0.00056
Magnesium (Mg)-Total	mg/L	0.05	-	-	-	43.1
Manganese (Mn)-Total	mg/L	0.0005	-	0.05	-	0.00827
Mercury (Hg)-Total	mg/L	0.00001	0.001	-	-	<0.000010
Molybdenum (Mo)-Total	mg/L	0.00005	-	-	-	0.00786
Nickel (Ni)-Total	mg/L	0.0005	-	-	-	0.0057
Phosphorus (P)-Total	mg/L	0.05	-	-	-	<0.050
Potassium (K)-Total	mg/L	0.05	-	-	-	1.61
Rubidium (Rb)-Total	mg/L	0.0002	-	-	-	0.00129
Selenium (Se)-Total	mg/L	0.00005	0.05	-	-	0.000076
Silicon (Si)-Total	mg/L	0.1	-	-	-	7.82
Silver (Ag)-Total	mg/L	0.00005	-	-	-	<0.000050

Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water
Sodium (Na)-Total	mg/L	0.5	20	200	-	229 *
Strontium (Sr)-Total	mg/L	0.001	-	-	-	0.247
Sulfur (S)-Total	mg/L	0.5	-	-	-	20.1
Tellurium (Te)-Total	mg/L	0.0002	-	-	-	<0.00020
Thallium (Tl)-Total	mg/L	0.00001	-	-	-	0.000167
Thorium (Th)-Total	mg/L	0.0001	-	-	-	<0.00010
Tin (Sn)-Total	mg/L	0.0001	-	-	-	<0.00010
Titanium (Ti)-Total	mg/L	0.0003	-	-	-	<0.00030
Tungsten (W)-Total	mg/L	0.0001	-	-	-	<0.00010
Uranium (U)-Total	mg/L	0.00001	0.02	-	-	0.000822
Vanadium (V)-Total	mg/L	0.0005	-	-	-	<0.00050
Zinc (Zn)-Total	mg/L	0.003	-	5	-	0.0729
Zirconium (Zr)-Total	mg/L	0.0003	-	-	-	<0.00030
Acetone	ug/L	20	-	-	-	<20
Benzene	ug/L	0.5	1	-	-	<0.50
Bromodichloromethane	ug/L	1	-	-	-	<1.0
Bromoform	ug/L	1	-	-	-	<1.0
Bromomethane	ug/L	0.5	-	-	-	<0.50
Carbon Disulfide	ug/L	1	-	-	-	<1.0
Carbon tetrachloride	ug/L	0.5	2	-	-	<0.50
Chlorobenzene	ug/L	0.5	80	30	-	<0.50
Dibromochloromethane	ug/L	1	-	-	-	<1.0
Chloroethane	ug/L	1	-	-	-	<1.0
Chloroform	ug/L	1	-	-	-	<1.0
Chloromethane	ug/L	1	-	-	-	<1.0
1,2-Dibromoethane	ug/L	0.2	-	-	-	<0.20
1,2-Dichlorobenzene	ug/L	0.5	200	3	-	<0.50
1,3-Dichlorobenzene	ug/L	0.5	-	-	-	<0.50
1,4-Dichlorobenzene	ug/L	0.5	5	1	-	<0.50
Dichlorodifluoromethane	ug/L	1	-	-	-	<1.0
1,1-Dichloroethane	ug/L	0.5	-	-	-	<0.50
1,2-Dichloroethane	ug/L	0.5	5	-	-	<0.50
1,1-Dichloroethylene	ug/L	0.5	14	-	-	<0.50
cis-1,2-Dichloroethylene	ug/L	0.5	-	-	-	<0.50
trans-1,2-Dichloroethylene	ug/L	0.5	-	-	-	<0.50
Dichloromethane	ug/L	2	50	-	-	<2.0
1,2-Dichloropropane	ug/L	0.5	-	-	-	<0.50
cis-1,3-Dichloropropene	ug/L	0.5	-	-	-	<0.50
trans-1,3-Dichloropropene	ug/L	0.5	-	-	-	<0.50
Ethylbenzene	ug/L	0.5	140	2.4	-	<0.50
n-Hexane	ug/L	0.5	-	-	-	<0.50
2-Hexanone	ug/L	20	-	-	-	<20
Methyl Ethyl Ketone	ug/L	20	-	-	-	<20
Methyl Isobutyl Ketone	ug/L	20	-	-	-	<20
MTBE	ug/L	0.5	15	-	-	<0.50
Styrene	ug/L	0.5	-	-	-	<0.50
1,1,1,2-Tetrachloroethane	ug/L	0.5	-	-	-	<0.50
1,1,2,2-Tetrachloroethane	ug/L	0.5	-	-	-	<0.50
Tetrachloroethylene	ug/L	0.5	10	-	-	<0.50
Toluene	ug/L	0.5	60	24	-	<0.50
1,1,1-Trichloroethane	ug/L	0.5	-	-	-	<0.50
1,1,2-Trichloroethane	ug/L	0.5	-	-	-	<0.50
Trichloroethylene	ug/L	0.5	5	-	-	<0.50
Trichlorofluoromethane	ug/L	1	-	-	-	<1.0
Vinyl chloride	ug/L	0.5	1	-	-	<0.50
o-Xylene	ug/L	0.5	-	-	-	<0.50
m+p-Xylenes	ug/L	1	-	-	-	<1.0
Xylenes (Total)	ug/L	1.1	90	300	-	<1.1
4-Bromofluorobenzene	%	Surrogate	-	-	-	99
1,4-Difluorobenzene	%	Surrogate	-	-	-	102.7
Total THMs	ug/L	2	100	-	-	<2.0
* = Result Qualified	**Color Key:**	Within Guideline	Exceeds Guideline			
Applied Guideline:	**Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON Drinking Water Standards, Objectives and Guidelines**					

Appendix D
Tavares Lands (Erin 3)
Drilling and Testing Results

Ontario Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*

Tag#:A235588

Well Record

Regulation 903 Ontario Water Resources Act

Page 3 of 3

Well Owner's Information

First Name: TOWN OF ERIN
Last Name / Organization:
E-mail Address:
☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name): 5684 TRAFALGAR RD NORTH
Municipality: HILLSBURGH
Province: ONT
Postal Code: N0B1Z0
Telephone No. *(inc. area code)*:

Well Location

Address of Well Location (Street Number/Name):
Township: ERIN
Lot: 19
Concession: 10
County/District/Municipality: WELLINGTON
City/Town/Village:
Province: Ontario
Postal Code:
UTM Coordinates Zone: NAD 8 3 17
Easting: 572744
Northing: 4849032
Municipal Plan and Sublot Number:
Other:

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
BROWN	SILTY SAND CLAY	ODD STONE		0	34ft
GRAY	SILTY GRAVEL CLAY	STONES		34ft	128ft
GRAY	CLAY & STONES			128ft	133ft
BROWN	LIMESTONE			133ft	168ft
GRAY	LIMESTONE LITE GRAY			168ft	210ft
GRAY	LIMESTONE			210ft	220ft
BROWN	LIMESTONE			220ft	230ft
GRAY	LIMESTONE			230ft	269ft
GRAY	RED SHALE			269ft	277ft

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	137ft	BENTONITE SLURRY	160gal

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify

If pumping discontinued, give reason: to be pumped later

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	74ft		
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
6½	steel	.188	0	137ft
6in	open hole		137ft	277ft

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 170ft and 190ft (m/ft) ☐ Gas | Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify
Water found at Depth 242ft (m/ft) ☐ Gas | Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	137ft	8.75in
137ft	277ft	6in

Map of Well Location

Please provide a map below following instructions on the back.

Comments:

Erin North TW3

Well Contractor and Well Technician Information

Business Name of Well Contractor: KEITH LANG WELL DRILLING INC
Well Contractor's Licence No.: 7154
Business Address (Street Number/Name): 251 ELDON ST GODERICH
Municipality:
Province: ONT
Postal Code: N7A3R9
Business E-mail Address:
Bus. Telephone No. *(inc. area code)*: 519-524-8159
Name of Well Technician (Last Name, First Name): KEITH LANG
Well Technician's Licence No.: t446
Signature of Technician and/or Contractor: K Lang
Date Submitted: 20181230

Well owner's information package delivered: ☐ Yes ☒ No
Date Package Delivered: Y Y Y Y M M D D
Date Work Completed: 2018 12 12

Ministry Use Only
Audit No. Z287088
Received

0506E (2014/11)

Well Owner's Copy

Lotowater
TECHNICAL SERVICES INC.

P.O. Box 451
Paris, ON N3L 3T5

92 Scott Avenue
Paris, ON N3L 3R1
T (519) 442-1749
T (800) 923-6923
F (519) 442 7242
www.lotowater.com

February 8, 2019

Reference: 148-003

Andrew Pentney, P. Geo.
Groundwater Science Corp.
Unit 2, 465 Kingscourt Drive
Waterloo, ON
N2K 3R5

Subject: Erin – Hillsburgh Well Testing and Video

This memo documents testing of four test wells drilled in bedrock in the Erin – Hillsburgh area in Ontario. The four wells tested included the following wells; Solmar (TW1), Solmar (TW2), Erin North (TW3) and Currie (TW4). Testing included video surveys, flow profiles and step test. In addition, groundwater sampling was performed by Groundwater Science Corp. (GSC). Field work was performed over several weeks from January 15 – 28, 2019. The purpose of this testing was to quantify basic well hydraulics and areas flow production from the bedrock.

Testing Procedure

The same general testing procedure was followed at each of the four wells. First, a video was performed using a dual view well video camera. A down scan image was captured first as the camera was run to the bottom of the well and a side scan image was performed on the way up stopping at important features. Video summaries were prepared in **Tables 1A-4A** and copies of the videos have been sent to GSC in DVD.

A step test was performed on each well using a submersible pump. A pump and 5hp motor was selected which could run on a single phase portable generator. This limited production to approximately 10 L/s. Note that Currie Well TW3 had a slightly deeper static water level which required a higher head lower flow pump and limited test flows to 6 L/s. In every case, the pumps were set within or near the base of the well casing. The well was pumped up to its full rate of 10 or 6 L/s for 30 minutes, then the flow reduced to the next 30 minute step. Two to three steps were performed at each well. Flow was measured using a turbine flow meter and levels measured using a manual level tape. Step test details are shown in **Tables 1B-4B** and graphically in **Figures 1A-4A**.

A flow profile was conducted during the step test to quantify the flow distribution in each well. Lotowater uses a spinner device manufactured by Swoffer with custom modifications for application in boreholes and wells. The tool has a small impeller that is oriented vertically.

Vertical flow in the well activates the impeller which transmits a signal to a digital readout at the surface for every ½ revolution of the impeller. The velocity of fluid is directly proportional to the rotational speed of the spinner tool. The spinner tool is regularly calibrated such that its readout is reported as a velocity in metres/second.

Flow profiling was conducted under non-pumping conditions first, to indicate natural water movement in the borehole, as well as under artificially induced pumping conditions. The spinner flow tool has a minimum threshold velocity of 0.03 m/s required to overcome internal friction and activate the tool. In most cases, there is not a strong enough vertical flow in the well to activate the flow tool, so a small submersible pump is installed to induce flow. Note that no ambient (non-pumping) flows were measured in any of the four wells tested.

Each well was flow profiled under the maximum flow obtained from the step test. In all cases, the pump was set entirely within the well casing. The flow tool is then run from the bottom of the well over the entire borehole, into the casing to the bottom of the pump. Flow measurements are recorded at a specified depth interval or whenever a change in flow is indicated. Flow profiles are shown graphically in **Figures 1B-4B**.

A brief summary of some of the important findings for each well are as follows:

Erin North TW3

- The casing and borehole were generally clear without any significant buildup besides some sediment on ledges of major features.

- The total depth measured was 83.5 m which was slightly less than the 84.4 m depth reported on the well record.

- This well was pumped at a lower flow rate than the other three wells, as a higher head pump was required due to deeper static levels. The well was pumped at 6 L/s with approximately 2.0 m drawdown yielding a specific capacity of about 3.02 L/s/m.

- The flow profile was performed at 6 L/s and shows approximately 70% of the flow under pumping conditions to be entering the well at the 74.0 m flow feature. Another 15% of the flow is entering the well at a 66.9 m flow feature. At the very bottom of the well, there is a shale layer that is contributing some flow estimated at 10%. The remaining 5% of the wells flow is estimated to be coming from a zone around 57.5 m.

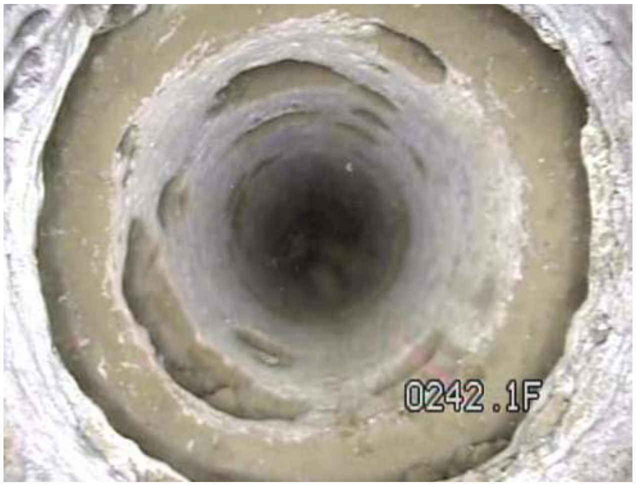


Photo 5: Looking down into a major (70%) flow feature in the well at 74.0 m

Photo 6: Looking down at the minor (15%) flow feature at 66.9 m

TABLE 3A

TOWNSHIP OF ERIN

North Well TW3
Static Video Summary
2019/01/22

Elapsed Time (h:min)	Depth (ft below MP)	Depth (m below MP)	Comments
0:00	2.8'	0.9	Below top of casing
0:01	16.5'	5.0	Casing joint
0:04	36.4'	11.1	Casing joint
0:07	56.3'	17.2	Casing joint
0:09	39.2'	11.9	Static water level
0:10	72.4'	22.1	Pause to clean camera
0:10	76.2'	23.2	Casing joint
0:13	96.1'	29.3	Casing joint
0:15	116.1'	35.4	Casing joint
0:18	136.1'	41.5	Casing joint
0:18	137.3'	41.8	Bottom of casing
0:19	138.5'	42.2	Horizontal ring feature, PWPZ
0:19	139.7'	42.6	Horizontal ring feature, PWPZ
0:19	140.5'	42.8	Horizontal ring feature, PWPZ
0:20	143.2'	43.6	Horizontal ring feature
0:21	148.1'	45.1	Horizontal ring feature, PWPZ
0:22	153.1'	46.7	Horizontal ring feature
0:22	154.5'	47.1	Vugs, PWPZ
0:26	176.6'	53.8	Horizontal ring feature
0:27	188'	57.3	Horizontal ring feature, PWPZ
0:29	199.6'	60.8	Small horizontal ring feature
0:29	202.1'	61.6	Small horizontal ring feature
0:32	219'	66.8	Horizontal ring feature, PWPZ
0:32	225.6'	68.8	Vugs
0:33	227'	69.2	Vugs
0:34	239.3'	72.9	Vugs
0:35	242.4'	73.9	Horizontal ring feature, Vugs, PWPZ
0:36	246'	75.0	Vugs
0:37	257.6'	78.5	Vugs
0:39	268.3'	81.8	Horizontal ring feature
0:39	269.8'	82.2	Horizontal ring feature
0:40	273.9'	83.5	Bottom of well, Rocks
0:42	268.7'	81.9	Horizontal ring feature
0:48	244.2'	74.4	Vugs, Sediment
0:49	242.9'	74.0	Horizontal ring feature, Sediment, PWPZ
0:52	227.5'	69.3	Vugs, Sediment, PWPZ
0:54	219.6'	66.9	Horizontal ring feature, Sediment, Flow in
1:00	188.5'	57.5	Horizontal ring feature, Sediment
1:07	155.1'	47.3	Vugs, Sediment
1:07	154.5'	47.1	Vugs, Sediment
1:08	153.6'	46.8	Small horizontal ring feature

TABLE 3A

TOWNSHIP OF ERIN

North Well TW3
Static Video Summary
2019/01/22

Elapsed Time (h:min)	Depth (ft below MP)	Depth (m below MP)	Comments
1:10	148.6'	45.3	Horizontal ring feature, PWPZ
1:11	143.9'	43.9	Horizontal ring feature, PWPZ
1:13	141.2'	43.0	Horizontal ring feature, Sediment, PWPZ
1:14	140.2'	42.7	Horizontal ring feature, Sediment, PWPZ
1:15	137.9'	42.0	Bottom of casing
1:16	137.7'	42.0	Casing joint
1:16	136.8'	41.7	Casing joint
1:20	116.8'	35.6	Threaded casing joint
1:23	97.1'	29.6	Casing joint
1:26	77.1'	23.5	Casing joint
1:28	69.9'	21.3	Static water level
1:29	57.2'	17.4	Threaded casing joint
1:32	37.3'	11.4	Threaded casing joint
1:35	17.5'	5.3	Threaded casing joint
1:39	3.5'	1.1	Below top of casing

Video survey conducted by Rodney Secor

Notes: Measuring point (MP) is top of casing which is 0.77 m above ground surface
PWPZ = Possible water producing zone

TABLE 3B

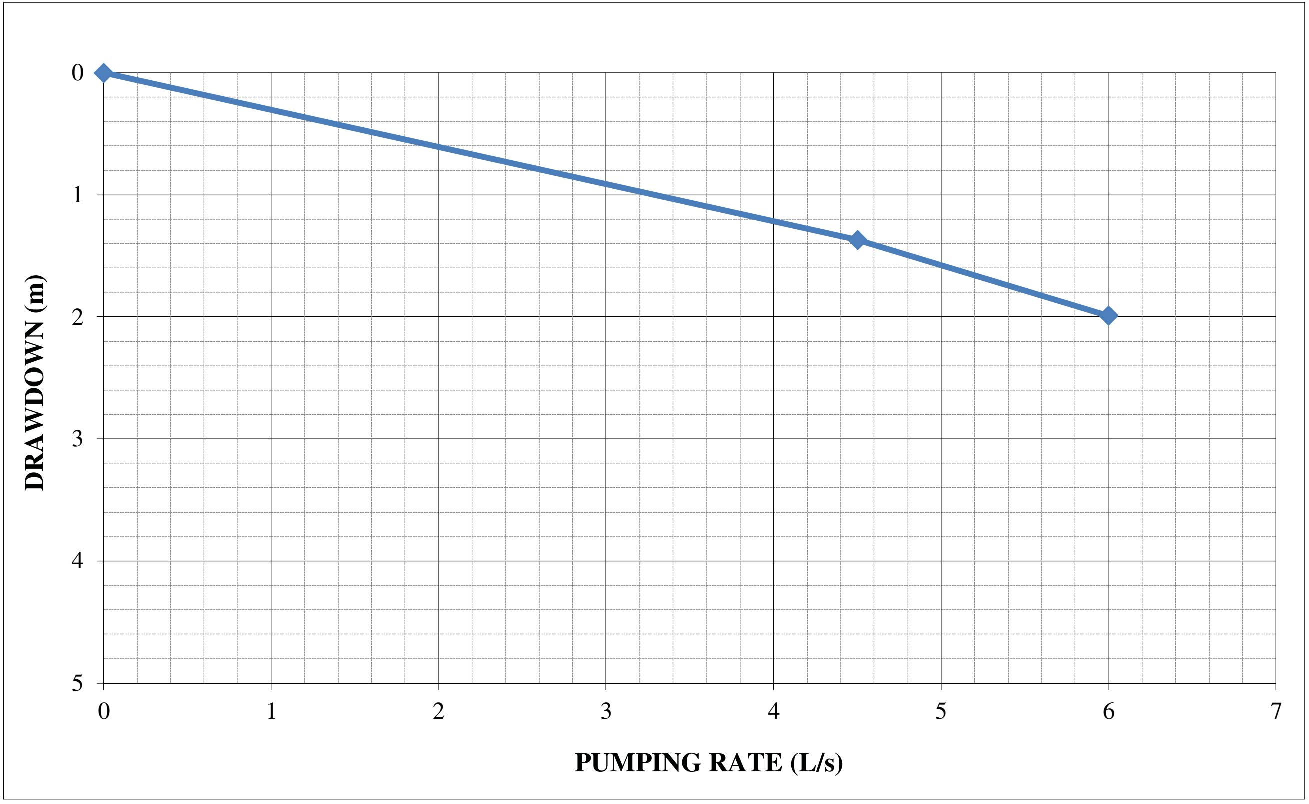
VARIABLE RATE PERFORMANCE TEST

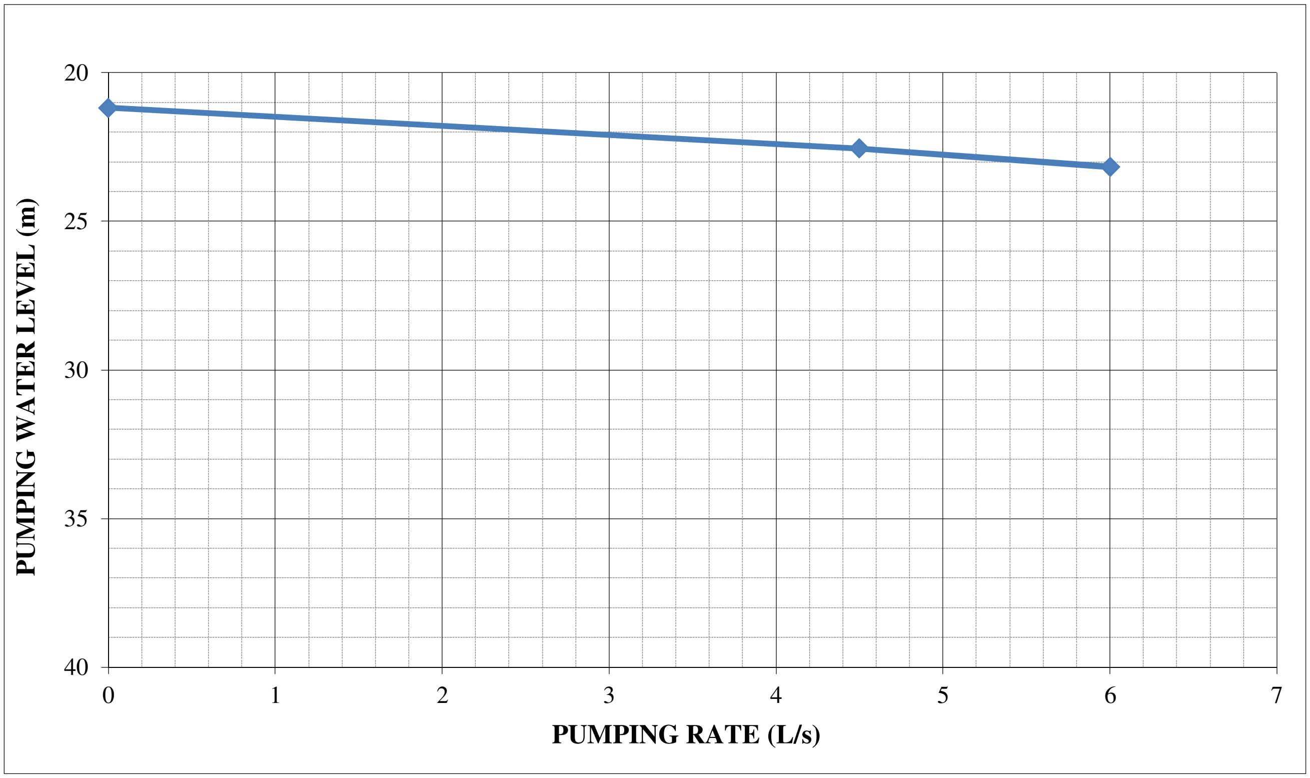
Lotowater
TECHNICAL SERVICES INC.

Well Name: North Well TW3
Client: Town of Erin (GSC)
Technician Name: Craig Lawson
Water Level Device: LTS water level meter
Water Level Reference: Top of casing (0.7 m agl)
Test Note: TD = 83.5 mbtc, Base of 150 mm diameter casing 42.0 mbtc

Project Number: 148-003
Date: January 28, 2019
Pump: Goulds 80GS50 (5hp)
Pump Inlet: 40 m
Flow Measuring Device: 2" Banjo

Time *hr:min*	**Elapsed Time** *min*	**Level** *mbtc*	**Drawdown** *m*	**Flow** *L/s*	**Note**
0:00	0	21.18	0.00	6.0	Start Step 1
0:01	1	21.51	0.33	6.0	
0:02	2	21.78	0.60	6.0	0 psi
0:03	3	21.98	0.80	6.0	
0:04	4	22.04	0.86	6.0	
0:05	5	22.10	0.92	6.0	
0:06	6	22.16	0.98	6.0	
0:08	8	22.26	1.08	6.0	
0:10	10	22.35	1.17	6.0	
0:12	12	22.42	1.24	6.0	
0:15	15	22.50	1.32	6.0	
0:20	20	22.62	1.44	6.0	
0:25	25	22.71	1.53	6.0	
0:30	30	22.81	1.63	6.0	
0:40	40	22.96	1.78	6.0	
0:50	50	23.05	1.87	6.0	
1:00	60	23.17	1.99	6.0	
1:01	1	22.87	1.69	4.5	Start Step 2
1:02	2	22.82	1.64	4.5	
1:03	3	22.76	1.58	4.5	
1:04	4	22.71	1.53	4.5	50 psi
1:05	5	22.68	1.50	4.5	
1:06	6	22.67	1.49	4.5	
1:08	8	22.65	1.47	4.5	
1:10	10	22.64	1.46	4.5	
1:12	12	22.62	1.44	4.5	
1:15	15	22.61	1.43	4.5	
1:20	20	22.57	1.39	4.5	
1:25	25	22.58	1.40	4.5	
1:30	30	22.56	1.38	4.5	
1:40	40	22.56	1.38	4.5	
1:50	50	22.55	1.37	4.5	
2:00	60	22.55	1.37	4.5	





Notes:

Test Date = January 28, 2019

All water levels are referenced from top of well casing

Top of casing = 0.77 m above ground surface

Base of well casing = 42.0 m

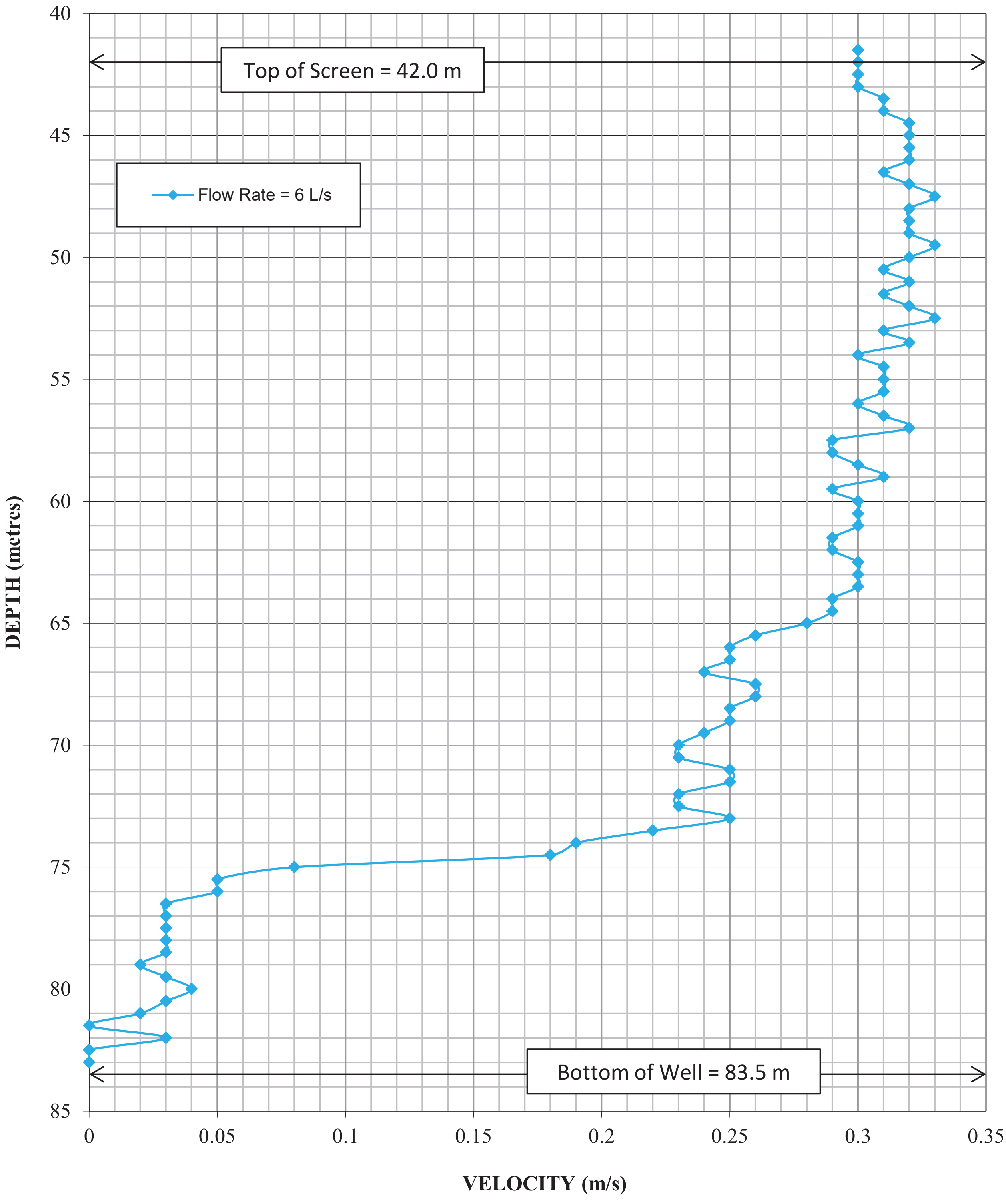
Township of Erin

North Well TW3

Comparison of Variable Rate Tests

Lotowater Technical Services Inc. **Figure 3A**

Reference: 148-003 2019-01-29



Notes:
Test Date = January 28, 2019
All water levels are referenced from top of well casing
Top of casing = 0.77 m above ground surface

Township of Erin

North Well TW3

Flow Profile

Lotowater Technical Services Inc. **Figure 3B**
Reference: 148-003 2019-01-29

ALS		Sample ID				ERIN NORTH TW3
2/17/2020		ALS ID				L2225802-1
L2225802		Date Sampled				1/28/2019 1:40:00 PM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water
Colour, Apparent	CU	2	-	5	-	5.4
Conductivity	umhos/cm	3	-	-	-	679
pH	pH units	0.1	-	6.5-8.5	-	7.8
Redox Potential	mV	-1000	-	-	-	223 *
Total Dissolved Solids	mg/L	20	-	500	-	445 *
Turbidity	NTU	0.1	-	5	-	2.58
Alkalinity, Bicarbonate (as CaCO3)	mg/L	10	-	-	-	190
Alkalinity, Carbonate (as CaCO3)	mg/L	10	-	-	-	<10
Alkalinity, Hydroxide (as CaCO3)	mg/L	10	-	-	-	<10
Alkalinity, Total (as CaCO3)	mg/L	10	-	-	500	190
Ammonia, Total (as N)	mg/L	0.02	-	-	-	0.133
Bromide (Br)	mg/L	0.1	-	-	-	<0.10
Chloride (Cl)	mg/L	0.5	-	250	-	2.05
Computed Conductivity	uS/cm	n/a	-	-	-	728
Conductivity % Difference	%	n/a	-	-	-	6.9
Fluoride (F)	mg/L	0.02	1.5	-	-	0.327
Hardness (as CaCO3)	mg/L	n/a	-	-	-	363
Ion Balance	%	n/a	-	-	-	105
Langelier Index		n/a	-	-	-	0.6
Nitrate (as N)	mg/L	0.02	10	-	-	<0.020
Nitrite (as N)	mg/L	0.01	1	-	-	<0.010
Saturation pH	pH	n/a	-	-	-	7.2
Orthophosphate-Dissolved (as P)	mg/L	0.003	-	-	-	<0.0030
TDS (Calculated)	mg/L	n/a	-	-	-	453
Sulfate (SO4)	mg/L	0.3	-	500	-	199
Sulphide (as S)	mg/L	0.018	-	0.05	-	<0.018
Sulphide (as H2S)	mg/L	0.019	-	0.05	-	<0.019
Anion Sum	me/L	n/a	-	-	-	7.35
Cation Sum	me/L	n/a	-	-	-	7.69
Cation - Anion Balance	%	n/a	-	-	-	2.2
Cyanide, Total	mg/L	0.002	-	-	-	<0.0020
Dissolved Carbon Filtration Location		n/a	-	-	-	LAB
Dissolved Organic Carbon	mg/L	0.5	-	5	-	0.75
Silica Total	mg/L	0.21	-	-	-	13.3
E. Coli	CFU/100mL	0	0	-	-	0
Total Coliform Background	CFU/100mL	0	-	-	-	2
Total Coliforms	CFU/100mL	0	0	-	-	0
Sodium Adsorption Ratio	SAR	0.1	-	-	-	0.2
Aluminum (Al)-Total	mg/L	0.01	-	-	0.1	<0.010
Antimony (Sb)-Total	mg/L	0.0001	0.006	-	-	<0.00010
Arsenic (As)-Total	mg/L	0.0001	0.01	-	-	0.00121
Barium (Ba)-Total	mg/L	0.0002	1	-	-	0.0144
Beryllium (Be)-Total	mg/L	0.0001	-	-	-	<0.00010
Bismuth (Bi)-Total	mg/L	0.00005	-	-	-	<0.000050
Boron (B)-Total	mg/L	0.01	5	-	-	0.035
Cadmium (Cd)-Total	mg/L	0.00001	0.005	-	-	<0.000010
Calcium (Ca)-Total	mg/L	0.5	-	-	-	98.7
Cesium (Cs)-Total	mg/L	0.00001	-	-	-	<0.000010
Chromium (Cr)-Total	mg/L	0.0005	0.05	-	-	<0.00050
Cobalt (Co)-Total	mg/L	0.0001	-	-	-	0.00086
Copper (Cu)-Total	mg/L	0.001	-	1	-	<0.0010
Iron (Fe)-Total	mg/L	0.05	-	0.3	-	0.14
Lead (Pb)-Total	mg/L	0.0001	0.01	-	-	0.0007
Magnesium (Mg)-Total	mg/L	0.05	-	-	-	28.3
Manganese (Mn)-Total	mg/L	0.0005	-	0.05	-	0.0486
Mercury (Hg)-Total	mg/L	0.00001	0.001	-	-	<0.000010
Molybdenum (Mo)-Total	mg/L	0.00005	-	-	-	0.00512
Nickel (Ni)-Total	mg/L	0.0005	-	-	-	0.00122
Phosphorus (P)-Total	mg/L	0.05	-	-	-	<0.050

Analyte	Units	LOR	Micro & Chemical Standards	AO	Upper Limit	Water
Potassium (K)-Total	mg/L	0.05	-	-	-	1.23
Rubidium (Rb)-Total	mg/L	0.0002	-	-	-	0.00132
Selenium (Se)-Total	mg/L	0.00005	0.05	-	-	0.000053
Silicon (Si)-Total	mg/L	0.1	-	-	-	6.22
Silver (Ag)-Total	mg/L	0.00005	-	-	-	<0.000050
Sodium (Na)-Total	mg/L	0.5	20	200	-	8.97
Strontium (Sr)-Total	mg/L	0.001	-	-	-	1.38
Sulfur (S)-Total	mg/L	0.5	-	-	-	68.3
Tellurium (Te)-Total	mg/L	0.0002	-	-	-	<0.00020
Thallium (Tl)-Total	mg/L	0.00001	-	-	-	0.000063
Thorium (Th)-Total	mg/L	0.0001	-	-	-	<0.00010
Tin (Sn)-Total	mg/L	0.0001	-	-	-	0.00012
Titanium (Ti)-Total	mg/L	0.0003	-	-	-	<0.00030
Tungsten (W)-Total	mg/L	0.0001	-	-	-	<0.00010
Uranium (U)-Total	mg/L	0.00001	0.02	-	-	0.0011
Vanadium (V)-Total	mg/L	0.0005	-	-	-	<0.00050
Zinc (Zn)-Total	mg/L	0.003	-	5	-	0.0254
Zirconium (Zr)-Total	mg/L	0.0003	-	-	-	<0.00030
Acetone	ug/L	20	-	-	-	<20
Benzene	ug/L	0.5	1	-	-	<0.50
Bromodichloromethane	ug/L	1	-	-	-	<1.0
Bromoform	ug/L	1	-	-	-	<1.0
Bromomethane	ug/L	0.5	-	-	-	<0.50
Carbon Disulfide	ug/L	1	-	-	-	<1.0
Carbon tetrachloride	ug/L	0.5	2	-	-	<0.50
Chlorobenzene	ug/L	0.5	80	30	-	<0.50
Dibromochloromethane	ug/L	1	-	-	-	<1.0
Chloroethane	ug/L	1	-	-	-	<1.0
Chloroform	ug/L	1	-	-	-	<1.0
Chloromethane	ug/L	1	-	-	-	<1.0
1,2-Dibromoethane	ug/L	0.2	-	-	-	<0.20
1,2-Dichlorobenzene	ug/L	0.5	200	3	-	<0.50
1,3-Dichlorobenzene	ug/L	0.5	-	-	-	<0.50
1,4-Dichlorobenzene	ug/L	0.5	5	1	-	<0.50
Dichlorodifluoromethane	ug/L	1	-	-	-	<1.0
1,1-Dichloroethane	ug/L	0.5	-	-	-	<0.50
1,2-Dichloroethane	ug/L	0.5	5	-	-	<0.50
1,1-Dichloroethylene	ug/L	0.5	14	-	-	<0.50
cis-1,2-Dichloroethylene	ug/L	0.5	-	-	-	<0.50
trans-1,2-Dichloroethylene	ug/L	0.5	-	-	-	<0.50
Dichloromethane	ug/L	2	50	-	-	<2.0
1,2-Dichloropropane	ug/L	0.5	-	-	-	<0.50
cis-1,3-Dichloropropene	ug/L	0.5	-	-	-	<0.50
trans-1,3-Dichloropropene	ug/L	0.5	-	-	-	<0.50
Ethylbenzene	ug/L	0.5	140	2.4	-	<0.50
n-Hexane	ug/L	0.5	-	-	-	<0.50
2-Hexanone	ug/L	20	-	-	-	<20
Methyl Ethyl Ketone	ug/L	20	-	-	-	<20
Methyl Isobutyl Ketone	ug/L	20	-	-	-	<20
MTBE	ug/L	0.5	15	-	-	<0.50
Styrene	ug/L	0.5	-	-	-	<0.50
1,1,1,2-Tetrachloroethane	ug/L	0.5	-	-	-	<0.50
1,1,2,2-Tetrachloroethane	ug/L	0.5	-	-	-	<0.50
Tetrachloroethylene	ug/L	0.5	10	-	-	<0.50
Toluene	ug/L	0.5	60	24	-	<0.50
1,1,1-Trichloroethane	ug/L	0.5	-	-	-	<0.50
1,1,2-Trichloroethane	ug/L	0.5	-	-	-	<0.50
Trichloroethylene	ug/L	0.5	5	-	-	<0.50
Trichlorofluoromethane	ug/L	1	-	-	-	<1.0
Vinyl chloride	ug/L	0.5	1	-	-	<0.50
o-Xylene	ug/L	0.5	-	-	-	<0.50
m+p-Xylenes	ug/L	1	-	-	-	<1.0

Analyte	Units	LOR	Micro & Chemical Standards	AO	Upper Limit	Water
Xylenes (Total)	ug/L	1.1	90	300	-	<1.1
4-Bromofluorobenzene	%	Surrogate	-	-	-	100.6
1,4-Difluorobenzene	%	Surrogate	-	-	-	102.3
Total THMs	ug/L	2	100	-	-	<2.0
* = Result Qualified	**Color Key:**	Within Guideline	Exceeds Guideline			
Applied Guideline:	**Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON Drinking Water Standards, Objectives and Guidelines**					

Appendix E
Firehall Well (Hillsburgh)
Testing Results

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11

6710148

MUNICIP 67003 CON. CON. 07

COUNTY OR DISTRICT [redacted]

TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: ERIN

CON., BLOCK, TRACT, SURVEY, ETC.: VII

LOT: 24

DATE COMPLETED: DAY 13 MO 05 YR 89

ELEVATION | RC | BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
	FILL			0	9
	TOPSOIL			9	11
Br.	GRAVEL	STONES		11	36
Gr.	Clay	Stones, Sand Ledges		36	43
Br	Limestone			43	139
Gr.	Limestone			139	200

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
55-60	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
192 TO 200	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 5 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
8	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	250	0	47
8	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE 5 ☐ PLASTIC		47	200
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)

DIAMETER INCHES

LENGTH FEET

MATERIAL AND TYPE

DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
0	25	Benseal Grout

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER AIR

PUMPING RATE: 150 GPM

DURATION OF PUMPING: 1 HOURS 30 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
18 FEET	22 FEET	22 FEET	22 FEET	22 FEET	22 FEET

WATER LEVELS DURING: 1 ☒ PUMPING 2 ☐ RECOVERY

IF FLOWING, GIVE RATE: GPM

PUMP INTAKE SET AT: FEET

WATER AT END OF TEST: 1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP

RECOMMENDED PUMP SETTING: 50 FEET

RECOMMENDED PUMPING RATE: 150 GPM

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☐ UNFINISHED
☐ DEWATERING

WATER USE

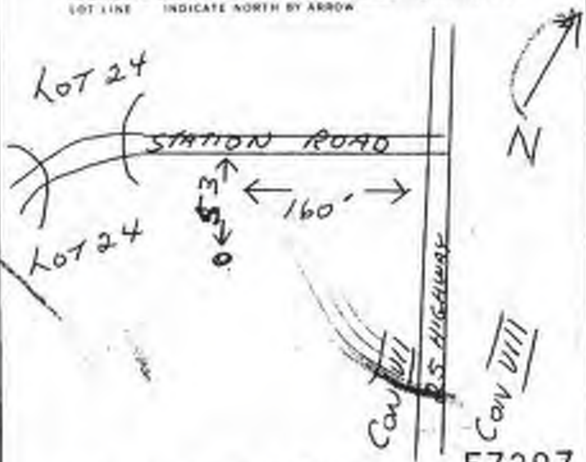
1 ☒ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☒ OTHER FIRE HALL
5 ☐ COMMERCIAL
6 ☐ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL
2 ☒ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☐ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING
☐ DIGGING
☐ OTHER

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



57307

DRILLERS REMARKS: TWC 500

CONTRACTOR

NAME OF WELL CONTRACTOR: LANG WELL DRILLING LTD

WELL CONTRACTOR'S LICENCE NUMBER: 3317

ADDRESS: R.R.#1 HILLSBURGH ONT.

NAME OF WELL TECHNICIAN: ROY LANG

WELL TECHNICIAN'S LICENCE NUMBER: T-0158

SIGNATURE OF TECHNICIAN/CONTRACTOR: R. Lang

SUBMISSION DATE: DAY 24 MO 11 YR 89

OFFICE USE ONLY

DATA SOURCE

CONTRACTOR: 3317

DATE RECEIVED: DEC 01 1989

DATE OF INSPECTION

INSPECTOR

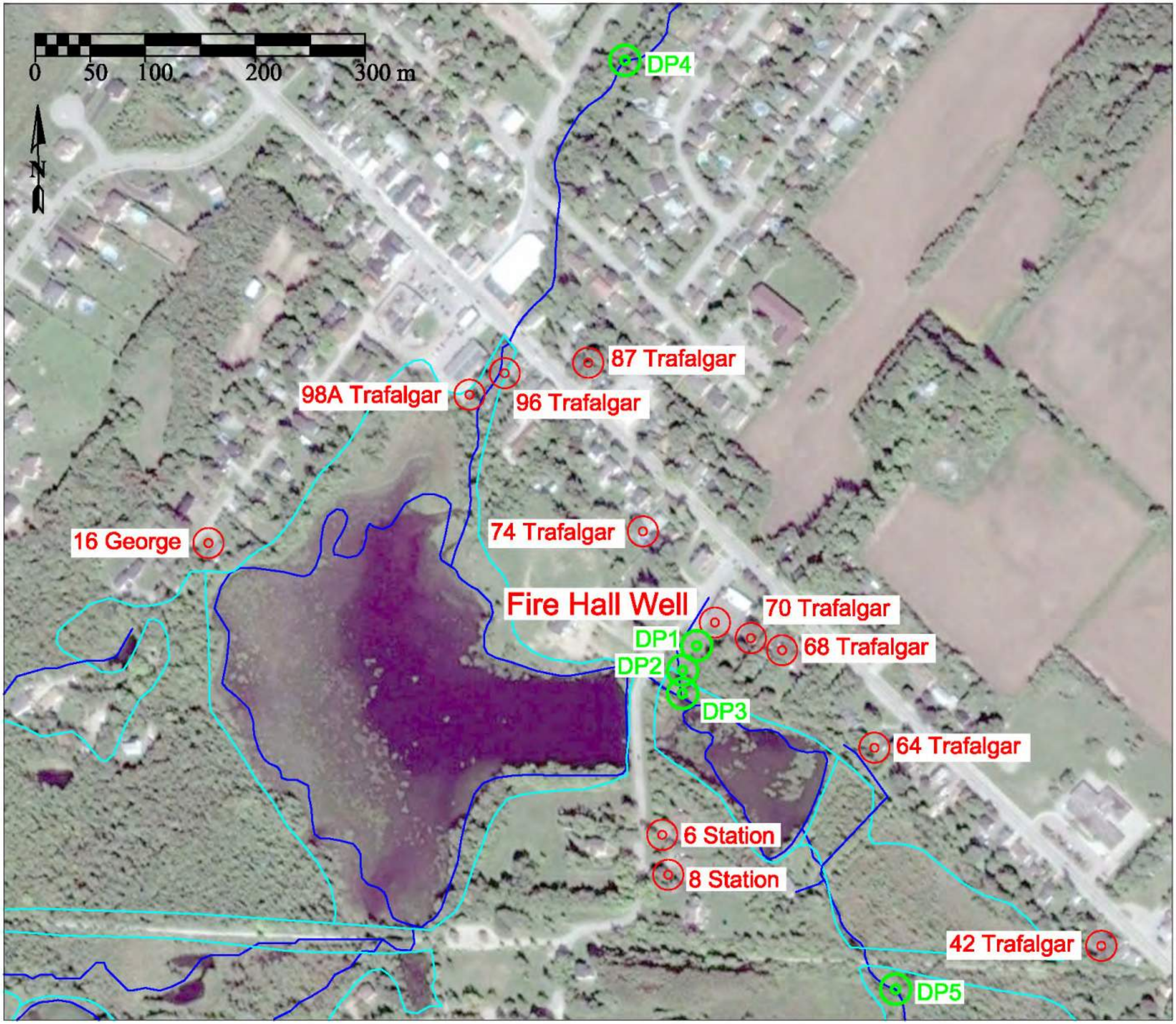
REMARKS

Firehall Well

CSS.ES

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9



Firehall Well

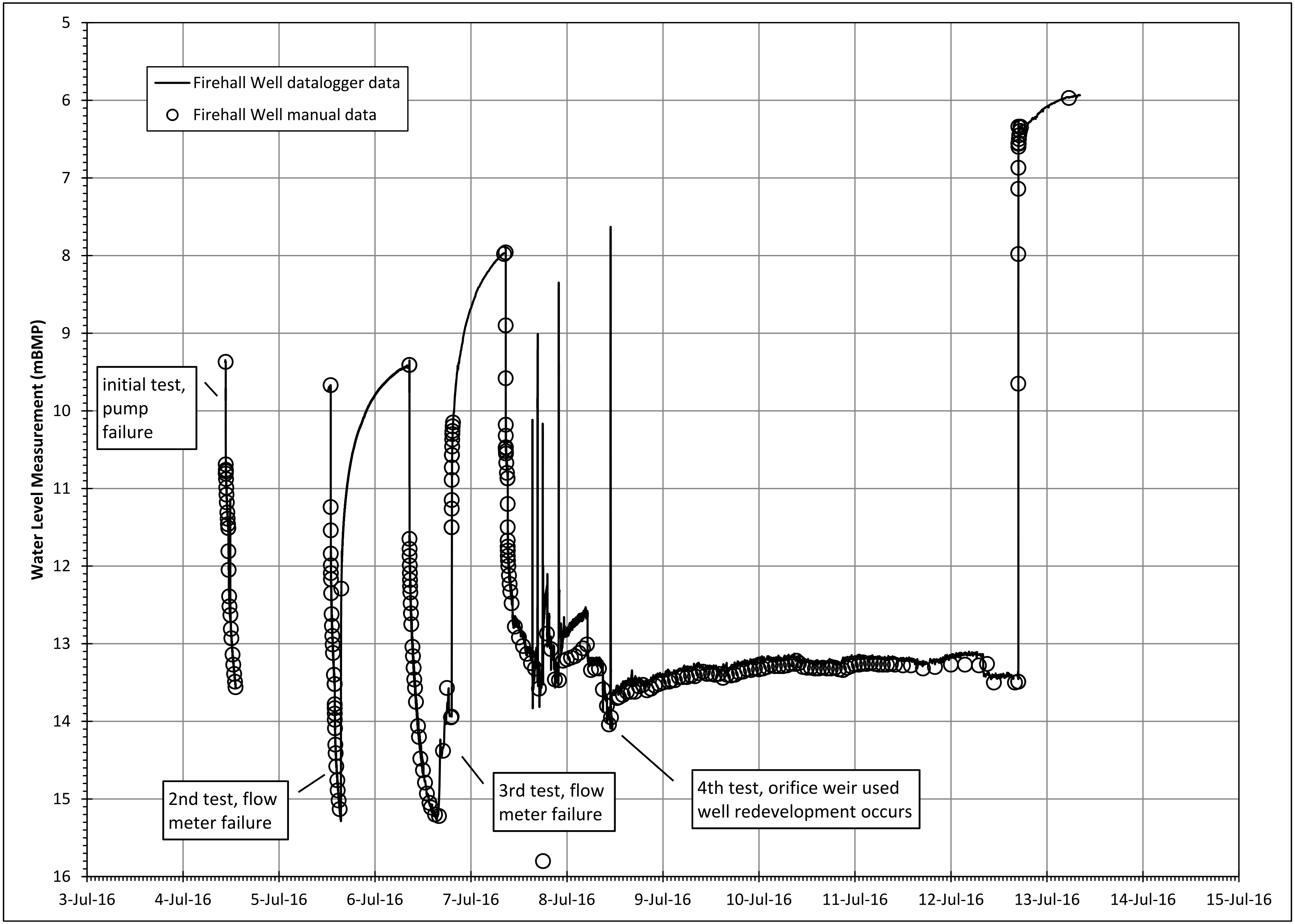
Monitoring Locations

Monitor	TD (mBOTW)	SU (mAGS)	SL (m)	TOS (mBGS)	BOS (mBGS)	Comment	WL (mBTOW)	SW (mBTOW)	Location
DP1-S	2.38	0.86	0.30	1.22	1.52	very slow recovery	2.32	-	closest to fire station
DP1-D	3.44	1.09	0.30	2.06	2.36	very slow recovery	1.53	-	(not yet recovered to static)
DP2-S	2.20	0.49	0.30	1.41	1.71	moderate recovery	0.49	-	edge of grass area at station
DP2-D	3.45	1.08	0.30	2.07	2.37	moderate recovery	1.04	-	
DP3	2.16	0.68	0.30	1.18	1.48	moderate recovery	0.24	0.68	creek/pond at station
DP4	2.99	1.15	0.30	1.54	1.84	very quick recovery	2.87	0.86	north redd area
	3.77	1.83	0.30	1.64	1.94	deepened to refusal July 4, 2016, measurements adjusted to new SU			
DP5	2.20	0.91	0.30	0.99	1.29	moderate recovery	0.80	0.77	south redd area

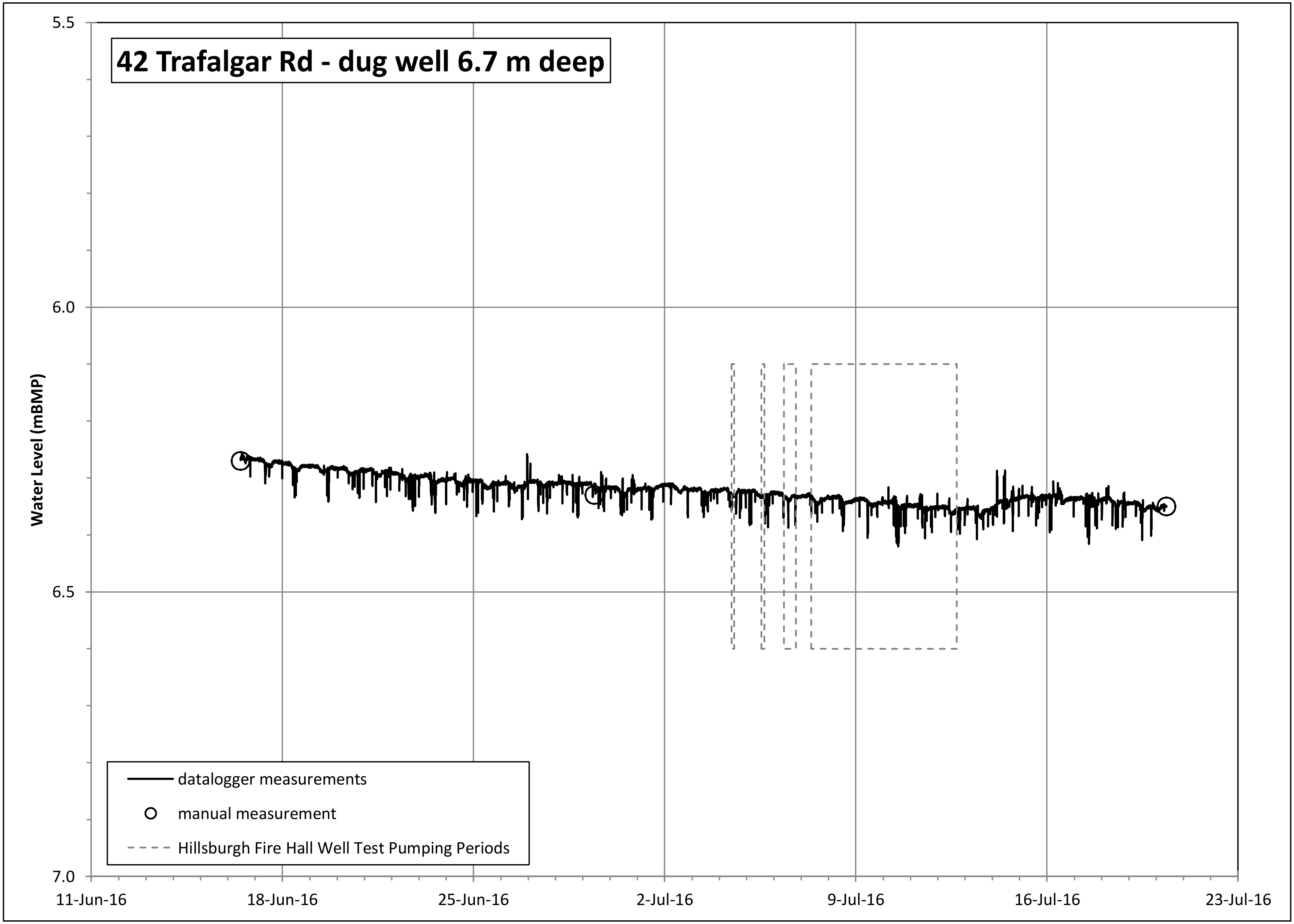
TD = total depth
SL = screen length
BOS = bottom of screen
all drive-points removed after test
SU = stick up
TOS = top of screen
WL = groundwater level in piezometer
SW = surface water level

Drive Point Installation Summary

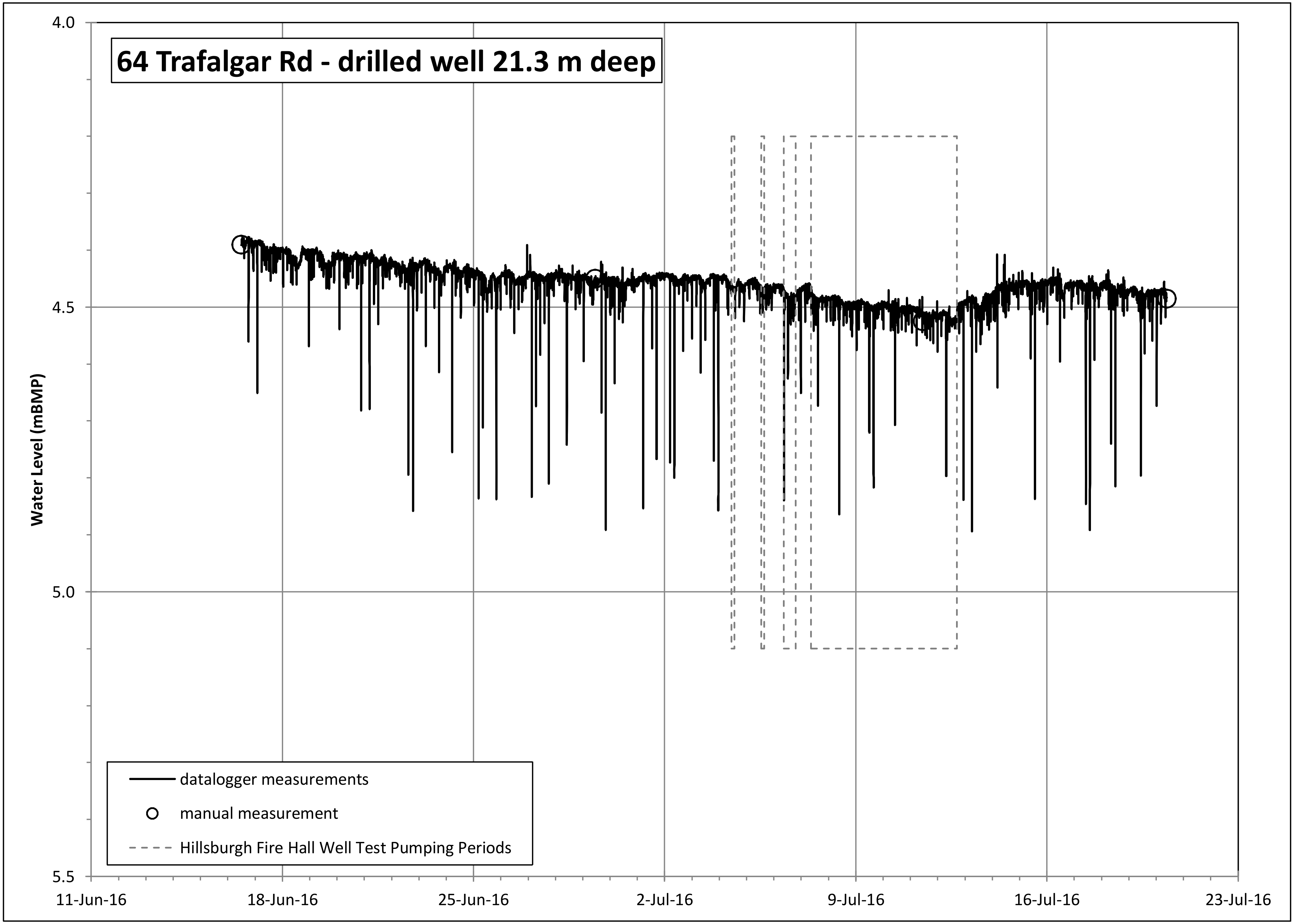
Firehall Well Test



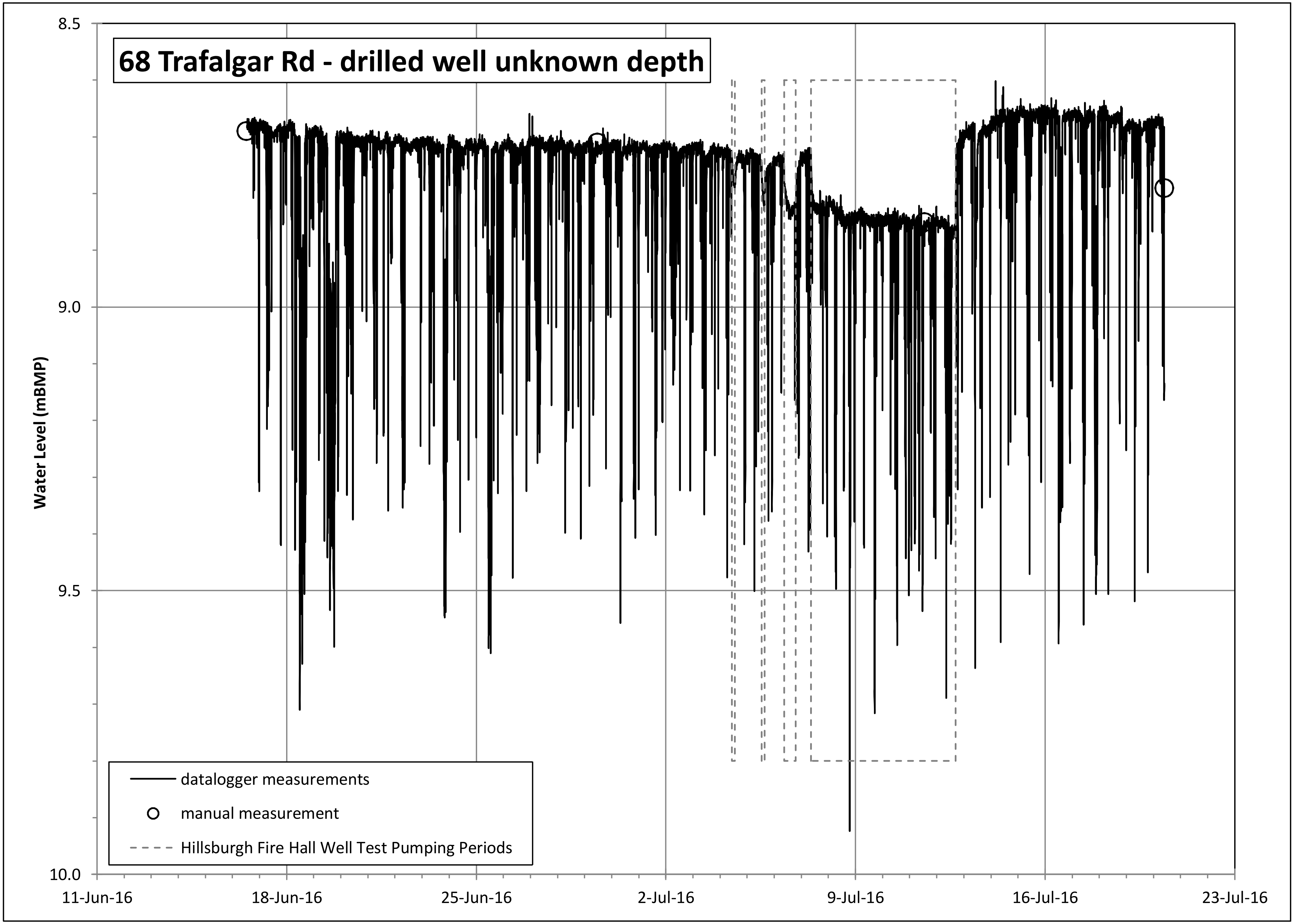
Hillsburgh Firehall Pump Test Hydrograph



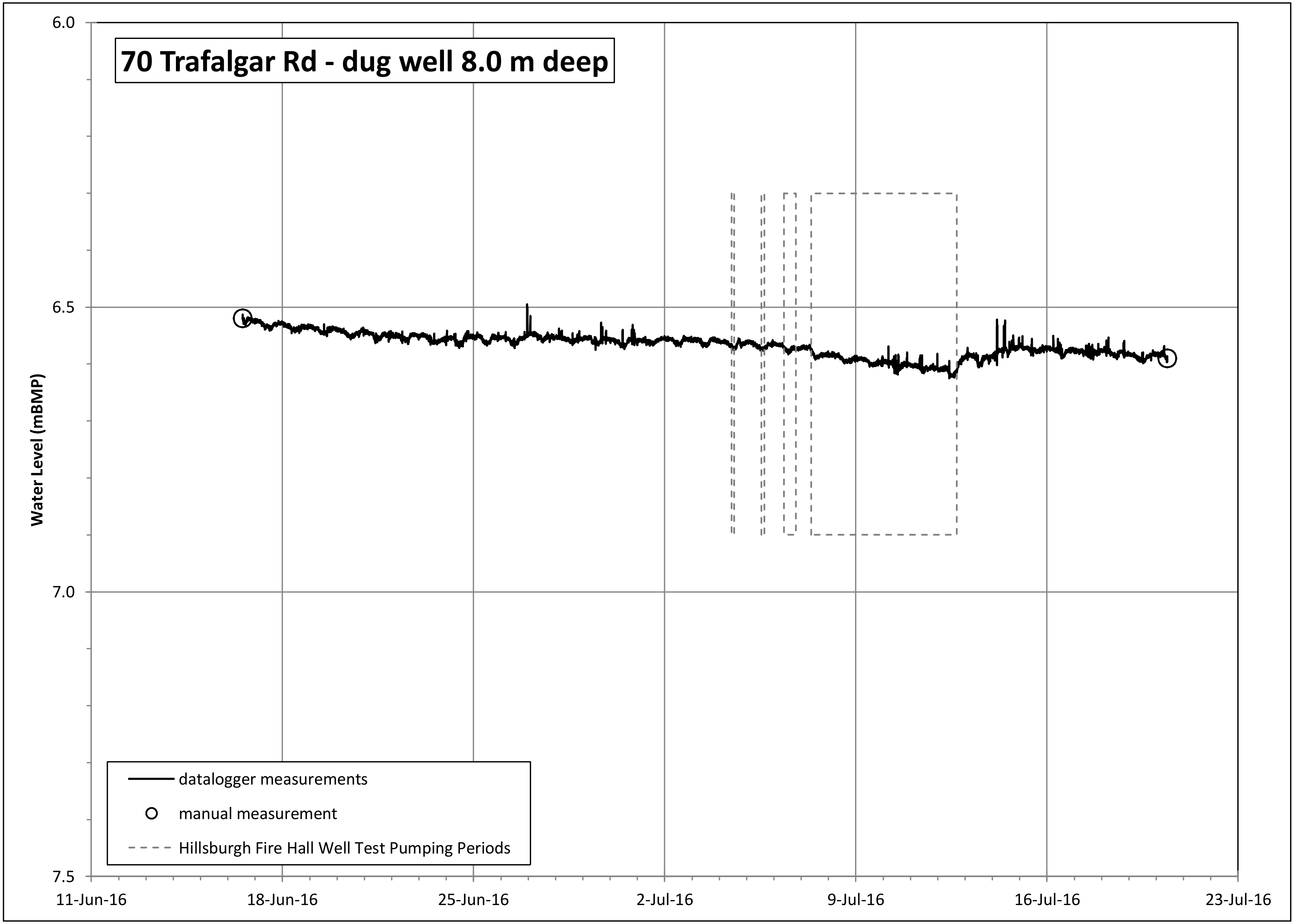
Firehall Well Pump Test Hydrograph – 42 Trafalgar Road



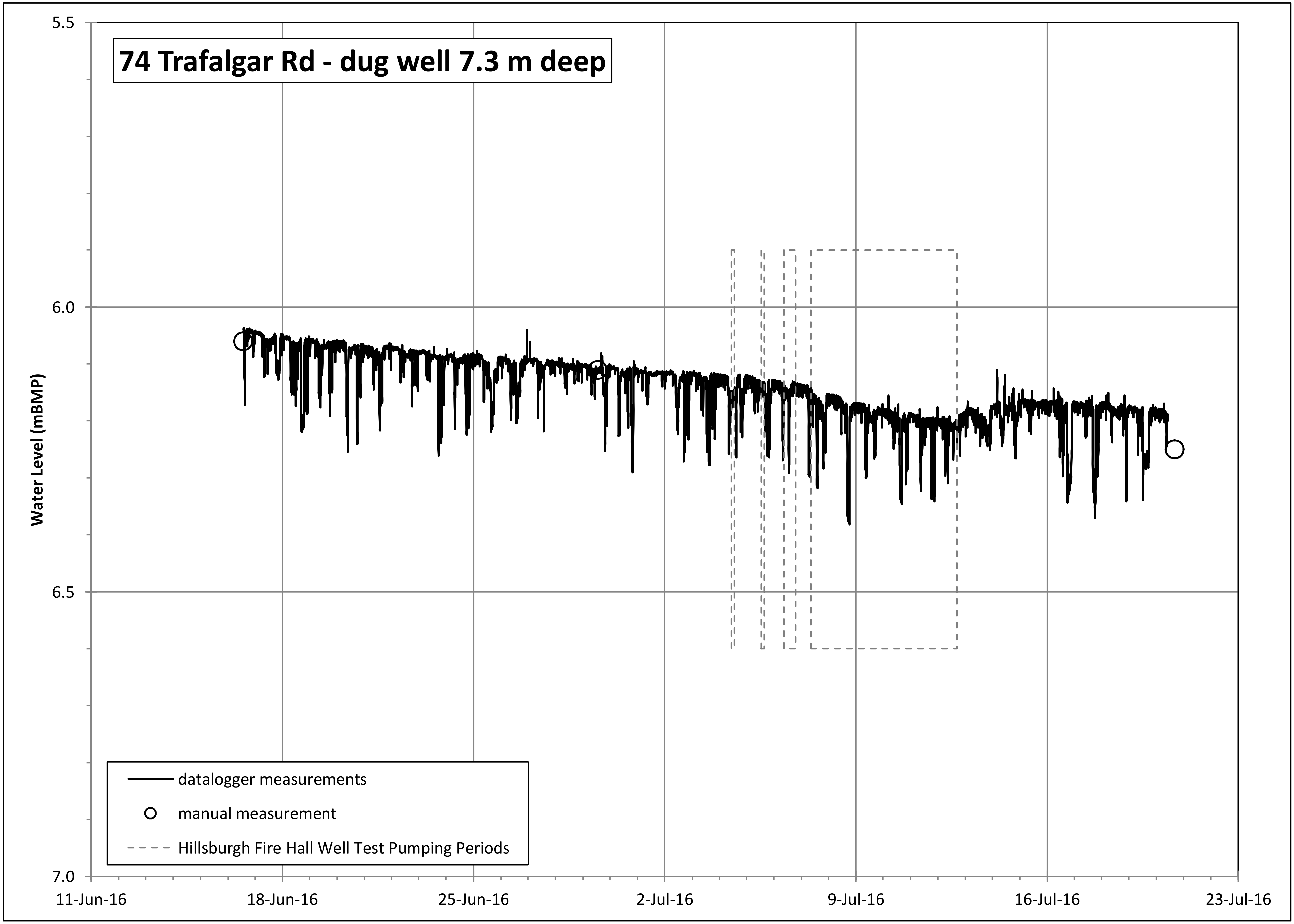
Firehall Well Pump Test Hydrograph – 64 Trafalgar Road



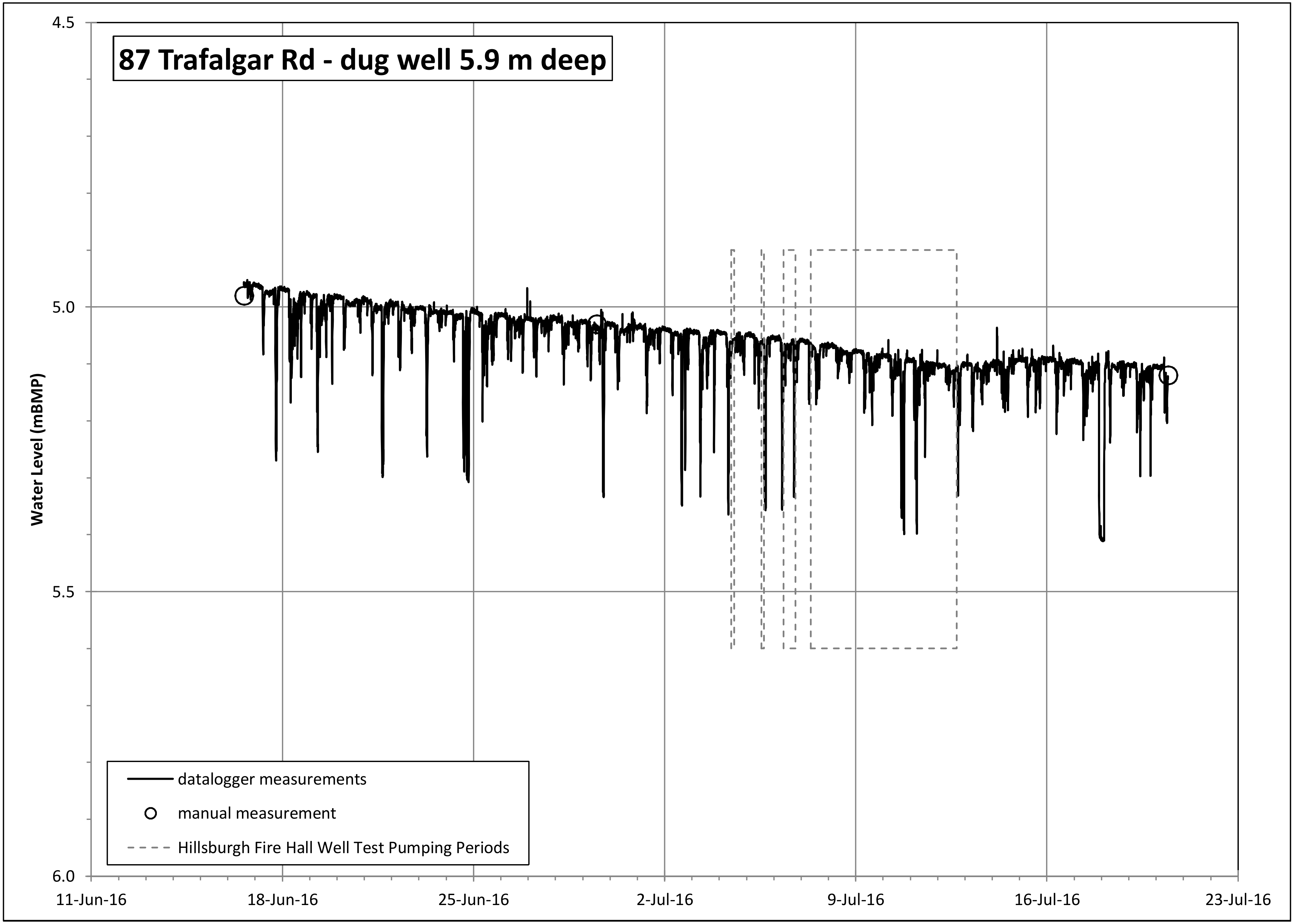
Firehall Well Pump Test Hydrograph – 68 Trafalgar Road



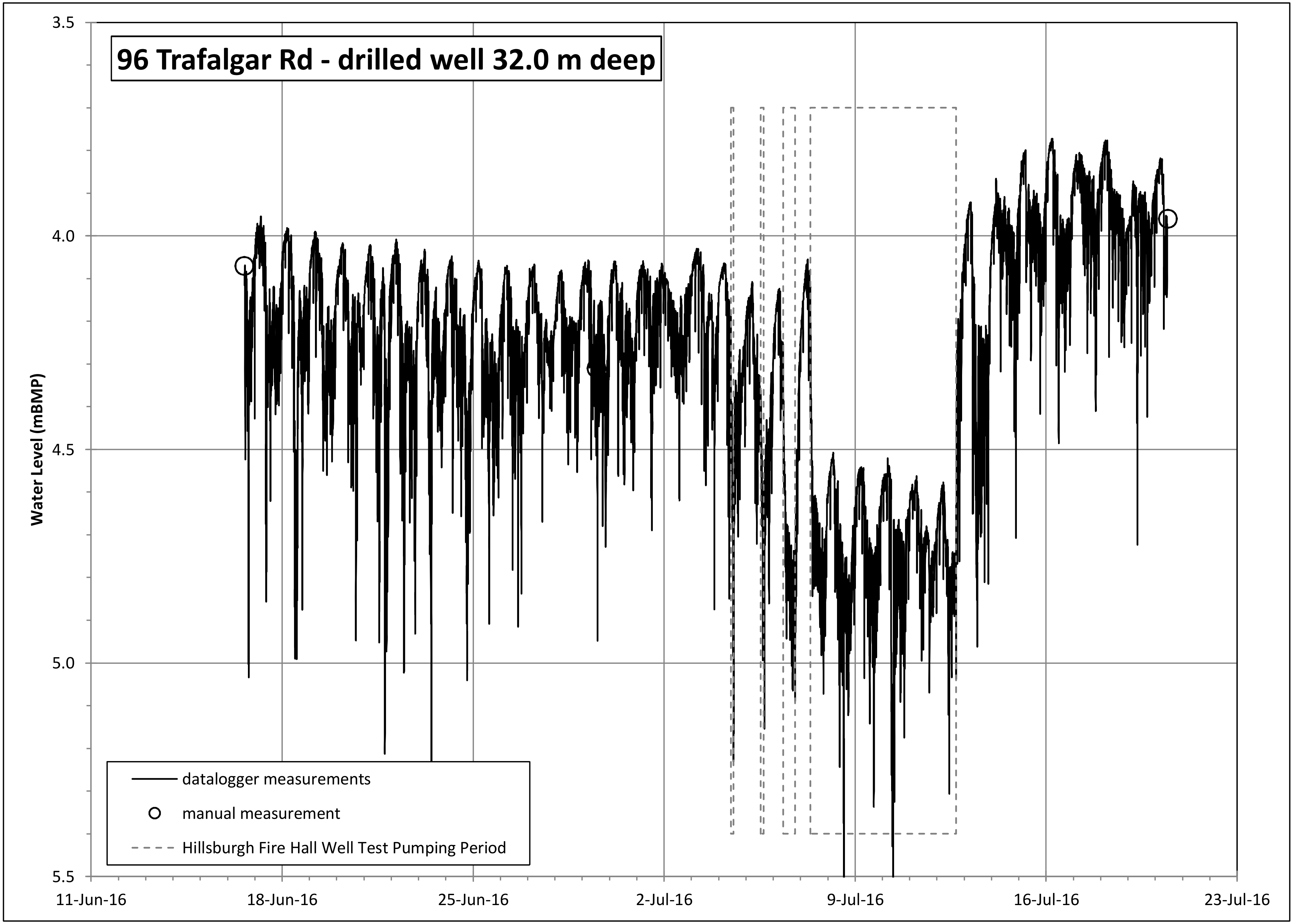
Firehall Well Pump Test Hydrograph – 70 Trafalgar Road



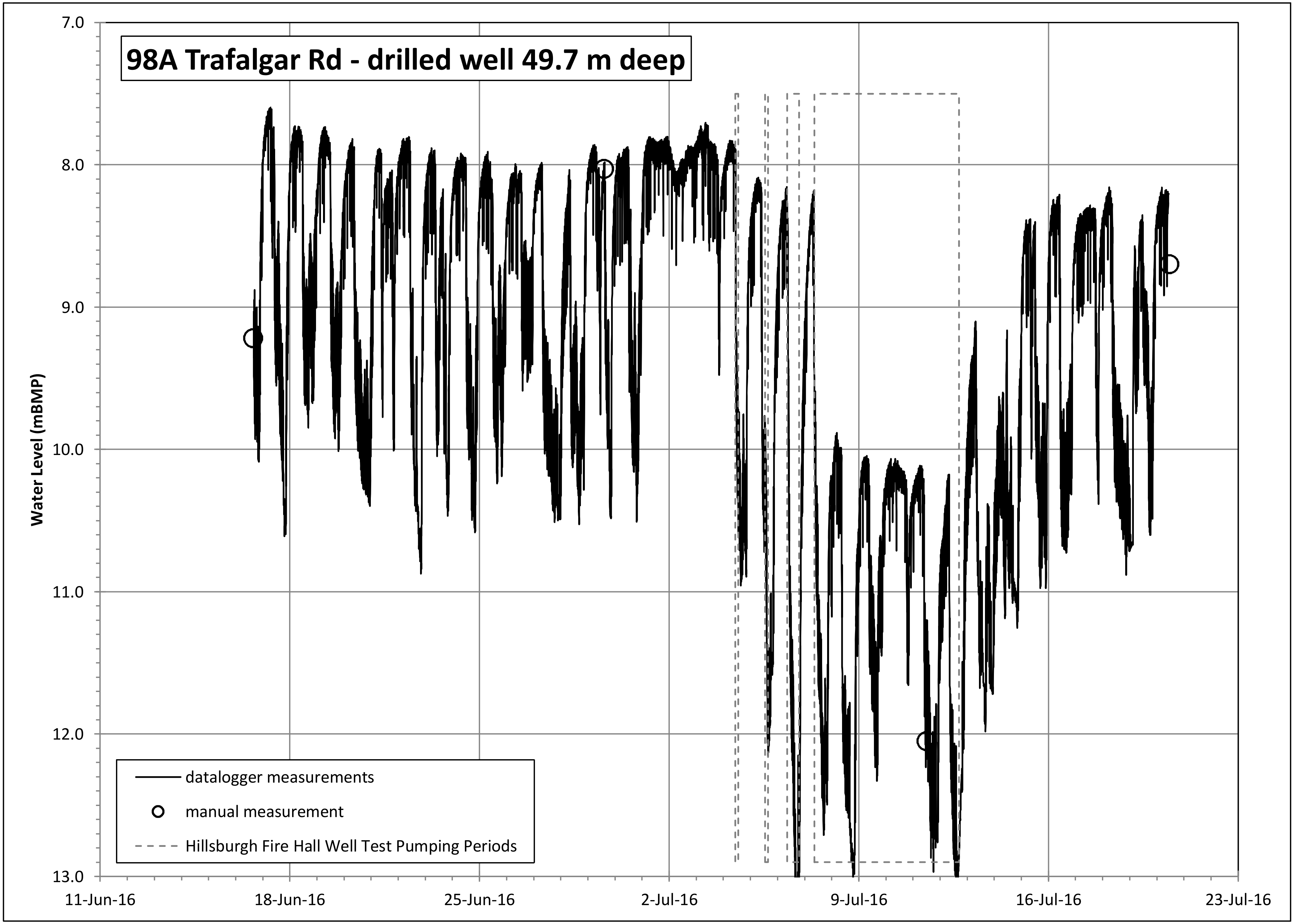
Firehall Well Pump Test Hydrograph – 74 Trafalgar Road



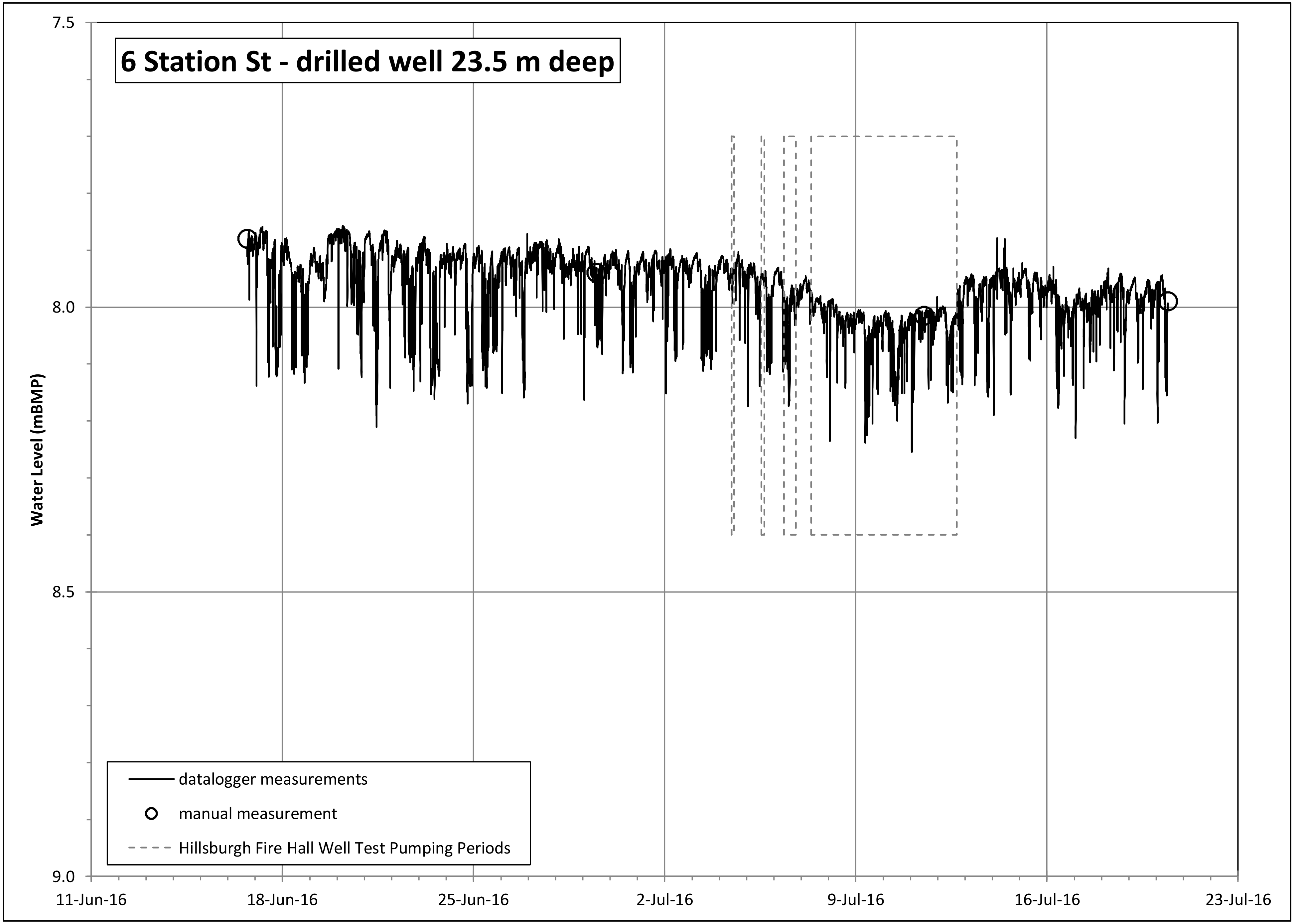
Firehall Well Pump Test Hydrograph – 87 Trafalgar Road



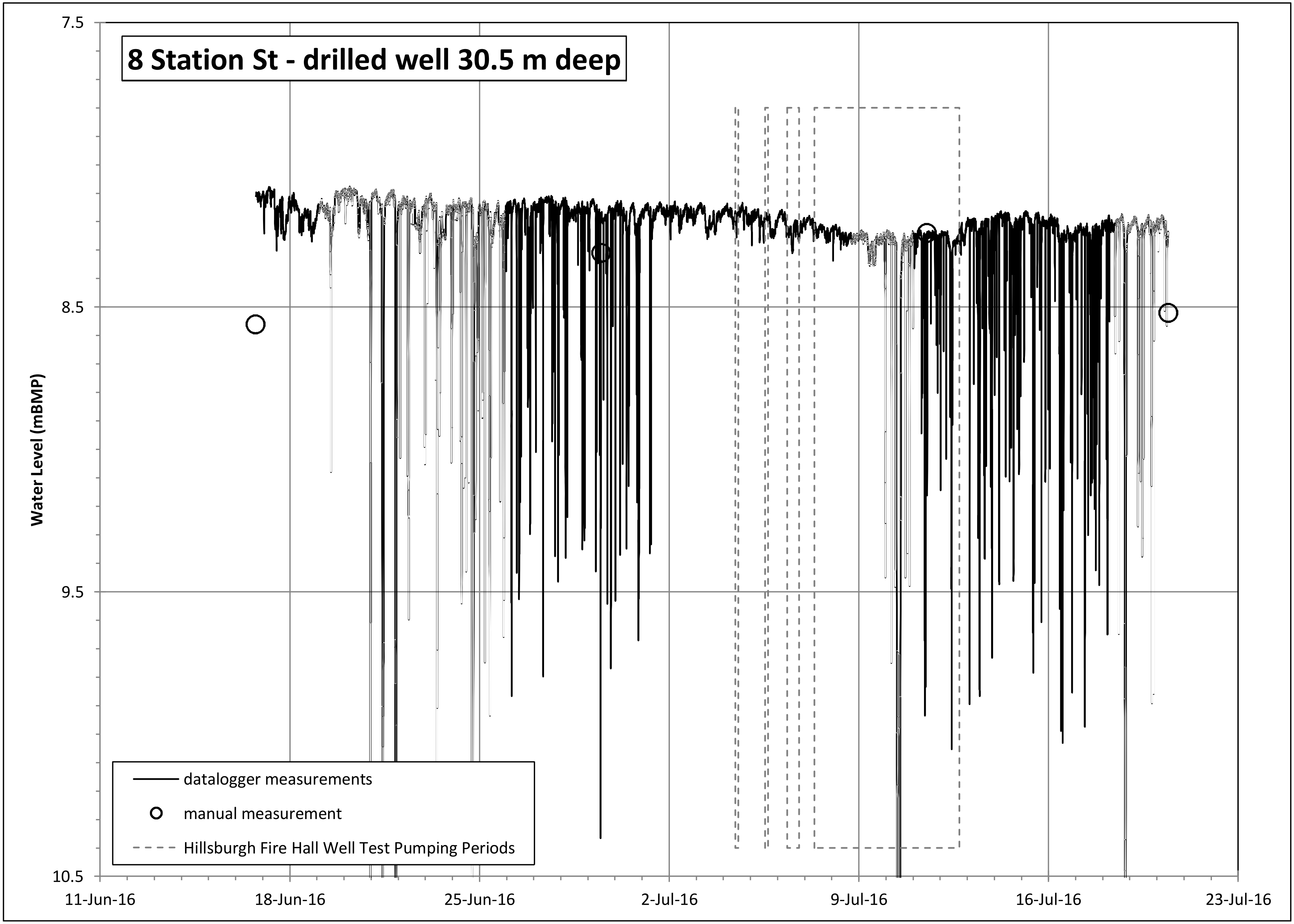
Firehall Well Pump Test Hydrograph – 96 Trafalgar Road



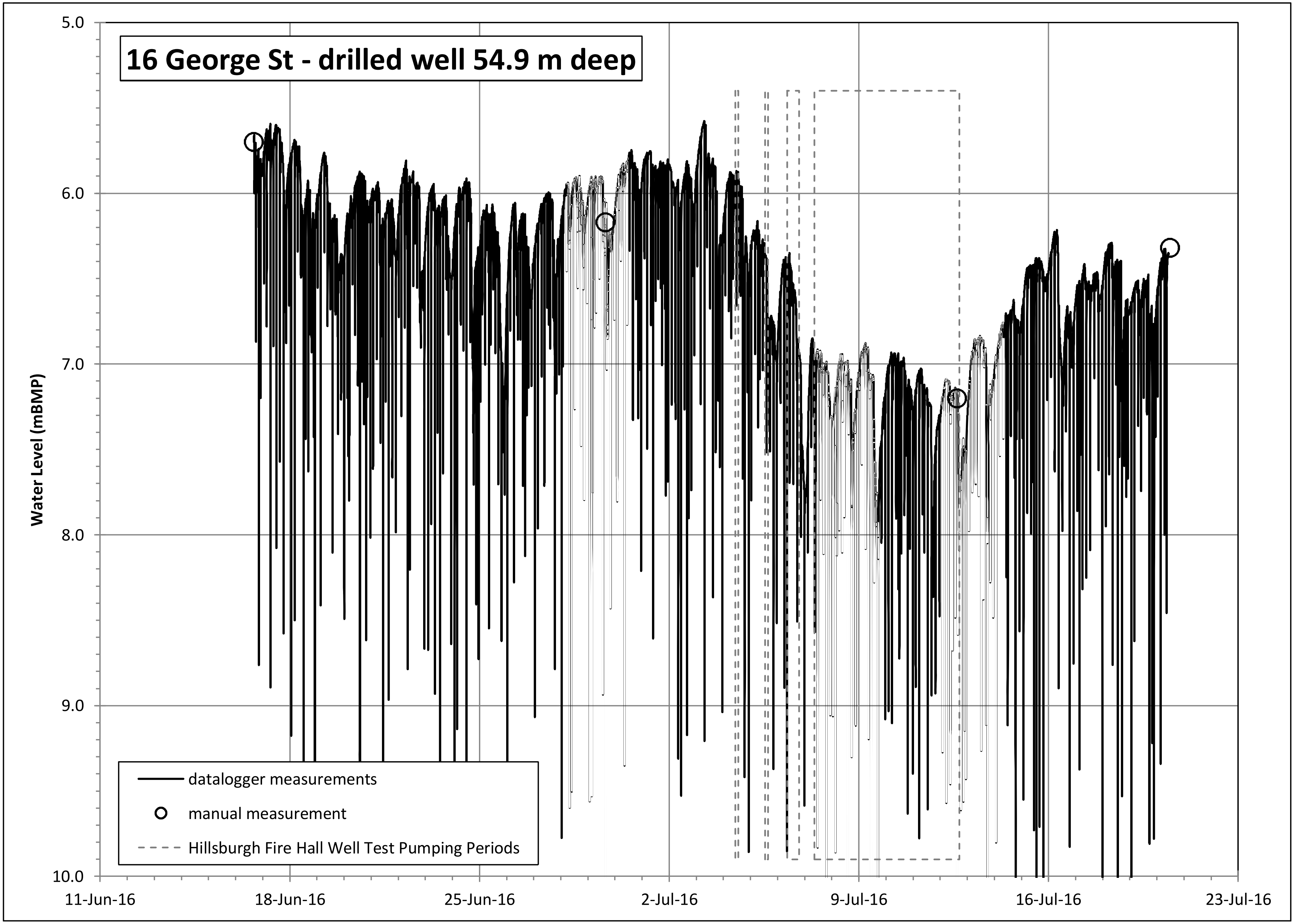
Firehall Well Pump Test Hydrograph – 98A Trafalgar Road



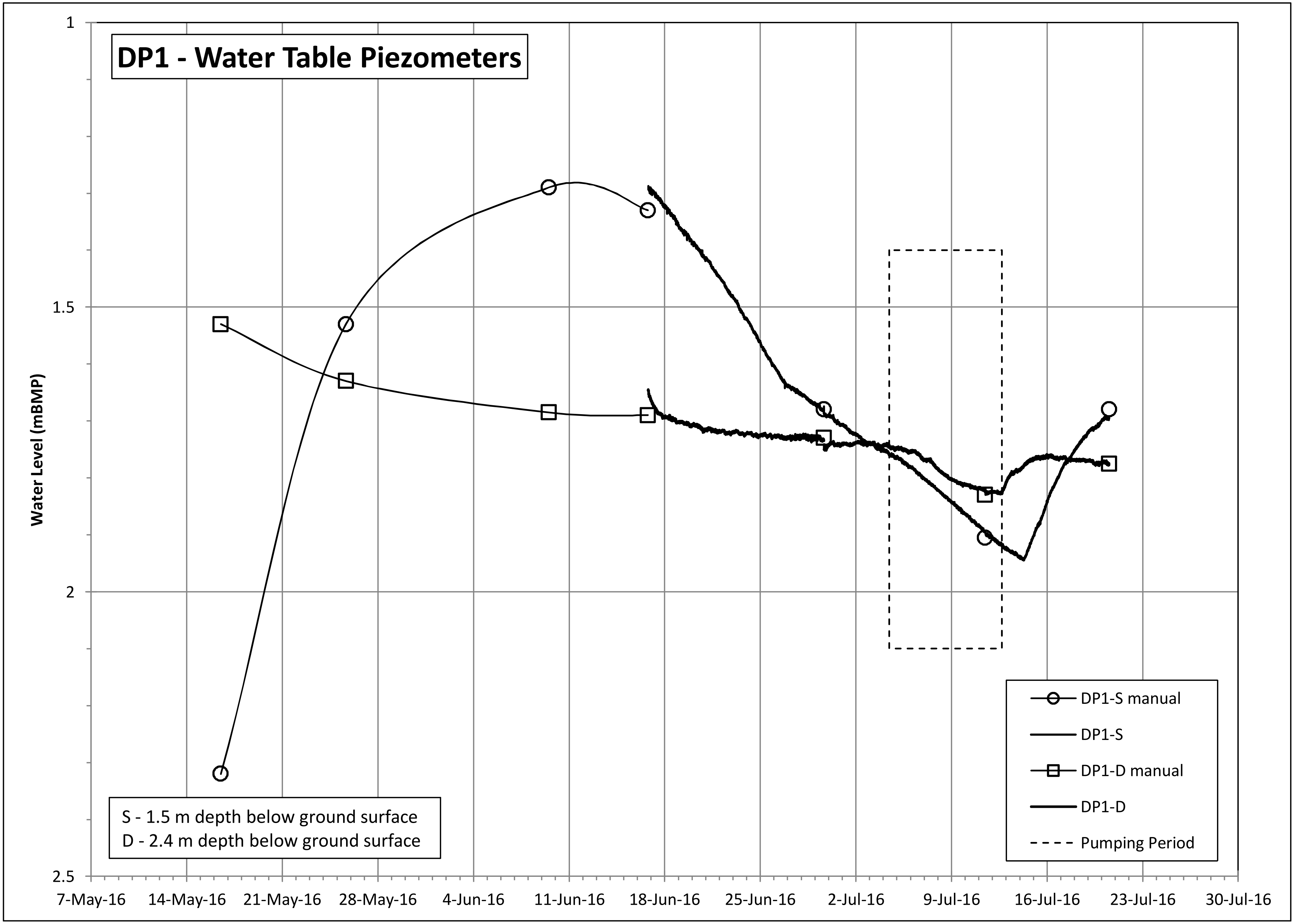
Firehall Well Pump Test Hydrograph – 6 Station Street



Firehall Well Pump Test Hydrograph – 8 Station Street



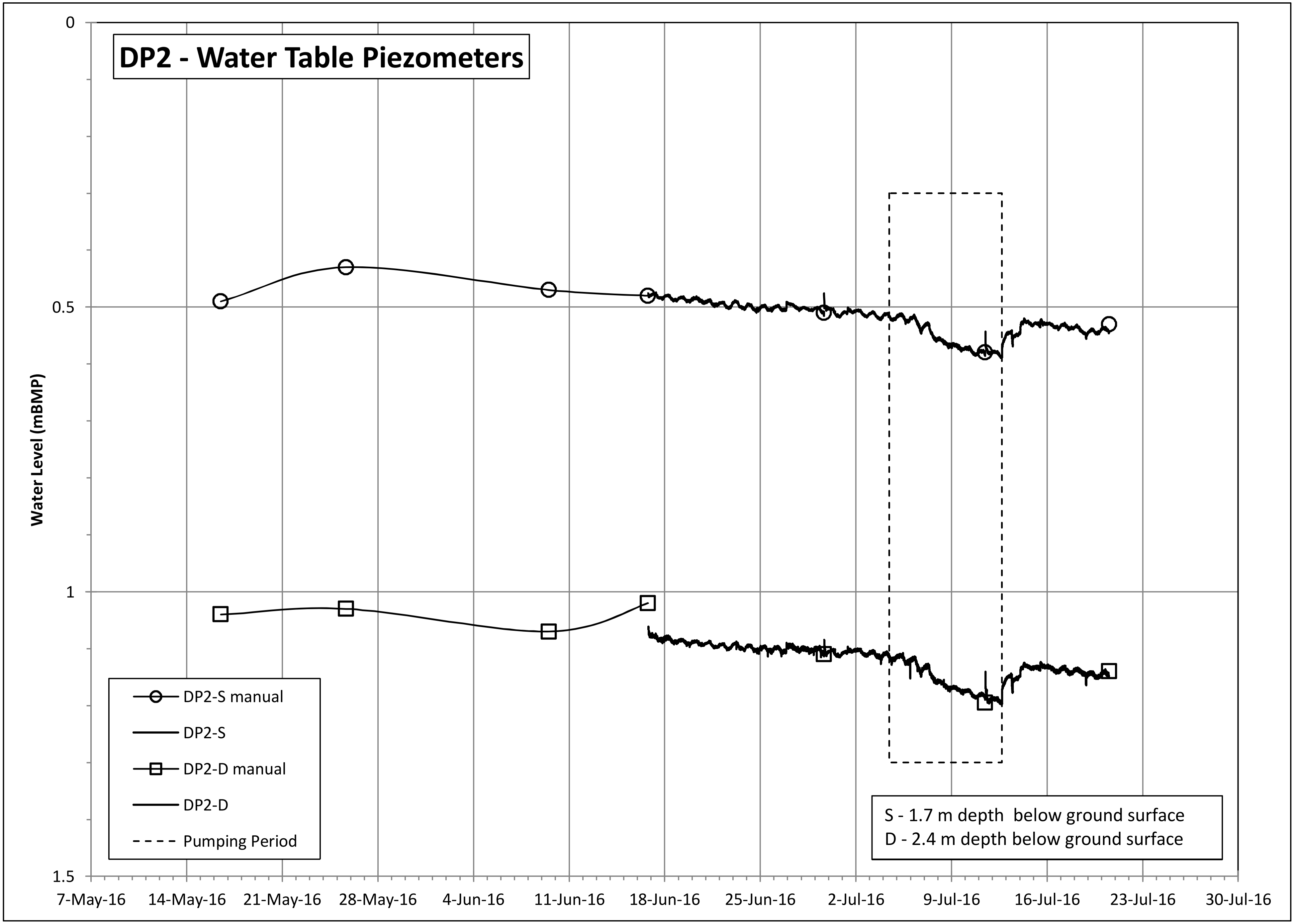
Firehall Well Pump Test Hydrograph – 16 George Street



Town of Erin
Water Supply EA

Firehall Pump Test Hydrograph - DP1 Nest

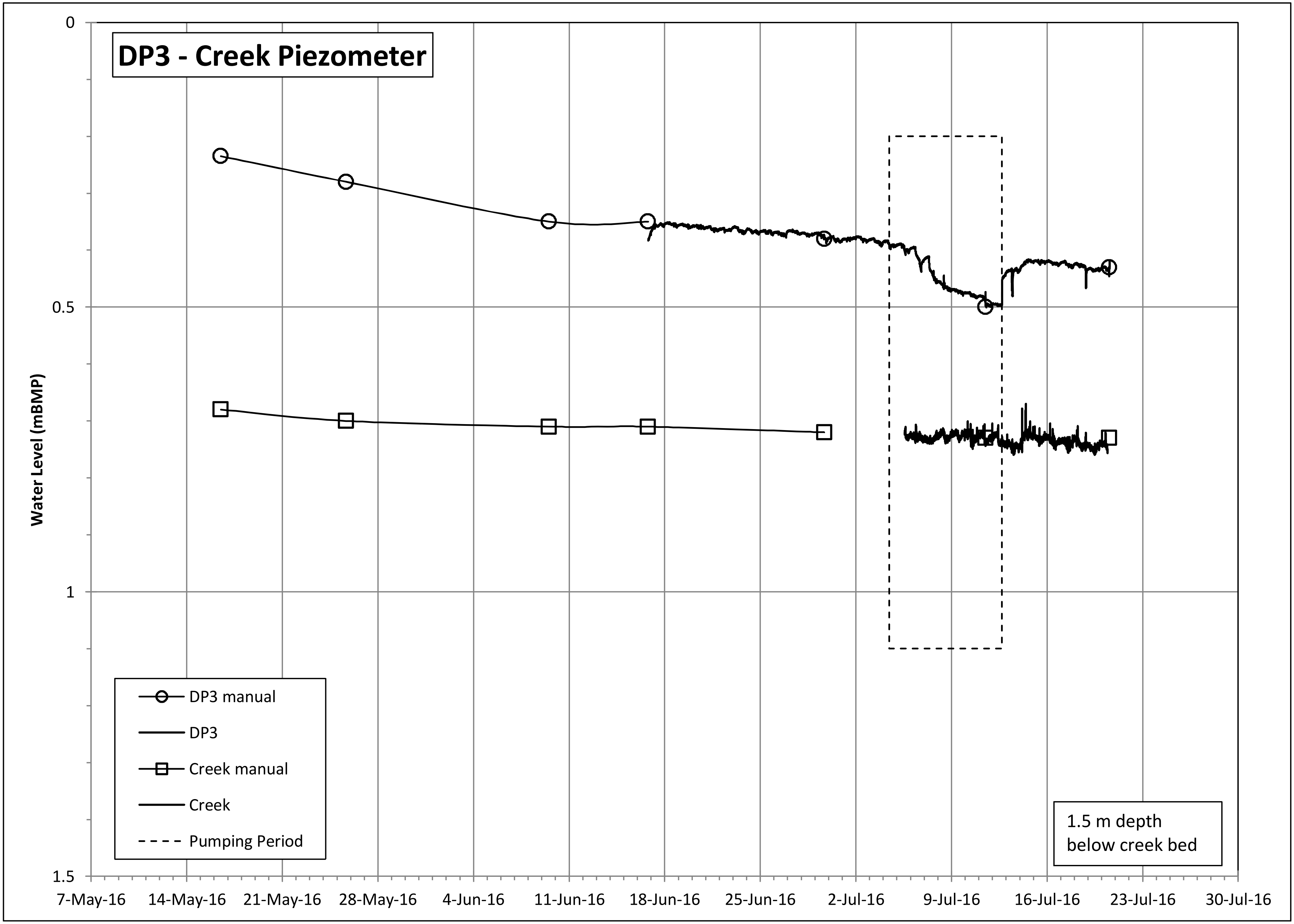
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

Firehall Pump Test Hydrograph - DP2 Nest

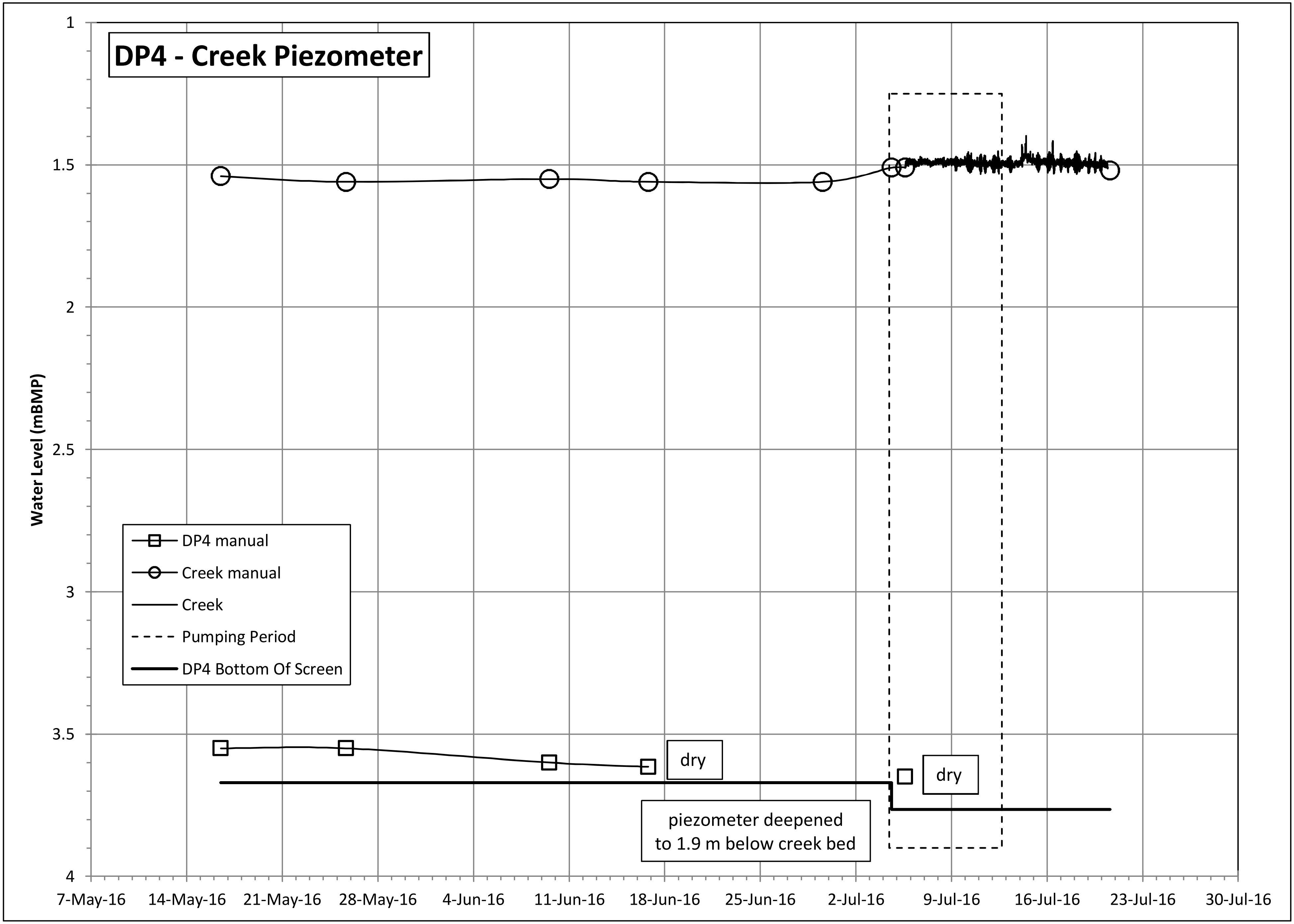
Groundwater Science Corp
Hydrogeological Assessment



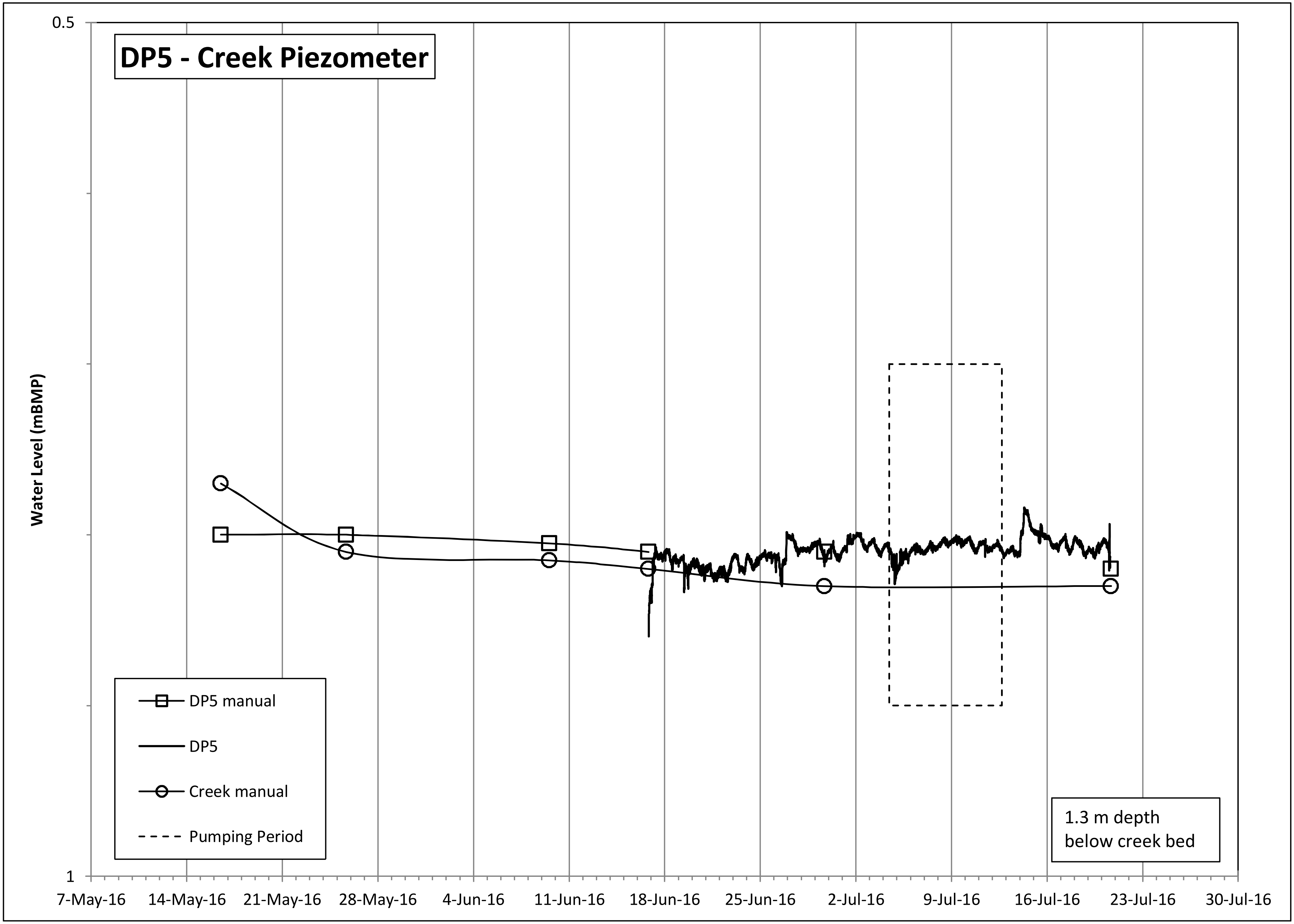
Town of Erin
Water Supply EA

Firehall Well Pump Test Hydrograph - DP3

Groundwater Science Corp
Hydrogeological Assessment



Firehall Pump Test Hydrograph - DP4



Firehall Well Pump Test Hydrograph - DP5

ALS				**Sample ID**		HILLSBURGH FIRE HALL WELL STEP TEST 1,2 HRS.	HILLSBURGH FIRE HALL WELL #2	HILLSBURGH FIRE HALL WELL #3
2/17/2020					**ALS ID**	L1793107-1	L1794270-1	L1794270-2
Multiple Work Orders				**Date Sampled**		7/4/2016 12:00:00 AM	7/5/2016 3:20:00 PM	7/6/2016 9:46:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water	Water
Colour, Apparent	CU	1	-	5	-	10.1	-	-
Turbidity	NTU	0.1	-	5	-	3.52	121	8.34
Bromide (Br)	mg/L	0.1	-	-	-	<0.10	<0.10	<0.10
Chloride (Cl)	mg/L	0.5	-	250	-	62.5	63	63
Fluoride (F)	mg/L	0.02	1.5	-	-	0.104	0.071	0.1
Nitrate (as N)	mg/L	0.02	10	-	-	5.14	5.22	5.23
Nitrite (as N)	mg/L	0.01	1	-	-	<0.010	<0.010	<0.010
Sulfate (SO4)	mg/L	0.3	-	500	-	28.6	30.3	29.6
Dissolved Metals Filtration Location		n/a	-	-	-	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	0.005	-	-	0.1	0.0974	<0.0050	<0.0050
Antimony (Sb)-Dissolved	mg/L	0.0001	0.006	-	-	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.0001	0.01	-	-	0.00034	0.00033	0.00031
Barium (Ba)-Dissolved	mg/L	0.0001	1	-	-	0.0663	0.0695	0.066
Beryllium (Be)-Dissolved	mg/L	0.0001	-	-	-	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L	0.00005	-	-	-	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	mg/L	0.01	5	-	-	0.014	0.014	0.013
Cadmium (Cd)-Dissolved	mg/L	0.00001	0.005	-	-	0.000035	0.000034	0.000028
Calcium (Ca)-Dissolved	mg/L	0.05	-	-	-	86.4	86.9	85.5
Cesium (Cs)-Dissolved	mg/L	0.00001	-	-	-	0.00001	<0.000010	<0.000010
Chromium (Cr)-Dissolved	mg/L	0.0005	0.05	-	-	0.00083	0.00079	0.0008
Cobalt (Co)-Dissolved	mg/L	0.0001	-	-	-	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	mg/L	0.0002	-	1	-	0.00348	0.00067	0.0007
Iron (Fe)-Dissolved	mg/L	0.01	-	0.3	-	0.053	0.01	0.011
Lead (Pb)-Dissolved	mg/L	0.00005	0.01	-	-	0.00234	0.00104	0.00113
Lithium (Li)-Dissolved	mg/L	0.001	-	-	-	0.0015	0.0012	0.0011
Magnesium (Mg)-Dissolved	mg/L	0.05	-	-	-	22.3	22	21.6
Manganese (Mn)-Dissolved	mg/L	0.0005	-	0.05	-	0.0024	0.00072	<0.00050
Molybdenum (Mo)-Dissolved	mg/L	0.00005	-	-	-	0.000831	0.000832	0.000773
Nickel (Ni)-Dissolved	mg/L	0.0005	-	-	-	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved	mg/L	0.05	-	-	-	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	0.05	-	-	-	1.74	1.65	1.65
Rubidium (Rb)-Dissolved	mg/L	0.0002	-	-	-	0.00096	0.00082	0.00078
Selenium (Se)-Dissolved	mg/L	0.00005	0.05	-	-	0.000238	0.000235	0.000219
Silicon (Si)-Dissolved	mg/L	0.05	-	-	-	5.23	5.05	5.08
Silver (Ag)-Dissolved	mg/L	0.00005	-	-	-	<0.000050	<0.000050	<0.000050
Sodium (Na)-Dissolved	mg/L	0.5	20	200	-	35	34.2	34.6
Strontium (Sr)-Dissolved	mg/L	0.001	-	-	-	0.157	0.159	0.15
Sulfur (S)-Dissolved	mg/L	0.5	-	-	-	9.94	10.1	10.1
Tellurium (Te)-Dissolved	mg/L	0.0002	-	-	-	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Dissolved	mg/L	0.00001	-	-	-	0.000019	0.000014	0.000015
Thorium (Th)-Dissolved	mg/L	0.0001	-	-	-	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	0.0001	-	-	-	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	0.0003	-	-	-	<0.0045 *	<0.00030	<0.00030
Tungsten (W)-Dissolved	mg/L	0.0001	-	-	-	<0.00010	<0.00010	<0.00010
Uranium (U)-Dissolved	mg/L	0.00001	0.02	-	-	0.00074	0.000644	0.000607
Vanadium (V)-Dissolved	mg/L	0.0005	-	-	-	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved	mg/L	0.001	-	5	-	0.0163	0.0151	0.0145
Zirconium (Zr)-Dissolved	mg/L	0.0003	-	-	-	<0.00030	<0.00030	<0.00030
* = Result Qualified	**Color Key:**	Within Guideline	Exceeds Guideline					
Applied Guideline:	**Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON Drinking Water Standards, Obje**							

ALS				**Sample ID**		FIRE HALL WELL #4	FIRE HALL WELL #5	FIRE HALL WELL #6	FIRE HALL WELL #7
2/17/2020					**ALS ID**	L1795672-1	L1796131-1	L1796131-2	L1796131-3
Multiple Work Orders				**Date Sampled**		7/8/2016 12:30:00 PM	7/9/2016 9:45:00 AM	7/9/2016 9:15:00 AM	7/9/2016 11:00:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water	Water	Water
Colour, Apparent	CU	1	-	5	-	-	-	-	-
Turbidity	NTU	0.1	-	5	-	47.4	14.3 *	11.3 *	5.50 *
Bromide (Br)	mg/L	0.1	-	-	-	<0.10	<0.10	<0.10	<0.10
Chloride (Cl)	mg/L	0.5	-	250	-	63.1	64	63.9	64
Fluoride (F)	mg/L	0.02	1.5	-	-	0.062	0.049	0.049	0.049
Nitrate (as N)	mg/L	0.02	10	-	-	4.48	4.61	4.62	4.65
Nitrite (as N)	mg/L	0.01	1	-	-	<0.010	<0.010	<0.010	<0.010
Sulfate (SO4)	mg/L	0.3	-	500	-	25.1	23.8	23.6	23.8
Dissolved Metals Filtration Location		n/a	-	-	-	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	0.005	-	-	0.1	<0.0050	<0.0050	<0.0050	<0.0050
Antimony (Sb)-Dissolved	mg/L	0.0001	0.006	-	-	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.0001	0.01	-	-	0.00045	0.00044	0.00048	0.00053
Barium (Ba)-Dissolved	mg/L	0.0001	1	-	-	0.0745	0.0728	0.0754	0.0756
Beryllium (Be)-Dissolved	mg/L	0.0001	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L	0.00005	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	mg/L	0.01	5	-	-	0.014	0.014	0.014	0.014
Cadmium (Cd)-Dissolved	mg/L	0.00001	0.005	-	-	0.00004	0.000035	0.000031	0.000034
Calcium (Ca)-Dissolved	mg/L	0.05	-	-	-	86.7	82	84.5	85.6
Cesium (Cs)-Dissolved	mg/L	0.00001	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Dissolved	mg/L	0.0005	0.05	-	-	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Dissolved	mg/L	0.0001	-	-	-	0.00026	0.00026	0.00026	0.00024
Copper (Cu)-Dissolved	mg/L	0.0002	-	1	-	0.00073	0.00069	0.0007	0.00069
Iron (Fe)-Dissolved	mg/L	0.01	-	0.3	-	0.039	0.059	0.075	0.088
Lead (Pb)-Dissolved	mg/L	0.00005	0.01	-	-	0.0014	0.00108	0.000946	0.000814
Lithium (Li)-Dissolved	mg/L	0.001	-	-	-	0.0014	0.0018	0.0019	0.002
Magnesium (Mg)-Dissolved	mg/L	0.05	-	-	-	21.8	21.5	21.6	21.6
Manganese (Mn)-Dissolved	mg/L	0.0005	-	0.05	-	0.057	0.0663	0.0692	0.0668
Molybdenum (Mo)-Dissolved	mg/L	0.00005	-	-	-	0.000573	0.000331	0.000338	0.000341
Nickel (Ni)-Dissolved	mg/L	0.0005	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved	mg/L	0.05	-	-	-	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	0.05	-	-	-	1.64	1.72	1.72	1.71
Rubidium (Rb)-Dissolved	mg/L	0.0002	-	-	-	0.001	0.00103	0.00098	0.00093
Selenium (Se)-Dissolved	mg/L	0.00005	0.05	-	-	0.000188	0.000171	0.000164	0.000177
Silicon (Si)-Dissolved	mg/L	0.05	-	-	-	5.21	5.2	5.2	5.15
Silver (Ag)-Dissolved	mg/L	0.00005	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (Na)-Dissolved	mg/L	0.5	20	200	-	33.1	33.2	33.6	33.2
Strontium (Sr)-Dissolved	mg/L	0.001	-	-	-	0.147	0.133	0.138	0.14
Sulfur (S)-Dissolved	mg/L	0.5	-	-	-	8.91	8.18	8.2	8.18
Tellurium (Te)-Dissolved	mg/L	0.0002	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Dissolved	mg/L	0.00001	-	-	-	0.000038	0.000036	0.000039	0.000039
Thorium (Th)-Dissolved	mg/L	0.0001	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	0.0001	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	0.0003	-	-	-	<0.00030	<0.00030	<0.00030	<0.00030
Tungsten (W)-Dissolved	mg/L	0.0001	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Dissolved	mg/L	0.00001	0.02	-	-	0.000592	0.000411	0.00042	0.000422
Vanadium (V)-Dissolved	mg/L	0.0005	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved	mg/L	0.001	-	5	-	0.0153	0.0134	0.013	0.0128
Zirconium (Zr)-Dissolved	mg/L	0.0003	-	-	-	<0.00030	<0.00030	<0.00030	<0.00030
* = Result Qualified	**Color Key:**	Within Guideline	Exceeds Guideline						
Applied Guideline:	**Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 :ctives and Guidelines**								

Groundwater
Science Corp.

328 Daleview Place,
Waterloo, ON N2L 5M5
Phone: (519) 746-6916
groundwaterscience.ca

May 12, 2016

RE: Hillsburgh Fire Hall Well Testing - Private Water Well Survey

Dear Resident:

The Town of Erin Servicing and Settlement Master Plan (SSMP) identified municipal water supply and storage deficiencies for the urban centres of Hillsburgh and Erin Village. The Town initiated a Class Environmental Assessment (Class EA) in May 2015 to address the current limitations of the water system and the needs for future development in both communities. For Hillsburgh, there is a need for an additional water supply source to provide redundancy in the system (e.g. to ensure peak water demand and fire flow requirements can be met if one of the two existing wells is out of service). As part of the water supply Class EA, the Hillsburgh Fire Hall well located at 2 Station Street has been identified as having the potential to be used as the additional municipal supply well. The Fire Hall well extends into the deep bedrock aquifer (60 m depth). The well has previously been tested over short periods and shown to produce a substantial volume of water. However, a longer term test is required to determine the current and sustainable capacity, and to determine the potential for impact on surrounding water users and local ecological features.

The Town of Erin has obtained temporary Permit To Take Water (PTTW) from the Ontario Ministry of the Environment and Climate Change (MOECC) to conduct this testing. The test is anticipated to occur in June. The well is to be pumped for several days and water levels will be monitored in a number of private wells selected for that purpose. In addition, groundwater levels adjacent to the West Credit River will also be monitored. If the well is shown to be acceptable, for both water quantity and water quality, this information will be used in support of an application for a long term Permit To Take Water to add the well to the Hillsburgh municipal water supply system.

The temporary PTTW requires water level monitoring at a representative number of private wells (i.e. wells at various depths and geographic locations) within approximately 500 m of the Fire Hall well. Prior to conducting the pumping test Groundwater Science Corp. (licensed water well contractors and technicians) are completing a survey and inventory of private water wells in the area, on behalf of the Town of Erin and the primary groundwater consultant for the study, Blackport Hydrogeology Inc.

The survey will collect information on existing local water supplies, such as type, location and depth of the wells, in addition to general comments on water quantity and quality. The survey results will augment available public information (water well records) obtained from the MOECC regarding local water supply wells. Based on the survey results private wells representing a variety of aquifer depths and geographic locations in the area will be selected for monitoring. Monitoring will include baseline conditions prior to the test.

A notice will be distributed to residents prior to the actual test with additional details. However, please note that as a condition of the PTTW, the Town and the study team are required by MOECC regulations to respond to, and address, any well interference complaint arising from the water taking.

Participation in the private water well survey and monitoring program is voluntary. This letter is to inform you of the testing, as well as provide you with an opportunity to complete the well survey and to indicate if you are interested in having your well monitored during the test.

Based on the number of survey responses, representative wells will be selected from within local areas for monitoring. For example, if there are five wells of similar depth in one area, only one or two of those wells may be selected for monitoring. Testing results and summaries of the information gathered will be available to all local residents as part of the Class EA reporting. **No personal information will be disclosed or referenced in the reporting**.

Once the survey results are reviewed and representative wells selected, we will contact the owners of the selected wells to arrange monitoring access. As part of that work **we are requesting permission to measure the water levels at your well for several weeks before the test, during the test and up to approximately two weeks after the test.** The well monitoring would include the installation of a measurement instrument in your well. This work would be completed by a MOECC Licensed Water Well Contractor and Technician.

Attached to this letter is a survey response and monitoring authorization form. **If you are interested in participating** please complete and return the survey/authorization form in the self-addressed stamped envelope (retain this letter for your information). Those residents interested in participating in the monitoring program will be contacted at a later date to arrange the well monitoring.

If you require assistance with the form, or have any questions about monitoring of your well, please call the survey contractor Dave Nahrgang of Groundwater Science Corp. at (519) 504-1446, or email dnahrgang@rogers.com. We would like to have the forms completed and returned by **May 24, 2016**, as we are hoping to commence the test in June.

If you have any questions about the well testing program please contact the primary technical consultant for the study, Ray Blackport of Blackport Hydrogeology Inc., at (519) 884-5549 or email blackport_hydrogeology@rogers.com.

Thank you in advance for your consideration in this matter.

Sincerely,

Dave Na

Dave Nahrgang, P.Geo.
Groundwater Science Corp.
Hydrogeologist

Water Well Inventory	Project: **Hillsburgh Fire Hall Well Testing**	Date:

Some personal information (name, address and phone number) is collected as part of this survey for the sole purpose of identifying and communicating with the respondent. There will be no electronic copy made of the personal information, and the personal information will not be disclosed to third parties or referenced in any reporting.

☐ **I consent to the collection and use of the following personal information for the above stated purpose.**

Respondent: ____________________ Municpal address ____________________
Mailing Address: ____________________ Telephone No.: ____________________

1. How is old the house? ____________ **2. How old is your well?** ____________

3. Water Use:
Domestic ☐ Pool ☐ Livestock ☐ Garden ☐ Other: ____________

Well Water Treatment (filter, softener, etc.): ____________________

4. Alternative Water Sources Used:
Bottled ☐ Cistern ☐ Bulk Delivery ☐ Other: ____________

5. Well Water Quality and Quantity Comments:
Quality (colour, odour, taste, staining, etc.) ____________________
____
Quantity (eg. does the well go dry?) ____________________
____
Has the well ever been tested for quality or quantity? ____________
Results of testing: ____________________

6. Water Well Record:
Do you have a copy of the MOECC Water Well Record? ______ MOECC Number: ____________
Who drilled the well? ____________________

7. **Sketch Map of Well Location** (show road, driveway, house and septic bed)

8. Well Construction:
Well Type Drilled ☐ Dug ☐
Well Casing Cement Tile ☐ Steel ☐
Buried ☐ **Diameter:** ____________
Describe well access (easy / not easy): ____________________

9. Pump Details:
Type: Jet ☐ Submersible ☐ Other ☐ Pump intake depth: ____________

10. Monitoring:
Would you agree to water level monitoring at your well? ____________
Completed by: ____________________ Date: ____________

Groundwater
Science Corp.

328 Daleview Place,
Waterloo, ON N2L 5M5
Phone: (519) 746-6916
groundwaterscience.ca

June 28, 2016

RE: Hillsburgh Fire Hall Well Testing – Pumping Test

Dear Resident:

This letter is to inform you of a pumping test being completed at the Hillsburgh Fire Hall well, located at 2 Station Street, as part of the Town of Erin Servicing and Settlement Master Plan (SSMP). The Fire Hall Well is a deep (60 metre) bedrock aquifer well. Previous testing indicates that water taking at the Fire Hall Well does not interfere with local water supplies. In order to meet current requirements a more detailed and longer term test is being completed in order to determine if the well can be used as a back-up supply for the Town of Hillsburgh. A Permit To Take Water (No. 2050-A5WKNY) has been obtained from the Ontario Ministry of the Environment and Climate Change (MOECC) for the test.

Work as part of the Fire Hall pumping test is scheduled to begin on Monday July 4, 2016, and will include some system tests and short-term pumping. The long term test is expected to begin on the morning of **July 5th** and continue for **7 days** until July 12th. The final timing of the test will depend on several factors, including contractor availability and site access.

During the test, water will be pumped from the Fire Hall Well. Detailed monitoring at observation points and private (house) water supply wells located around the Fire Hall will occur to determine if there are any impacts to private wells. The Town and the study team are required by MOECC regulations to respond to, and address, any well interference complaint arising from the water taking.

We are not expecting any water supply interference during the test. However, if you have any water supply disruption, or are experiencing water well interference, possibly due to pumping at the Fire Hall Well over the pump test period, please call one of the following phone numbers to report your problem:

1st) **Keith Lang** (pump test contractor on-site)	**Mobile (519) 440-8884**
2nd) Andrew Pentney (pump test hydrogeologist)	Mobile (519) 580-7325
3rd) Joe Babin (Water Manager, Town of Erin)	Mobile (519) 827-5072

We will then respond to you as soon as possible to ensure you have an adequate water supply.

If you have any questions about the well testing program please contact the primary technical consultant for the study, Ray Blackport of Blackport Hydrogeology Inc., at (519) 884-5549 or email blackport_hydrogeology@rogers.com.

Sincerely,

Andrew Pentney, P.Geo.
Hydrogeologist

		Survey Response Summary							
Address (In order of survey)	Date Survey Completed	Response Date	Date Well Constructed	MECP Number	Well Type	Well Diameter	Well Depth	Pump Type	Pump Depth
35 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
42 Trafalgar Road	12-May-16	12-May-16	unknown	unknown	dug	3 ft	not reported	jet	not reported
44 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
46 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
50 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
52 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
54 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
56 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
58 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
58 1/2 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
51 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
53 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
55 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
57 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
59 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
61 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
63 A Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
63 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
65 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
70 Trafalgar Road	12-May-16	14-May-16	unknown	not reported	dug	not reported	not reported	other	not reported
68 Trafalgar Road	12-May-16	23-May-16	2006 or prior	unknown	drilled	not reported	not reported	submersible	90 ft
66 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
64 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
64 Trafalgar Road	12-May-16	19-May-16	1996	unknown	drilled	8 inch	not reported	submersible	unknown
62 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
60 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
72 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
74 Trafalgar Road	12-May-16	3-Jun-16	1940's	not reported	dug	32 inch	24 ft	jet	24 ft
76 Trafalgar Road	12-May-16	14-May-16	1986	unknown	drilled	4.5 inch	not reported	submersible	25 m
78 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
80 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
82 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
84 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
86 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
88 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
90 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
92 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
94 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
96 Trafalgar Road	12-May-16	28-May-16	1991	unknown	drilled	5 inch	90 ft	submersible	unknown
93 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
91 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
89 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
87 Trafalgar Road	12-May-16	12-May-16	unknown	unknown	dug	not reported	not reported	submersible	unknown
85 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
79 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-

		Survey Response Summary							
Address (In order of survey)	Date Survey Completed	Response Date	Date Well Constructed	MECP Number	Well Type	Well Diameter	Well Depth	Pump Type	Pump Depth
77 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
75 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
73 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
71 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
98A Trafalgar Road	12-May-16	12-May-16	1989	unknown	drilled	not reported	not reported	submersible	180 ft
100 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
102 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
110 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
112 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
114 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
115 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
113 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
111 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
109 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
107 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
105 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
103 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
99 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
97 Trafalgar Road	12-May-16	none	-	-	-	-	-	-	-
4 Mill Street	12-May-16	none	-	-	-	-	-	-	-
2 Ann Street	12-May-16	none	-	-	-	-	-	-	-
4 Ann Street	12-May-16	none	-	-	-	-	-	-	-
6 Ann Street	12-May-16	none	-	-	-	-	-	-	-
8 Ann Street	12-May-16	none	-	-	-	-	-	-	-
3 Ann Street	12-May-16	none	-	-	-	-	-	-	-
1 Ann Street	12-May-16	none	-	-	-	-	-	-	-
1 Spruce Street	12-May-16	16-May-16	unknown	unknown	dug	not reported	25 ft	jet	not reported
1 George Street	12-May-16	none	-	-	-	-	-	-	-
3 George Street	12-May-16	none	-	-	-	-	-	-	-
5 George Street	12-May-16	none	-	-	-	-	-	-	-
7 George Street	12-May-16	none	-	-	-	-	-	-	-
11 George Street	12-May-16	none	-	-	-	-	-	-	-
13 George Street	12-May-16	none	-	-	-	-	-	-	-
6 George Street	12-May-16	none	-	-	-	-	-	-	-
15 George Street	12-May-16	none	-	-	-	-	-	-	-
17 George Street	12-May-16	none	-	-	-	-	-	-	-
19 George Street	12-May-16	none	-	-	-	-	-	-	-
21 George Street	12-May-16	none	-	-	-	-	-	-	-
23 George Street	12-May-16	none	-	-	-	-	-	-	-
25 George Street	12-May-16	none	-	-	-	-	-	-	-
27 George Street	12-May-16	none	-	-	-	-	-	-	-
29 George Street	12-May-16	none	-	-	-	-	-	-	-
31 George Street	12-May-16	none	-	-	-	-	-	-	-
18 George Street	12-May-16	none	-	-	-	-	-	-	-

		Survey Response Summary							
Address (In order of survey)	**Date Survey Completed**	**Response Date**	**Date Well Constructed**	**MECP Number**	**Well Type**	**Well Diameter**	**Well Depth**	**Pump Type**	**Pump Depth**
16 George Street	12-May-16	13-May-16	unknown	unknown	drilled	not reported	not reported	submersible	89 ft
14 George Street	12-May-16	23-May-16	1987	unknown	drilled	not reported	190 ft	submersible	unknown
12 George Street	12-May-16	none	-	-	-	-	-	-	-
10 George Street	12-May-16	none	-	-	-	-	-	-	-
4 George Street	12-May-16	none	-	-	-	-	-	-	-
2 George Street	12-May-16	none	-	-	-	-	-	-	-
3 Station Street	12-May-16	none	-	-	-	-	-	-	-
6 Station Street	12-May-16	30-May-16	1984	not reported	drilled	5 inch	not reported	submersible	not reported
8 Station Street	12-May-16	24-May-16	1988	unknown	drilled	not reported	not reported	jet	not reported
9 Station Street	12-May-16	1-Jun-16	not reported	not reported	drilled	4 inch	21 ft	jet	not reported
10 Station Street	12-May-16	none	-	-	-	-	-	-	-
11 Station Street	12-May-16	none	-	-	-	-	-	-	-
12 Station Street	12-May-16	none	-	-	-	-	-	-	-
14 Station Street	12-May-16	none	-	-	-	-	-	-	-
15 Station Street	12-May-16	none	-	-	-	-	-	-	-
17 Station Street	13-May-16	none	-	-	-	-	-	-	-

Date / Time	Water Level (mBMP)	Elapsed Time (min)	Drawdown (m)	Event Rate According To Flow Meter
04/07/2016 10:40:00	9.37	0.0	0	Static, Step 1 start
04/07/2016 10:41:00	10.81	1.0	1.44	150 USGPM = 125 IGPM = 0.56 m3/min
04/07/2016 10:42:00	10.69	2.0	1.32	in-line flow meter used
04/07/2016 10:43:00	10.76	3.0	1.39	rate set
04/07/2016 10:44:00	10.78	4.0	1.41	
04/07/2016 10:46:00	10.88	6.0	1.51	
04/07/2016 10:50:00	10.99	10.0	1.62	
04/07/2016 10:53:00	11.08	13.0	1.71	
04/07/2016 10:58:00	11.18	18.0	1.81	
04/07/2016 11:05:00	11.31	25.0	1.94	
04/07/2016 11:10:00	11.39	30.0	2.02	
04/07/2016 11:15:00	11.46	35.0	2.09	
04/07/2016 11:19:00	11.51	39.0	2.14	
04/07/2016 11:20:00	11.51	40.0	2.14	Step 2
04/07/2016 11:22:00	11.81	42.0	2.44	200 USGPM = 167 IGPM = 0.75 m3/min
04/07/2016 11:25:00	12.05	45.0	2.68	
04/07/2016 11:32:00	12.39	52.0	3.02	rate set
04/07/2016 11:38:00	12.52	58.0	3.15	
04/07/2016 11:51:00	12.63	71.0	3.26	Pump off for brief period
04/07/2016 11:58:00	12.81	78.0	3.44	
04/07/2016 12:06:00	12.93	86.0	3.56	
04/07/2016 12:23:00	13.14	103.0	3.77	
04/07/2016 12:35:00	13.27	115.0	3.9	
04/07/2016 12:48:00	13.39	128.0	4.02	Pump unable to achieve desired rate,
04/07/2016 13:00:00	13.49	140.0	4.12	to be replaced with new pump
04/07/2016 13:09:00	13.56	149.0	4.19	and test re-started

Date / Time	Water Level (mBMP)	Elapsed Time (min)	Drawdown (m)	Event Rate According To Flow Meter
05/07/2016 12:55:00	9.67	0.0	0	Static, Step 1 start
05/07/2016 12:55:30	11.24	0.5	1.57	240 USGPM = 200 IGPM = 0.91 m3/min
05/07/2016 12:56:00	11.54	1.0	1.87	in-line flow meter used
05/07/2016 12:57:00	11.84	2.0	2.17	
05/07/2016 12:58:00	11.99	3.0	2.32	rate set
05/07/2016 12:59:00	12.09	4.0	2.42	
05/07/2016 13:00:00	12.17	5.0	2.5	discharge clear
05/07/2016 13:03:00	12.35	8.0	2.68	
05/07/2016 13:10:00	12.62	15.0	2.95	
05/07/2016 13:15:00	12.77	20.0	3.1	
05/07/2016 13:20:00	12.9	25.0	3.23	discharge clear
05/07/2016 13:25:00	13.01	30.0	3.34	
05/07/2016 13:30:00	13.12	35.0	3.45	discharge clear
05/07/2016 13:45:00	13.4	50.0	3.73	
05/07/2016 13:54:00	13.52	59.0	3.85	
05/07/2016 13:55:00	13.52	60.0	3.85	
05/07/2016 13:55:30	13.78	60.5	4.11	Step 2
05/07/2016 13:56:00	13.83	61.0	4.16	264 USGPM = 220 IGPM = 1 m3/min
05/07/2016 13:57:00	13.9	62.0	4.23	
05/07/2016 13:58:00	13.98	63.0	4.31	rate adjustments

Date / Time	Water Level (mBMP)	Elapsed Time (min)	Drawdown (m)	Event Rate According To Flow Meter
05/07/2016 14:00:00	14.09	65.0	4.42	
05/07/2016 14:05:00	14.3	70.0	4.63	
05/07/2016 14:10:00	14.41	75.0	4.74	Valve full open
05/07/2016 14:20:00	14.58	85.0	4.91	
05/07/2016 14:35:00	14.76	100.0	5.09	
05/07/2016 14:40:00	14.89	105.0	5.22	
05/07/2016 14:54:00	15.02	119.0	5.35	
05/07/2016 15:11:00	15.13	136.0	5.46	discharge cloudy
05/07/2016 15:34:00	12.29	159.0	2.62	flow meter failure due to sediment,
06/07/2016 8:36:00	9.41	1181.0	-0.26	to be replaced and test re-started

Date / Time	Water Level (mBMP)	Elapsed Time (min)	Drawdown (m)	Event Rate According To Flow Meter
06/07/2016 8:36:00	9.41	0.0	0	Static, start
06/07/2016 8:38:00	11.65	2.0	2.24	240 USGPM = 200 IGPM = 0.91 m3/min
06/07/2016 8:39:00	11.78	3.0	2.37	in-line flow meter used
06/07/2016 8:40:00	11.87	4.0	2.46	rate set
06/07/2016 8:42:00	11.99	6.0	2.58	
06/07/2016 8:44:00	12.09	8.0	2.68	
06/07/2016 8:46:00	12.18	10.0	2.77	
06/07/2016 8:48:00	12.26	12.0	2.85	
06/07/2016 8:50:00	12.34	14.0	2.93	
06/07/2016 8:55:00	12.48	19.0	3.07	
06/07/2016 9:00:00	12.61	24.0	3.2	
06/07/2016 9:05:00	12.75	29.0	3.34	
06/07/2016 9:22:00	13.04	46.0	3.63	
06/07/2016 9:30:00	13.16	54.0	3.75	
06/07/2016 9:40:00	13.31	64.0	3.9	some sediment noted
06/07/2016 9:50:00	13.46	74.0	4.05	
06/07/2016 10:00:00	13.57	84.0	4.16	
06/07/2016 10:15:00	13.75	99.0	4.34	
06/07/2016 10:45:00	14.06	129.0	4.65	
06/07/2016 11:00:00	14.2	144.0	4.79	
06/07/2016 11:20:00	14.48	164.0	5.07	
06/07/2016 12:00:00	14.63	204.0	5.22	
06/07/2016 12:30:00	14.79	234.0	5.38	discharge becomes cloudy (silty/clayey)
06/07/2016 13:00:00	14.93	264.0	5.52	
06/07/2016 13:37:00	15.05	301.0	5.64	
06/07/2016 14:00:00	15.11	324.0	5.7	
06/07/2016 15:00:00	15.2	384.0	5.79	
06/07/2016 16:00:00	15.22	444.0	5.81	rate fluctuations,
06/07/2016 17:00:00	14.38	504.0	4.97	possible re-development of well
06/07/2016 18:00:00	13.57	564.0	4.16	
06/07/2016 19:00:00	13.95	624.0	4.54	
06/07/2016 19:10:00	13.94	634.0	4.53	
06/07/2016 19:10:15	11.5	634.2	2.09	
06/07/2016 19:10:30	11.5	634.5	2.09	
06/07/2016 19:10:45	11.26	634.7	1.85	
06/07/2016 19:11:00	11.15	635.0	1.74	

Date / Time	Water Level (mBMP)	Elapsed Time (min)	Drawdown (m)	Event Rate According To Flow Meter
06/07/2016 19:12:00	10.89	636.0	1.48	
06/07/2016 19:13:00	10.73	637.0	1.32	
06/07/2016 19:14:00	10.57	638.0	1.16	
06/07/2016 19:15:00	10.57	639.0	1.16	
06/07/2016 19:17:00	10.46	641.0	1.05	
06/07/2016 19:19:00	10.37	643.0	0.96	
06/07/2016 19:21:00	10.3	645.0	0.89	
06/07/2016 19:23:00	10.26	647.0	0.85	
06/07/2016 19:25:00	10.2	649.0	0.79	
06/07/2016 19:30:00	10.15	654.0	0.74	flow meter failure due to sediment,
07/07/2016 8:17:00	7.98	1421.0	-1.43	to be replaced and test re-started

Date / Time	Water Level (mBMP)	Elapsed Time (min)	Drawdown (m)	Event Rate According To Flow Meter
07/07/2016 8:40:00	7.96	0.0	0	Static, Step 1 start
07/07/2016 8:40:15	8.9	0.2	0.94	158 USGPM = 132 IGPM = 0.6 m3/min
07/07/2016 8:40:30	9.58	0.5	1.62	orifice weir used
07/07/2016 8:41:00	10.48	1.0	2.52	
07/07/2016 8:41:30	10.18	1.5	2.22	
07/07/2016 8:42:00	10.32	2.0	2.36	
07/07/2016 8:43:00	10.47	3.0	2.51	
07/07/2016 8:44:00	10.52	4.0	2.56	
07/07/2016 8:45:00	10.55	5.0	2.59	
07/07/2016 8:50:00	10.67	10.0	2.71	
07/07/2016 9:00:00	10.8	20.0	2.84	
07/07/2016 9:08:00	10.87	28.0	2.91	
07/07/2016 9:10:00	10.87	30.0	2.91	Step 2
07/07/2016 9:10:15	11.2	30.2	3.24	241 USGPM = 201 IGPM = 0.91 m3/min
07/07/2016 9:10:30	11.5	30.5	3.54	
07/07/2016 9:11:00	11.67	31.0	3.71	
07/07/2016 9:11:30	11.75	31.5	3.79	
07/07/2016 9:12:00	11.8	32.0	3.84	
07/07/2016 9:13:00	11.87	33.0	3.91	
07/07/2016 9:15:00	11.93	35.0	3.97	
07/07/2016 9:20:00	12	40.0	4.04	
07/07/2016 9:30:00	12.12	50.0	4.16	
07/07/2016 9:40:00	12.23	60.0	4.27	
07/07/2016 9:50:00	12.33	70.0	4.37	
07/07/2016 10:10:00	12.48	90.0	4.52	rate adjustments needed
07/07/2016 11:00:00	12.78	140.0	4.82	
07/07/2016 12:00:00	12.92	200.0	4.96	
07/07/2016 13:00:00	13.03	260.0	5.07	
07/07/2016 14:00:00	13.13	320.0	5.17	
07/07/2016 15:00:00	13.25	380.0	5.29	rate adjusted, pump shut down
07/07/2016 16:00:00	13.32	440.0	5.36	and restarted to clear impellers
07/07/2016 17:00:00	13.58	500.0	5.62	
07/07/2016 18:00:00	15.8	560.0	7.84	shut down again
07/07/2016 19:00:00	12.87	620.0	4.91	rate adjusted
07/07/2016 20:00:00	13.07	680.0	5.11	

Date / Time	Water Level (mBMP)	Elapsed Time (min)	Drawdown (m)	Event Rate According To Flow Meter
07/07/2016 21:00:00	13.46	740.0	5.5	
07/07/2016 22:00:00	13.47	800.0	5.51	shut down again to clear
07/07/2016 23:00:00	13.22	860.0	5.26	
08/07/2016 0:00:00	13.2	920.0	5.24	
08/07/2016 1:00:00	13.18	980.0	5.22	
08/07/2016 2:00:00	13.16	1040.0	5.2	
08/07/2016 3:00:00	13.12	1100.0	5.16	
08/07/2016 4:00:00	13.06	1160.0	5.1	
08/07/2016 5:00:00	13.01	1220.0	5.05	
08/07/2016 6:00:00	13.34	1280.0	5.38	
08/07/2016 7:00:00	13.32	1340.0	5.36	
08/07/2016 8:00:00	13.32	1400.0	5.36	
08/07/2016 9:00:00	13.59	1460.0	5.63	
08/07/2016 10:00:00	13.8	1520.0	5.84	
08/07/2016 10:30:00	14.04	1550.0	6.08	pump off for short period
08/07/2016 11:00:00	13.95	1580.0	5.99	204 USGPM = 170 IGPM = 0.77 m3/min
08/07/2016 12:30:00	13.7	1670.0	5.74	at 11:15 am
08/07/2016 13:00:00	13.69	1700.0	5.73	
08/07/2016 14:00:00	13.66	1760.0	5.7	
08/07/2016 15:00:00	13.62	1820.0	5.66	
08/07/2016 16:00:00	13.62	1880.0	5.66	
08/07/2016 17:00:00	13.62	1940.0	5.66	
08/07/2016 18:00:00	13.55	2000.0	5.59	
08/07/2016 19:00:00	13.53	2060.0	5.57	
08/07/2016 20:00:00	13.6	2120.0	5.64	
08/07/2016 21:00:00	13.58	2180.0	5.62	
08/07/2016 22:00:00	13.54	2240.0	5.58	
08/07/2016 23:00:00	13.52	2300.0	5.56	
09/07/2016 0:00:00	13.5	2360.0	5.54	
09/07/2016 1:30:00	13.49	2450.0	5.53	
09/07/2016 2:00:00	13.47	2480.0	5.51	
09/07/2016 3:00:00	13.47	2540.0	5.51	
09/07/2016 4:00:00	13.43	2600.0	5.47	
09/07/2016 5:00:00	13.43	2660.0	5.47	
09/07/2016 6:00:00	13.43	2720.0	5.47	
09/07/2016 7:00:00	13.41	2780.0	5.45	
09/07/2016 8:00:00	13.42	2840.0	5.46	
09/07/2016 9:00:00	13.38	2900.0	5.42	
09/07/2016 10:00:00	13.36	2960.0	5.4	rate adjusted
09/07/2016 11:00:00	13.39	3020.0	5.43	rate adjusted
09/07/2016 12:00:00	13.39	3080.0	5.43	
09/07/2016 13:00:00	13.4	3140.0	5.44	rate adjusted
09/07/2016 14:00:00	13.39	3200.0	5.43	
09/07/2016 15:00:00	13.44	3260.0	5.48	
09/07/2016 16:00:00	13.4	3320.0	5.44	
09/07/2016 17:00:00	13.41	3380.0	5.45	rate adjusted
09/07/2016 18:00:00	13.4	3440.0	5.44	
09/07/2016 19:00:00	13.37	3500.0	5.41	rate adjusted
09/07/2016 20:00:00	13.36	3560.0	5.4	

Date / Time	Water Level (mBMP)	Elapsed Time (min)	Drawdown (m)	Event Rate According To Flow Meter
09/07/2016 21:00:00	13.33	3620.0	5.37	
09/07/2016 22:00:00	13.34	3680.0	5.38	
09/07/2016 23:00:00	13.32	3740.0	5.36	
10/07/2016 0:00:00	13.33	3800.0	5.37	
10/07/2016 1:00:00	13.32	3860.0	5.36	
10/07/2016 2:00:00	13.3	3920.0	5.34	
10/07/2016 3:00:00	13.27	3980.0	5.31	
10/07/2016 4:00:00	13.29	4040.0	5.33	
10/07/2016 5:00:00	13.29	4100.0	5.33	
10/07/2016 6:00:00	13.29	4160.0	5.33	
10/07/2016 7:00:00	13.28	4220.0	5.32	
10/07/2016 8:00:00	13.26	4280.0	5.3	
10/07/2016 9:00:00	13.26	4340.0	5.3	
10/07/2016 9:19:00	13.22	4359.0	5.26	
10/07/2016 10:00:00	13.25	4400.0	5.29	rate adjusted
10/07/2016 11:00:00	13.3	4460.0	5.34	
10/07/2016 12:00:00	13.31	4520.0	5.35	
10/07/2016 13:00:00	13.31	4580.0	5.35	
10/07/2016 14:00:00	13.32	4640.0	5.36	
10/07/2016 15:00:00	13.32	4700.0	5.36	
10/07/2016 16:00:00	13.31	4760.0	5.35	
10/07/2016 17:00:00	13.32	4820.0	5.36	
10/07/2016 18:00:00	13.32	4880.0	5.36	
10/07/2016 19:00:00	13.31	4940.0	5.35	
10/07/2016 20:00:00	13.33	5000.0	5.37	
10/07/2016 21:00:00	13.34	5060.0	5.38	
10/07/2016 22:00:00	13.31	5120.0	5.35	
10/07/2016 23:00:00	13.29	5180.0	5.33	
11/07/2016 0:00:00	13.27	5240.0	5.31	
11/07/2016 1:00:00	13.27	5300.0	5.31	
11/07/2016 2:00:00	13.26	5360.0	5.3	
11/07/2016 3:00:00	13.26	5420.0	5.3	
11/07/2016 4:00:00	13.25	5480.0	5.29	
11/07/2016 5:00:00	13.26	5540.0	5.3	
11/07/2016 6:00:00	13.27	5600.0	5.31	
11/07/2016 7:00:00	13.27	5660.0	5.31	
11/07/2016 8:00:00	13.27	5720.0	5.31	
11/07/2016 9:00:00	13.26	5780.0	5.3	
11/07/2016 10:00:00	13.27	5840.0	5.31	
11/07/2016 12:00:00	13.28	5960.0	5.32	
11/07/2016 14:00:00	13.28	6080.0	5.32	
11/07/2016 17:00:00	13.32	6260.0	5.36	
11/07/2016 20:00:00	13.3	6440.0	5.34	
12/07/2016 0:00:00	13.27	6680.0	5.31	
12/07/2016 3:30:00	13.27	6890.0	5.31	
12/07/2016 7:00:00	13.28	7100.0	5.32	
12/07/2016 9:00:00	13.26	7220.0	5.3	
12/07/2016 10:45:00	13.5	7325.0	5.54	
12/07/2016 16:00:00	13.5	7640.0	5.54	

Date / Time	Water Level (mBMP)	Elapsed Time (min)	Drawdown (m)	Event Rate According To Flow Meter
12/07/2016 16:49:00	13.49	7689.0	5.53	
12/07/2016 16:50:00	13.49	7690.0	5.53	pump off
12/07/2016 16:50:15	9.65	7690.2	1.69	
12/07/2016 16:50:30	7.98	7690.5	0.02	
12/07/2016 16:50:45	7.14	7690.7	-0.82	
12/07/2016 16:51:00	6.87	7691.0	-1.09	
12/07/2016 16:51:30	6.34	7691.5	-1.62	
12/07/2016 16:52:30	6.56	7692.5	-1.4	
12/07/2016 16:53:00	6.6	7693.0	-1.36	
12/07/2016 16:54:00	6.55	7694.0	-1.41	
12/07/2016 16:55:00	6.56	7695.0	-1.4	
12/07/2016 16:57:00	6.56	7697.0	-1.4	
12/07/2016 17:00:00	6.5	7700.0	-1.46	
12/07/2016 17:05:00	6.45	7705.0	-1.51	
12/07/2016 17:15:00	6.395	7715.0	-1.565	
12/07/2016 17:25:00	6.34	7725.0	-1.62	
12/07/2016 17:30:00	6.35	7730.0	-1.61	
13/07/2016 5:30:00	5.97	8450.0	-1.99	

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

This document is a Clone of Permit # **4217-A4FLNA**.

AMENDED PERMIT TO TAKE WATER

Pumping Test
NUMBER 2050-A5WKNY

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

The Corporation of the Town of Erin
5684 Trafalgar Rd., R.R. #2
Hillsburgh, Ontario N0B 1Z0

For the water taking from: One Well -- Hillsburgh Fire Hall

Located at: Lot 24, Concession 7, Geographic Township of Erin
Erin, County of Wellington

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

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.

(b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment and Climate Change.

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

(e) "Permit" means this Permit to Take Water No. 2050-A5WKNY including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.

(f) "Permit Holder" means The Corporation of the Town of Erin.

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

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

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated September 25, 2015 and signed by Joe Babin, 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.

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 **August 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:	Zone/ Easting/ Northing:
1	Hillsburgh Fire Hall	Well Drilled	Pumping Test	Miscellaneous	1,364	24	1,964,160	7	17 569090 4848450
						Total Taking:	1,964,160		

4. Monitoring

4.1 Notification to Well Owners
Prior to commencement of the pumping test, the Permit Holder shall identify all wells within the area of the anticipated potential cone of influence, or within 500 metres of the test site, whichever is greater. At least 24 hours prior to beginning the pumping test, the Permit Holder shall provide written notification to the owners of the wells identified within the potential cone of influence. The notification shall include the expected date, time and duration of the pumping test, and a contact telephone number that may be used to report any interferences with water supplies.

4.2 Measuring Water Depths
To establish baseline conditions, well depths and depths to water levels for identified representative wells in the area of the water taking shall be recorded by the Permit Holder. During the pumping test, water levels in the identified wells shall be recorded. The pumping test must be of sufficient duration to accurately predict the long term impacts of the proposed water taking. Water levels in the identified wells shall continue to be monitored beyond the water taking period until at least 85% recovery is achieved.

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

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 Restoration of Water Supply
Where 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 doing so.

5.3 The discharge of water shall be controlled in such a way as to avoid erosion and sedimentation in the receiving stream.

6. Director May Amend Permit

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

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

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.

2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the 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) 326-5370
Email: ERTTribunalsecretary@ontario.ca

AND

The Director, Section 34.1, Ministry of the Environment and Climate Change
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	by Fax at	by e-mail at
(416) 212-6349	(416) 326-5370	www.ert.gov.on.ca
Toll Free 1(866) 448-2248	Toll Free 1(844) 213-3474	

This Permit cancels and replaces Permit Number 5782-A4FLN9, issued on 2015/11/24.

Dated at Hamilton this 6th day of January, 2016.

B. Koblik

Belinda Koblik
Director, Section 34.1
Ontario Water Resources Act, R.S.O. 1990

Appendix F
Tavares Lands (Hillsburgh 2)
Drilling and Testing Results

Ontario
Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
Tag#:A235584

Well Record

Regulation 903 Ontario Water Resources Act

Page 3 of 3

Well Owner's Information

First Name TOWN OF ERIN	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner

Mailing Address (Street Number/Name) 5684 TRAFALGAR RD NORTH	Municipality ERIN HILLSBURGH	Province ONT	Postal Code N0B1Z0	Telephone No. *(inc. area code)*

Well Location

Address of Well Location (Street Number/Name)	Township ERIN	Lot 24	Concession 8
County/District/Municipality WELLINGTON	City/Town/Village	Province **Ontario**	Postal Code
UTM Coordinates Zone 17 Easting 569338 Northing 4849211 NAD 83	Municipal Plan and Sublot Number	Other	

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
BROWN	SILTY CLAY & STONE			0	15ft
GRAY	GRAVEL SAND STONES			15ft	58ft
BROWN	LIMESTONES SOFT			58ft	72ft
BROWN	LIMESTONE MED			72ft	145ft
GRAY BROWN	LIMESTONE LAYERS			145ft	308ft
GRAY	SHALE RED LAYERS			308ft	320ft
		USED CENTRALIZERS			

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	68ft	BENTONITE SLURRY	80gal

Results of Well Yield Testing

After test of well yield, water was:
☒ Clear and sand free
☐ Other, specify

If pumping discontinued, give reason:
pump test to be done later

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	37ft		
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
6½	steel	.188	0	68ft
6in	open hole		68ft	320ft

Construction Record - Screen

Outside Diameter *(cm/in)*	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

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

Water Details

Water found at Depth 70ft (m/ft) ☐ Gas | Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify
Water found at Depth 283ft (m/ft) ☐ Gas | Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter *(cm/in)*
0	68ft	8.75in
68ft	320ft	6in

Well Contractor and Well Technician Information

Business Name of Well Contractor KEITH LANG WELL DRILLING INC	Well Contractor's Licence No. 7154
Business Address (Street Number/Name) 251 ELDON ST GODERICH	Municipality

Province ONT	Postal Code N7A3R9	Business E-mail Address

Bus.Telephone No. *(inc. area code)* 519-524-8159	Name of Well Technician (Last Name, First Name) KEITH LANG

Well Technician's Licence No. T446	Signature of Technician and/or Contractor K. Lang	Date Submitted 20181230

Map of Well Location

Please provide a map below following instructions on the back.

Comments:

TW4

Well owner's information package delivered ☐ Yes ☒ No	Date Package Delivered YYYYMMDD	**Ministry Use Only** Audit No. Z287089
	Date Work Completed 2018 12 6	Received

0506E (2014/11)

Well Owner's Copy

Lotowater
TECHNICAL SERVICES INC.

P.O. Box 451
Paris, ON N3L 3T5

92 Scott Avenue
Paris, ON N3L 3R1
T (519) 442-1749
T (800) 923-6923
F (519) 442 7242
www.lotowater.com

February 8, 2019

Reference: 148-003

Andrew Pentney, P. Geo.
Groundwater Science Corp.
Unit 2, 465 Kingscourt Drive
Waterloo, ON
N2K 3R5

Subject: Erin – Hillsburgh Well Testing and Video

This memo documents testing of four test wells drilled in bedrock in the Erin – Hillsburgh area in Ontario. The four wells tested included the following wells; Solmar (TW1), Solmar (TW2), Erin North (TW3) and Currie (TW4). Testing included video surveys, flow profiles and step test. In addition, groundwater sampling was performed by Groundwater Science Corp. (GSC). Field work was performed over several weeks from January 15 – 28, 2019. The purpose of this testing was to quantify basic well hydraulics and areas flow production from the bedrock.

Testing Procedure

The same general testing procedure was followed at each of the four wells. First, a video was performed using a dual view well video camera. A down scan image was captured first as the camera was run to the bottom of the well and a side scan image was performed on the way up stopping at important features. Video summaries were prepared in **Tables 1A-4A** and copies of the videos have been sent to GSC in DVD.

A step test was performed on each well using a submersible pump. A pump and 5hp motor was selected which could run on a single phase portable generator. This limited production to approximately 10 L/s. Note that Currie Well TW3 had a slightly deeper static water level which required a higher head lower flow pump and limited test flows to 6 L/s. In every case, the pumps were set within or near the base of the well casing. The well was pumped up to its full rate of 10 or 6 L/s for 30 minutes, then the flow reduced to the next 30 minute step. Two to three steps were performed at each well. Flow was measured using a turbine flow meter and levels measured using a manual level tape. Step test details are shown in **Tables 1B-4B** and graphically in **Figures 1A-4A**.

A flow profile was conducted during the step test to quantify the flow distribution in each well. Lotowater uses a spinner device manufactured by Swoffer with custom modifications for application in boreholes and wells. The tool has a small impeller that is oriented vertically.

Vertical flow in the well activates the impeller which transmits a signal to a digital readout at the surface for every ½ revolution of the impeller. The velocity of fluid is directly proportional to the rotational speed of the spinner tool. The spinner tool is regularly calibrated such that its readout is reported as a velocity in metres/second.

Flow profiling was conducted under non-pumping conditions first, to indicate natural water movement in the borehole, as well as under artificially induced pumping conditions. The spinner flow tool has a minimum threshold velocity of 0.03 m/s required to overcome internal friction and activate the tool. In most cases, there is not a strong enough vertical flow in the well to activate the flow tool, so a small submersible pump is installed to induce flow. Note that no ambient (non-pumping) flows were measured in any of the four wells tested.

Each well was flow profiled under the maximum flow obtained from the step test. In all cases, the pump was set entirely within the well casing. The flow tool is then run from the bottom of the well over the entire borehole, into the casing to the bottom of the pump. Flow measurements are recorded at a specified depth interval or whenever a change in flow is indicated. Flow profiles are shown graphically in **Figures 1B-4B**.

A brief summary of some of the important findings for each well are as follows:

Currie Well TW4

- The casing and borehole were generally clear, but many ledges on the borehole were covered with a soft buildup, especially near the bottom of the well.

- There is a strong downward flow in this well with water coming in from a large feature near the base of the well casing at 21.5 m and flowing down the well and out from another large feature at 86.3 m.

- There was no flow recorded in the flow profile under ambient (non-pumping) conditions despite the obvious visual indication of downward flow in the video. This indicates the ambient vertical flow down the well was less than the minimum threshold velocity of the flow tool of 0.03 m/s. This means the ambient flow down the well was less than 0.5 L/s.

- The total depth measured was 89.2 m which is significantly less than the 97.5 m total depth reported in the well record.

- The well was pumped at 10 L/s with approximately 0.77 m drawdown yielding a specific capacity of approximately 13.0 L/s/m. This well has the highest specific capacity of any of the four wells tested.

- The flow profile was performed at 10 L/s. This pumping flow profile was inconclusive. It is believed that under pumping most of the flow is entering the well at the upper feature at 21.5 m. It is suspected that there is no flow shown above this feature as we were very near the base of the pump motor at approximately 20.75 m which did not allow enough room for the flow tool to get a good measurement. Below this there was no measurable flow, indicating any flow contributions from deep in the well were below the minimum threshold of the tool which indicates any flows were less than 0.5 L/s.

- Additional packer testing could be performed here that isolated the deep portion of the well from the shallow feature below 21.5 m to confirm and better quantify the hydraulic conditions of both the deep and shallow portions of the aquifer here.

Photo 7: Looking down at the deep feature where water was seen exiting the well at 86.3 m

Photo 8: Looking down into the expected main flow feature at 21.5 m just below the casing base

Please contact the undersigned if you have any questions.

Respectfully submitted,
Lotowater Technical Services Inc.

Boyd Pendleton, P. Geo.
Vice President

TABLE 4A

TOWNSHIP OF ERIN

Currie Well TW4
Static Video Summary
2019/01/22

Elapsed Time (h:min)	Depth (ft below MP)	Depth (m below MP)	Comments
0:00	2.8'	0.9	Below top of casing
0:02	17.5'	5.3	Casing joint
0:04	30.7'	9.4	Static water level
0:07	37.2'	11.3	Casing joint
0:10	57.1'	17.4	Casing joint
0:12	70'	21.3	Bottom of casing
0:12	70.6'	21.5	Large rock fracture, Flow in
0:13	72.1'	22.0	Vugs, PWPZ
0:13	75.3'	23.0	Vugs, PWPZ
0:14	76.4'	23.3	Vugs, PWPZ
0:14	81.1'	24.7	Vugs
0:15	83.9'	25.6	Horizontal ring feature, PWPZ
0:15	87.2'	26.6	Fractures
0:16	89.8'	27.4	Vugs
0:18	102.8'	31.3	Vugs, Fracture starts, PWPZ
0:20	114'	34.7	Vugs, Fracture ends, PWPZ
0:20	116.7'	35.6	Horizontal ring feature
0:22	128.2'	39.1	Vugs
0:25	144'	43.9	Vugs
0:26	156.8'	47.8	Vugs
0:28	165.5'	50.4	Vugs
0:28	168.8'	51.5	Vugs
0:29	175.6'	53.5	Vugs
0:30	181.5'	55.3	Horizontal ring feature
0:31	187.5'	57.2	Horizontal ring feature
0:34	210.1'	64.0	Horizontal ring feature
0:37	231.7'	70.6	Horizontal ring feature
0:39	252'	76.8	Horizontal ring feature
0:40	254'	77.4	Cavern, PWPZ
0:40	259.2'	79.0	Horizontal ring feature, PWPZ
0:41	262.2'	79.9	Horizontal ring feature, PWPZ
0:42	270.1'	82.3	Horizontal ring feature, Sediment, PWPZ
0:42	271.6'	82.8	Vertical fracture, PWPZ
0:42	273.4'	83.3	Vertical fracture, PWPZ
0:43	275'	83.8	Vugs start, Horizontal ring feature
0:44	282'	86.0	Vugs end, Horizontal ring feature
0:44	283.1'	86.3	Top of large cavern
0:47	289.1'	88.1	Turbidity increasing
0:49	292.7'	89.2	Bottom of well, rock
0:51	287.9'	87.8	Bottom of large cavern, Fractures
0:54	284'	86.6	Top of large cavern, Fracture

TABLE 4A

TOWNSHIP OF ERIN

Currie Well TW4
Static Video Summary
2019/01/22

Elapsed Time (h:min)	Depth (ft below MP)	Depth (m below MP)	Comments
0:57	278.1'	84.8	Vugs, Fracture starts
0:59	273.5'	83.4	Vertical and horizontal fracture
1:00	271.9'	82.9	Vertical and horizontal fracture, Flow in
1:03	262.6'	80.0	Horizontal ring feature, Flow in, Fracture
1:05	259.7'	79.2	Horizontal ring feature, Flow in, Fracture
1:08	254.5'	77.6	Cavern, PWPZ
1:09	257.6'	78.5	Horizontal ring feature, PWPZ
1:14	232.2'	70.8	Horizontal ring feature, PWPZ
1:19	210.6'	64.2	Horizontal ring feature, PWPZ
1:25	187.9'	57.3	Horizontal ring feature, PWPZ
1:26	185.5'	56.5	Vugs, PWPZ
1:31	169.5'	51.7	Horizontal ring feature, PWPZ
1:36	152.5'	46.5	Fractures, PWPZ
1:44	117.7'	35.9	Vugs, PWPZ
1:45	112'	34.1	Vugs start, PWPZ
1:48	102'	31.1	Vugs end, PWPZ
1:52	84.7'	25.8	Horizontal ring feature, PWPZ
1:54	73.2'	22.3	Large vugs, PWPZ
1:55	72.3'	22.0	Horizontal ring feature, PWPZ
1:57	71.6'	21.8	Large cavern, Flow in
1:58	71'	21.6	Bottom of casing
2:00	58.2'	17.7	Casing joint
2:04	38.9'	11.9	End of video

Video survey conducted by Rodney Secor

Notes: Measuring point (MP) is top of casing which is 0.67 m above ground surface
PWPZ = Possible water producing zone

TABLE 4B

VARIABLE RATE PERFORMANCE TEST

Lotowater
TECHNICAL SERVICES INC.

Well Name:	Currie Well TW4	**Project Number:**	148-003
Client:	Town of Erin (GSC)	**Date:**	January 22, 2018
Technician Name:	Craig Lawson	**Pump:**	Grundfos 230S200-2 (5hp)
Water Level Device:	LTS water level meter	**Pump Inlet:**	19.8 m
Water Level Reference:	Top of casing (0.67 m agl)	**Flow Measuring Device:**	4" McCrometer Impeller

Test Note: TD = 89.20 mbtc, Base of 150 mm diameter casing 21.6 mbtc

Time ***hr:min***	**Elapsed Time** ***min***	**Level** ***mbtc***	**Drawdown** ***m***	**Flow** ***L/s***	**Note**
12:30	0	9.46	0.00	3.5	Start Step 1
12:31	1	9.56	0.10	3.5	
12:32	2	9.56	0.10	3.5	
12:33	3	9.56	0.10	3.5	30 psi
12:34	4	9.62	0.16	3.5	
12:35	5	9.65	0.19	3.5	
12:36	6	9.66	0.20	3.5	
12:38	8	9.68	0.22	3.5	
12:40	10	9.70	0.24	3.5	
12:42	12	9.71	0.25	3.5	
12:45	15	9.72	0.26	3.5	
12:50	20	9.74	0.28	3.5	
12:55	25	9.75	0.29	3.5	
13:00	30	9.75	0.29	3.5	
13:10	40	9.76	0.30	3.5	
13:20	50	9.76	0.30	3.5	
13:30	60	9.77	0.31	3.5	
13:31	1	9.82	0.36	6.0	Start Step 2
13:32	2	9.84	0.38	6.0	
13:33	3	9.85	0.39	6.0	25 psi
13:34	4	9.86	0.40	6.0	
13:35	5	9.87	0.41	6.0	
13:36	6	9.87	0.41	6.0	
13:38	8	9.88	0.42	6.0	
13:40	10	9.89	0.43	6.0	
13:42	12	9.90	0.44	6.0	
13:45	15	9.90	0.44	6.0	
13:50	20	9.91	0.45	6.0	
13:55	25	9.92	0.46	6.0	
14:00	30	9.93	0.47	6.0	
14:10	40	9.93	0.47	6.0	
14:20	50	9.93	0.47	6.0	
14:30	60	9.93	0.47	6.0	

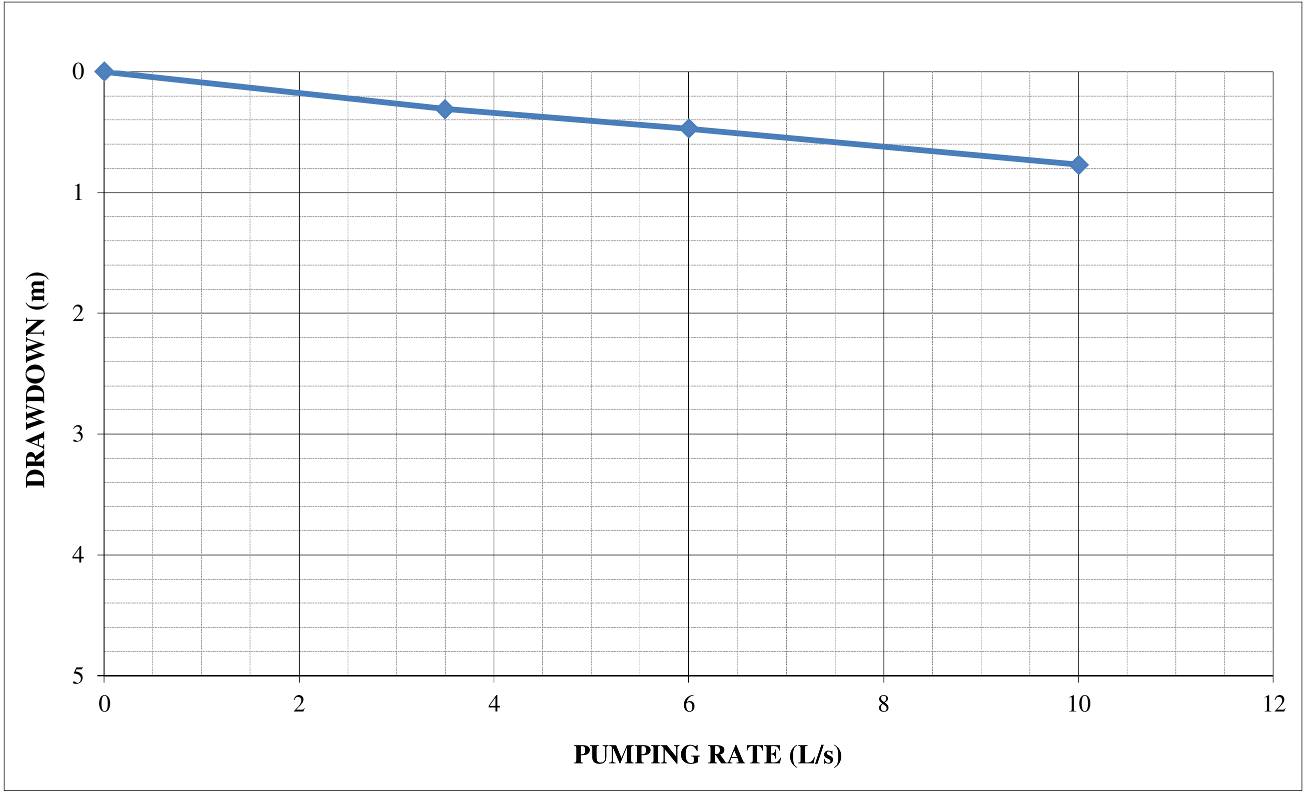
TABLE 4B

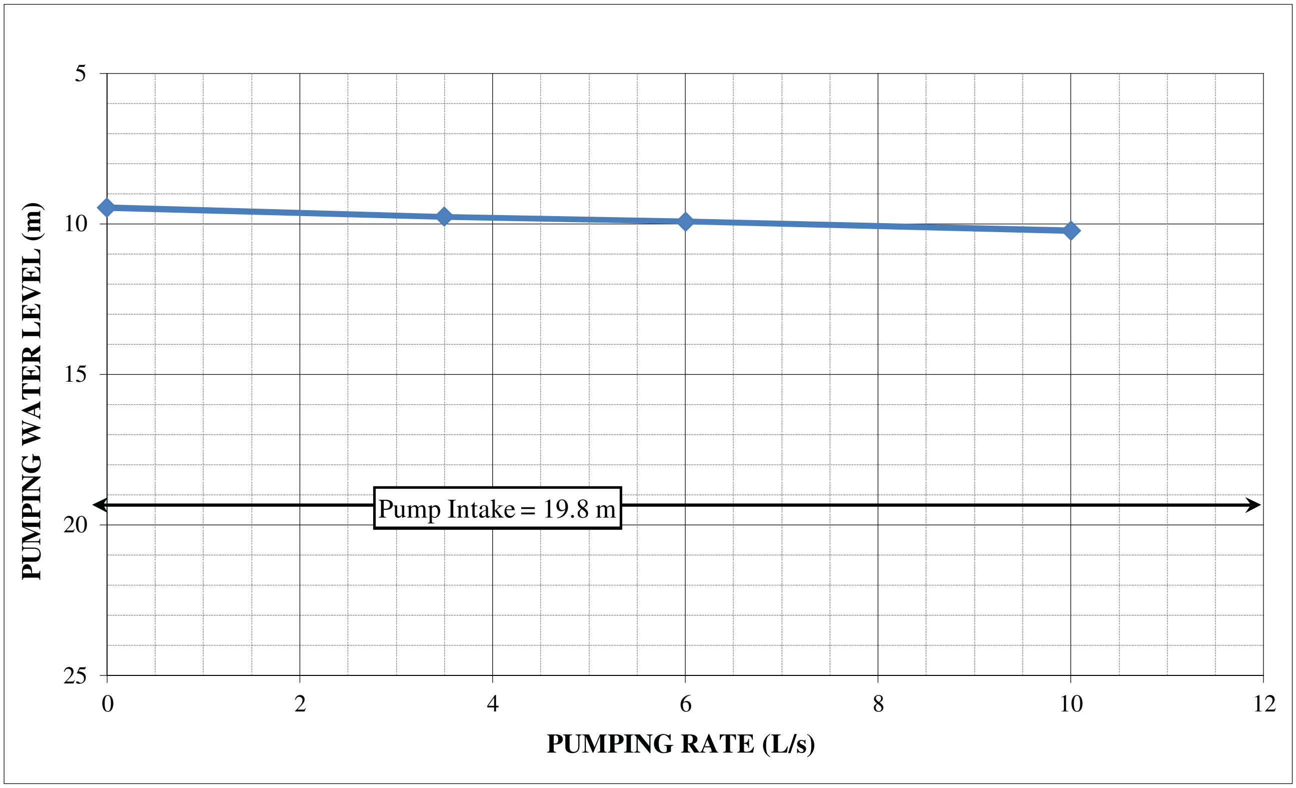
VARIABLE RATE PERFORMANCE TEST

Lotowater TECHNICAL SERVICES INC.

Well Name: Currie Well TW4
Project Number: 148-003
Client: Town of Erin (GSC)
Date: January 22, 2018
Technician Name: Craig Lawson
Pump: Grundfos 230S200-2 (5hp)
Water Level Device: LTS water level meter
Pump Inlet: 19.8 m
Water Level Reference: Top of casing (0.67 m agl)
Flow Measuring Device: 4" McCrometer Impeller
Test Note: TD = 89.20 mbtc, Base of 150 mm diameter casing 21.6 mbtc

Time *hr:min*	**Elapsed Time** *min*	**Level** *mbtc*	**Drawdown** *m*	**Flow** *L/s*	**Note**
14:31	1	10.02	0.56	9.5	Start Step 3
14:32	2	10.06	0.60	9.5	
14:33	3	10.07	0.61	9.5	20 psi
14:34	4	10.08	0.62	9.5	
14:35	5	10.09	0.63	9.5	
14:36	6	10.10	0.64	9.5	
14:38	8	10.12	0.66	9.5	
14:40	10	10.13	0.67	9.5	
14:42	12	10.14	0.68	9.5	
14:45	15	10.15	0.69	9.5	
14:50	20	10.17	0.71	9.5	
14:55	25	10.18	0.72	9.5	
15:00	30	10.19	0.73	9.5	
15:10	40	10.21	0.75	9.5	
15:20	50	10.23	0.77	9.5	
15:30	60	10.23	0.77	9.5	





Notes:

Test Date = January 22, 2019

All water levels are referenced from top of well casing

Top of casing = 0.67 m above ground surface

Base of well casing = 21.6 m

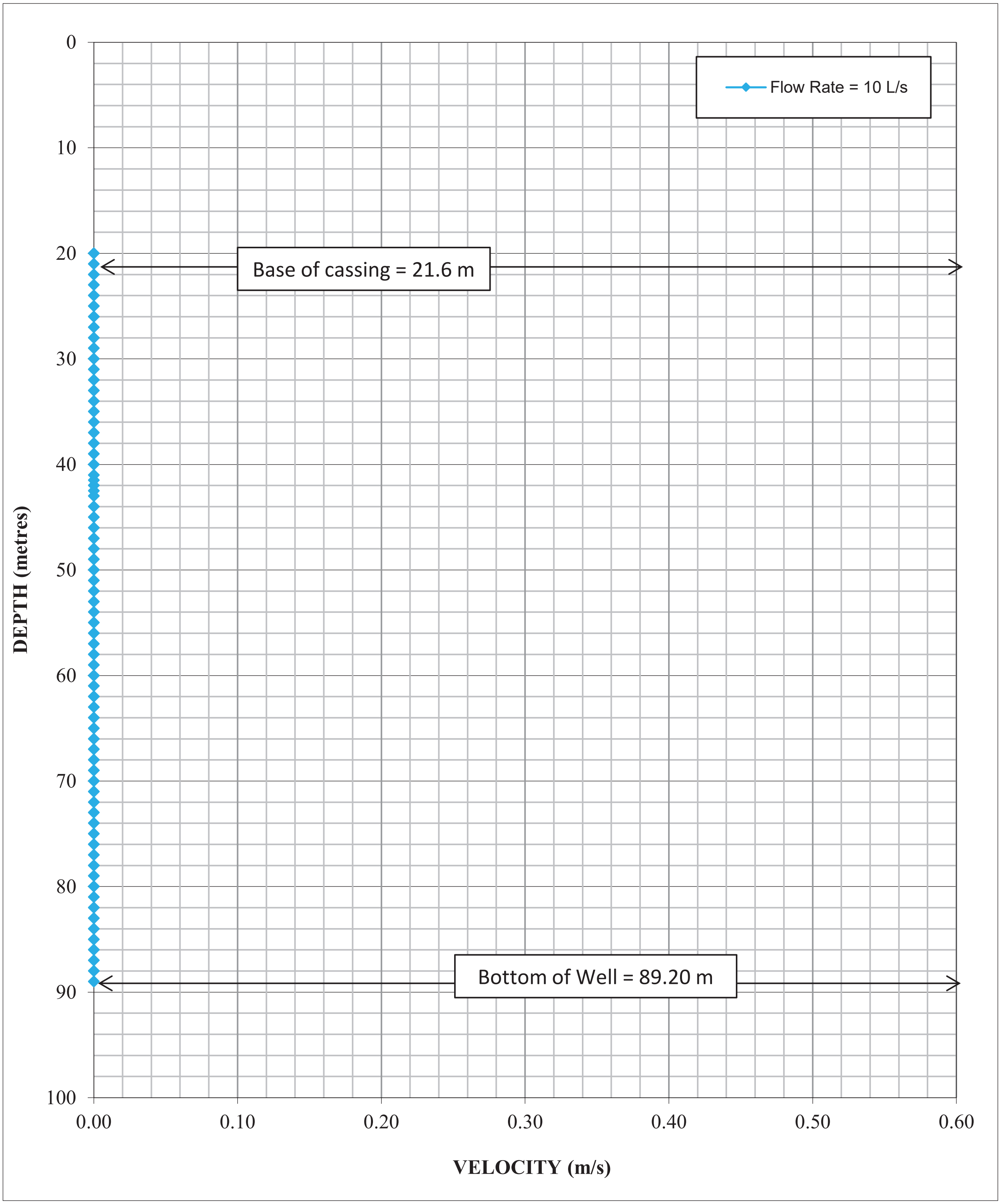
Township of Erin

Currie Well TW4

Comparison of Variable Rate Tests

Lotowater Technical Services Inc. **Figure 4A**

Reference: 148-003 2019-01-23



Notes:

Test Date = January 15, 2019

All water levels are referenced from top of well casing

Top of casing = 0.47 m above ground surface

Bottom of pump motor at 20.75 m

Township of Erin

Currie TW4

Flow Profile

Lotowater Technical Services Inc. **Figure 4B**

Reference: 148-003 2019-02-04

ALS		Sample ID				CURRIE DRIVE TW4	TW4 LOWER ZONE
2/17/2020		ALS ID				L2223735-1	L2240317-1
Multiple Work Orders		Date Sampled				1/22/2019 2:00:00 PM	03/05/2019 12:00:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water
Colour, Apparent	CU	2	-	5	-	82.8	49.7
Conductivity	umhos/cm	3	-	-	-	672	661
pH	pH units	0.1	-	6.5-8.5	-	7.53	7.65
Redox Potential	mV	-1000	-	-	-	233 *	383 *
Total Dissolved Solids	mg/L	20	-	500	-	382 *	396 *
Turbidity	NTU	0.1	-	5	-	0.2	9.27
Alkalinity, Bicarbonate (as CaCO3)	mg/L	10	-	-	-	244	216
Alkalinity, Carbonate (as CaCO3)	mg/L	10	-	-	-	<10	<10
Alkalinity, Hydroxide (as CaCO3)	mg/L	10	-	-	-	<10	<10
Alkalinity, Total (as CaCO3)	mg/L	10	-	-	500	244	216
Ammonia, Total (as N)	mg/L	0.01	-	-	-	0.254	0.134
Bromide (Br)	mg/L	0.1	-	-	-	<0.10	<0.10
Chloride (Cl)	mg/L	0.5	-	250	-	49	31
Computed Conductivity	uS/cm	n/a	-	-	-	625	642
Conductivity % Difference	%	n/a	-	-	-	-7.2	0
Fluoride (F)	mg/L	0.02	1.5	-	-	0.187	0.286
Hardness (as CaCO3)	mg/L	n/a	-	-	-	285	302
Ion Balance	%	n/a	-	-	-	109	110
Langelier Index		n/a	-	-	-	0.4	0
Nitrate (as N)	mg/L	0.02	10	-	-	<0.020	0.023
Nitrite (as N)	mg/L	0.01	1	-	-	<0.010	<0.010
Saturation pH	pH	n/a	-	-	-	7.16	7.2
Orthophosphate-Dissolved (as P)	mg/L	0.003	-	-	-	0.0064	<0.0030
TDS (Calculated)	mg/L	n/a	-	-	-	379	392
Sulfate (SO4)	mg/L	0.3	-	500	-	51.2	103
Sulphide (as S)	mg/L	0.18	-	0.05	-	1.94 *	-
Sulphide (as H2S)	mg/L	0.19	-	0.05	-	2.06	-
Anion Sum	me/L	n/a	-	-	-	6.47	6.58
Cation Sum	me/L	n/a	-	-	-	7.06	6.99
Cation - Anion Balance	%	n/a	-	-	-	4.3	0
Cyanide, Total	mg/L	0.002	-	-	-	<0.0020	-
Dissolved Carbon Filtration Location		n/a	-	-	-	LAB	-
Dissolved Organic Carbon	mg/L	0.5	-	5	-	1.78	-
Silica Total	mg/L	0.21	-	-	-	12.1	11.6
E. Coli	CFU/100mL	0	0	-	-	0	0
Total Coliform Background	CFU/100mL	10	-	-	-	660 *	150 *
Total Coliforms	CFU/100mL	0	0	-	-	0	0
Sodium Adsorption Ratio	SAR	0.1	-	-	-	0.79	0.53
Aluminum (Al)-Total	mg/L	0.01	-	-	0.1	<0.010	<0.010
Antimony (Sb)-Total	mg/L	0.0001	0.006	-	-	<0.00010	0.00013
Arsenic (As)-Total	mg/L	0.0001	0.01	-	-	0.0013	0.00186
Barium (Ba)-Total	mg/L	0.0002	1	-	-	0.0383	0.0311
Beryllium (Be)-Total	mg/L	0.0001	-	-	-	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	0.00005	-	-	-	<0.000050	<0.000050
Boron (B)-Total	mg/L	0.01	5	-	-	0.022	0.024
Cadmium (Cd)-Total	mg/L	0.00001	0.005	-	-	0.000014	0.000017
Calcium (Ca)-Total	mg/L	0.5	-	-	-	80.5	84
Cesium (Cs)-Total	mg/L	0.00001	-	-	-	<0.000010	<0.000010
Chromium (Cr)-Total	mg/L	0.0005	0.05	-	-	<0.00050	<0.00050
Cobalt (Co)-Total	mg/L	0.0001	-	-	-	0.00047	0.0003
Copper (Cu)-Total	mg/L	0.001	-	1	-	0.0042	<0.0010
Iron (Fe)-Total	mg/L	0.05	-	0.3	-	1.73	1.13
Lead (Pb)-Total	mg/L	0.0001	0.01	-	-	0.00432	0.00328
Magnesium (Mg)-Total	mg/L	0.05	-	-	-	20.3	22.4
Manganese (Mn)-Total	mg/L	0.0005	-	0.05	-	0.266	0.143
Mercury (Hg)-Total	mg/L	0.00001	0.001	-	-	<0.000010	-
Molybdenum (Mo)-Total	mg/L	0.00005	-	-	-	0.00201	0.00414
Nickel (Ni)-Total	mg/L	0.0005	-	-	-	0.00066	0.00064
Phosphorus (P)-Total	mg/L	0.05	-	-	-	<0.050	<0.050
Potassium (K)-Total	mg/L	0.05	-	-	-	0.952	0.852
Rubidium (Rb)-Total	mg/L	0.0002	-	-	-	0.0002	0.00045
Selenium (Se)-Total	mg/L	0.00005	0.05	-	-	<0.000050	<0.000050
Silicon (Si)-Total	mg/L	0.1	-	-	-	5.66	5.41
Silver (Ag)-Total	mg/L	0.00005	-	-	-	<0.000050	<0.000050

TW4 Water Quality Analysis Results

Analyte	Units	LOR	Micro & Chemical Standards	AO	Upper Limit	Water	Water
Sodium (Na)-Total	mg/L	0.5	20	200	-	30.5	21.2
Strontium (Sr)-Total	mg/L	0.001	-	-	-	0.224	0.626
Sulfur (S)-Total	mg/L	0.5	-	-	-	17.5	35.2
Tellurium (Te)-Total	mg/L	0.0002	-	-	-	<0.00020	<0.00020
Thallium (Tl)-Total	mg/L	0.00001	-	-	-	0.000024	0.000016
Thorium (Th)-Total	mg/L	0.0001	-	-	-	<0.00010	<0.00010
Tin (Sn)-Total	mg/L	0.0001	-	-	-	0.00053	<0.00010
Titanium (Ti)-Total	mg/L	0.0003	-	-	-	<0.00030	<0.00030
Tungsten (W)-Total	mg/L	0.0001	-	-	-	<0.00010	<0.00010
Uranium (U)-Total	mg/L	0.00001	0.02	-	-	0.000622	0.000561
Vanadium (V)-Total	mg/L	0.0005	-	-	-	0.00095	0.00093
Zinc (Zn)-Total	mg/L	0.003	-	5	-	0.0324	0.0187
Zirconium (Zr)-Total	mg/L	0.0003	-	-	-	0.00038	<0.00030
Acetone	ug/L	20	-	-	-	<20	-
Benzene	ug/L	0.5	1	-	-	<0.50	-
Bromodichloromethane	ug/L	1	-	-	-	<1.0	-
Bromoform	ug/L	1	-	-	-	<1.0	-
Bromomethane	ug/L	0.5	-	-	-	<0.50	-
Carbon Disulfide	ug/L	1	-	-	-	<1.0	-
Carbon tetrachloride	ug/L	0.5	2	-	-	<0.50	-
Chlorobenzene	ug/L	0.5	80	30	-	<0.50	-
Dibromochloromethane	ug/L	1	-	-	-	<1.0	-
Chloroethane	ug/L	1	-	-	-	<1.0	-
Chloroform	ug/L	1	-	-	-	<1.0	-
Chloromethane	ug/L	1	-	-	-	<1.0	-
1,2-Dibromoethane	ug/L	0.2	-	-	-	<0.20	-
1,2-Dichlorobenzene	ug/L	0.5	200	3	-	<0.50	-
1,3-Dichlorobenzene	ug/L	0.5	-	-	-	<0.50	-
1,4-Dichlorobenzene	ug/L	0.5	5	1	-	<0.50	-
Dichlorodifluoromethane	ug/L	1	-	-	-	<1.0	-
1,1-Dichloroethane	ug/L	0.5	-	-	-	<0.50	-
1,2-Dichloroethane	ug/L	0.5	5	-	-	<0.50	-
1,1-Dichloroethylene	ug/L	0.5	14	-	-	<0.50	-
cis-1,2-Dichloroethylene	ug/L	0.5	-	-	-	<0.50	-
trans-1,2-Dichloroethylene	ug/L	0.5	-	-	-	<0.50	-
Dichloromethane	ug/L	2	50	-	-	<2.0	-
1,2-Dichloropropane	ug/L	0.5	-	-	-	<0.50	-
cis-1,3-Dichloropropene	ug/L	0.5	-	-	-	<0.50	-
trans-1,3-Dichloropropene	ug/L	0.5	-	-	-	<0.50	-
Ethylbenzene	ug/L	0.5	140	2.4	-	<0.50	-
n-Hexane	ug/L	0.5	-	-	-	<0.50	-
2-Hexanone	ug/L	20	-	-	-	<20	-
Methyl Ethyl Ketone	ug/L	20	-	-	-	<20	-
Methyl Isobutyl Ketone	ug/L	20	-	-	-	<20	-
MTBE	ug/L	0.5	15	-	-	<0.50	-
Styrene	ug/L	0.5	-	-	-	<0.50	-
1,1,1,2-Tetrachloroethane	ug/L	0.5	-	-	-	<0.50	-
1,1,2,2-Tetrachloroethane	ug/L	0.5	-	-	-	<0.50	-
Tetrachloroethylene	ug/L	0.5	10	-	-	<0.50	-
Toluene	ug/L	0.5	60	24	-	<0.50	-
1,1,1-Trichloroethane	ug/L	0.5	-	-	-	<0.50	-
1,1,2-Trichloroethane	ug/L	0.5	-	-	-	<0.50	-
Trichloroethylene	ug/L	0.5	5	-	-	<0.50	-
Trichlorofluoromethane	ug/L	1	-	-	-	<1.0	-
Vinyl chloride	ug/L	0.5	1	-	-	<0.50	-
o-Xylene	ug/L	0.5	-	-	-	<0.50	-
m+p-Xylenes	ug/L	1	-	-	-	<1.0	-
Xylenes (Total)	ug/L	1.1	90	300	-	<1.1	-
4-Bromofluorobenzene	%	Surrogate	-	-	-	97.7	-
1,4-Difluorobenzene	%	Surrogate	-	-	-	101.6	-
Total THMs	ug/L	2	100	-	-	<2.0	-
* = Result Qualified	**Color Key:**	Within Guideline	Exceeds Guideline				
Applied Guideline:	**Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON Drinking Water Standar**						

Appendix E.2

Erin Village Municipal Well E9 Drilling and Testing Hydrogeological Report
(Groundwater Science Corp., February 2020)

Groundwater
Science Corp.

Unit 2, 465 Kingscourt Drive,
Waterloo, ON N2K 3R5
Phone: (519) 746-6916
groundwaterscience.ca

Town of Erin Water Supply EA
New Water Supply Source Investigation
Erin Village Municipal Well E9
Drilling and Testing
Hydrogeological Report

Prepared For:

Corporation of the Town of Erin
5684 Trafalgar Rd.
Hillsburgh, Ontario
N0B 1Z0

February 2020

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1.0 INTRODUCTION

This report provides a summary of hydrogeological work and assessment undertaken to drill and test a new municipal well for the Town of Erin, referenced as E9. This work was completed in support of the Corporation of the Town of Erin (Town) Urban Centre Water Servicing Municipal Class Environmental Assessment (Class EA). The Class EA was initiated in May 2015 and is administered on behalf of the Town by Triton Engineering Services Limited (Triton). Triton is preparing the Project File Reporting for the Class EA, this hydrogeologic assessment is intended as an appendix to the Project File Report.

As part of the overall Class EA assessment, the minimum initial water supply target (maximum daily demand) of 2,457 m^3/d (28.4 L/s over 24 hours) was identified for Erin Village, which corresponds to the population growth forecast to year 2031, as outlined in the Final Growth Management Strategy Report (Dillon, October 2019) for the Town.

1.1 INVESTIGATION BACKGROUND

Well E9 well is located at a test well drilling site, referenced as Erin 3 (site). The location of the Erin 3 site is shown on **Figure 1**.

In December 2018 a nominal 152 mm diameter exploratory test well, referenced as TW3, was drilled and developed by Keith Lang Well Drilling Inc. at the Erin 3 site. The investigation results (including well record and testing records) for the Erin 3 site are included in **Appendix A** of this report.

The TW3 drilling results are summarized as follows:

- clay till overburden extends to bedrock, encountered at a depth of 40.5 m below ground surface (mBGS);
- brown to grey limestone (dolostone), interpreted to be the (former) Amabel Formation, encountered to a depth of 82.0 mBGS;
- shale (base of bedrock aquifer) encountered from 82.0 to 84.4 m depth;
- well casing installed to 41.8 m depth, open hole from 41.8 to 84.4 mBGS; and,
- two significant water producing zones (e.g. fractures) encountered at depths of 51.8 mBGS, and, 73.8 mBGS.

Video well inspection, flow profiling and step testing at TW3 was completed by Lotowater Technical Services Inc. (Lotowater) on January 22 and 28, 2019. The test results are summarized as follows:

- TW3 video inspection and flow profiling indicates water production zones at depths of 56.7 mBGS (10% of inflow), 66.1 m (15% of inflow), and 73.2 m (70% of inflow);
- TW3 step testing indicated a specific capacity of 3.15 L/s/m for that well;
- projected potential pumping rate of 31.5 L/s (2,722 m^3/d) based on an assumed operationally sustainable drawdown of 10 m; and,
- overall good water quality results are noted; however sulfate is noted as present (at concentrations below drinking water guidelines), sodium and chloride are also present at relatively low concentrations.

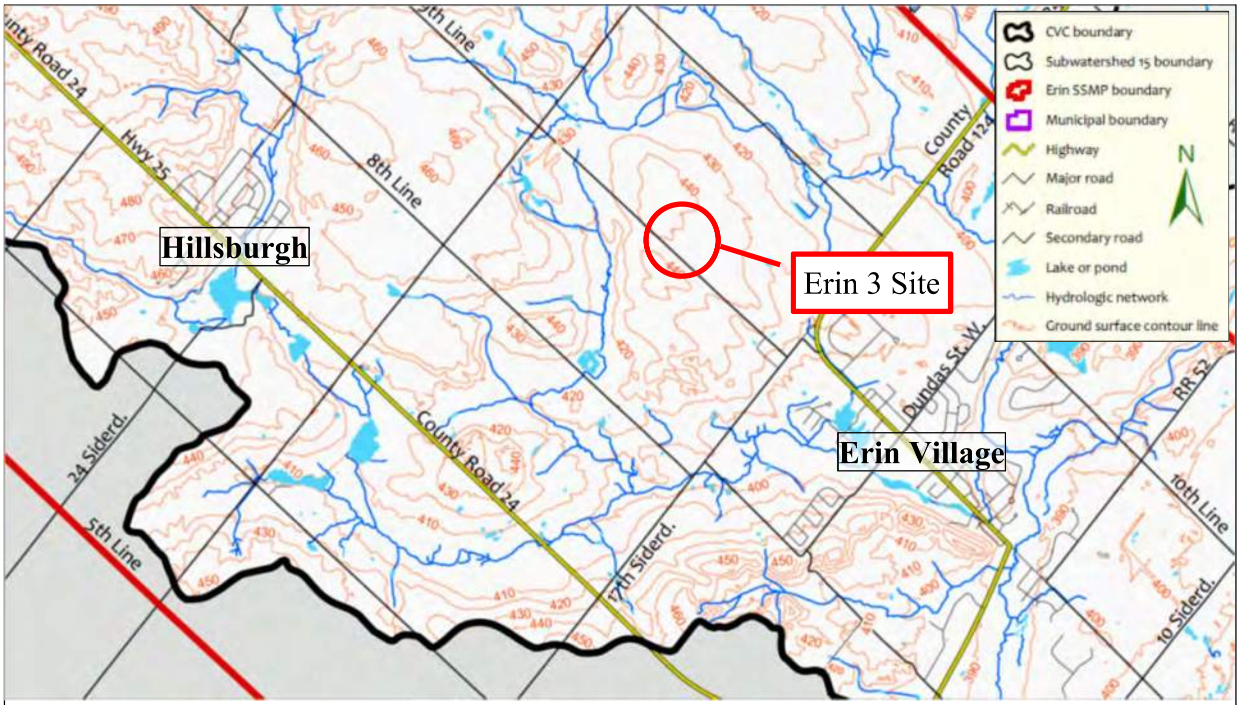
Based on the drilling and testing results, a decision was made to proceed to the municipal well construction and testing stage at the Erin 3 site.

2.0 HYDROGEOLOGIC CONDITIONS

2.1 PHYSICAL SETTING AND DRAINAGE

Considerable background information is available through watershed and subwatershed scale studies completed for the overall study area. For the purposes of this assessment, the *Erin Servicing and Settlement Master Plan Phase 1 - Environmental Component Report – Existing Conditions Report* (SSMP, May 2011; Credit Valley Conservation, Aquafor Beech Inc., Blackport Hydrogeology Inc.) is assumed to provide the most complete and up to date synthesis of local information.

The Erin 3 site is located within the West Credit River subwatershed. **Figure 1**, modified from the SSMP (May 2011) report, shows general topographic contour elevations, in metres above sea level (mASL), and, surface water systems in the overall study area.



Source: Figure 2.1.1, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 1: Physical Setting

The site is located within an agricultural field, just southwest of a local topographic high point, which is shown at approximately 445 mASL. Based on available mapping, ground surface at the site is approximately 440 mASL. Overall topographic slope is to the southeast.

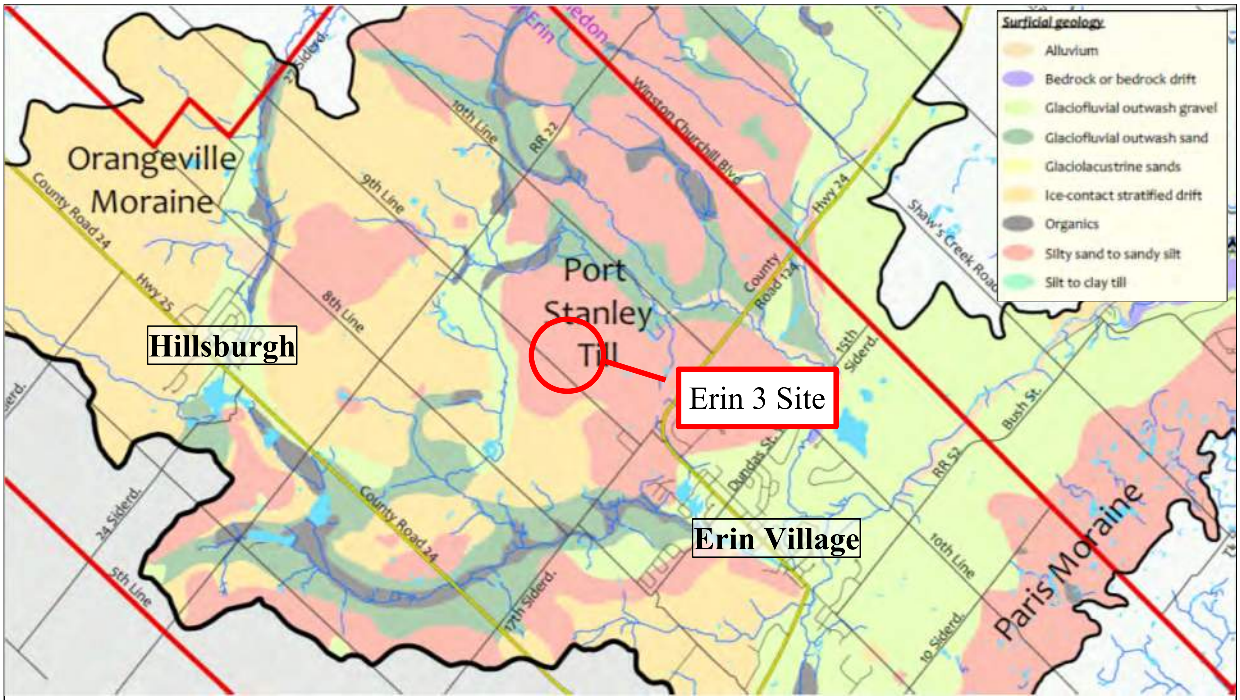
Two tributaries of the West Credit system occur in the general area of the Erin 3 site. We note there are some discrepancies between stream channel (reach) delineation in this area between Ministry of Natural Resources (MNRF) mapping and the SSMP report. As noted previously, the SSMP mapping is assumed to represent the best available data at the time of this analysis.

The closest stream is the tributary system west of the site is shown as originating east of Wellington Road 23 (9th Line), approximately 1.2 km north of the site, at an estimated elevation of 422 mASL. This tributary crosses Wellington Road 23 and flows in a southerly direction. The closest portion of this tributary is located approximately 560 m west of the site, at an estimated elevation of 419 mASL. The creek crosses 8th Line approximately 1.4 km southwest of the site at an estimated elevation of 413 mASL.

A second tributary is located north and east of the Erin 3 site, originating in several separate channels northwest of Wellington Road 22 which then merge and flow eastward to 10th Line, then southeastward and crossing Wellington Road 124. The creek elevation at the closest Wellington Road 22 crossing, approximately 1.6 km northwest of the site, is estimated to be 426 mASL. The closest portion of this tributary is approximately 1.1 km north of the site, at an estimated elevation of 422 mASL. The creek elevation at the at the first 10th Line crossing, located approximately 1.3 km northeast of the site, is estimated to be 413 mASL. The creek elevation at the Wellington Road 124 crossing, located approximately 2.4 km southeast of the site, is estimated to be 399 mASL.

2.2 SURFICIAL GEOLOGY

The surficial geology of the study area is shown in **Figure 2**.



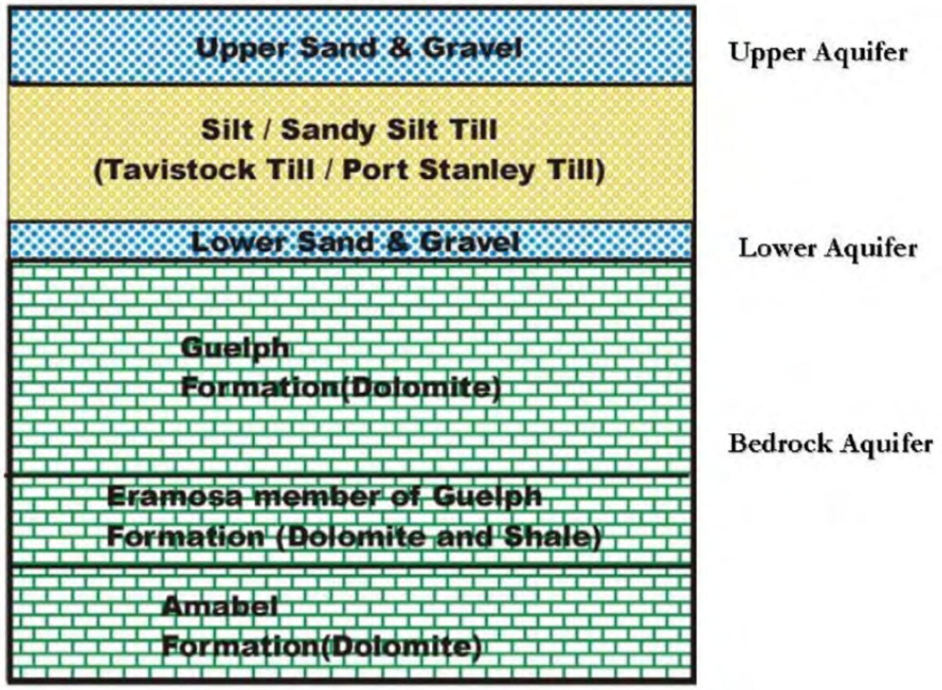
Source: Figure 2.1.2, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 2: Surficial Geology

As shown, the Erin 3 site is located within an upland area mapped as Port Stanley Till, described generally as silty sand till. Ice contact stratified drift is reported at surface west and southwest of the site. Outwash gravel is mapped along the tributary system west of the site. Outwash sand is mapped along the tributary system north and east of the site.

2.3 SUBSURFACE GEOLOGY

A generalized conceptual model of the subsurface geology in the study area, as presented in the SSMP report, is shown in **Figure 3**.



Source: Figure 2.1.3, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011).

Figure 3: Conceptual Geologic Model

As noted in the SSMP report, the geologic units vary in thickness, and may not be continuous in extent through the study area.

The upper sand and gravel layer is comprised of permeable surficial geologic units, primarily associated with kame moraine, till moraine, or ice contact sand and gravel deposits of the Orangeville Moraine and the Paris Moraine. These deposits are not continuous across the study area.

The till sequence consists primarily of the two major till deposits identified in this area; the Port Stanley Till; and, the Wentworth Till. Both are described as sandy silt tills. The till units can occur at ground surface, or underlie the upper sand and gravel layer. The till units are interpreted to have a moderate to low permeability and can act as aquitards where present in sufficient thickness.

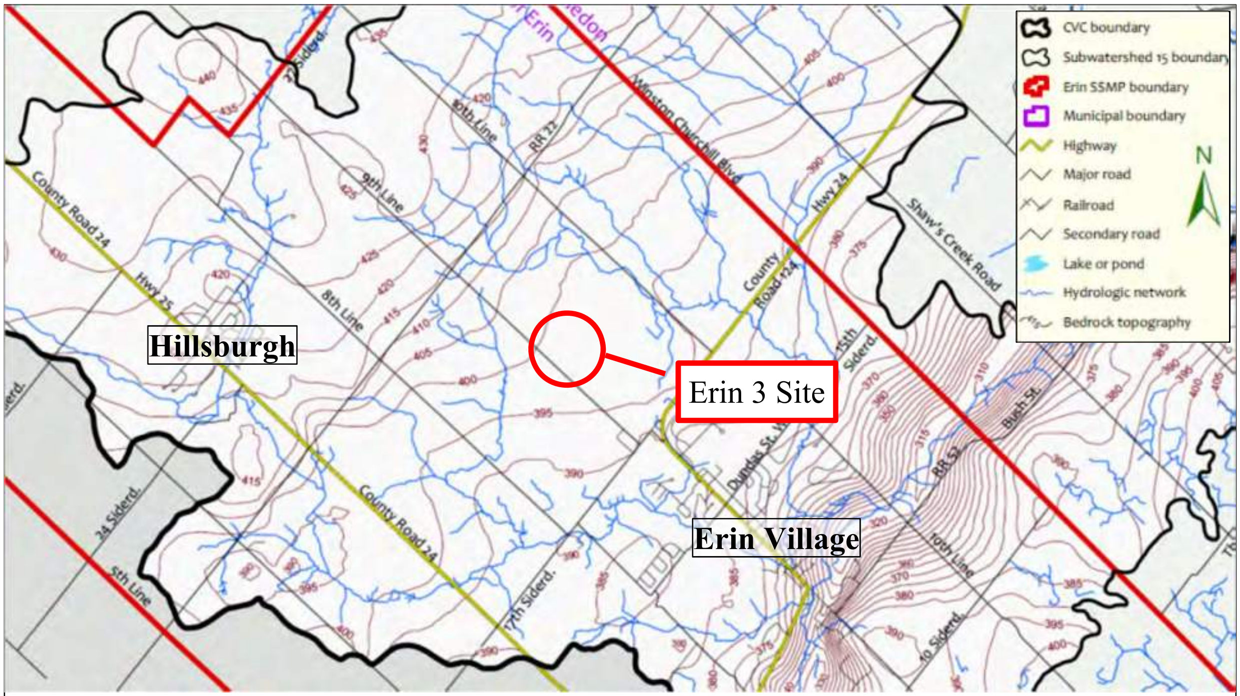
Underlying the till units, and immediately above bedrock, discontinuous sand and gravel (glaciofluvial) deposits are reported. The lower sand and gravel units can be hydraulically connected to the upper bedrock, and where connected the sand/gravel/bedrock system can act as one aquifer unit.

We note that the stratigraphic characterization and nomenclature of the Silurian bedrock sequence has been revised by the Ontario Geologic Survey (e.g. Brunton and Brintnell, 2001). However for simplicity and consistency with the SSMP and published Source Protection reporting, in this report we will utilize the previous formation references.

Based on geologic mapping and water well record descriptions, the Guelph Formation (and Eramosa member) is not continuous over the study area and is largely absent near Erin Village. The Amabel Formation is described as a *gray to blue-gray medium* *crystalline dolomite* (SSMP, May 2011). The Amabel Formation is also capable of producing substantial quantities of water, typically from major fracture zones reported at depth. Much of the water produced from local private well and municipal wells for Erin Village is produced from the Amabel Formation, however few wells penetrate the full formation thickness.

The municipal water systems and majority of private residential wells obtain water from the Silurian dolostone (dolomite) bedrock aquifer system. The dolostone sequence is underlain by shale units that form the base of the bedrock aquifer system.

The interpreted bedrock topography (contours in mASL) within the study area is shown in **Figure 4**.



Source: Figure 2.1.6, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

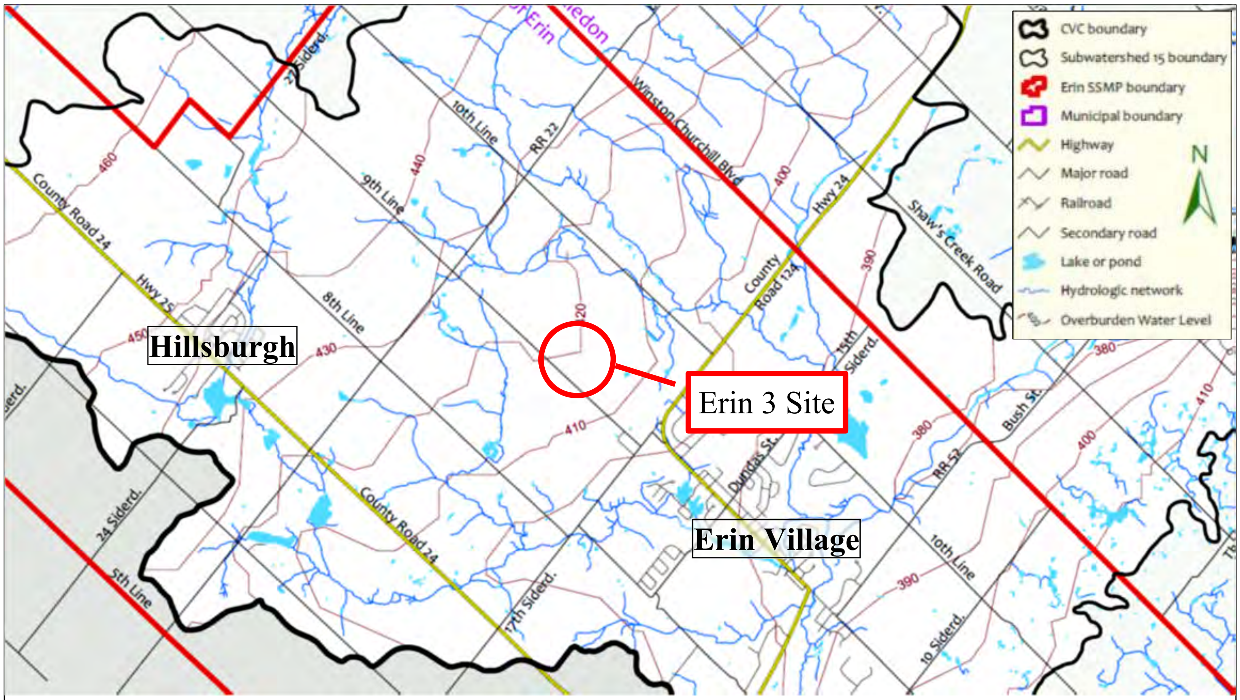
Figure 4: Bedrock Topography

As shown, bedrock elevation estimated to be approximately 398 mASL at the Erin 3 site, indicating an overburden thickness of 42 m. Based on the bedrock elevations shown and the stream elevations listed in **Section 2.1**, overburden thickness along the tributary system west of the site varies from approximately 14 m (at Wellington Road 23) to 21 m (at 8th Line). A depth of 19 m is calculated at the tributary reach closest to the site.

Similarly, the calculated overburden thickness along the tributary system north and east of the site varies from 8 m (at the Road 124 crossing) to 16 m at the closest stream crossing at 10th Line, and, 11 m at the Wellington Road 22 crossing. A depth of 17 m is calculated at the stream reach closest to the site for this tributary.

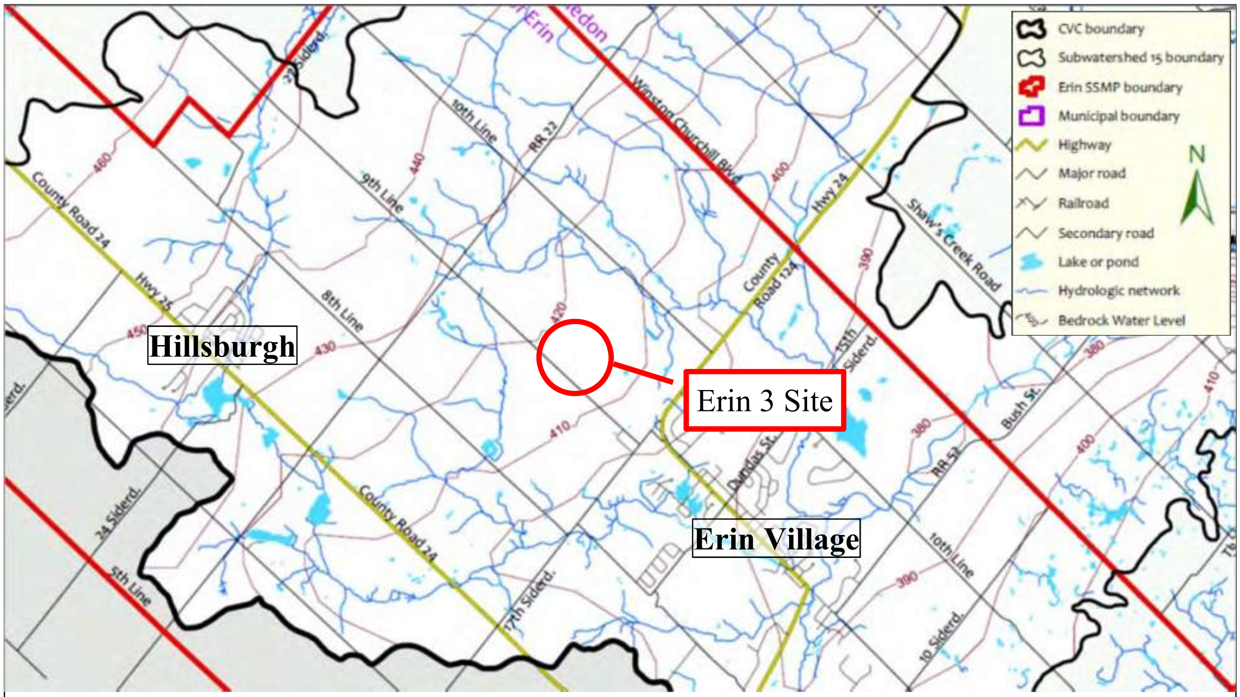
2.4 GROUNDWATER FLOW

The reported regional shallow (water table) groundwater flow system is shown in **Figure 5**. The reported deeper bedrock aquifer system is shown in **Figure 6**.



Source: Figure 2.1.7, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 5: Water Table Contours



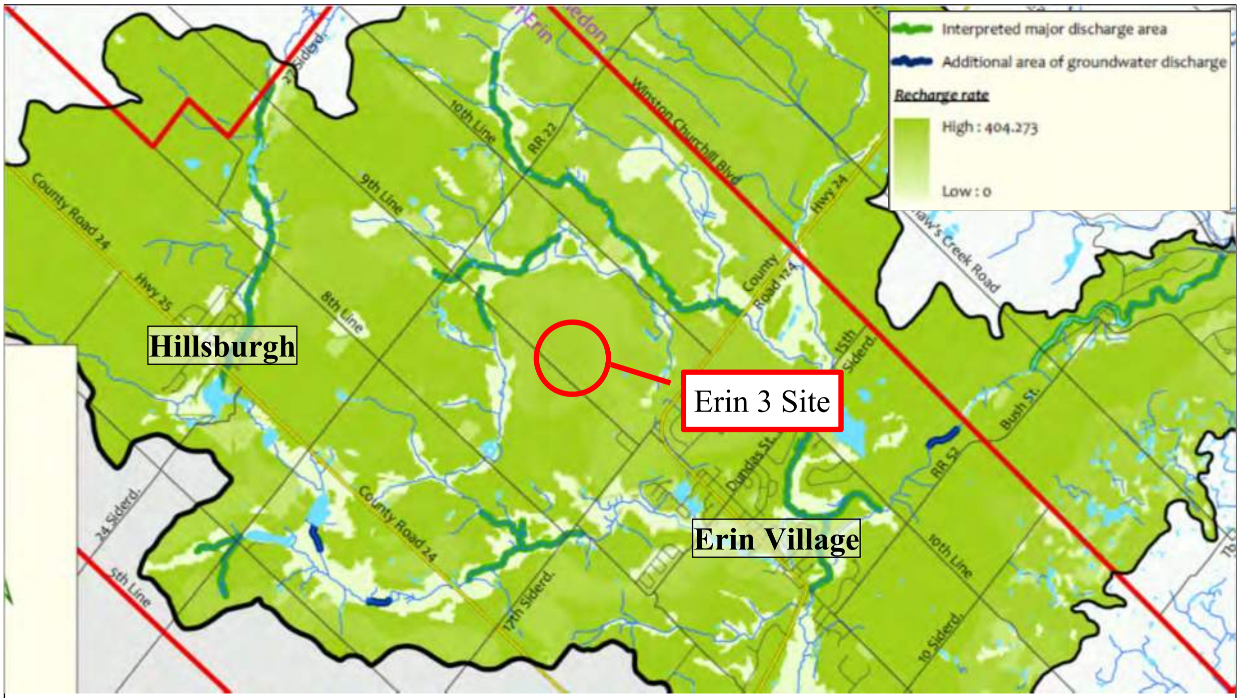
Source: Figure 2.1.8, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 6: Bedrock Water Levels

Both the regional water table and bedrock groundwater contours generally follow topographic relief, with and interpreted flow direction southeast near the site. Based on the water level contours shown, downward gradients occur at the site.

2.5 GROUNDWATER RECHARGE AND DISCHARGE

Generalized regional groundwater recharge and discharge conditions within the study area, as reported by the SSMP, is shown in **Figure 7**.



Source: Figure 2.1.6, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 7: Groundwater Recharge and Discharge

As shown, much of the area is characterized as having relatively high recharge rates. This recharge supports both local and regional flow systems. Where surface water systems associated with the West Credit, or other natural environment features (e.g. ponds, wetlands, etc.) intercept the water table, groundwater discharge to surface occurs. Groundwater discharge can also be a result of regional flow systems from both the overburden and bedrock.

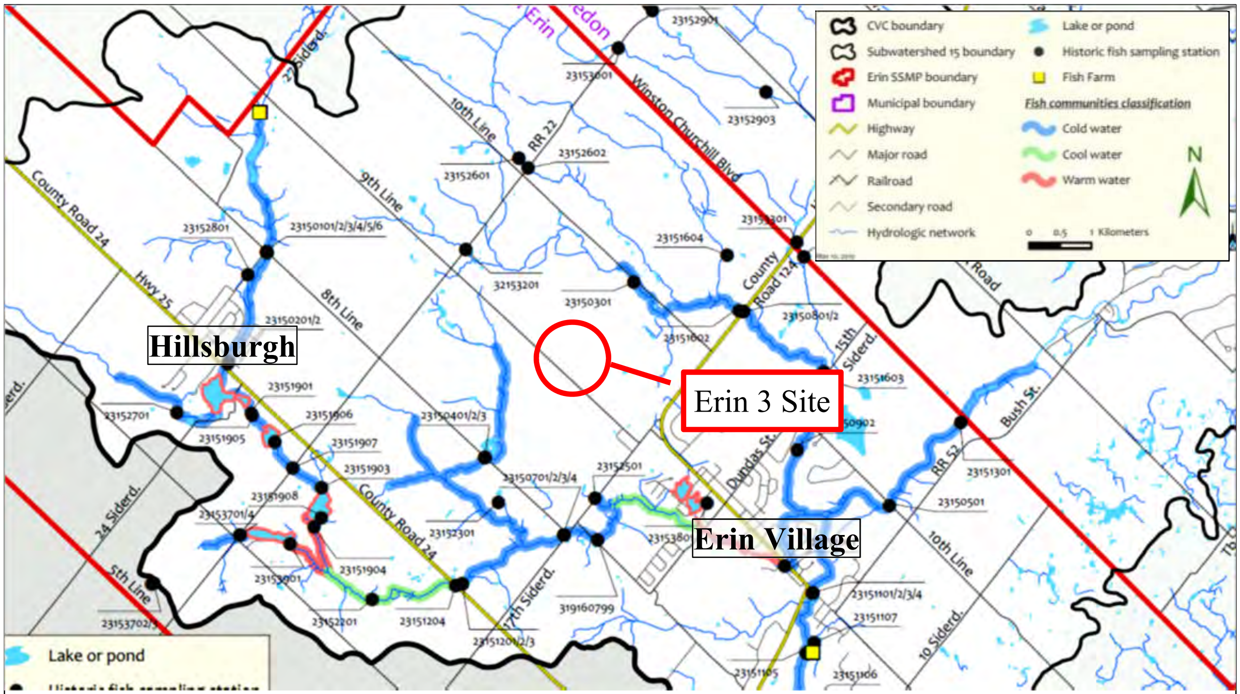
Additional investigation regarding local conditions within the West Credit system near the Erin 3 site is provided in **Section 3.3** and assessed later in this report.

2.6 STREAM CLASSIFICATIONS AND WETLANDS

Stream characterization in the area of the site, as related to fish community classification reported by the SSMP, is shown in **Figure 8**.

As shown, both tributary systems discussed in **Section 2.1** have reaches identified with fish communities classified as Cold Water. These reaches are assumed to be supported by groundwater discharge.

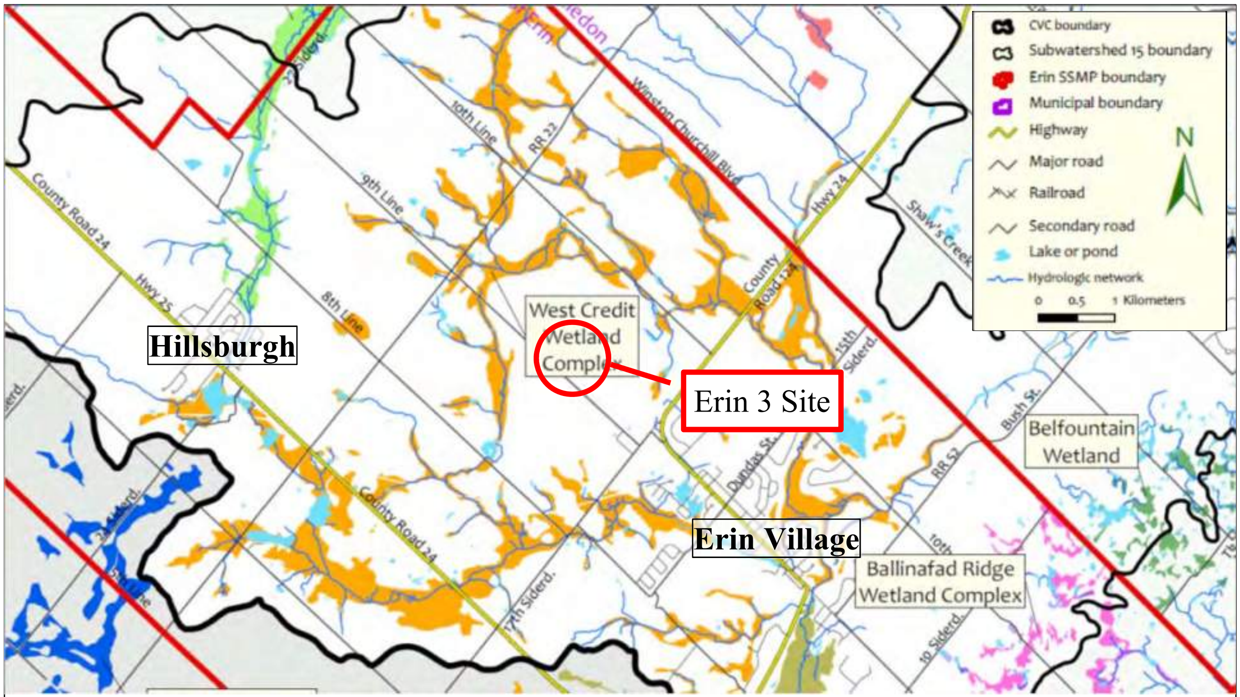
Additional field investigations, coordinated with Credit Valley Conservation staff, were completed for this study in order to guide monitoring program development for the pumping test. The investigations are discussed in **Section 3.3**.



Source: Figure 2.6.1, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 8: Stream Classification

Mapped wetland areas are shown on **Figure 9**.



Source: Figure 2.3.3, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

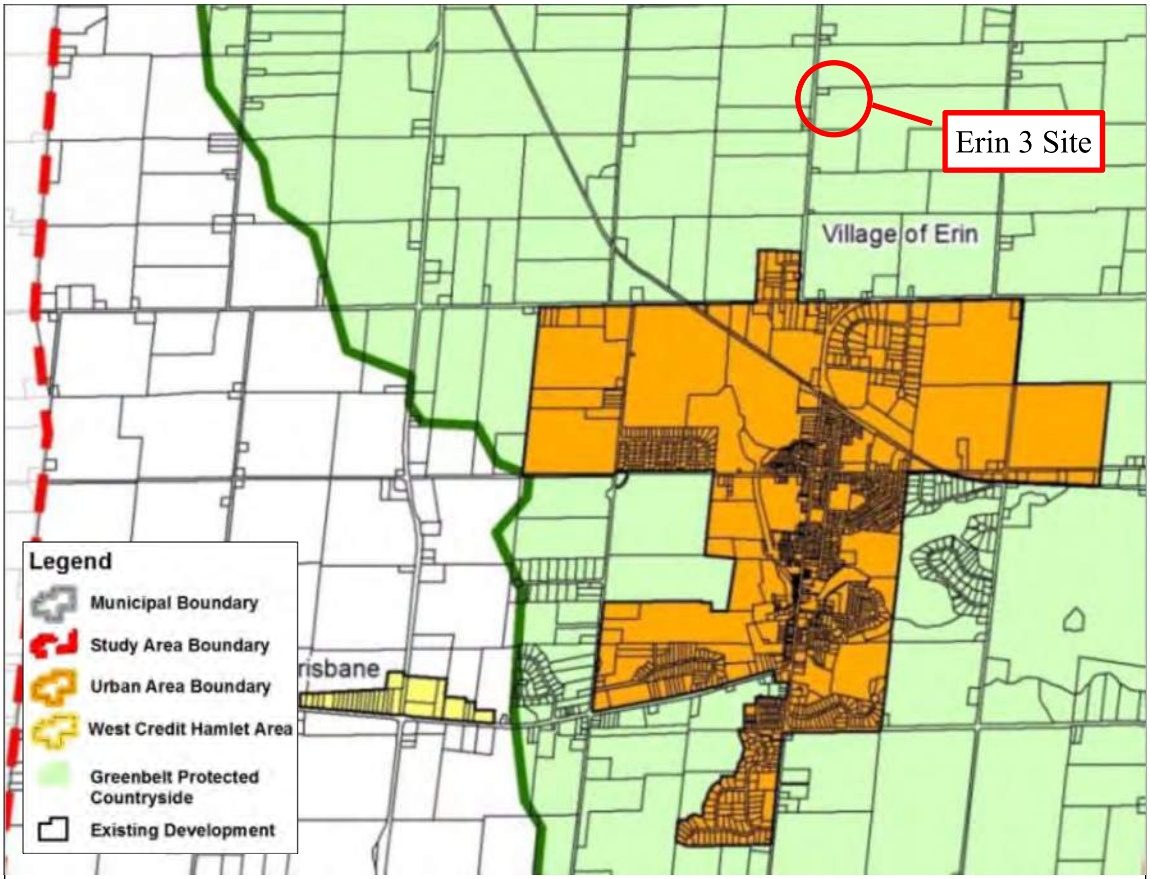
Figure 9: Wetland Areas

As shown, wetlands are reported along the tributary systems. Well E9 is located approximately 450 m from the nearest identified wetland (part of the West Credit Wetland Complex).

2.7 GROUNDWATER USAGE

As noted in the SSMP reporting, groundwater uses within the subwatershed include municipal drinking water supply, private (e.g. residential) water supply, commercial water taking, aquaculture, agricultural, industrial, institutional and commercial uses.

Figure 10 shows the approximate urban area boundaries for Erin Village.



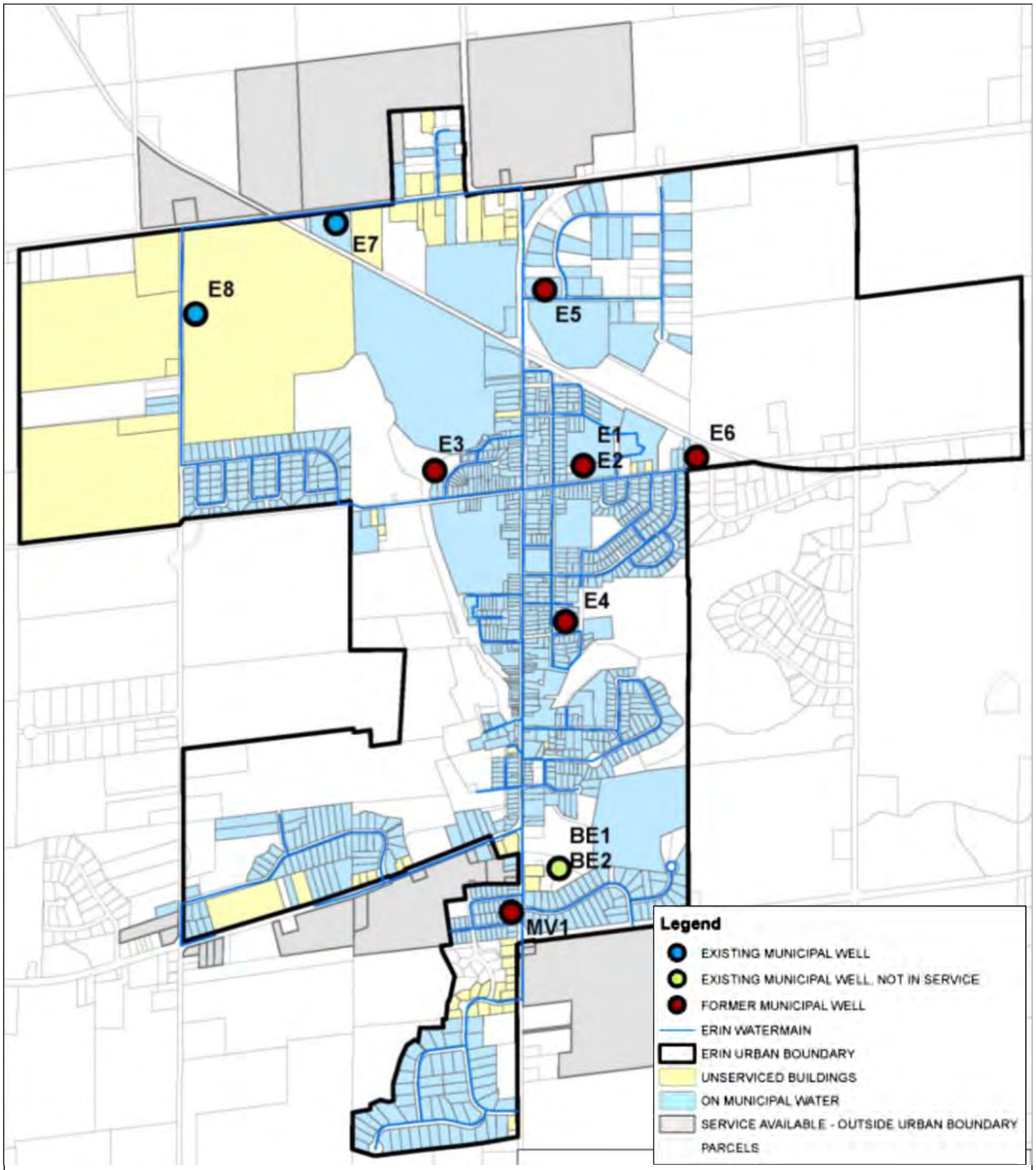
Source: Figure 2-4, Town of Erin Servicing and Settlement Master Plan Final Report, August 2014 (not to scale)

Figure 10: Urban Boundaries

The Town provides municipal water supply within portions of the urban boundaries of Erin Village, however the water distribution system does not extend to all properties within the two communities.

2.6.1 Municipal Water Supply – Erin Village

The location of existing and former municipal water supply wells, and the approximate current extent of water distribution system within Erin Village is shown on **Figure 11**. Two sources are currently in use in the Village of Erin, well E7 and well E8.



Source: Figure 7-5, Town of Erin Servicing and Settlement Master Plan Final Report, August 2014 (not to scale)

Figure 11: Erin Village Water Supply System

Well E7 was drilled in January 1986 and has been in production since the early 1990's. The well was completed in bedrock at a total depth of 42 m. Bedrock was encountered at 10.7 m. In October 2004 the well casing was extended to 19.1 m depth. The well was originally artesian, flowing at a reported rate of about 657 m^3/day. Well E7 was originally tested at a rate of 1,961 m^3/day, with drawdown stabilized at 10 m below ground surface. Most water of the water production is interpreted to be from the lower portion of the bedrock. No hydraulic connection to surface sources of water was found. Well E7 is currently approved for water taking at rates up to 30.0 L/s and daily volumes up to 2,160 m^3/day. Based on Town pumping records, daily use of well E7 averaged approximately 4 hours per day in 2018.

Well E8 was drilled in December 1991and has been in production since 1993. The well is completed in bedrock at a total depth of 46 m. Bedrock was encountered at 6.6 m and water bearing zones reported from 9.8 to 15.5 m depth, and, from 18.9 to 46 m depth. The upper bedrock zone was sealed (pressure grouted) to a depth of 16.8 m to minimize potential connection to surface water. The well is artesian, flowing at an estimated rate of 1,600 m^3/day and with a static level about 6.4 m above ground surface at the time of construction. Well E8 was originally tested at a rate of 2,620 m^3/day, with a total drawdown of 16.7 m. Testing in 1992 and 1993 indicated there was no direct connection or impact of groundwater discharge to the West Credit River or adjacent wetlands. Well E8 is currently approved for water taking at rates up to 27.3 L/s and daily volumes up to 1,968 m^3/day. Based on Town pumping records, daily use of well E8 averaged approximately 7 hours per day in 2018.

The Town also owns two non-operational municipal water supply wells, originally installed for the Bel-Erin subdivision (Bel-Erin Wells), referenced as BE1 and BE2. The wells are non-operational as an upgrade to the treatment system would be required for municipal use.

2.6.2 Local Water Taking

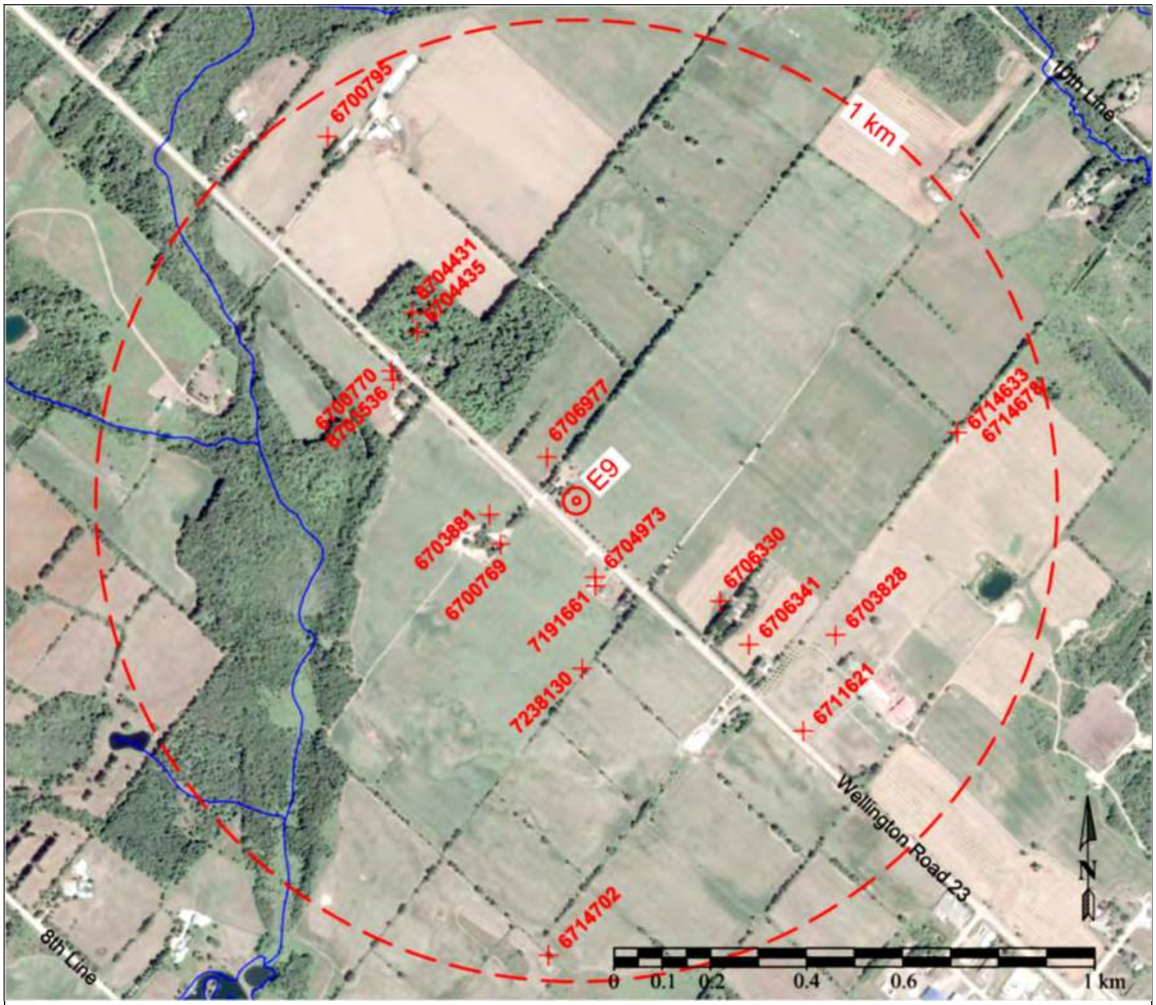
The status of Permit To Take Water (PTTW) locations in the area of the site was reviewed based on information available at the MECP online application: *Map: Permits to take water*, available at: https://www.ontario.ca/environment-and-energy/map-permits-take-water. According to the MECP mapping, there are no PTTW locations within 1 km of the Erin 3 site. The closest permit locations (between approximately 1.5 and 2 km of the site) correspond to municipal taking for the Town of Erin at E7, remediation taking (TCE capture and treat system) at a manufacturing location (Budcan Holdings Inc.) in the north end of Erin Village, and, commercial taking for the Derrydale Golf Course.

2.6.3 Private Water Supply

Private residences outside of the urban boundaries, and residences inside the urban boundaries that are not connected to the municipal water supply system, rely on private wells for water supply.

A review was completed of all reported water well records within 1 km of well E9. A total of 18 well records are reported. The reported well record locations are shown on **Figure 12** and reported information summarized in **Table 1**.

As shown, well records generally correspond to farm and residence locations. However 3 records are plotted at the lot center, which indicates that actual locations have not been determined for these wells. One of these records (#6714702) is for the abandonment of a surface well pit at a residence on 8th Line (beyond 1 km from E9). The other 2 records (#'s 6714633 and 6714678) are for locations on 10th Line (also beyond 1 km distance). Based on a review of the well record map and description, location 6700770 also appears to be located on 10th Line (beyond 1 km).



Source: OBM, Google Earth, MECP Well records

+ well record location

Figure 12: Well Record Review

Well usage is predominantly for domestic residential use, 4 records also list livestock watering (farm) use. Of the 14 wells within 1 km of E9, one well is reported to be completed in a confined gravel layer (depth of 25.9 mBGS) and the remaining wells are completed in bedrock at depths between 21.6 and 46 mBGS.

The water well record information indicates that the deep bedrock is the primary source for private wells in the area. Given the setting, shallow dug wells would not be expected to be in use within 1 km of E9.

As part of this study a door to door water well survey was completed to further assess private water supply in the area and to request monitoring access. This work is outlined in **Section 3.6** of this report.

Record	Use	Depth to Bedrock (m)	Total Depth (m)	Casing Depth (m)	Source	Comment
6700769	do	N/A	31.1	25.9	gravel	confined aquifer
6700770	do	19.8	41.1	21.6	bedrock	incorrect location
6700795	do, st	29.6	54.6	30.5	bedrock	
6703536	do, st	39.3	47.5	40.5	bedrock	
6703828	do, st	39.3	57.3	40.5	bedrock	
6703881	do, st	41.8	56.4	41.8	bedrock	
6704431	do	39.3	67.1	41.1	bedrock	
6704435	do	39.6	67.7	43.0	bedrock	
6704973	do	40.8	42.7	41.5	bedrock	
6706330	do	42.7	72.5	43.3	bedrock	
6706341	do	38.1	73.2	40.8	bedrock	
6706977	do	43.6	73.5	43.6	bedrock	
6711621	do	37.2	53.3	38.9	bedrock	
6714633	do	12.2	31.4	12.5	bedrock	incorrect location
6714678	do	21.3	42.4	21.9	bedrock	incorrect location
6714702	N/A	N/A	N/A	-	N/A	well abandonment
7191661	do	38.1	55.5	39.3	bedrock	
7238130	do	45.4	54.9	46.0	bedrock	
do = domestic st = stock N/A = not available						

Table 1: Water Well Record Summary

2.8 WELL HEAD PROTECTION AREAS

Selected mapping from the *Approved Source Protection Plan: CTC Source Protection Region* (July 28, 2015) report, showing reported Well Head Protection Area (WHPA) and Significant Groundwater Quality Threat Areas for each of the current Town municipal water supply wells is included in **Appendix B** for reference. There are no WHPA's identified as extending to the Erin 3 site.

3.0 WELL E9 DRILLING AND TESTING

3.1 WELL DRILLING AND CONSTRUCTION

Drilling and well construction at well E9 was completed by Aardvark Drilling Inc. Drilling began on July 24, 2019 and the last stage of well construction (chlorination and provision of locking well cap and well tag) was completed by December 23, 2019. The location of E9 is shown on **Figure 11**. A copy of the E9 well record is included in **Appendix C**. Well E9 is located approximately 10 m from test well TW3.

As shown on the water well record, bedrock was encountered at 39.9 m depth. A nominal 508 mm diameter hole was drilled to 1.2 m depth and for the final well construction a nominal 406 mm diameter hole advanced to 44.5 mBGS. A nominal 254 mm diameter stainless steel casing was installed to 44.5 mBGS and the entire annular space from surface to bottom of casing sealed using bentonite grout. A nominal 254 mm diameter hole was advanced through bedrock to a final depth of 79.2 mBGS (incorrect depth shown on record).

The well drilling and construction included a number of phases, including:

- installation of a nominal 508 mm diameter starter casing to 1.2 m depth;
- nominal 152 mm diameter pilot hole drilling and temporary casing installation approximately 3 m into bedrock;
- initial well development and production rate estimation through air lifting;
- temporary casing removal and borehole reaming to nominal 406 mm diameter through overburden and approximately 4 m into bedrock;
- installation and grouting of final nominal 254 mm dimeter stainless steel casing (included removal of starter casing prior to grouting);
- reaming bedrock hole to final nominal diameter of 254 mm; and,
- final well development.

The well was largely complete and ready for testing after the final well development, which was finished on November 14, 2019.

The bottom of TW3 was sealed with bentonite cement grout from 79.2 to 84.4 mBGS as part of the municipal drilling program.

3.2 TEMPORARY PERMIT TO TAKE WATER

A Category 2 (temporary) PTTW was obtained from the MECP to allow pump testing well E9. A copy of the permit (#0850-BGDL7V) is included in **Appendix D**.

The permit allowed water taking from well E9 at a maximum rate of 2,046 L/min (34.1 L/s), 24 hours per day, for a maximum of 6 days.

3.3 CVC CONSULTATION AND REDD SURVEY

As part of the preparation process for the pump test CVC was consulted regarding test timing, monitoring and assessment. As part of discussions with CVC staff in July 2018, it was determined that stream inspections and a trout spawning (redd) survey should be completed at accessible properties in the area of the Erin 3 drilling site.

The stream inspection and redd survey was intended to identify areas in which groundwater discharge may support both sensitive fish habitat and spawning locations, and thereby guide the pump test monitoring program to assess potential impacts related to water taking. In order to facilitate the stream inspections a survey request letter was delivered door to door to all properties in which portions of the two tributary systems referenced in **Section 2.1** are mapped within approximate 1.5 m of the Erin 3 site. The properties included residences on 8th Line, Wellington Road 23, 10th Line, Wellington Road 22, and, Wellington Road 124.

A copy of the access permission letter is included in **Appendix E**. The letter was delivered to a total of 21 residences on October 2nd and 3rd, 2018. A total of 7 responses were received and access permission was obtained at 5 locations in the area of the Erin 3 site. They stream surveys were completed at those 5 properties in conjunction with CVC staff on October 29, 2018 and November 1, 2018. The properties in which stream inspection and redd surveys were completed are shown in **Appendix E**.

The stream inspection and redd survey results were recorded by CVC staff. Based on the results, in stream monitoring locations were chosen and instrumented for the pumping test. The stream monitoring locations are summarized in **Section 3.5**.

Further discussions with CVC occurred in September 2019 in preparation for the pumping test implementation. An email string outlining the consultation summary is included in **Appendix E** for reference. The final pumping test monitoring plan incorporated the recommended monitoring and assessment strategies to the extent possible within the scope and time frame of the EA study requirements.

3.4 MONITORING WELL SELECTION AND INSTALLATION

A total of 28 locations were monitored as part of the E9 pumping test. The complete monitoring network is shown on **Figure F1** in **Appendix F**. Monitor details for all locations are provided in **Table F1** (**Appendix F**). The locations include: observation wells installed for, or available to, this study; stream bed piezometers installed for this study; surface water locations installed for this study; and, accessible private wells.

The following bedrock observation wells, owned by the Town or available to this study, were incorporated into the pumping test monitoring program:

- Test well TW3 (at the Erin 3 site);
- TW2 (test well drilled south of Wellington Road 124, near the intersection with 10th Line; and,
- E7-MW1-09 (existing observation well associated with well E7).

The following water table observation wells were monitored as part of the pumping test:

- E7-MW1S-10 (adjacent to bedrock well E7-MW1-09);
- E9-MW1-19 (installed for this study at Wellington Road 23 north of E9); and,
- E9-MW1-19 (installed for this study at 10th Line near identified redd locations).

As noted above, two water table monitors were installed in November 2019 as part of this assessment to provide water level information next to wetland and sensitive stream habitat as identified through consultations with CVC and the stream surveys completed in fall 2018. Water well records for all of the monitoring wells are included in **Appendix F**.

With the exception of E7-MW-09, water levels at each of the monitoring well locations were recorded using both Diver® model water level transducer/dataloggers (dataloggers) and occasional manual measurements using a Heron Instruments® electronic water level meter. Monitor E7-MW1-09 was already equipped with a Levelogger® LT500 vented datalogger as part of the monitoring program associated with well E7.

3.5 STREAMBED PIEZOMETER INSTALLATION

Stream bed piezometers were installed at 6 locations for this monitoring program (see **Appendix F**). The locations were chosen based on access availability, one location (DP3) was installed within an area on private property identified through the redd/habitat survey. The remaining locations consist of the nearest roadside access points in areas interpreted to have groundwater discharge and or sensitive fish habitat (e.g. DP1 to DP2, and, DP4 to DP6).

Nested piezometers were installed at 3 (DP1, DP2 and DP4) of the 6 locations to assess vertical gradients within the groundwater system at the creek. In addition, at 1 piezometer location (DP6) a stilling well was installed to compare stream level to groundwater levels within the piezometer. This location is also next to water table monitor E9-MW2-19, therefore the combination of stilling well, piezometer and water table well also provides for an analysis of vertical gradients near the creek. The piezometer locations were chosen based on the results of the redd/habitat survey to provide an analysis of potential impact to groundwater conditions at the creek to the extent possible given access limitations.

The streambed piezometers consist of nominal 38 mm diameter 0.3 m long stainless steel drive-point screens, threaded steel coupling and 1.8 m long galvanized riser pipe. The piezometer was manually installed (driven) to the desired depth below the stream using a fence post pounder. The piezometer was then pumped and flushed with water until the discharge water and water level response indicated the installation was successful. The installation was considered successful if, for example:

- the discharge water cleared (or was sandy), the piezometer could be pumped continuously, and, an appropriate vertical gradient was observed; or,
- the sediment observed in the discharge water (e.g. silt) indicated that any organic/much encountered during installation had been removed from the screen, and, the appropriate water level response (e.g. slow recovery) was observed to pumping.

The stilling well at DP6 consisted of a nominal 25 mm diameter open ended PVC pipe, slotted over the bottom 10 cm. The stilling well was attached to the piezometer using gear clamps. All measurements were obtained from the top of DP6.

Water levels at each of the piezometer locations were recorded using both Diver® model dataloggers and occasional manual measurements using a Heron Instruments® electronic water level meter.

3.6 PRIVATE WELL SURVEY AND MONITORING

In order to augment the MECP database and to obtain monitoring access, a private water well survey was completed on October 11, 2019. The survey area included all residences and properties within approximately 1.5 km of well E9. A total of 83 locations were canvassed. As part of the survey an information and response package was delivered door to door within the survey area. The package included a response form and stamped return envelope, in addition to telephone and email contact information. A copy of the survey letter and response form is included in **Appendix G**. Based on a limited response to the initial survey, additional attempts were made in November and December 2019 to contact specific well owners in the vicinity of the Erin 3 site, and to obtain monitoring locations on 8th Line and 10th Line.

The water well survey response results are summarized in **Table G1** (**Appendix G**). A total of 19 responses were received. Two dug wells were identified through the survey, both located at residences along Wellington Road 22, at distances of over 1.4 km from well E9. Based on the overall setting (overburden depth, depth to water table) and location of residences, dug wells would not be expected within a 1 km radius of well E9.

Based on location, well type and access permission, a total of 15 locations were visited to attempt to install monitoring equipment. Of those locations, 5 wells were determined to be inaccessible due to construction type (primarily buried wells below ground where well head seals could not be safely opened).

A total of 10 private wells were monitored for the test, including 1 dug well, 1 drilled overburden well and 8 drilled bedrock wells (see **Appendix F**). At each private drilled well a temporary access pipe (small diameter flush join PVC pipe, screened at bottom) was suspended in the well to allow measurements to be taken and equipment installed safely without disturbing existing pumping equipment. The access pipe was removed after monitoring was complete. The access pipe was installed and removed by Lotowater Technical Services (pumping test contractor).

At one residence the homeowner also expressed interest in having the water level in their pond (in addition to their well) monitored for the test. A temporary stilling well was installed in the pond, consisting of a nominal 25 mm diameter open ended PVC pipe, slotted over the bottom 30 cm. The stilling well was attached to a fixed (permanent) dock in the pond. The stilling well was removed after the monitoring period ended.

Water levels at each of the private well locations were recorded using both Diver® model dataloggers and occasional manual measurements using a Heron Instruments® electronic water level meter.

Prior to the initiation of the pumping test, a pump test notification letter was distributed door to door on December 10, 2019 within the water well survey area. A copy of the letter notification is provided in **Appendix G**.

3.7 WELL E9 STEP TEST

A step test was competed at E9 by Lotowater on December 11, 2019, starting at 12:40 pm and ending at 3:40 pm. The test consisted of 3 one hour consecutive steps at rates of 19 L/s, 26 L/s and 34 L/s respectively. Some initial generator problems resulted in several aborted attempts to start the test, however Lotowater ensured water levels had recovered fully from those attempts before the final test was initiated.

The step test water was discharged to the roadside ditch on the east side of Wellington Road 23, approximately 500 m south of E9. Water flow from that point is southward along the ditch, then crosses Wellington Road 23 through a culvert approximately 860 m south of E9, and flows southeast through an agricultural field then into a stormwater pond located north of Pioneer Road. The stormwater pond discharge flows southward through established routes to the West Credit river.

Water level measurements were obtained manually by Lotowater using an electronic water level meter over the test period. Full recovery was obtained using a Diver® model datalogger. The results are provided in **Appendix H**.

3.8 WELL E9 PUMPING TEST

The pumping test at E9 was also competed by Lotowater. The test began on December 12, 2019 1:15 pm and ended on December 17, 2019 1:15 pm. The reported average pumping rate over the test period was 32 L/s. The same discharge location was used. Some initial problems with frozen discharge lines resulted in three aborted attempts to start the test, however Lotowater ensured water levels had fully recovered from those attempts before the final test was initiated.

Water level measurements were obtained manually by Lotowater using an electronic water level meter, and using a Diver® model datalogger, over the test and recovery periods. Pumping rates were measured and recorded by Lotowater using an inline flow meter installed for that purpose. The results are provided in **Appendix I**.

3.9 WATER QUALITY SAMPLING

Over the 5 day pump test period, water quality samples for general parameters were obtained on December 12, 2019 1:45 pm (test start) and December 15, 2019 1:15 pm (3rd day of test). At the end of the pumping test, on December 17, 2019 11:30 am, a sample was obtained for a more complete drinking water suite of parameters. The water quality samples were obtained using sample bottles provided by the laboratory and submitted immediately for analysis to ALS Environmental (ALS Canada Inc.) in Waterloo, Ontario. The water samples were taken at a sample spigot located at the well head prior to the flow meter. The water quality sampling results are summarized in tabular form in **Appendix J** and discussed in **Section 4.7**. Copies of the laboratory analysis certificates were provided to the Town.

3.10 WEATHER CONDITIONS

In order to provide an assessment of weather conditions over the pump test period, Environment Canada reported daily precipitation and temperature data was obtained for the Fergus Shand Dam weather station. The results are provided on a vertical bar graph illustrating reported rainfall and snowfall contributions to daily precipitation, and maximum daily reported temperatures, in **Appendix K**.

Rainfall, or accumulated snowfall melt events, result in increased streamflow and can result in groundwater recharge events. As indicated by the climate graph, precipitation events in November, December and January included both rainfall and snowfall.

The climate data indicates that there were no significant rainfall or snowmelt events over the E9 test period. However, rainfall/snowmelt events did occur on November 27, 2019 and December 8th to 9th, 2019, prior to the E9 test.

4.0 PUMPING TEST RESULTS AND ANALYSIS

4.1 STEP TEST

The E9 step test hydrograph and analysis is included in **Appendix H**. Based on the pre-test static level and test pump setting, total available drawdown for the step test (and long term aquifer test) was 23 m.

The pre-test static level measured at E9 was 21.33 m below the temporary reference point established for the testing (21.06 m below top of well). Total drawdown at the end of the 3 consecutive steps was measured to be 4.62 m, 7.43 m and 9.71 m, respectively. By 8:40 pm on December 11, 2019 (i.e. after 5 hours) 95% recovery had been achieved.

As shown in the analysis, the calculated Specific Drawdown over the 3 pumping steps is relatively consistent, indicating good well efficiency. The calculated Specific Capacities at 19, 27 and 34 L/s are 4.1, 3.5 and 3.5 L/s/m of drawdown respectively, with an average Specific Capacity of 3.7 L/s/m.

The step test results indicate E9 is a relatively efficient high capacity well capable of producing water over the short term at rates that meet identified current Town water supply targets, with moderate amounts of drawdown.

Based on the step test results a target pumping rate of 34 L/s was identified for the long term pumping test.

4.2 WELL E9 PUMPING TEST

The E9 pumping test hydrographs are included in **Appendix I**.

The long-term hydrograph shows measurements starting on November 21, 2019 (3 weeks prior to testing) and extending to January 10, 2020 (3 weeks after testing). As indicated by the long-term hydrograph, the overall seasonal trend within the bedrock system at E9 over this period consists of a slight decline, of approximately 0.14 m. Small-scale short-term fluctuations also occur, potentially related to aquifer recharge, or, private well use in the area. No specific response to water taking at Erin Village wells E7 or E8 is identified at well E9.

The short-term hydrograph shows measurements obtained over the pumping test period. As shown, most drawdown occurred over the first 10 hours of the test, after which water levels within E9 were largely stable for the remainder to the test. Some minor variations occurred related to pumping rate adjustments made at the well head.

The pre-test static level measured at E9 was 21.38 m below the temporary reference point established for the testing (21.13 m below top of well). Total drawdown at the end of the 5 day (120 hour) test was measured to be 12.15 m. By 8:45 pm on December 17, 2019 (i.e. after 7.5 hours) over 95% recovery had been achieved.

4.3 OBSERVATION WELLS

The long-term and pumping test hydrographs for the three bedrock observation wells and one water table observation well monitored as part of this study are included in **Appendix L**.

Test well TW3 responded closely to pumping at E9, as expected given the proximity and similar construction depths. Monitoring at TW3 began in July 2019, therefore a longer record is available, showing E9 well construction and development responses in addition to the step test and pumping test effects. The overall seasonal trend over July to December consists of a slight water level decline (0.13 m). Observed drawdown at the end of the E9 pumping test was 10.97 m.

Test well TW2 is located approximately 1.9 km east of well E9. Test well TW2 is constructed in bedrock through the entire aquifer thickness (Amabel Formation, extending to the underlying shale) at a total depth of 51.8 m. No response to E9 pumping was observed at TW2. The overall trend over the monitoring period consisted of a moderate rise in water levels (0.7 m) in response to seasonal recharge.

Monitoring well E7-MW1-09 is located approximately 1.5 km south of well E9. Well E7-MW1-09 is constructed in bedrock through the majority (estimated >90%) of the aquifer thickness to a total depth of 45.7 m. Monitoring well E7-MW1S-10 is a water table monitor constructed in the sand/gravel overburden adjacent to the bedrock monitoring well, to a total depth of 6.1 m. Two comparison plots showing relative depths to water over the entire monitoring period, and over the pumping test period, are included in **Appendix L**. As shown, no response to E9 pumping is observed in the bedrock aquifer or within the water table at this location. The bedrock aquifer monitor responds to regular pumping at Erin well E7, and appears to have a subdued response to the recharge events that are evident in the water table monitor. No response to well E7 pumping is noted within the water table at this location.

4.4 DRIVE-POINT PIEZOMETERS AND WATER TABLE MONITORS

The long-term and pumping test hydrographs for the two water table observation wells and 6 drive-point piezometer sites installed for this study included in **Appendix M**. All of these locations were installed to help assess potential impacts to water table conditions near, and potential for groundwater discharge to, the closest tributary systems in the area.

Nested drive-point location DP1 is located approximately 1.4 km southwest of E9. Some anomalous water level changes occurred at DP1-D prior to, and after, the test period, however water levels over the test period appear accurate. The anomalous water level patterns may be a result of ice plugs forming within the piezometer. The monitoring results indicate upward gradients from the deep to shallow piezometers. Responses to snowmelt and related increases in both streamflow and local water table elevations are observed (e.g. December 9th to 10th, prior to the step test at E9). As shown by the long term and pumping test hydrographs, no response and no significant change in vertical gradient, is observed over the E9 pumping period.

Water table monitoring well E9-MW1-19 is located approximately 360 m northwest of well E9. As shown by the long term hydrograph, no response is observed to E9 pumping. A slight decline in water level (0.11 m) is observed over the monitoring period.

Nested drive-point location DP2 is located approximately 1.1 km northwest of E9. Some anomalous water level changes occur at DP2-D prior to the test period, however water levels over the test period appear accurate. The anomalous water level patterns may be a result of ice plugs forming within the piezometer. The monitoring results indicate downward gradients from the shallow to deep piezometers. Responses to snowmelt and related increases in both streamflow and local water table elevations are observed. An increase in water levels, and brief gradient reversal, is noted on December 9th to 10th, after which water levels decline slowly to December 27th. The vertical gradient slowly increases over this time period, however the pattern appears to be consistent and gradual, without any markers that would be associated with a pump test response (such as recovery after E9 pumping is ended). As shown by the long term and pumping test hydrographs, no water level response is observed over the E9 pumping period.

DP3 is located approximately 1.3 km north-northwest of E9. Water levels at this location appear consistent and accurate over the monitoring period, however frozen conditions (both inside the piezometer and in the creek) were observed during the monitoring event immediately after the pumping test. The initial measurements after installation are indicative of a very fine grained, low hydraulic conductivity, sediments at the creek at this location. The monitoring results indicate downward gradients from the creek to the piezometer. Responses to snowmelt and related increases in both streamflow and local water table elevations are observed (e.g. December 9th to 10th, prior to the step test at E9, and on December 13th during the test). As shown by the long term and pumping test hydrographs, no response is observed over the E9 pumping period.

Nested drive-point location DP4 is located approximately 1.4 km northeast of E9. Water levels at this location appear consistent and accurate over the monitoring period. The monitoring results indicate upward gradients from the deep to shallow piezometers. Responses to snowmelt and related increases in both streamflow and local water table elevations are observed (e.g. December 9th to 10th, prior to the step test at E9). As shown by the long term and pumping test hydrographs, no response and no significant change in vertical gradient, is observed over the E9 pumping period.

DP5 is located approximately 1.3 km northeast of E9. Water levels at this location appear consistent and accurate over the monitoring period. The monitoring results indicate upward gradients from the piezometer to the creek. Responses to snowmelt and related increases in both streamflow and local water table elevations are observed (e.g. December 9th to 10th, prior to the step test at E9). As shown by the long term and pumping test hydrographs, no response is observed over the E9 pumping period.

DP6 is located approximately 1.5 km northeast of E9. Both the creek level and groundwater level in the piezometer are measured at DP6. Water levels at this location appear consistent and accurate over the monitoring period. The monitoring results indicate upward gradients from the piezometer to the creek. Responses to snowmelt and related increases in both streamflow and local water table elevations are observed (e.g. December 9th to 10th, and, December 12th, prior to the step test at E9). As shown by the long term and pumping test hydrographs, no response and no significant change in vertical gradient is observed over the E9 pumping period.

Water table monitoring well E9-MW2-19 is located adjacent to DP6. As shown by the long term hydrograph, no response is observed to E9 pumping. Similar to DP6, responses to snowmelt and related increases in both streamflow and local water table elevations are observed (e.g. December 9th to 10th, prior to the step test at E9). An overall increase in water level (0.2 m) is observed over the monitoring period.

4.5 PRIVATE WELLS

A total of 10 private wells and 1 private pond were monitored as part of this study. The water level hydrographs for the private locations monitored for this study are included in **Appendix N**. Well location, construction details and water level response are summarized in **Table 2**, and described briefly as follows:

- most private wells showed little drawdown associated with normal domestic use, typically less than 1 m, indicating the high capacity of the bedrock (and overburden) source aquifers;
- no water level response was observed at the dug well or pond;
- a 0.3 m water level response to the E9 pumping test occurred at the drilled overburden well located at an approximately 1.4 km distance, based on the response the deep overburden aquifer at this location is assumed to be connected to the bedrock system; and,
- water level response to the E9 step test and pumping test occurred in most private bedrock wells, observed drawdown ranged from 7.9 m at a distance of 195 m, to 0.9 m at 1.5 km distance.

Address	Distance From E9 (m)	Well Type	Aquifer	Well Depth (m)	Pre Test Static (mBTOW)	Drawdown (m)
5653 8th Line	1390	drilled	gravel	25.9	2.66	0.31
5659 10th Line	1400	drilled	bedrock	39.6	2.99	none
5662 10th Line	1050	drilled	bedrock	42.4	3.35	1.42
9621 Well Rd 22	1510	drilled	bedrock	34.7	4.79	0.65
9629 Well Rd 22	1410	dug	shallow	2.7	0.70	none
5635 Well Rd 23	515	drilled	bedrock	73.2	19.42	5.51
5644 Well Rd 23	550	drilled	bedrock	53.3	16.64	5.11
5668 Well Rd 23	195	drilled	bedrock	55.5	19.76	7.75
5709 Well Rd 23	480	drilled	bedrock	91.4	20.30	5.10
5757 Well Rd 23	1320	drilled	bedrock	37.2	8.02	0.80

Table 2: Private Well Drawdown Summary

One water supply interference incident due to pumping test induced drawdown occurred on December 14, 2019, at 5635 Wellington Road 22. In response the pump was lowered from 21.9 m depth to 36.6 m depth by Flow Water Solutions (MECP licenced water well contractor working on behalf of the Town). This restored water service to the household on the same day the complaint was received. No other well interference complaints were received and no other interference was observed.

4.6 AQUIFER PARAMETER SUMMARY

Aquifer parameter estimation was completed for wells exhibiting a measurable pump test drawdown response. The pump test drawdown data was analyzed using the Hantush-

Jacob Leaky Aquifer method within the AQTESOLV® analysis program. The analysis plots are included in **Appendix O**.

The analysis estimated bulk aquifer Transmisivity (T) and Storativity (S). The corresponding aquifer hydraulic conductivity (K) is estimated assuming an aquifer thickness of 42 m (T=Kb), as measured at E9. The results are summarized in **Table 3**.

Location	T (m^2/s)	S	K (m/s)
E9	0.002091	-	5.0E-05
TW3	0.002072	0.0005307	4.9E-05
5653 8th Line	0.0006427	0.0001019	1.5E-05
5662 10th Line	0.0007243	0.00005276	1.7E-05
9621 Well Rd 22	0.01194	0.0002274	2.8E-04
5635 Well Rd 23	0.0008805	0.0000367	2.1E-05
5644 Well Rd 23	0.0006548	0.00004237	1.6E-05
5668 Well Rd 23	0.001117	0.00003907	2.7E-05
5709 Well Rd 23	0.001129	0.00002157	2.7E-05
5757 Well Rd 23	0.007169	0.0001909	1.7E-04

Table 3: Aquifer Parameter Estimates

The calculated T, S and K values reflect the highly productive aquifer capacity at E9.

4.7 WATER QUALITY

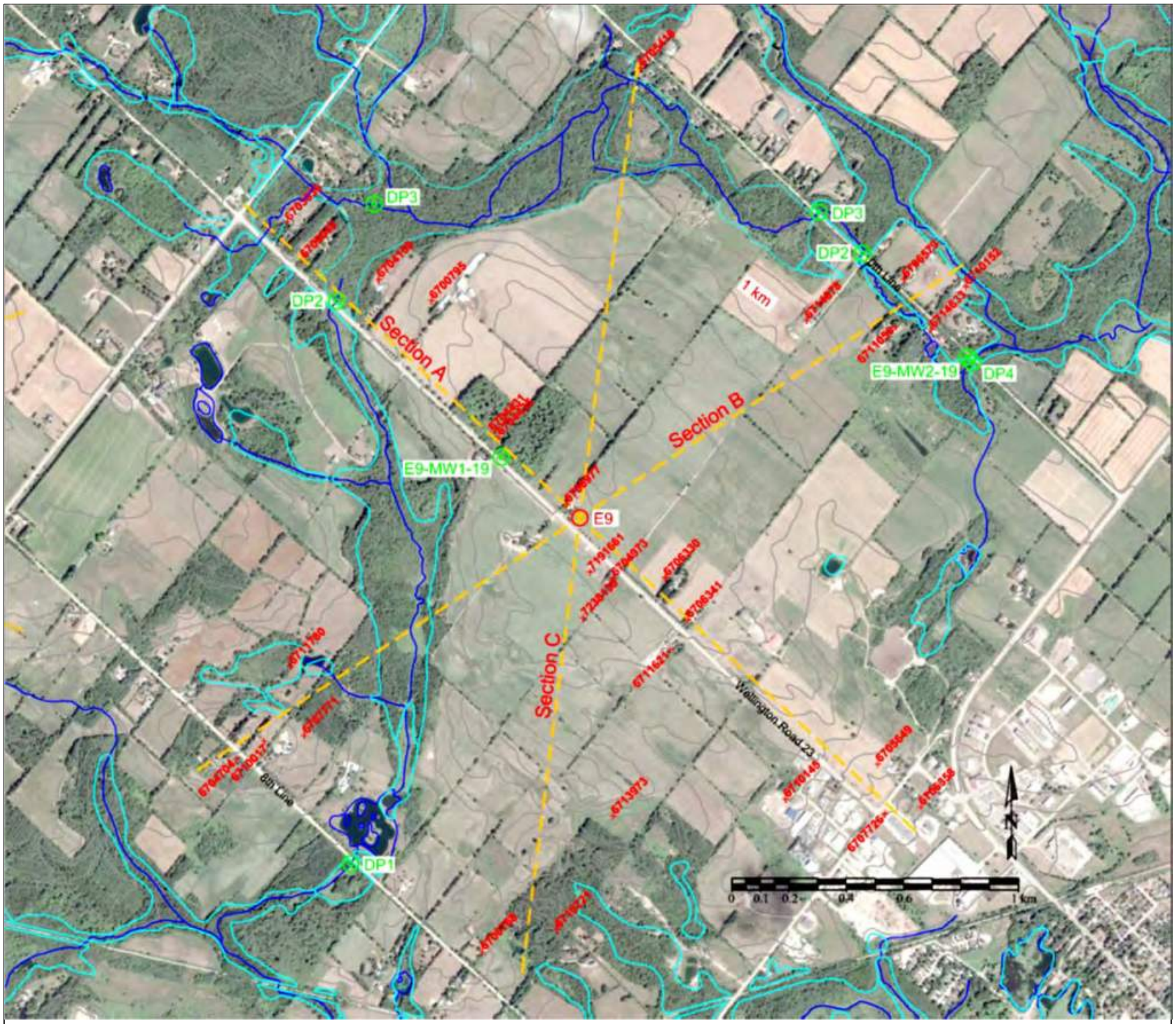
As shown by the results, the only drinking water quality exceedance was Total Coliforms, reported to be approximately 2 CFU/100mL at the end of the pumping test. The presence of Total Coliforms may be indicative of the need for additional development. We also note that the sample was taken prior to the final well chlorination that was completed as the final stage of well construction. The Total Coliforms is expected to decrease with additional pumping and use.

In general, the water quality as tested was good and there are no treatability or other health related concerns. There is no indication of any direct influence from a surface water source and no indication of any anthropogenic contaminants. For example, concentrations of nitrogen species were low (non-detect), and sodium and chloride concentrations were relatively low. As well, no pesticides or herbicides were detected.

5.0 IMPACT ASSESSMENT

5.1 GEOLOGIC CONDITIONS

In order to provide context to the impact discussion, 3 schematic cross-sections were developed illustrating local conditions within the E9 monitoring area (Sections A to C). The cross-section locations are shown on **Figure 13**. The cross-sections are provided as **Figures 14 to 16**.



Source: OBM, Google Earth, MECP Well records

Figure 13: Section Locations

The sections are based on the drilling and monitoring results obtained by this study, in addition to available topographic mapping and the MECP water well record database. Some of the well record locations shown on **Figure 13** have been corrected based on the water well record review and information obtained through the private well survey.

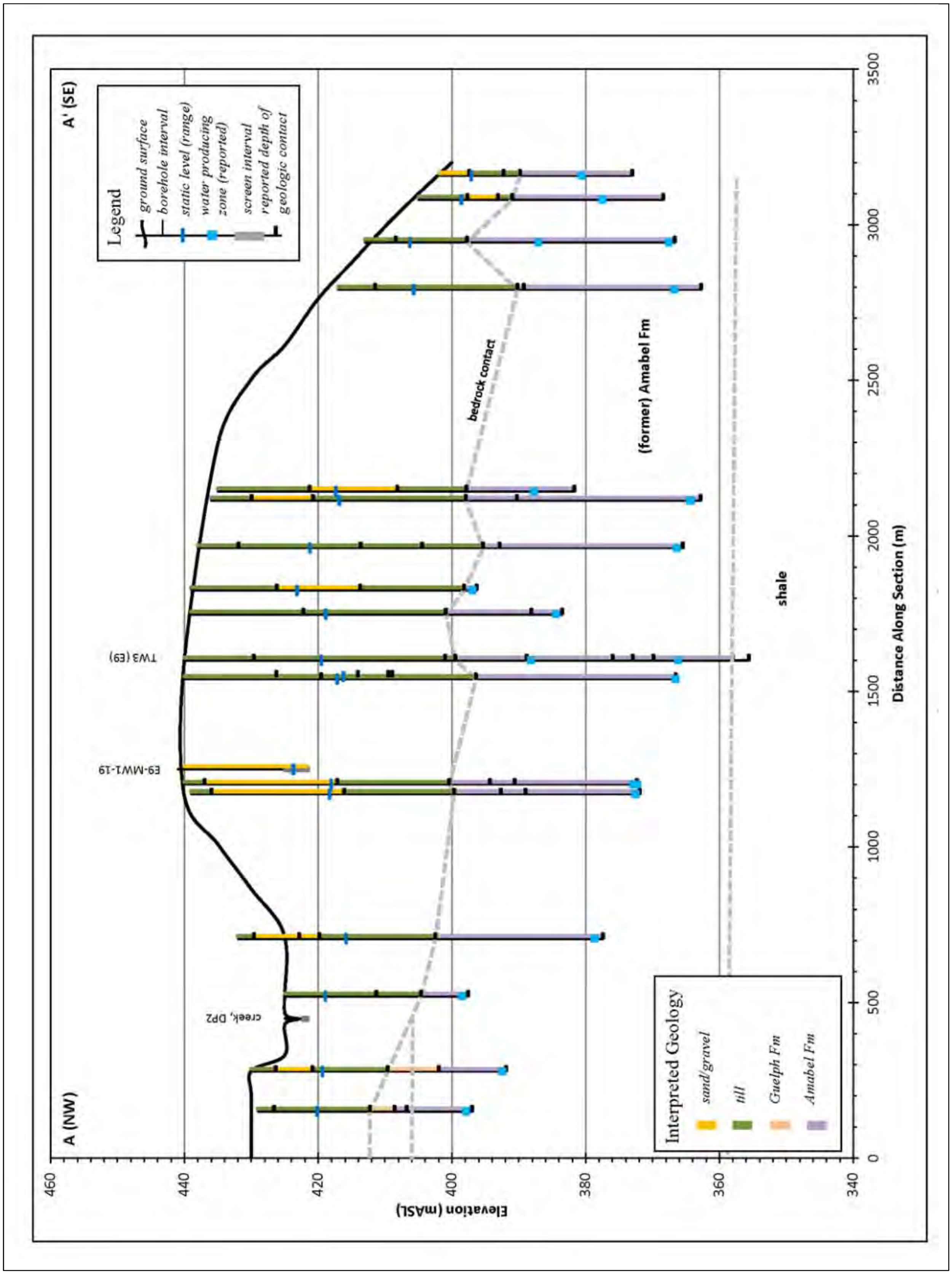


Figure 14: Section A

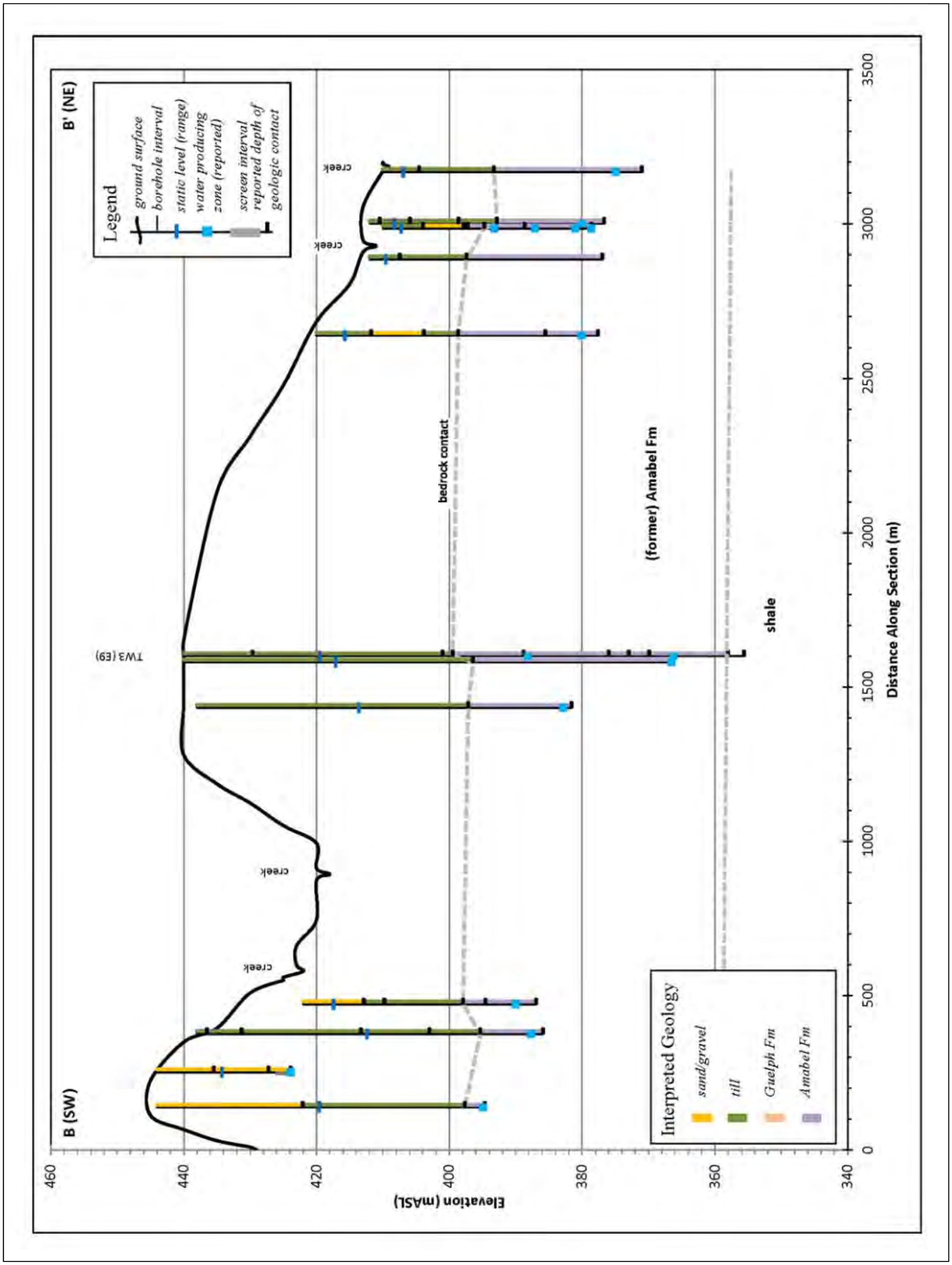


Figure 15: Section B

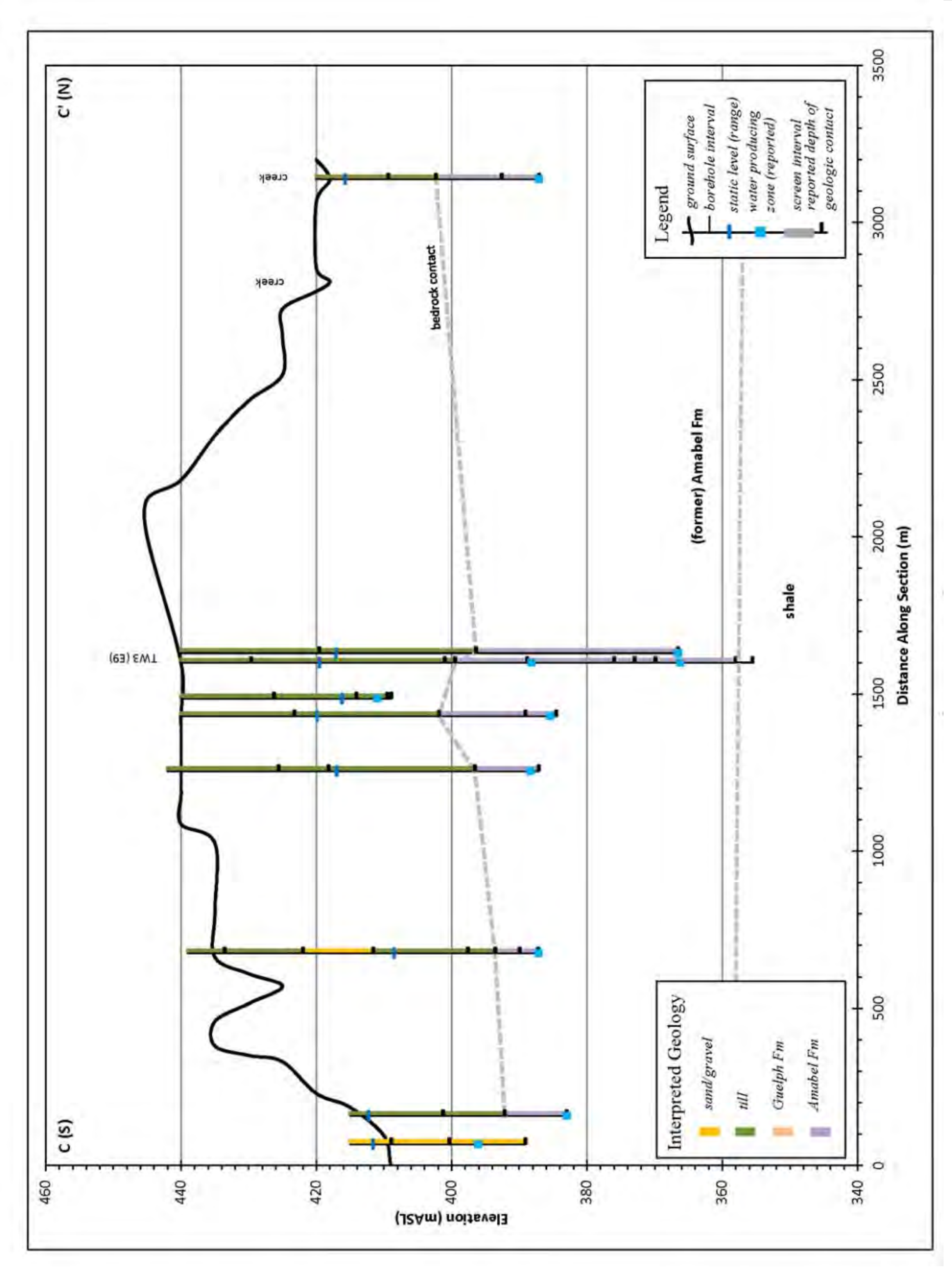


Figure 16: Section C

The geologic conditions shown are based primarily on the water well record information. For simplicity the material descriptions were classified into 5 categories, as follows:

- sand/gravel (aquifer) layers as described on the well record;
- till layers (any material description that included clay/silt, or if listed as hardpan);
- Guelph Formation (light or brown coloured bedrock/dolostone);
- Amabel Formation (grey or darker coloured bedrock/dolostone); and,
- shale.

The sections illustrate the local topography, overburden thickness, overburden geology, bedrock aquifer thickness, and primary water bearing zones within the bedrock system. As shown, E9 intercepts the full bedrock aquifer and accesses deep high capacity water bearing horizons. A number of private wells extend to similar elevations and also intercept the deeper zone.

Sand and gravel layers are reported at surface and at depth within the overburden in some locations. However, based on the reported information the till unit is relatively consistent and laterally extensive in this area. The till forms a confining layer for the bedrock aquifer, however as indicated by the pumping test results, some recharge is expected from the till units to the bedrock. Due to the nature of the system the recharge can be expected to be distributed over a wide area.

5.2 DISTANCE VS DRAWDOWN

Figure 17 shows a distance-drawdown plot showing the extent of pumping test response (after 5 days of continuous pumping).

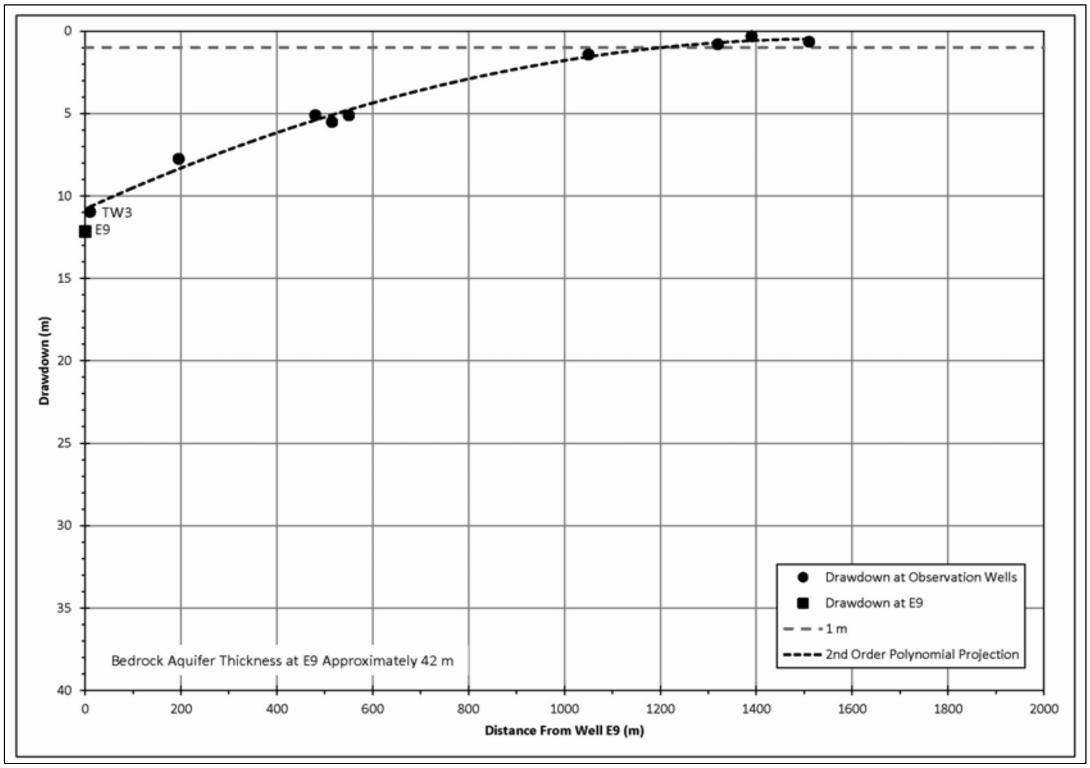


Figure 17: Distance-Drawdown

As shown, pumping effects beyond approximately 1.2 km from well E9 were limited to less than 1 m, and less than 5 m beyond 500 m distance.

5.3 WATER TABLE RESPONSE

No significant water table response was observed due to pumping well E9. This is likely due to the fine grained nature of the till units over bedrock and the total overburden thickness in the area. While overburden thickness may be reduced along the creek systems, based on the distance-drawdown plot, significant drawdowns are not expected at most creek and wetland systems in the area. The closest creek and wetland system (west of E9) was not accessible for monitoring. However, water table monitoring data is available at E9-MW1-19, which is positioned near this creek system in order to provide as much data as possible in this area. As noted previously, no pumping influence was observed was observed at E9-MW1-19 or nested location DP2.

The pumping test as completed stressed the system for an extended period of time (5 days continuous pumping). Routine average daily pumping for normal municipal demands is typically much less (e.g. 4 hours/day and 7 hours/day at well E7 and E8 respectively), therefore short term impacts will be less than observed over the pumping test. The initial Water Supply EA target (maximum daily demand) for Erin includes emergency uses (such as fire flow needs) that would only occur as needed. Typical daily demands are lower, therefore daily pumping cycles are relatively short.

5.4 BEDROCK AQUIFER RESPONSE

Water levels at both the pumping well (E9) and other bedrock wells in the area stabilized relatively quickly during the pumping test. The pumping test response is typical of a leaky or semi-confined system, which indicates that recharge from the overburden moderates drawdown. However this recharge is distributed over a large area therefore local effects at surface are expected to be small.

Most of the water available to well E9 appears to be from deep bedrock zones, and as a result the pumping effect will be distributed within the regional flow system, again indicating that significant local impacts to shallow groundwater systems in the area would not be expected.

5.5 IMPACT TO PRIVATE WELLS

Pumping effects were observed at local water wells during the test. However, with the exception of one location, the water level changes that did occur during the test did not interfere with local water supplies. This indicates that local pump settings are deep enough that available drawdown (water column above the pump) is sufficient to accommodate both E9 pumping influences and individual drawdown due to pumping at each well. As shown by the hydrographs, local wells have high capacity and routine domestic pumping does not result in extensive drawdowns. The one water supply interruption that did occur was resolved by lowering the pump in that private well.

Significant drawdowns are not expected beyond about 1 km from well E9. Within this area, if water supply interruptions do occur due to E9 pumping, remedies are available such as lowering pumps and/or deepening wells.

Based on the test results, the overall capacity of the bedrock aquifer in this area can accommodate both domestic taking and the proposed municipal taking.

We propose continued monitoring at bedrock monitor TW3 in order to assess long-term effects on the bedrock system due to the proposed taking, and to provide information that may be needed to assist in responding to any future water well interference complaints that may occur.

5.6 IMPACT TO NATURAL ENVIRONMENT FEATURES

It is recognized that the pumping test occurred in December, which is not representative of typical “dry” annual conditions. Therefore groundwater recharge, and increased streamflow, in response to fall/winter precipitation and snowmelt events could “mask” potential drawdown effects within the shallow zone. Recharge event indicators, including water table and stream level rises, are observed at the drive point and E9-MW2-19 monitoring locations.

However, the monitoring program was designed to include a large number of drive-point piezometers (essentially all accessible stream locations within 1.5 km of well E9), with most locations consisting of multi-level (nested) monitors. In addition, two water table wells in areas of potential groundwater contribution to the stream and wetland system, and locations indicative of potential for impacts from pumping well E9 on those systems, were installed. On a broader basis, one dug well and a private pond was included to help assess potential for impacts within the extensive natural environment system along Wellington Road 22. Detailed monitoring was undertaken using dataloggers at all of these locations, and included extended pre and post-test monitoring.

No recognizable effect on local water table levels, or vertical gradients, were observed due to pumping well E9 continuously for 5 days. It is our interpretation that this represents an adequate assessment of potential for the type of short-term impact that would be expected due to the proposed municipal taking.

The drive-point and water table observation wells were left in place for future monitoring, if needed. In order to examine potential for longer term impacts, and to assess potential for impact during dry annual conditions, we propose a monitoring program as part of an eventual permit to take water for E9, to include some of the established locations. The monitoring program should include: E9-MW1-09; E9-MW2-19; DP2 nest; DP4 nest; and, DP6.

5.7 IMPACT TO MUNICIPAL WELLS

Water level trends for wells E7 and E8 during November/December 2019 and January 2020, as provided by the Town, are included in **Appendix P**. Printed SCADA data graphs were provided. The approximate pump test times are marked on the graphs. As indicated by the summaries, both wells E7 and E8 were in regular usage over the pumping test period. No mutual interference was observed.

No impact to water levels at the existing wells occured over the E9 pumping test period. Pumping levels, recovery/static levels between pumping periods and daily patterns of water level change reported at E7 and E9 over the E9 test period are consistent with routine levels and patterns reported both pre and post-test. Similarly, no effect of pumping E7 and E8 is observed at E9 prior to, during, or after the pumping test.

5.8 GUDI CONSIDERATIONS

Based on the well drilling and testing program, well E9 is not interpreted to be a GUDI (Groundwater Under the Direct Influence of surface water) water source. Well E9 is a bedrock well capable of supplying water at a rate greater than 0.58 L/s and although it is located within 500 m of a wetland and creek, the following is noted:

- Well E9 is a drilled well with a watertight stainless steel casing that extends greater than 6 m below ground surface;
- Well E9 obtains water from a confined bedrock aquifer that is overlain by till, which forms a protective layer and isolates the bedrock aquifer from surface water systems;
- Long-term testing at high pumping rates indicated no vertical hydraulic connection to, and water level response within, the shallow overburden or surface water systems in the vicinity of the well;
- There are no nearby enhanced recharge or infiltration facilities;
- Water quality testing during the pumping test does not exhibit evidence of contamination by surface water.

It is noted that extensive microbiological related analysis was completed, including: Cryptosporidium; E. Coli; Giardia; Nonviable Cryptosporidium; Nonviable Giardia; Total Coliforms; Viable Cysts; Viable oocysts; Microcystin; and, Nitrilotriacetic Acid (NTA), all of which returned “non-detect” results.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Based on the Town of Erin Water Supply Class EA Well E9 drilling and testing program, the following conclusions are made:

1. The additional firm capacity provided by well E9 will meet the current Urban Centre Water Supply Class EA minimum initial water supply target (maximum daily demand) for the Village of Erin of 2,457 m^3/d (28.4 L/s over 24 hours), which corresponds to the population growth forecast to year 2031, as outlined in the Final Growth Management Strategy Report (Dillon, October 2019) for the Town.
2. A well yield of 32 L/s is achievable from well E9.
3. Based on information available at this time, routine daily use of well E9 is not expected to interrupt local water supplies in the future. If impacts do occur after E9 is in service, water supply at private wells can be reestablished through routine established methods such as lowering pumps and/or deepening wells.
4. The operation of well E9 is expected to have minimal mutual interference with existing well E7 and well E8.
5. Water quality obtained from well E9 is good, and after routine use and treatment is expected to meet applicable drinking water standards. There is no evidence of anthropogenic contamination at well E9.
6. The bedrock aquifer at well E9 is well protected by the overlying till unit, which provides hydraulic isolation from shallow overburden and surface water systems.
7. Based on the pumping test response and water quality analysis results well E9 is interpreted to be not a GUDI well, primarily due to the protection the overlying aquitard provides and depth of primary water bearing zones.

6.1 RECOMMENDATIONS

Based on the results of this study, the following recommendations are made:

1. Well E9 be incorporated into the Erin Village Municipal Water Supply System once applicable permits are obtained.
2. A Permit To Take Water should be obtained for a maximum rate of 32 L/s and daily maximum taking volume of 2,765 m3/day at well E9. As part of that process, a pre-consultation with MECP and CVC may be required.
3. A water level monitoring and reporting program should be implemented as part of the Permit To Take Water conditions that includes the following locations:
    - TW3
    - E9-MW1-19 and E9-MW2-19
    - DP2 nest, DP4 nest and DP6

Sincerely,

Andrew Pentney, P.Geo.
Senior Hydrogeologist
Groundwater Science Corp.

Appendix A
TW3 Drilling and Testing Results

Ontario Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*

Tag#:A235588

Well Record

Regulation 903 Ontario Water Resources Act

Page 3 of 3

Well Owner's Information

First Name: TOWN OF ERIN
Last Name / Organization:
E-mail Address:
☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name): 5684 TRAFALGAR RD NORTH
Municipality: HILLSBURGH
Province: ONT
Postal Code: N0B1Z0
Telephone No. *(inc. area code)*:

Well Location

Address of Well Location (Street Number/Name):
Township: ERIN
Lot: 19
Concession: 10
County/District/Municipality: WELLINGTON
City/Town/Village:
Province: Ontario
Postal Code:
UTM Coordinates Zone: NAD 8 3 17 Easting: 572744 Northing: 4849032
Municipal Plan and Sublot Number:
Other:

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
BROWN	SILTY SAND CLAY	ODD STONE		0	34ft
GRAY	SILTY GRAVEL CLAY	STONES		34ft	128ft
GRAY	CLAY & STONES			128ft	133ft
BROWN	LIMESTONE			133ft	168ft
GRAY	LIMESTONE LITE GRAY			168ft	210ft
GRAY	LIMESTONE			210ft	220ft
BROWN	LIMESTONE			220ft	230ft
GRAY	LIMESTONE			230ft	269ft
GRAY	RED SHALE			269ft	277ft

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	137ft	BENTONITE SLURRY	160gal

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify
If pumping discontinued, give reason: to be pumped later
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	74ft		
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
6¼	steel	.188	0	137ft
6in	open hole		137ft	277ft

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 170ft [illegible] 190ft (m/ft) ☐ Gas — Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify
Water found at Depth 242ft (m/ft) ☐ Gas — Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify
Water found at Depth (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	137ft	8.75in
137ft	277ft	6in

Map of Well Location

Please provide a map below following instructions on the back.

Comments:

Erin North TW3

Well Contractor and Well Technician Information

Business Name of Well Contractor: KEITH LANG WELL DRILLING INC
Well Contractor's Licence No.: 7154
Business Address (Street Number/Name): 251 ELDON ST GODERICH
Municipality:
Province: ONT
Postal Code: N7A3R9
Business E-mail Address:
Bus. Telephone No. *(inc. area code)*: 519-524-8159
Name of Well Technician (Last Name, First Name): KEITH LANG
Well Technician's Licence No.: T446
Signature of Technician and/or Contractor: K. Lang
Date Submitted: 2018 12 30

Well owner's information package delivered: ☐ Yes ☒ No
Date Package Delivered: Y Y Y Y M M D D
Date Work Completed: 2018 12 12

Ministry Use Only
Audit No. Z287088
Received

0506E (2014/11)

Well Owner's Copy

Lotowater
TECHNICAL SERVICES INC.

P.O. Box 451
Paris, ON N3L 3T5

92 Scott Avenue
Paris, ON N3L 3R1
T (519) 442-1749
T (800) 923-6923
F (519) 442 7242
www.lotowater.com

February 8, 2019

Reference: 148-003

Andrew Pentney, P. Geo.
Groundwater Science Corp.
Unit 2, 465 Kingscourt Drive
Waterloo, ON
N2K 3R5

Subject: Erin – Hillsburgh Well Testing and Video

This memo documents testing of four test wells drilled in bedrock in the Erin – Hillsburgh area in Ontario. The four wells tested included the following wells; Solmar (TW1), Solmar (TW2), Erin North (TW3) and Currie (TW4). Testing included video surveys, flow profiles and step test. In addition, groundwater sampling was performed by Groundwater Science Corp. (GSC). Field work was performed over several weeks from January 15 – 28, 2019. The purpose of this testing was to quantify basic well hydraulics and areas flow production from the bedrock.

Testing Procedure

The same general testing procedure was followed at each of the four wells. First, a video was performed using a dual view well video camera. A down scan image was captured first as the camera was run to the bottom of the well and a side scan image was performed on the way up stopping at important features. Video summaries were prepared in **Tables 1A-4A** and copies of the videos have been sent to GSC in DVD.

A step test was performed on each well using a submersible pump. A pump and 5hp motor was selected which could run on a single phase portable generator. This limited production to approximately 10 L/s. Note that Currie Well TW3 had a slightly deeper static water level which required a higher head lower flow pump and limited test flows to 6 L/s. In every case, the pumps were set within or near the base of the well casing. The well was pumped up to its full rate of 10 or 6 L/s for 30 minutes, then the flow reduced to the next 30 minute step. Two to three steps were performed at each well. Flow was measured using a turbine flow meter and levels measured using a manual level tape. Step test details are shown in **Tables 1B-4B** and graphically in **Figures 1A-4A**.

A flow profile was conducted during the step test to quantify the flow distribution in each well. Lotowater uses a spinner device manufactured by Swoffer with custom modifications for application in boreholes and wells. The tool has a small impeller that is oriented vertically.

Vertical flow in the well activates the impeller which transmits a signal to a digital readout at the surface for every ½ revolution of the impeller. The velocity of fluid is directly proportional to the rotational speed of the spinner tool. The spinner tool is regularly calibrated such that its readout is reported as a velocity in metres/second.

Flow profiling was conducted under non-pumping conditions first, to indicate natural water movement in the borehole, as well as under artificially induced pumping conditions. The spinner flow tool has a minimum threshold velocity of 0.03 m/s required to overcome internal friction and activate the tool. In most cases, there is not a strong enough vertical flow in the well to activate the flow tool, so a small submersible pump is installed to induce flow. Note that no ambient (non-pumping) flows were measured in any of the four wells tested.

Each well was flow profiled under the maximum flow obtained from the step test. In all cases, the pump was set entirely within the well casing. The flow tool is then run from the bottom of the well over the entire borehole, into the casing to the bottom of the pump. Flow measurements are recorded at a specified depth interval or whenever a change in flow is indicated. Flow profiles are shown graphically in **Figures 1B-4B**.

A brief summary of some of the important findings for each well are as follows:

Erin North TW3

- The casing and borehole were generally clear without any significant buildup besides some sediment on ledges of major features.

- The total depth measured was 83.5 m which was slightly less than the 84.4 m depth reported on the well record.

- This well was pumped at a lower flow rate than the other three wells, as a higher head pump was required due to deeper static levels. The well was pumped at 6 L/s with approximately 2.0 m drawdown yielding a specific capacity of about 3.02 L/s/m.

- The flow profile was performed at 6 L/s and shows approximately 70% of the flow under pumping conditions to be entering the well at the 74.0 m flow feature. Another 15% of the flow is entering the well at a 66.9 m flow feature. At the very bottom of the well, there is a shale layer that is contributing some flow estimated at 10%. The remaining 5% of the wells flow is estimated to be coming from a zone around 57.5 m.

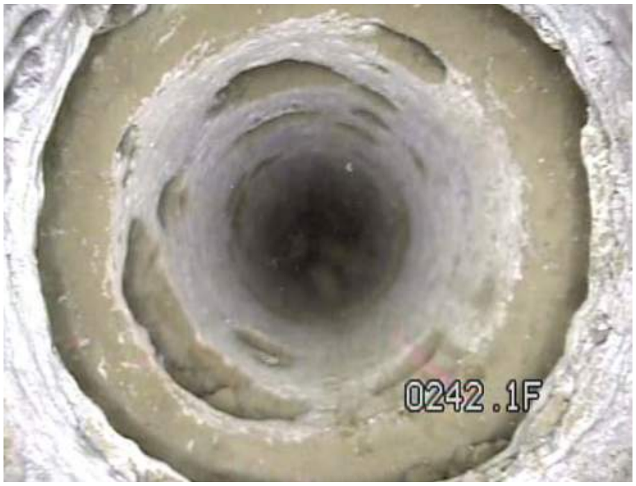
 **Photo 5:** Looking down into a major (70%) flow feature in the well at 74.0 m	 **Photo 6:** Looking down at the minor (15%) flow feature at 66.9 m

TABLE 3A

TOWNSHIP OF ERIN

North Well TW3
Static Video Summary
2019/01/22

Elapsed Time (h:min)	Depth (ft below MP)	Depth (m below MP)	Comments
0:00	2.8'	0.9	Below top of casing
0:01	16.5'	5.0	Casing joint
0:04	36.4'	11.1	Casing joint
0:07	56.3'	17.2	Casing joint
0:09	39.2'	11.9	Static water level
0:10	72.4'	22.1	Pause to clean camera
0:10	76.2'	23.2	Casing joint
0:13	96.1'	29.3	Casing joint
0:15	116.1'	35.4	Casing joint
0:18	136.1'	41.5	Casing joint
0:18	137.3'	41.8	Bottom of casing
0:19	138.5'	42.2	Horizontal ring feature, PWPZ
0:19	139.7'	42.6	Horizontal ring feature, PWPZ
0:19	140.5'	42.8	Horizontal ring feature, PWPZ
0:20	143.2'	43.6	Horizontal ring feature
0:21	148.1'	45.1	Horizontal ring feature, PWPZ
0:22	153.1'	46.7	Horizontal ring feature
0:22	154.5'	47.1	Vugs, PWPZ
0:26	176.6'	53.8	Horizontal ring feature
0:27	188'	57.3	Horizontal ring feature, PWPZ
0:29	199.6'	60.8	Small horizontal ring feature
0:29	202.1'	61.6	Small horizontal ring feature
0:32	219'	66.8	Horizontal ring feature, PWPZ
0:32	225.6'	68.8	Vugs
0:33	227'	69.2	Vugs
0:34	239.3'	72.9	Vugs
0:35	242.4'	73.9	Horizontal ring feature, Vugs, PWPZ
0:36	246'	75.0	Vugs
0:37	257.6'	78.5	Vugs
0:39	268.3'	81.8	Horizontal ring feature
0:39	269.8'	82.2	Horizontal ring feature
0:40	273.9'	83.5	Bottom of well, Rocks
0:42	268.7'	81.9	Horizontal ring feature
0:48	244.2'	74.4	Vugs, Sediment
0:49	242.9'	74.0	Horizontal ring feature, Sediment, PWPZ
0:52	227.5'	69.3	Vugs, Sediment, PWPZ
0:54	219.6'	66.9	Horizontal ring feature, Sediment, Flow in
1:00	188.5'	57.5	Horizontal ring feature, Sediment
1:07	155.1'	47.3	Vugs, Sediment
1:07	154.5'	47.1	Vugs, Sediment
1:08	153.6'	46.8	Small horizontal ring feature

TABLE 3A

TOWNSHIP OF ERIN

North Well TW3
Static Video Summary
2019/01/22

Elapsed Time (h:min)	Depth (ft below MP)	Depth (m below MP)	Comments
1:10	148.6'	45.3	Horizontal ring feature, PWPZ
1:11	143.9'	43.9	Horizontal ring feature, PWPZ
1:13	141.2'	43.0	Horizontal ring feature, Sediment, PWPZ
1:14	140.2'	42.7	Horizontal ring feature, Sediment, PWPZ
1:15	137.9'	42.0	Bottom of casing
1:16	137.7'	42.0	Casing joint
1:16	136.8'	41.7	Casing joint
1:20	116.8'	35.6	Threaded casing joint
1:23	97.1'	29.6	Casing joint
1:26	77.1'	23.5	Casing joint
1:28	69.9'	21.3	Static water level
1:29	57.2'	17.4	Threaded casing joint
1:32	37.3'	11.4	Threaded casing joint
1:35	17.5'	5.3	Threaded casing joint
1:39	3.5'	1.1	Below top of casing

Video survey conducted by Rodney Secor

Notes: Measuring point (MP) is top of casing which is 0.77 m above ground surface
PWPZ = Possible water producing zone

TABLE 3B

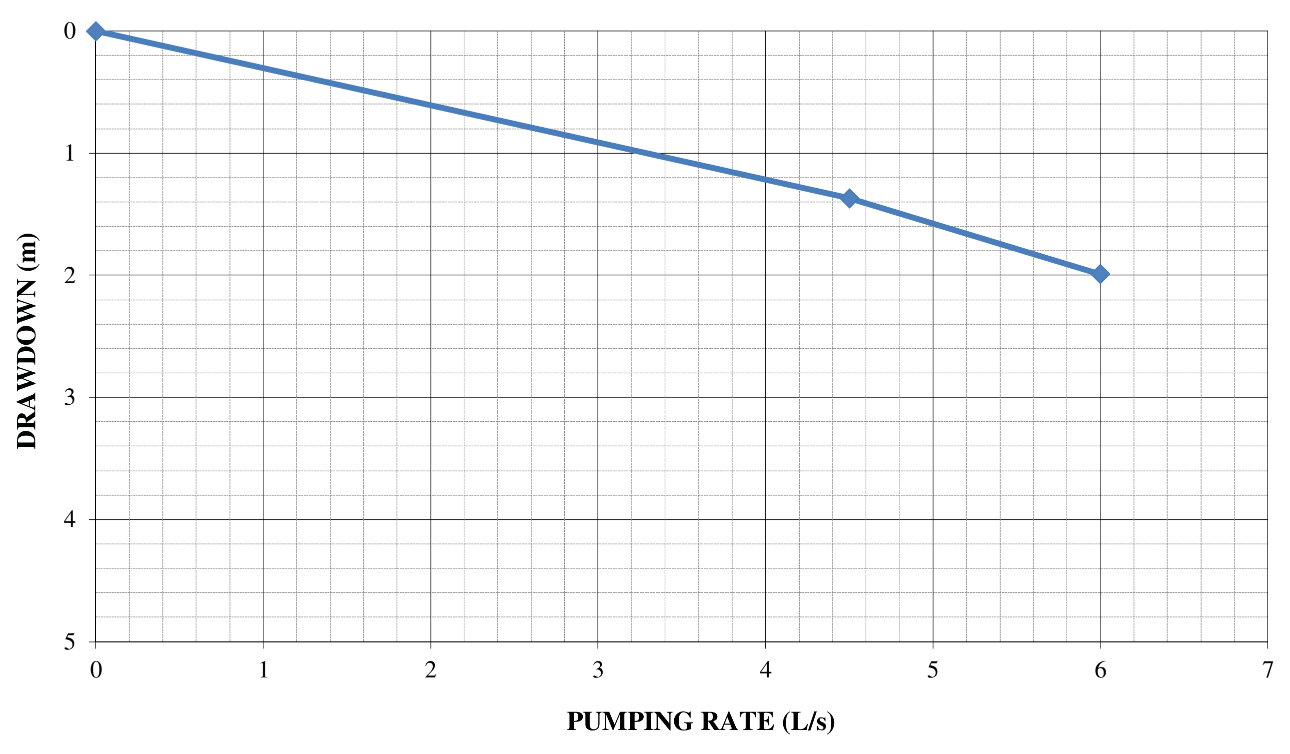
VARIABLE RATE PERFORMANCE TEST

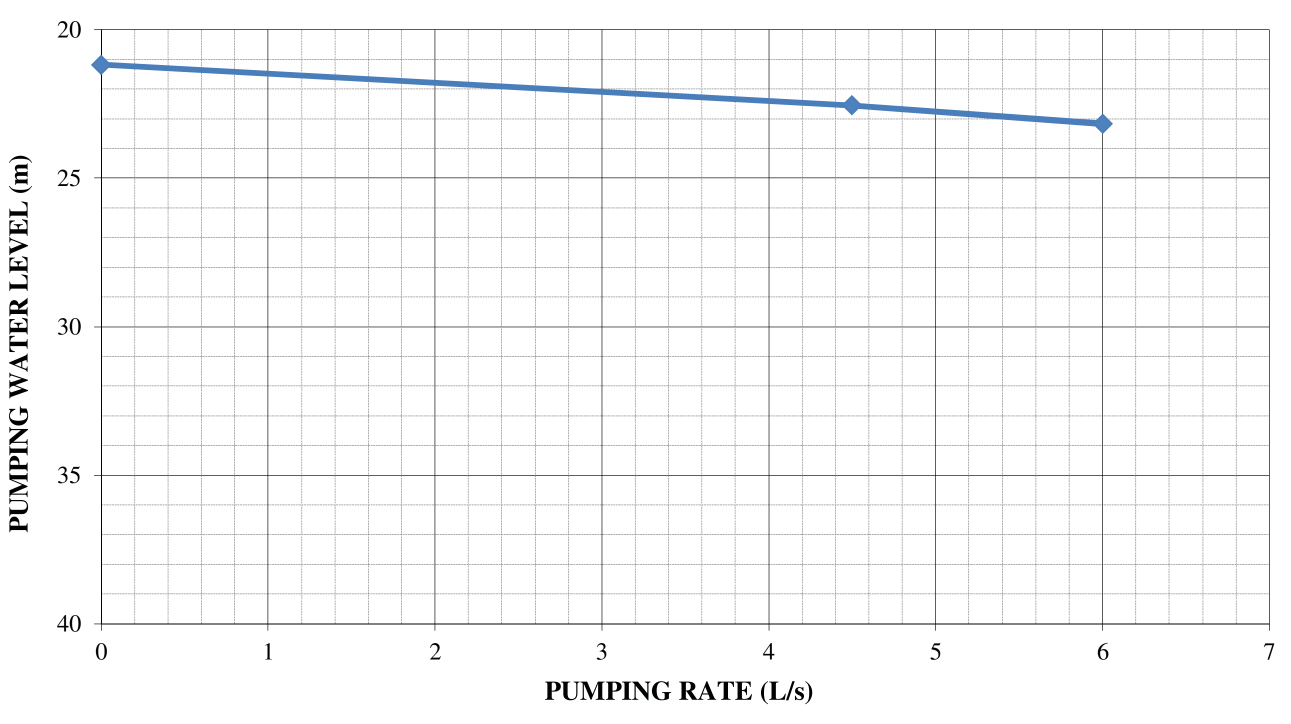
LOTOWATER TECHNICAL SERVICES INC.

Well Name: North Well TW3
Client: Town of Erin (GSC)
Technician Name: Craig Lawson
Water Level Device: LTS water level meter
Water Level Reference: Top of casing (0.7 m agl)
Test Note: TD = 83.5 mbtc, Base of 150 mm diameter casing 42.0 mbtc

Project Number: 148-003
Date: January 28, 2019
Pump: Goulds 80GS50 (5hp)
Pump Inlet: 40 m
Flow Measuring Device: 2" Banjo

Time *hr:min*	Elapsed Time *min*	Level *mbtc*	Drawdown *m*	Flow *L/s*	Note
0:00	0	21.18	0.00	6.0	Start Step 1
0:01	1	21.51	0.33	6.0	
0:02	2	21.78	0.60	6.0	0 psi
0:03	3	21.98	0.80	6.0	
0:04	4	22.04	0.86	6.0	
0:05	5	22.10	0.92	6.0	
0:06	6	22.16	0.98	6.0	
0:08	8	22.26	1.08	6.0	
0:10	10	22.35	1.17	6.0	
0:12	12	22.42	1.24	6.0	
0:15	15	22.50	1.32	6.0	
0:20	20	22.62	1.44	6.0	
0:25	25	22.71	1.53	6.0	
0:30	30	22.81	1.63	6.0	
0:40	40	22.96	1.78	6.0	
0:50	50	23.05	1.87	6.0	
1:00	60	23.17	1.99	6.0	
1:01	1	22.87	1.69	4.5	Start Step 2
1:02	2	22.82	1.64	4.5	
1:03	3	22.76	1.58	4.5	
1:04	4	22.71	1.53	4.5	50 psi
1:05	5	22.68	1.50	4.5	
1:06	6	22.67	1.49	4.5	
1:08	8	22.65	1.47	4.5	
1:10	10	22.64	1.46	4.5	
1:12	12	22.62	1.44	4.5	
1:15	15	22.61	1.43	4.5	
1:20	20	22.57	1.39	4.5	
1:25	25	22.58	1.40	4.5	
1:30	30	22.56	1.38	4.5	
1:40	40	22.56	1.38	4.5	
1:50	50	22.55	1.37	4.5	
2:00	60	22.55	1.37	4.5	





Notes:

Test Date = January 28, 2019

All water levels are referenced from top of well casing

Top of casing = 0.77 m above ground surface

Base of well casing = 42.0 m

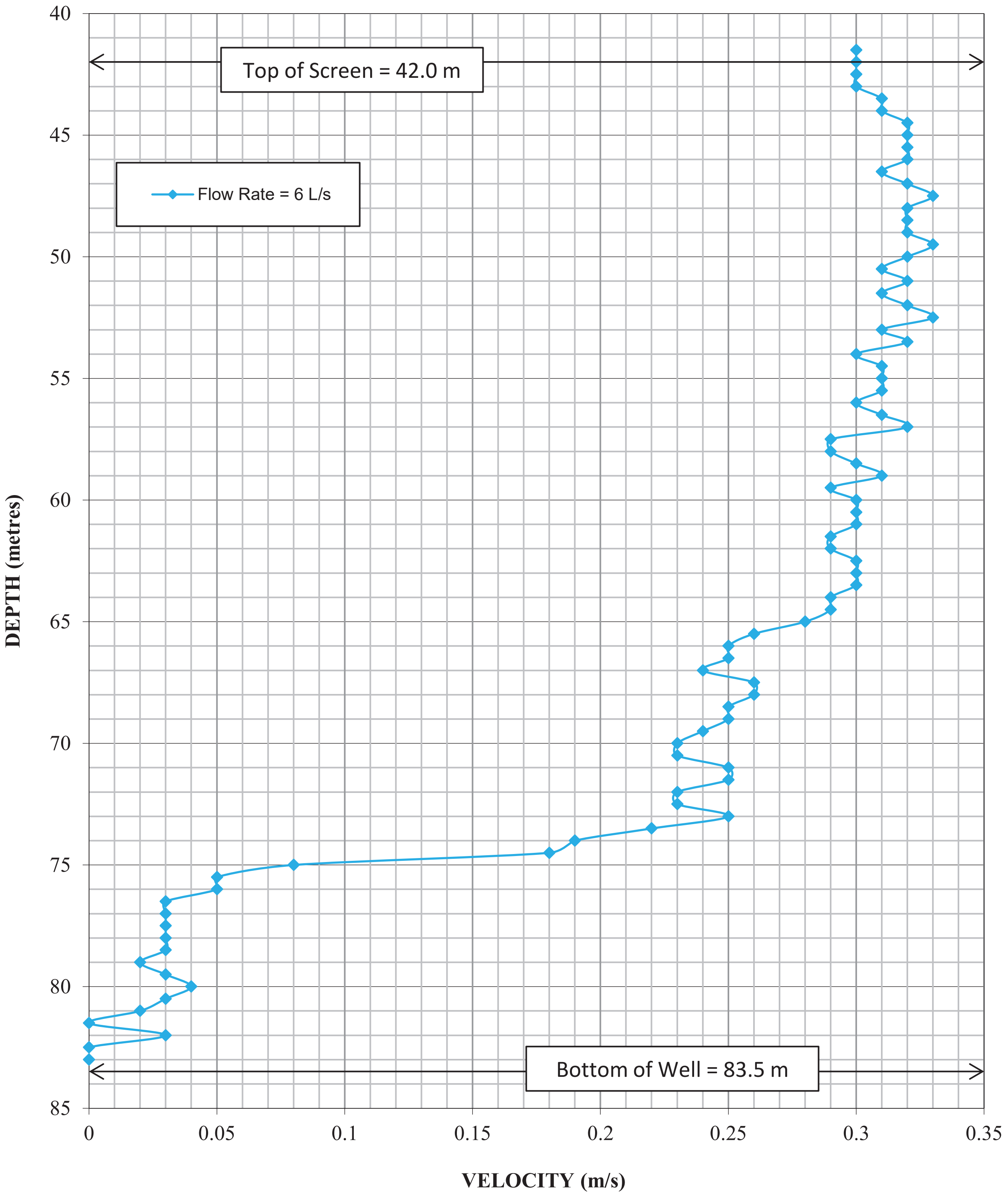
Township of Erin

North Well TW3

Comparison of Variable Rate Tests

Lotowater Technical Services Inc. **Figure 3A**

Reference: 148-003 2019-01-29



Notes:

Test Date = January 28, 2019

All water levels are referenced from top of well casing

Top of casing = 0.77 m above ground surface

Township of Erin

North Well TW3

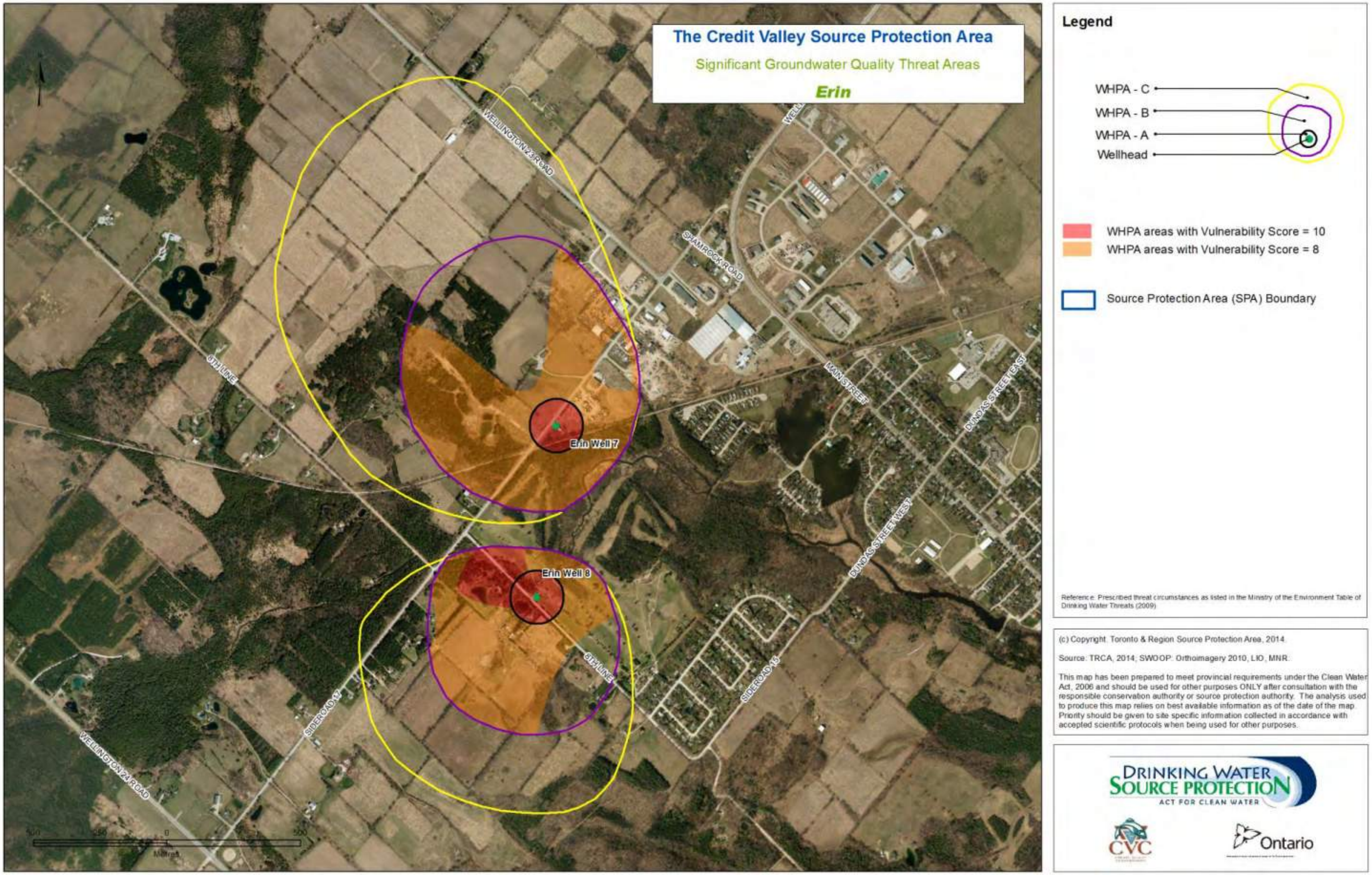
Flow Profile

Lotowater Technical Services Inc. **Figure 3B**

Reference: 148-003 2019-01-29

Appendix B

Source Protection Mapping



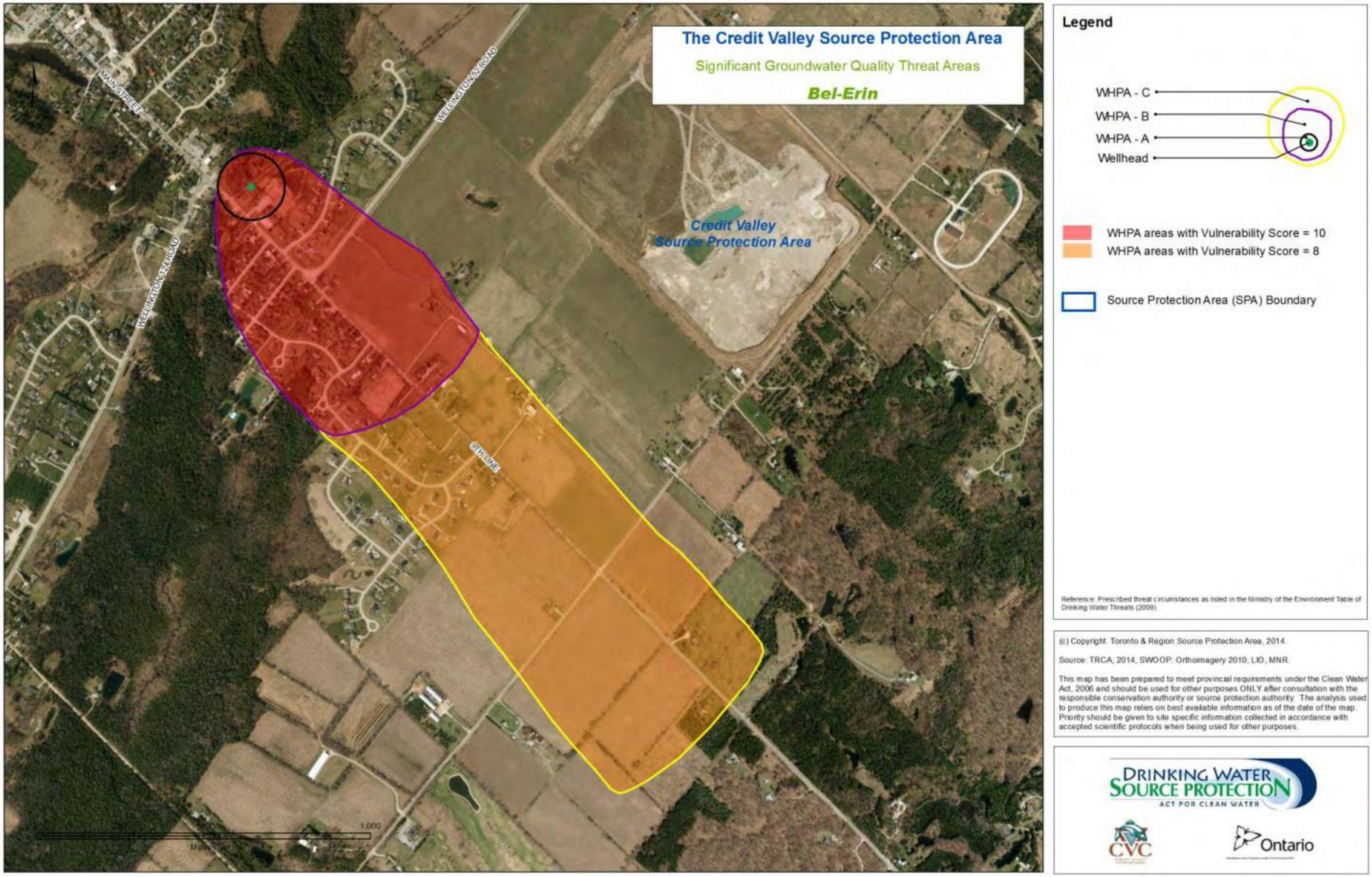
Reference: Prescribed threat circumstances as listed in the Ministry of the Environment Table of Drinking Water Threats (2009)

(c) Copyright: Toronto & Region Source Protection Area, 2014.

Source: TRCA, 2014; SWOOP: Orthoimagery 2010, LIO, MNR.

This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.

Map 1.5: Erin – Significant Groundwater Quality Threat Areas



Reference: Prescribed threat circumstances as listed in the Ministry of the Environment Table of Drinking Water Threats (2009)

Source: TRCA, 2014; SWOOP: Orthoimagery 2010, LIO, MNR.

This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.

Map 1.6: Bel-Erin – Significant Groundwater Quality Threat Areas

Appendix C

Well E9 Drilling Results

19-0147-01

Ontario Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
Tag#:A273293

Well Record
Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name:
Last Name / Organization: Corporation of the Town of Erin
E-mail Address:
☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name): 5684 Trafalgar Rd
Municipality: Hillsburgh
Province: ON
Postal Code: N0B1Z0
Telephone No. *(inc. area code)*: 5198554407

Well Location

Address of Well Location (Street Number/Name): 5657 Wellington Rd 23
Township: Erin
Lot: 20
Concession: 10
County/District/Municipality: Wellington
City/Town/Village: Erin
Province: **Ontario**
Postal Code:
UTM Coordinates: NAD 83 Zone 17 Easting 572770 Northing 4849030
Municipal Plan and Sublot Number:
Other:

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
	Sand, Gravel, Cobbles			0	121
	Clay, Gravel, Sand			121	131
	Rock		Broken	131	133
	Limestone		Bedrock	133	279

Annular Space

Depth Set at (m/[✓ ft]) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *([✓ m³]/ft³)*
0	146	Bentonite/Cement	3

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
10	steel (Stanles)	-.375	+2	146
	open		146	279

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To
	OPEN HOLE			

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*

Water Details

Water found at Depth 50 (m/[✓ ft]) ☐ Gas | Kind of Water: ☐ Fresh ☒ Untested ☐ Other, *specify*
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Hole Diameter

Depth (m/[✓ ft]) From	To	Diameter (cm/[✓ in])
0	4	20
4	146	16
146	279	10

Well Contractor and Well Technician Information

7675

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: N1H1E9
Business E-mail Address: **www.aardvarkdrillinginc.com**
Bus.Telephone No. *(inc. area code)*: 5198269340
Name of Well Technician (Last Name, First Name): AWT- Kielburger, N; WT- Richards, A
Well Technician's Licence No.: 2554
Signature of Technician and/or Contractor:
Date Submitted: 20200117

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

See attached Log

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level			
		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 E9

Well owner's information package delivered ☐ Yes ☐ No
Date Package Delivered: Y Y Y Y M M D D
Date Work Completed: 20191223

Ministry Use Only
Audit No. Z323875
Received


19-0147-01
Legend
5687 Wellington Rd 23,
Erin
Tag#:A273293
SideRoad 17
1.4km
Google Earth
Image © 2019 Maxar Technologies
N
300 ft

Appendix D
Temporary PTTW

Ontario

Ministry of the Environment, Conservation and Parks
Ministère de l'Environnement, de la Protection de la nature et des Parcs

PERMIT TO TAKE WATER

Pumping Test

NUMBER 0850-BGDL7V

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

The Corporation of the Town of Erin
5684 Trafalgar Rd
Hillsburgh, Ontario
N0B 1Z0

For the water taking from: One drilled well

Located at: 9614 Wellington Road 23
Erin, County of Wellington

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

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.

(b) “Provincial Officer” means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment, Conservation and Parks.

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

(e) "Permit" means this Permit to Take Water No. 0850-BGDL7V including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.

(f) "Permit Holder" means The Corporation of the Town of Erin.

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

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

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated August 9, 2019 and signed by Nathan Hyde, 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.

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 **March 31, 2020**. 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:	Zone/ Easting/ Northing:
1	E9	Well Drilled	Pumping Test	Miscellaneous	2,046	24	2,945,808	6	17 572774 4849028
						Total Taking:	2,945,808		

3.3 Water taking under the authorization of this Permit shall only occur for one six (6) consecutive day period between the date of issuance and March 31, 2020.

3.4 Prior to taking of water under this Permit, the Permit Holder shall ensure that any and all applicable permits or authorizations are obtained from Federal and Provincial Agencies having legislative mandates in water resources management.

4. Monitoring

4.1 Notification to Well Owners
Prior to commencement of the pumping test, the Permit Holder shall identify all wells within the area of the anticipated potential cone of influence, or within 1000 metres of the test site, whichever is greater. At least 24 hours prior to beginning the pumping test, the Permit Holder shall provide written notification to the owners of the wells identified within the potential cone of influence. The notification shall include the expected date, time and duration of the pumping test, and a contact telephone number that may be used to report any interferences with water supplies.

4.2 Measuring Water Depths
To establish baseline conditions, well depths and depths to water levels for identified representative wells in the area of the water taking shall be recorded by the Permit Holder. During the pumping test, water levels in the identified wells shall be recorded. The pumping test must be of sufficient duration to accurately predict the long term impacts of the proposed water taking. Water levels in the identified wells shall continue to be monitored beyond the water taking period until at least 85% recovery is achieved.

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

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 Restoration of Water Supply

Where 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 doing so.

6. Director May Amend Permit

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

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

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.

2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

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

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

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

This notice must be served upon:

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

AND

The Director, Section 34.1,
Ministry of the Environment, Conservation and Parks
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	by Fax at	by e-mail at
(416) 212-6349	(416) 326-5370	www.ert.gov.on.ca
Toll Free 1(866) 448-2248	Toll Free 1(844) 213-3474	

Dated at Hamilton this 30th day of September, 2019.

B. Koblik

Belinda Koblik
Director, Section 34.1
Ontario Water Resources Act , R.S.O. 1990

Appendix E

Stream Survey and CVC Consultation

Groundwater
Science Corp.

Unit 2, 465 Kingscourt Drive,
Waterloo, ON N2K 3R5
Phone: (519) 746-6916
groundwaterscience.ca

October 1, 2018

RE: Creek Inspection and Monitoring Access
Town of Erin Water Supply Environmental Assessment.

Dear Landowner and/or Resident:

Groundwater Science Corp is working for the Town of Erin to assist in developing new municipal water supply wells for Hillsburgh and Erin. This work is part of the Town of Erin Water Supply Environmental Assessment project.

As part of the project, Groundwater Science Corp is arranging inspection and monitoring access to water courses and wetlands in areas surrounding planned test well drilling sites. The inspection and monitoring will help to ensure that natural environment features are protected in the future. A water course or wetland area of interest occurs on your property.

The visual inspections would be completed in conjunction with Credit Valley Conservation (CVC) during the months of October or November 2018, and would determine the need for ongoing monitoring. Monitoring, if needed, would occur through the remainder of 2018 and 2019.

We are going door to door this week to request access to complete inspections, with CVC personnel, of the water courses and/or wetlands on your property in October or November 2018. If ongoing monitoring is needed we would discuss additional access after the inspections are completed.

Please fill out the attached permission form and return either by email/text (scan or photo) to Andrew Pentney using the contact information below, or, by using the included postage paid envelope.

If you have any questions related to this access request, please contact myself by phone or email as follows:

Andrew Pentney P.Geo., Hydrogeologist, Groundwater Science Corp.
Office Phone: 519-746-6916 Mobile Phone: 519-580-7325
Email: apentney@rogers.com

For further information you can also contact the Town of Erin as follows:

Jessica Spina, Communications and Special Projects Officer, Town of Erin
Phone: 519-855-4407 extension 239
Email: jessica.spina@erin.ca

Sincerely,

Andrew Pentney

Andrew Pentney, P.Geo.
Hydrogeologist

APPROVAL FOR ACCESS TO PRIVATE PROPERTY
TOWN OF ERIN WATER SUPPLY CLASS EA

Property Owner's Name: ______________________________

Address: ______________________________

____

Telephone Number: ______________________________

Email: ______________________________

☐ I <u>do not</u> grant permission for consultants with the Town of Erin to access my property to conduct the necessary studies for the above project

☐ I hereby grant permission for consultants with the Town of Erin to access my property to conduct the necessary studies for the above project.

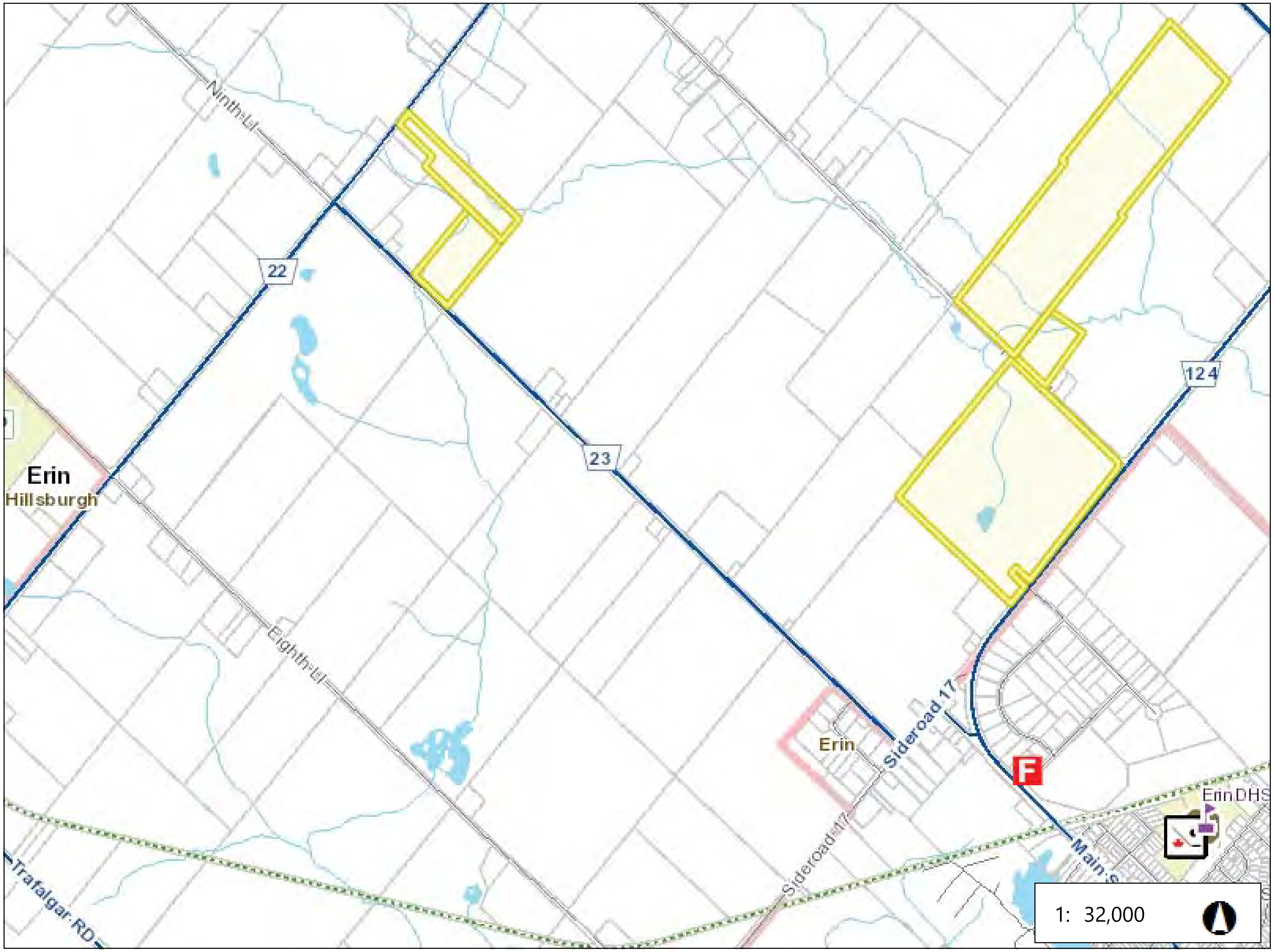
Signature: ______________________________

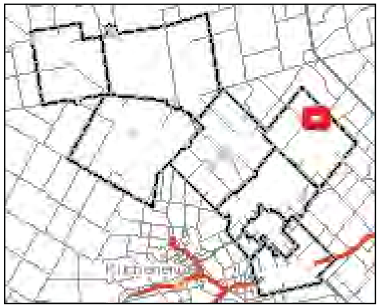
Name *(please print):* ______________________________

Date: ______________________________

Explore Wellington

Map of Wellington County





Legend

- Municipal Offices
- OPP Stations
- Hospitals
- Fire Stations
- Information Centres
- Schools
- Post Offices
- Arenas
- Communuty Centres
- Curling Rinks
- Libraries
- Museums
- Park Parking Lots
- County Garages
- ☐ Parcels
- Roads
  - Local Road
  - County Road
  - Highway
- Railways
- Trails
- 🟦 Waterbodies
- Watercourses
- 🟩 Parks
- 🟥 Urban Centres and Hamlets
- Municipalities

1.6 0 0.81 1.6 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

THIS IS NOT SURVEY DATA. Parcels - Teranet 2002, Wellington County 2018

Notes

Erin Water Supply EA - Well E9 Testing
Steam Inspection and Redd Survey
Access Permission Ownership Parcels

RE: Erin and Hillsburgh Municipal Well Testing

From: Slaght, Tyler (tyler.slaght@cvc.ca)

To: apentney@rogers.com

Cc: rkirtz@tritoneng.on.ca; nick.colucci@erin.ca

Date: Tuesday, October 1, 2019, 8:47 a.m. EDT

Hi Andrew,

CVC staff have provided feedback on the summary you've provided in red below. Please let me know if you have any questions.

Regards,

Tyler Slaght, RPP

Regulations Officer | Credit Valley Conservation

905-670-1615 ext 406 | C: 647-286-7427 | 1-800-668-5557

tyler.slaght@cvc.ca | cvc.ca

From: Andrew Pentney <apentney@rogers.com>
Sent: Tuesday, September 24, 2019 4:42 PM
To: Slaght, Tyler <Tyler.Slaght@cvc.ca>
Cc: Marray, Liam <Liam.Marray@cvc.ca>; Mulchansingh, Kerry <Kerry.Mulchansingh@cvc.ca>; Ray Kirtz <rkirtz@tritoneng.on.ca>; Nick Colucci <nick.colucci@erin.ca>
Subject: Re: Erin and Hillsburgh Municipal Well Testing

Hi Tyler,

I am providing a point form summary of our meeting (CVC, GWS) last Wednesday regarding the municipal well testing program referenced above.

Can you please review, along with Liam and Kerry, and let me know if you have any edits or additions.

- CVC's primary commenting role will be for the EA assessment and potential future Category 3 Permit application, so we are looking to consult at this time to ensure the monitoring results and impact assessment are thorough. Areas of interest are impacts to PPS significant features (PSW wetlands (focus on organic communities), springs and fish habitat (focus on brook trout spawning areas), CVC staff note that if a decision is eventually taken to move ahead on using either / both wells for municipal supply, then a whole host of technical study requirements will kick in (WHPA delineations, vulnerability work, threats assessment etc.). These studies will have to be completed, introduced into the technical companion to the SPP (called the Assessment Report), checked by CVC, subjected to public consultation, reviewed and then approved by MECP, **BEFORE** Erin can turn on the tap. Please be aware of these requirements (introduced in summer 2018 with new Reg 287),

for both E9 and H4 pumping tests CVC would like to have the effect of simultaneous pumping at existing municipal wells assessed (e.g. cumulative taking impacts)

  - GWS to consult with Town to plan (if possible) existing well use during test, with the intent to have the nearest existing municipal wells both "on" and "off" over periods of the test

- for both E9 and H4 baseline data (pre and post test) should be used as possible to comment on the potential impact of existing taking

based on the potential timing of the tests (outside of the preferred June to August dry period window), it may be possible to increase the number of monitoring stations (above that proposed) to allow more complete assessment in light of the potential "masking" effects of recharge, higher water tables and higher streamflow. If undertaking pump test outside the preferred time, a trigger should be established to stop the pump test (e.g. reversal of gradient in stream piezometers). Thereby limiting impacts during the pump test.

-
  - GWS to review proposed monitoring locations

- nested piezometers are preferred (at select locations) to assess vertical gradients at creeks, and may help overcome any potential masking effects due to timing
  - GWS to select locations, we note that previous drive-point piezometer installations were very difficult in Hillsburgh, the proposed overburden monitor will assist with the gradient monitoring

- CVC notes that there are surface water features just beyond the identified 1 km radius for both E9 adn H4, and that certain areas appear under-represented, so the assessment should be completed in such a way to be able to comment on impacts on those features and in those areas
- Liam requested a map showing property access availability for the Redd surveys (and drive-point piezometer locations) to better understand how locations were chosen
  - GWS to provide maps

- with regard to E9 test monitoring the need to adequately monitor (as access is available) the shallow+deep groundwater system, and conditions at the creek, near the closest stream reaches was stressed - CVC may be able to facilitate access to some stream reaches, in areas where no creek access exists monitoring of the water table can also help assess potential impacts
  - placement of the two proposed shallow overburden monitoring locations consider the lack

of access
  - ○ GWS will request additional access on the property immediately west of E9 as part of the intended private water well survey

- with regard to H4 test monitoring suggested additional monitoring locations include the new creek alignment downstream of the reservoir (CVC may be able to facilitate access), the pond/wetland system on Road 22 between Trafalgar Road and 8 Line, and the potential wetland just north of the sports facility on 8 Line in addition, for H4 test the need for adequate number of shallow and deep private wells to the south and east was stressed, and monitoring of potential wells at the sports facility (if wells exist) was suggested - to ensure that the assessment can comment on potential impacts to major discharge areas along the west credit south of Hillsburgh Our records have not confirmed there are any springs or organic soils in this area, so this wetland may be less sensitive to changes in groundwater levels. Discharge location should be outside of and downgradient of the pump-testing radius.

I have attached maps showing access at the time of the Redd survey - John Clayton had ranked the sites in order of inspection "priority" or order.

Thanks for your assistance.

Andrew Pentney P.Geo.
Groundwater Science Corp.
Unit 2, 465 Kingscourt Drive
Waterloo, ON
N2K 3R5

office 519-746-6916
mobile 519-580-7325
groundwaterscience.ca

On Thursday, September 5, 2019, 3:36:16 p.m. EDT, Andrew Pentney <apentney@rogers.com> wrote:

Hi Tyler - that works for me, go ahead and book the room please.

I will plan to attend (in person).

thanks,

Appendix F
Monitoring Network

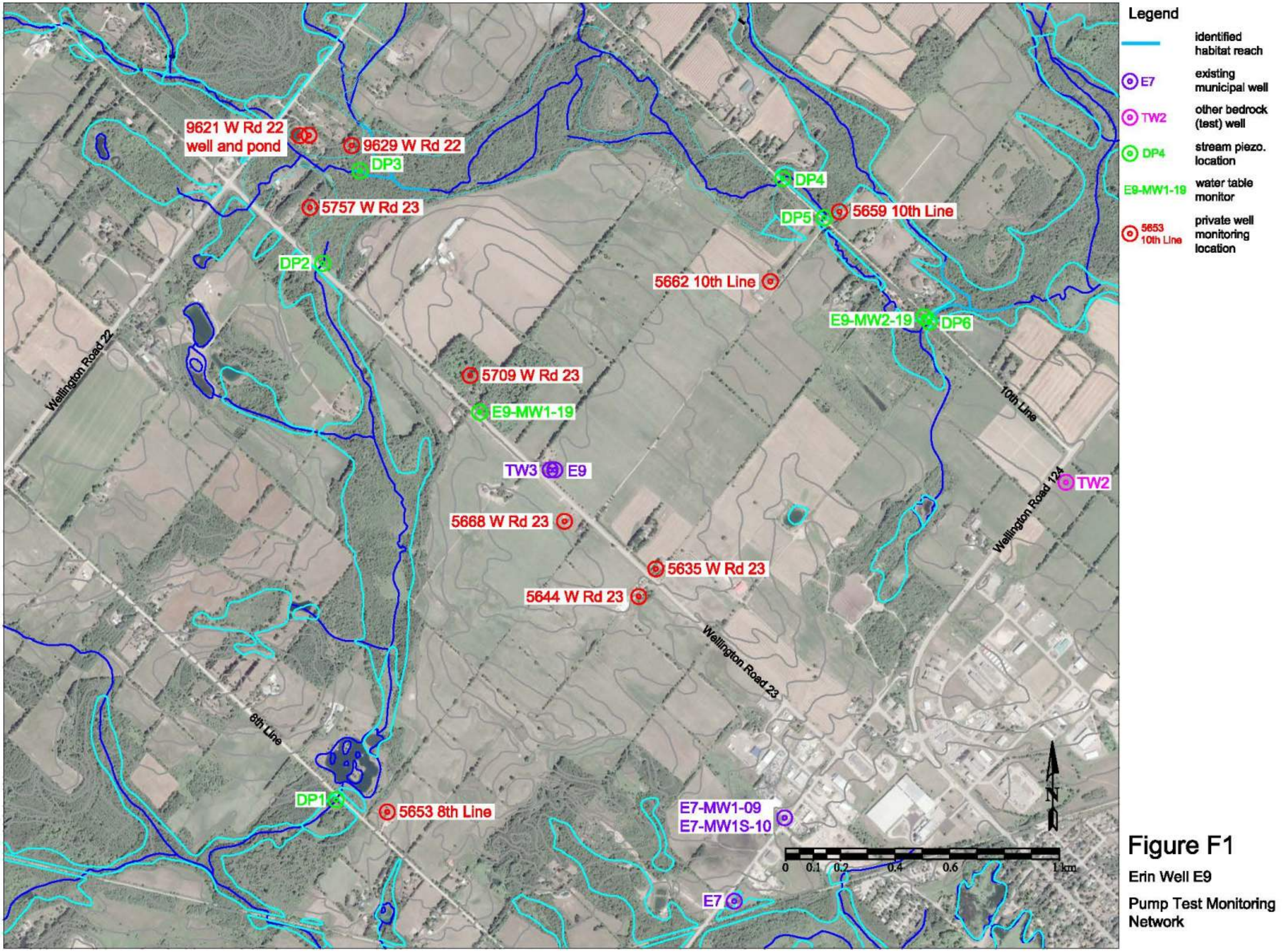


Figure F1

Erin Well E9

Pump Test Monitoring Network

Location	Distance From E9 (m)	Estimated Elevation (mASL)	Type	Aquifer	Depth to Bedrock (mBGS)	Total Depth (mBGS)	Screen or OH Interval	
							Top (mBGS)	Bottom (mBGS)
E9	-	440	drilled	confined bedrock	39.9	79.2	44.5	79.2
TW3	10	440	drilled	confined bedrock	40.5	79.2	41.8	79.2
TW2	1,900	408	drilled	confined bedrock	17.7	51.8	19.2	51.8
E7-MW1-09	1,500	404	drilled	confined bedrock	9.8	45.7	10.4	45.7
E7-MW1S-10	1,500	404	drilled	water table	-	6.1	3.0	6.1
E9-MW1-19	360	440	drilled	water table	-	18.3	15.2	18.3
E9-MW2-19	1,500	408	drilled	water table	-	7.0	4.0	7.0
5653 8th Line	1,390	415	drilled	confined overburden	-	25.9	25.9	25.9
5659 10th Line	1,400	414	drilled	confined bedrock	19.8	39.6	21.3	39.6
5662 10th Line	1,050	421	drilled	confined bedrock	21.3	42.4	21.9	42.4
9621 Well Rd 22	1,510	426	drilled	confined bedrock	8.2	34.7472	13.1064	34.7472
9621 Well Rd 22	1,540	426	pond	-	-	-	-	-
9629 Well Rd 22	1,410	424	dug	water table	-	2.7	0.0	2.7
5635 Well Rd 23	515	436	drilled	confined bedrock	38.1	73.2	40.8	73.2
5644 Well Rd 23	550	433	drilled	confined bedrock	26.8	53.3	38.9	53.3
5668 Well Rd 23	195	439	drilled	confined bedrock	38.1	55.5	39.3	55.5
5709 Well Rd 23	480	440	drilled	confined bedrock	39.3	91.4	N/A	91.4
5757 Well Rd 23	1,320	428	drilled	confined bedrock	18.0	37.2	19.8	37.2
DP1-S	1,400	413	drive-point	water table	-	0.77	0.47	0.77
DP1-D	1,400	413	drive-point	water table	-	1.73	1.43	1.73
DP2-S	1,100	422	drive-point	water table	-	0.83	0.53	0.83
DP2-D	1,100	422	drive-point	water table	-	1.73	1.43	1.73
DP3	1,300	423	drive-point	water table	-	1.35	1.05	1.35
DP4-S	1,400	413	drive-point	water table	-	0.67	0.37	0.67
DP4-D	1,400	413	drive-point	water table	-	1.56	1.26	1.56
DP5	1,300	412	drive-point	water table	-	0.97	0.67	0.97
DP6	1,500	405	drive-point	water table	-	1.16	0.86	1.16
DP6 Creek	1,500	405	stilling well	water table	-	-	-	-

Table F1: Monitoring Network Summary

Ontario

Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
219470 Tag#:A219470

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Well Owner's Information

First Name TOWN OF ERIN	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)

Well Location

Address of Well Location (Street Number/Name)	Township ERIN	Lot 17	Concession 10
County/District/Municipality WELLINGTON	City/Town/Village	Province **Ontario**	Postal Code
UTM Coordinates NAD 83 Zone 17 Easting 574608 Northing 4848974	Municipal Plan and Sublot Number	Other	

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
BROWN	CLAY & STONES			0	35ft
GRAY	CLAY & STONES			35ft	58ft
BROWN	LIMESTONE			58ft	87ft
GRAY	LIMESTONE			87ft	165ft
GRAY	SHALE			165ft	170ft

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	63ft	BENTONITE SLURRY	70 GAL

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
6i	steel	.188	0	63ft
6in	open hole		63ft	170ft

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 92-95ft (m/ft) ☐ Gas — Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify
Water found at Depth 141-143ft (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify
Water found at Depth (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
-0	63ft	8.75in
63ft	170ft	6in

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) 150 gpm

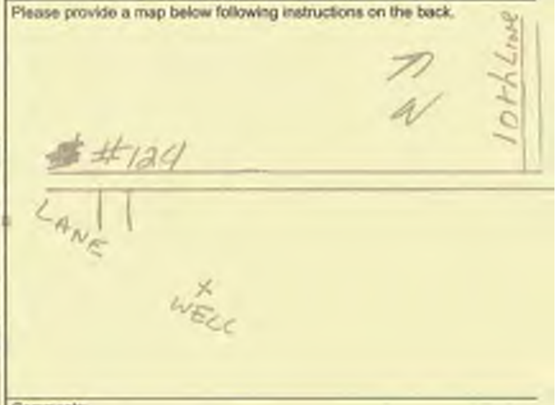
Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	40.5ft		
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	

Pump test Done By Others

Map of Well Location

Please provide a map below following instructions on the back.



Comments: TW2

Well Contractor and Well Technician Information

Business Name of Well Contractor KEITH LANG WELL DRILLING INC	Well Contractor's Licence No. 7154
Business Address (Street Number/Name) 251 ELDON ST GODERICH	Municipality

Province ONT	Postal Code N7A3R9	Business E-mail Address

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name) KEITH LANG

Well Technician's Licence No. T4461	Signature of Technician and/or Contractor K. Lang	Date Submitted Y Y Y Y M M D D

Well owner's information package delivered ☒ Yes ☐ No

Date Package Delivered Y Y Y Y M M D D

Date Work Completed 20180717

Ministry Use Only

Audit No. Z287031

Received

0506E (2014/11)

Contractor's Copy

Ontario Ministry of the Environment

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. (Place
A073327

A 073327

Well Record

Regulation 903 Ontario Water Resources Act

Page ______ of ______

Well Owner's Information

First Name	Last Name / Organization TOWNSHIP OF ERIN	E-mail Address	☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name) 5684 TRAFALGER RD	Municipality HILLSBURGH	Province ONT	Postal Code NOM 1Z0
Telephone No. (inc. area code)			

Well Location

Address of Well Location (Street Number/Name)	Township ERIN	Lot 18	Concession 9
County/District/Municipality WELLINGTON	City/Town/Village	Province Ontario	Postal Code
UTM Coordinates Zone 17 Easting 573611 Northing 4846524 NAD 83	Municipal Plan and Sublot Number	Other	

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
BROWN	SILTY CLAY & STONES			0	27ft
GRAY	CLAY & STONES			27ft	32ft
BROWN	LIMESTONE			32ft	117ft
GRAY	LIMESTONE			117ft	150ft

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	34ft	CEMENT 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) 25ft

Pumping rate (l/min / GPM) 10gpm

Duration of pumping 1 hrs + 0 min

Final water level end of pumping (m/ft) 9ft

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	8ft		
1		1	
2		2	
3		3	
4		4	
5	9ft	5	8ft
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60	9ft	60	8ft

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
4¼ion	STEEL	.188	0	34ft
4in	open hole		34ft	150ft

Status of Well

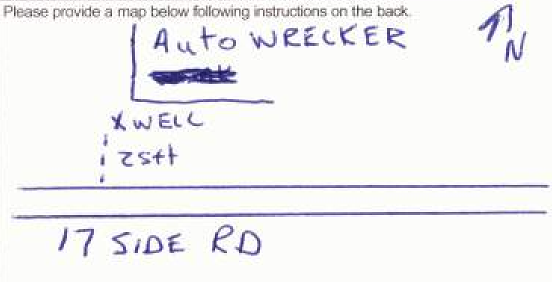
☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☒ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

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.



E7-MW1-09

Water Details

Water found at Depth	Kind of Water
87ft (m/ft) ☐ Gas	☒ Fresh ☐ Untested ☐ Other, specify
101ft (m/ft) ☐ Gas	☒ Fresh ☐ Untested ☐ Other, specify
112ft (m/ft) ☐ Gas	☒ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	34ft	8in
34ft	150ft	4in

Well Contractor and Well Technician Information

Business Name of Well Contractor KEITH LANG WELL DRILLING INC	Well Contractor's Licence No. 7154
Business Address (Street Number/Name) 251 ELDON ST GODERICH ONT	Municipality
Province ONT	Postal Code N7A 3R9
Business E-mail Address	
Bus.Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name) KEITH LANG
Well Technician's Licence No. T446	Signature of Technician and/or Contractor K. Lang
Date Submitted	

Comments:

Well owner's information package delivered ☐ Yes ☒ No

Date Package Delivered

Date Work Completed 2009 3 26

Ministry Use Only

Audit No. Z 89738

Received JUN 0 8 2009

0506E (12/2007)

Ministry's Copy

Ontario Ministry of the Environment

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*

A 100858

Well Record

Regulation 903 Ontario Water Resources Act

Page ______ of ______

Well Owner's Information

First Name:
Last Name / Organization: Erin Auto Recyclers
E-mail Address:
☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name): P.O. Box 704
Municipality: Erin
Province: Ontario
Postal Code: N0B 1T0
Telephone No. *(inc. area code)*:

Well Location

Address of Well Location (Street Number/Name): 9572 17th Sideroad
Township: Erin
Lot: 14
Concession: 6
County/District/Municipality: Wellington
City/Town/Village: Erin
Province: **Ontario**
Postal Code: N0B 1T0
UTM Coordinates: NAD 83 Zone 08 Easting 0051115 Northing 4846750
Municipal Plan and Sublot Number:
Other:

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	Depth (m/ft) To
Brown	Gravel (Fine)	Boulders	Hard	0'	8'
Brown	Gravel (Course)	Sand	Firm	8'	18'
Brown	Sand	—	Soft.	18'	20'

Annular Space

Depth Set at (m/ft) From	Depth Set at (m/ft) To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
10	20	Silica Sand Around Screen	10 bgs.
0	18	Benseal Bentonite	2 Bags.
8	0	Bentonite Slurry	6 Bags.
		Cement Grout Top 2'	

Method of Construction

☐ Cable Tool
☐ Rotary (Conventional)
☐ Rotary (Reverse)
☐ Boring
☐ Air percussion
☒ Other, specify Augering
☐ 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	Depth (m/ft) To
2"	Plastic.	.350	0'	20'

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To
2"	Plastic	.50	10'	20'

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

Water Details

Water found at Depth 18 (m/ft) ☐ Gas | Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify
Water found at Depth ____ (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify
Water found at Depth ____ (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
0	20'	2"

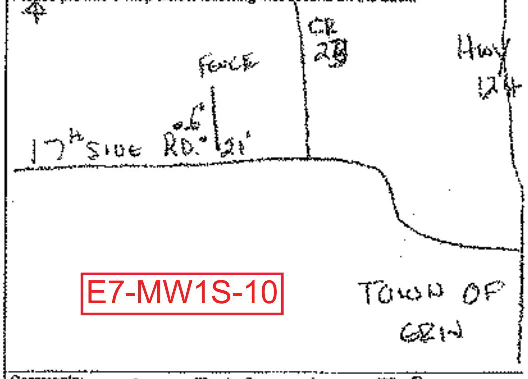
Results of Well Yield Testing

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)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	12'2"		
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.



E7-MW1S-10

Comments: Monitoring well for Twp Erin

Well Contractor and Well Technician Information

Business Name of Well Contractor: Smithwater Systems Inc.
Well Contractor's Licence No.: 7410
Business Address (Street Number/Name): P.O. Box 787
Municipality: Erin
Province: Ont
Postal Code: N0B 1T0
Business E-mail Address: mike@smithwatersystem.com
Bus. Telephone No. *(inc. area code)*: 5198332000
Name of Well Technician (Last Name, First Name): Smith, Simon
Well Technician's Licence No.: T3146
Signature of Technician and/or Contractor:
Date Submitted: 2010 08 12

Well owner's information package delivered ☒ Yes ☐ No
Date Package Delivered: 2010 08 14
Date Work Completed: 2010 08 10

Ministry Use Only
Audit No. Z115151
Received

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Contractor's Copy

Shared use Monitoring well just to west of 9572 17SR
Shallow Monitoring well ((Erin Auto Recyclers located bie town Property
Paid for by Rob Smith (Erin Auto Recyclers) Aug 27/10 TS

19-0147-01

Ontario Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
A273281

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization Corporation of the Town of Erin	E-mail Address	☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name) 5684 Trafalgar Rd.	Municipality Hillsburgh	Province ON	Postal Code N0B 1Z0
Telephone No. *(inc. area code)* 5198554407			

Well Location

Address of Well Location (Street Number/Name) Wellington Rd 23	Township	Lot 20	Concession 10
County/District/Municipality Wellington	City/Town/Village Erin	Province Ontario	Postal Code
UTM Coordinates Zone Easting Northing NAD 83 17 572515 4849235	Municipal Plan and Sublot Number	Other	

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
	Sand		wet @ 53'	0	60

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	48	Hole Plug	
48	60	Sand	

Method of Construction

☐ Cable Tool
☐ Rotary (Conventional)
☐ Rotary (Reverse)
☐ Boring
☐ Air percussion
☒ Other, *specify* HSA
☐ 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
2			0	50

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To
2.375	PVC	10	50	60

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*

Water Details

Water found at Depth 53 (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☒ Untested ☐ Other, *specify*

Water found at Depth (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Water found at Depth (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	60	8

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.

E9-MW1-19

Comments:
See Attached Map

Well Contractor and Well Technician Information 7675

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)* 5198269340	Name of Well Technician (Last Name, First Name) Brown, Eric
Well Technician's Licence No. 4023	Signature of Technician and/or Contractor
Date Submitted 20191202	

Well owner's information package delivered ☐ Yes ☐ No	Date Package Delivered Y Y Y Y M M D D
	Date Work Completed 20191107

Ministry Use Only
Audit No. Z323881
Received

0506E (2018/12)

Ministry's Copy

19-0147-01

Ontario
Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
A 273280

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
	Corporation of the Town of Erin		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
5684 Trafalgar Rd	Hillsburgh	ON	N0B1Z0	5198554407

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
10 Line	Erin	19	11

County/District/Municipality	City/Town/Village	Province	Postal Code
Wellington	Erin	**Ontario**	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	574118	4849625		

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	Depth (m/ft) To
	Sand & Boulders			0	15
	Sand			15	23

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	12	Hole Plug	
12	23	Sand	

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* HSA
☐ 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
2	PVC		0	13 ~~23~~

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
2.375	PVC	10	13	23

Map of Well Location

Please provide a map below following instructions on the back.

E9-MW2-19

Water Details

?
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	To	Diameter *(cm/in)*
0	23	8

Well Contractor and Well Technician Information

7675

Business Name of Well Contractor	Well Contractor's Licence No.
Aardvark Drilling Inc.	7238

Business Address (Street Number/Name)	Municipality
25-C Lewis Road	**Guelph**

Province	Postal Code	Business E-mail Address
ON	**N1H1E9**	**www.aardvarkdrillinginc.com**

Bus.Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)
5198269340	Brown, Eric

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
4 0 1 2 1 3		20191202

Comments:
See Attached map

Well owner's information package delivered
☐ Yes
☐ No

Date Package Delivered
Y Y Y Y M M D D

Date Work Completed
20191107

Ministry Use Only
Audit No. Z323882
Received

0506E (2018/12)

Ministry's Copy

Appendix G

Private Well Survey and Notification

Groundwater
Science Corp.

Unit 2, 465 Kingscourt Drive,
Waterloo, ON N2K 3R5
Phone: (519) 746-6916
groundwaterscience.ca

October 11, 2019

RE: Erin Municipal Well Testing - Private Water Well Survey

Dear Resident:

The Town of Erin (Town) Servicing and Settlement Master Plan (SSMP) identified municipal water supply and storage deficiencies for the urban centre of Erin. The Town initiated a Class Environmental Assessment (Class EA) in May 2015 to address the current limitations of the water system and the needs for future development. For the urban centre of Erin, there is a need for an additional water supply source to provide redundancy in the system (e.g. to ensure peak water demand and fire flow requirements can be met if one of the two existing wells is out of service), and to allow some growth.

As part of the water supply Class EA, a new water supply well has been drilled north of Erin, at a property on Wellington Road 23. The new well extends into the deep bedrock aquifer (79 m depth). The well has been tested over short periods and shown to produce a substantial volume of water. However, a longer term test is required to determine the current and sustainable capacity, and to determine the potential for impact on surrounding water users and local ecological features.

The Town of Erin has obtained a temporary Permit To Take Water (PTTW) from the Ontario Ministry of the Environment Conservation and Parks (MECP) to conduct this testing. The test is anticipated to occur in November. The well is to be pumped for several days and water levels will be monitored in a number of private wells selected for that purpose. In addition, groundwater levels adjacent to the West Credit River and other surface water features will also be monitored. If the well is shown to be acceptable, for both water quantity and water quality, this information will be used to help obtain the required approvals to add the well to the Erin municipal water supply system.

The temporary PTTW requires water level monitoring at a representative number of private wells (i.e. wells at various depths and geographic locations). Prior to conducting the pumping test Groundwater Science Corp. is completing a survey and inventory of private water wells in the area, on behalf of the Town of Erin.

The survey will collect information on existing local water supplies, such as type, location and depth of the wells, in addition to general comments on water quantity and quality. The survey results will augment available public information (water well records) obtained from the MECP regarding local water supply wells. Based on the survey results private wells representing a variety of aquifer depths and geographic locations in the area will be selected for monitoring. Monitoring will include baseline conditions prior to the test.

A notice will be distributed to residents prior to the actual test with additional details. However, please note that as a condition of the PTTW, the Town and the study team are required by MECP regulations to respond to, and address, any well interference complaint arising from the water taking.

Participation in the private water well survey and monitoring program is voluntary. This letter is to inform you of the testing, as well as provide you with an opportunity to complete the well survey and to indicate if you are interested in having your well monitored during the test.

Based on the number of survey responses, representative wells will be selected from within local areas for monitoring. For example, if there are five wells of similar depth in one area, only one or two of those wells may be selected for monitoring. Testing results and general summaries of the information gathered will be available to all local residents as part of the Class EA reporting. **No personal information will be disclosed or referenced in the reporting**.

Once the survey results are reviewed and representative wells selected, we will contact the owners of the selected wells to arrange monitoring access. As part of that work **we are requesting permission to measure the water levels at your well for up to 4 weeks before the test, during the test and up to 4 weeks after the test.** The well monitoring would include the installation of a measurement instrument in your well. This work would be completed by a MECP Licensed Water Well Contractors and Technicians.

Attached to this letter is a survey response and monitoring authorization form. **If you are interested in participating** please complete and return the survey/authorization form in the self-addressed stamped envelope (retain this letter for your information). Those residents interested in participating in the monitoring program will be contacted at a later date to arrange the well monitoring.

If you require assistance with the form, or have any questions about well monitoring, please call the Andrew Pentney of Groundwater Science Corp. at (519) 580-7325, or email apentney@rogers.com. We would like to have the forms completed and returned by **October 21st**, as we are hoping to commence the test in November.

Thank you in advance for your consideration in this matter.

Sincerely,

Andrew Pentney, P.Geo.
Groundwater Science Corp.
Hydrogeologist

Water Well Inventory	Project: **Erin Municipal Well Testing**	Date:

Some personal information (name, address and phone number) is collected as part of this survey for the sole purpose of identifying and communicating with the respondent. There will be no electronic copy made of this information and the data will not be disclosed to third parties or referenced in the environmental study report.

☐ I consent to the collection and use of the following personal information for the above stated purpose.

Respondent: ____________________ Emergency Locate (Road) No.: __________

Mailing Address: ________________________________ Telephone No.: __________

1. How old is the house? ______________ **2. How old is the well?** ______________

3. Water Use:

Domestic ☐ Pool ☐ Livestock ☐ Garden ☐ other: ____________________

Well Water Treatment (filter, softener, etc.): ________________________________

4. Alternative Water Sources Used:

Bottled ☐ Cistern ☐ Bulk Delivery ☐ other: ____________________

5. Well Water Quality and Quantity Comments:

Quality (colour, odour, taste, staining, etc.) ____________________

____

Quantity (eg. does the well go dry?) ____________________

____

Has the well ever been tested for quality or quantity? ______________

Results of testing: ____________________________________

6. Water Well Record:

Do you have a copy of the MECP Water Well Record? __________ Well Record #: __________

Who drilled the well? ____________________________

7. **Sketch Map of Well Location** (show road, driveway, house and septic bed)

8. Well Construction:

Well Type Drilled ☐ Dug ☐

Well Casing Cement Tile ☐ Steel ☐ Buried ☐ **Diameter:** ________

Well Depth (feet): __________ Describe well access (easy / not easy): __________

9. Pump Details:

Type: jet ☐ submersible ☐ other ☐ pump (intake) depth: __________

10. Monitoring:

Would you agree to water level monitoring at your well? __________

Requested by: ____________________ Date: __________

Survey Summary			Survey Response Summary							MOECC Water Well Record Match			
Address		Survey		Well	Well	Well	Well	Pump	Pump	MOECC	Well	Formation	Note
Number	Street	Date	Date	Age	Type	Diam.	Depth	Type	Depth	Number	Depth	Depth	(well record match information, etc.)
5617	Eighth Line	11-Oct-19								6710221	105	bedrock	location match
5631	Eighth Line	11-Oct-19								6700768	85	overburden	location match
5653	Eighth Line	11-Oct-19	21-Nov-19	1990's	drilled	6 inch	120 ft	submersible	-	6711562	85	overburden	location match
5681	Eighth Line	11-Oct-19								6712149	130	bedrock	address listed on WWR
5689	Eighth Line	11-Oct-19								6707771	171	bedrock	location match
5707	Eighth Line	-								6711780	115	bedrock	location match
										6711781	151	bedrock	location match
										6710017	66	overburden	reported location, limited information
5721	Eighth Line	11-Oct-19								7119263	120	bedrock	address listed on WWR
5733	Eighth Line	11-Oct-19											
5759	Eighth Line	11-Oct-19								6711625	163	bedrock	location match
9549	Well Rd 22	11-Oct-19								6711624	155	bedrock	location match
										7124726	226	bedrock	address listed on WWR
										7168837	203	bedrock	address listed on WWR
										7168838	186	bedrock	address listed on WWR
										7168839	185	bedrock	address listed on WWR
9621	Well Rd 22	11-Oct-19	22-Nov-19	1984	drilled	-	150 ft	submersible	-	6707556	114	bedrock	location and use match
9625	Well Rd 22	11-Oct-19	19-Nov-19	1994-1989	dug	-	10-15 ft	jet	2 ft				
9629	Well Rd 22	11-Oct-19	13-Nov-19	1974	dug	-	15-20 ft	other	-				
9639	Well Rd 22	11-Oct-19											
9651	Well Rd 22	11-Oct-19											
5695	Tenth Line	22-Nov-19											
5691	Tenth Line	22-Nov-19											
5681	Tenth Line	22-Nov-19											
5685	Tenth Line	22-Nov-19											
5671	Tenth Line	22-Nov-19											
5659	Tenth Line	22-Nov-19	26-Nov-19	1998	drilled	-	130 ft	submersible	-	6712843	130	bedrock	address listed on WWR
5649	Tenth Line	22-Nov-19											
5641	Tenth Line	22-Nov-19											
5752	Tenth Line	11-Oct-19											
5732	Tenth Line	11-Oct-19								6714678	139	bedrock	location match
5726	Tenth Line	11-Oct-19											
5724	Tenth Line	11-Oct-19											
5722	Tenth Line	11-Oct-19											
5716	Tenth Line	11-Oct-19											
5708	Tenth Line	11-Oct-19								6700770	135	bedrock	per map and use
5702	Tenth Line	11-Oct-19											
5662	Tenth Line	11-Oct-19	2-Dec-19	2003	drilled	-	139 ft	jet	-	6714678	139	bedrock	location match
5650	Tenth Line	11-Oct-19											
5630	Tenth Line	11-Oct-19								6714633	103	bedrock	address listed on WWR
9660	Well Rd 124	11-Oct-19	13-Nov-19	1976	drilled	5 inch	120 ft	submersible	60 ft	6706333	122	bedrock	copy provided by landowner
										6700793	118	bedrock	location match, replaced by 6706333?
9650	Well Rd 124	11-Oct-19								6700794	120	bedrock	location match
9638	Well Rd 124	11-Oct-19								6712853	165	bedrock	location match
9630	Well Rd 124	11-Oct-19								6708814	106	bedrock	location match

Table G1: Private Water Well Survey Summary

Survey Summary			Survey Response Summary							MOECC Water Well Record Match			
Address		Survey Date	Date	Well Age	Well Type	Well Diam.	Well Depth	Pump Type	Pump Depth	MOECC Number	Well Depth	Formation Depth	Note (well record match information, etc.)
Number	Street												
9628	Well Rd 124	11-Oct-19											
9614	Sideroad 17	11-Oct-19											
9608	Sideroad 17	11-Oct-19											
9580	Sideroad 17	11-Oct-19								6709708	170	bedrock	location match
9572	Sideroad 17	11-Oct-19								7143591	-	-	address listed on WWR - well alteration
9556	Sideroad 17	11-Oct-19								7152280	-	-	address listed on WWR - well abandonment
9538	Sideroad 17	11-Oct-19								6709343	125	bedrock	location match
11	Pioneer Dr	11-Oct-19								6705649	152	bedrock	location match
19	Pioneer Dr	11-Oct-19								6711343	140	bedrock	location match
31	Pioneer Dr	11-Oct-19								6710527	129	bedrock	location match
32	Pioneer Dr	11-Oct-19											
44	Pioneer Dr	11-Oct-19											
39	Pioneer Dr	11-Oct-19								6710145	178	bedrock	location match
36	Pioneer Dr	11-Oct-19											
5635	Well Rd 23	11-Oct-19	21-Nov-19	-	drilled	4 inch	-	submersible	72 ft	6706341	240	bedrock	location match
5644	Well Rd 23	11-Oct-19	21-Nov-19	~2006	drilled	6 inch	-	submersible	-	6711621	175	bedrock	per map
										6713973	170	bedrock	location match - observation well
5645	Well Rd 23	11-Oct-19	18-Nov-19	-	drilled	-	-	jet	-	6706330	238	bedrock	location match
5645	Well Rd 23	11-Oct-19											second residence
5660	Well Rd 23	11-Oct-19	23-Nov-19	1974	drilled	-	200+ft	submersible	200 ft	6704973	140	bedrock	approx date and location match
5668	Well Rd 23	11-Oct-19	21-Nov-19	-	drilled	6 inch	-	submersible	-	7191661	182	bedrock	location match
5672	Well Rd 23	11-Oct-19								7238130	180	bedrock	location match
5677	Well Rd 23	25-Jul-19	25-Jul-19	-	drilled	4 inch	-	submersible	-	6706977	241	bedrock	location match, consulted prior to drilling
5680	Well Rd 23	11-Oct-19	29-Nov-19	-	drilled	4 inch	-	submersible	-	6700769	102	overburden	location match, no longer used?
										6703881	185	bedrock	location match, in use
5703	Well Rd 23	11-Oct-19								6704435	222	bedrock	location match
5705	Well Rd 23	11-Oct-19	17-Nov-19	1976	drilled	-	-	jet	-	6704431	220	bedrock	location match
5702	Well Rd 23	11-Oct-19	17-Nov-19	1969	drilled	-	-	submersible	-	6703536	156	bedrock	date, driller and location match
5709	Well Rd 23	11-Oct-19	14-Nov-19	-	drilled	-	65 ft	submersible	-				
5729	Well Rd 23	11-Oct-19								6700795	179	bedrock	location match
5743	Well Rd 23	11-Oct-19								6704159	90	bedrock	location match
5757	Well Rd 23	11-Oct-19	15-Nov-19	1982	drilled	-	150 ft	-	50 ft (?)	6707780	122	bedrock	copy provided by landowner
5767	Well Rd 23	11-Oct-19								6709040	125	bedrock	location match
5771	Well Rd 23	11-Oct-19								6703836	105	bedrock	location match
5627	Well Rd 23	18-Nov-19	18-Nov-19	-	drilled	-	-	jet	-	6703828	188	bedrock	location match

Table G1: Private Water Well Survey Summary

TOWN OF ERIN

Infrastructure Services

5684 Trafalgar Rd.
Hillsburgh, Ontario N0B 1Z0
Tel: (519) 855-4407, Ext.227
Fax: (519) 855-4821
E-mail: nick.colucci@erin.ca
www.erin.ca

RE: Erin Municipal Well Testing

Dear Resident: December 10, 2019

This letter is to inform you that the Town of Erin (Town) is planning a 6 day pumping test at the new water supply well (constructed by the Town), located on the east side of Wellington Road 23, approximately half way between Wellington Road 22 and Sideroad 17. The testing is planned to **begin on December 11, 2019** and **end on December 17, 2019**. Over most of that period, water will be pumped from the well on a continuous basis.

The test is required to determine the sustainable well capacity, and, to determine the potential for impact on surrounding water users and local ecological features. Water level measurements at the pumping well and observation locations are used to determine the potential for impact. If the well is shown to be acceptable, for both water quantity and water quality, this information will be used to help obtain the required approvals to add the well to the Erin municipal water supply system.

The Town of Erin has obtained a temporary Permit To Take Water (PTTW) from the Ontario Ministry of the Environment, Conservation and Parks (MECP) to conduct this testing. Water levels will be monitored in a number of private wells selected for that purpose. In addition, groundwater levels will also be monitored within dedicated observation wells, and, locations at the West Credit River and other surface water features.

As a condition of the PTTW, the Town and the study team are required by MECP to respond to, and address, well interference complaints arising from the water taking.

If you have, any questions regarding the testing program please contact:

Andrew Pentney (Project Hydrogeologist, Groundwater Science Corp): (519) 580-7325
or,
Nick Colucci (Town of Erin, Director of Infrastructure Services): (519) 855-4407 Ext. 227

If you require assistance with your well over the testing period, please contact one of the following:

Andrew Pentney (Groundwater Science Corp): (519) 580-7325

Dave Nahrgang (Groundwater Science Corp): (519) 501-1446

Town of Erin: (519) 855-4407

Lotowater Technical Services: (519) 717-3070

Thank you,

Nick Colucci

Nick Colucci

Appendix H
Step Test Results

VARIABLE RATE PERFORMANCE TEST

Lotowater
TECHNICAL SERVICES INC.

Well Name:	Well E9	**Project Number:**	148-004
Client:	Town of Erin	**Date:**	12/12/2019
Technician Name:	Justin Bickell	**Pump:**	LTS test pump
Water Level Device:	LTS water level meter	**Pump Inlet:**	Approx 44.1 m
Water Level Reference:	Top of casing	**Flow Measuring Device:**	LTS flow meter
Test Note:			

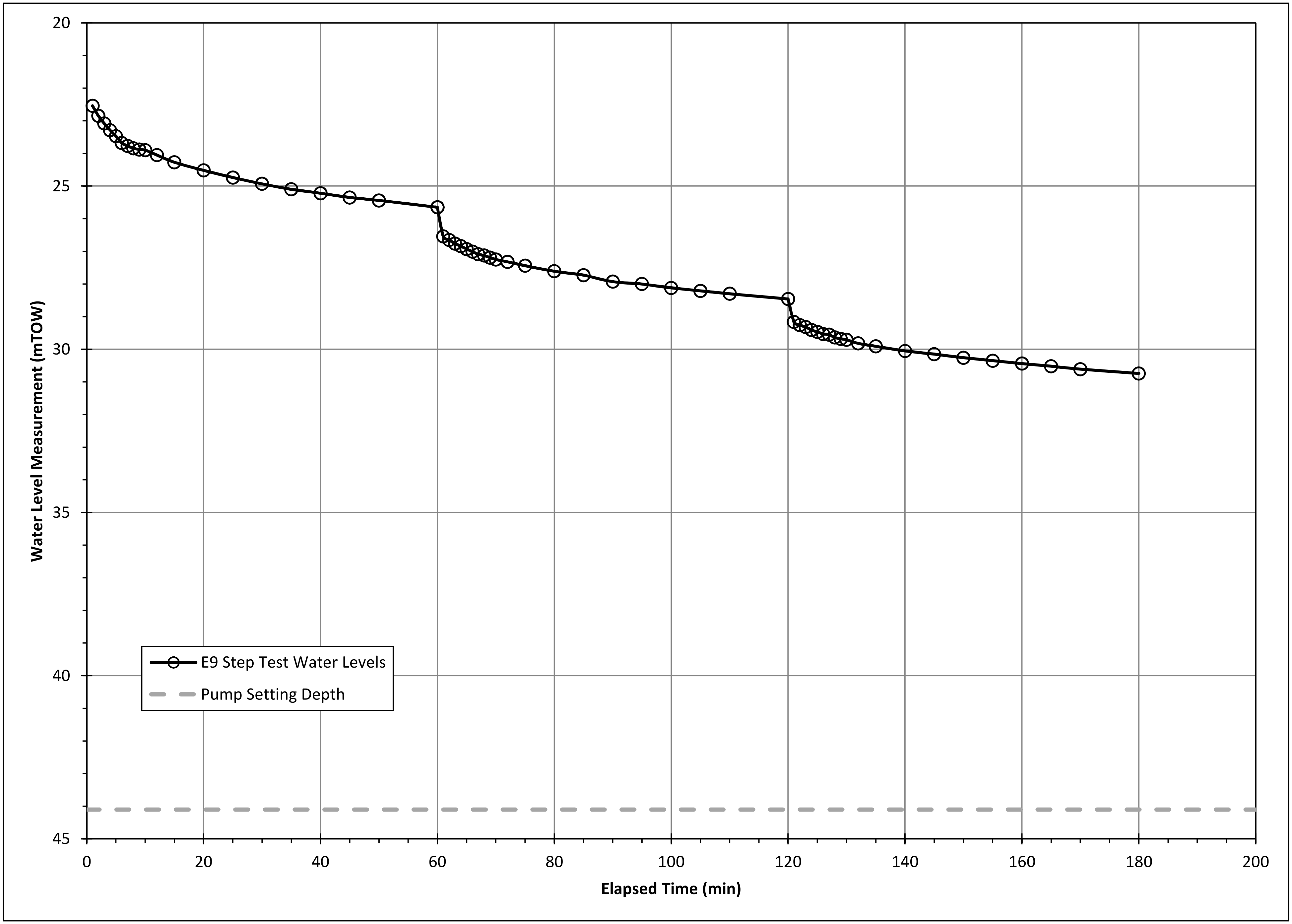
Time ***hr:min***	**Elapsed Time** ***min***	**Level** ***mbtc***	**Drawdown** ***m***	**Flow** ***L/s***	**Note**
0:00	0	21.03	0.00	19.0	Start Step 1
0:01	1	22.54	1.51	19.0	
0:02	2	22.85	1.82	19.0	
0:03	3	23.08	2.05	19.0	
0:04	4	23.29	2.26	19.0	
0:05	5	23.47	2.44	19.0	
0:06	6	23.68	2.65	19.0	
0:07	7	23.77	2.74	19.0	
0:08	8	23.84	2.81	19.0	
0:09	9	23.88	2.85	19.0	
0:10	10	23.90	2.87	19.0	
0:12	12	24.05	3.02	19.0	
0:15	15	24.27	3.24	19.0	
0:20	20	24.52	3.49	19.0	
0:25	25	24.74	3.71	19.0	
0:30	30	24.93	3.90	19.0	
0:35	35	25.10	4.07	19.0	
0:40	40	25.22	4.19	19.0	
0:45	45	25.35	4.32	19.0	
0:50	50	25.44	4.41	19.0	
1:00	60	25.65	4.62	19.0	
1:01	1	26.54	5.51	26.0	Start Step 2
1:02	2	26.65	5.62	26.0	
1:03	3	26.76	5.73	26.0	
1:04	4	26.84	5.81	26.0	
1:05	5	26.93	5.90	26.0	
1:06	6	27.01	5.98	26.0	
1:07	7	27.09	6.06	26.0	
1:08	8	27.13	6.10	26.0	
1:09	9	27.19	6.16	26.0	
1:10	10	27.25	6.22	26.0	
1:12	12	27.32	6.29	26.0	
1:15	15	27.44	6.41	26.0	
1:20	20	27.61	6.58	26.0	
1:25	25	27.73	6.70	26.0	
1:30	30	27.93	6.90	26.0	
1:35	35	28.00	6.97	26.0	
1:40	40	28.12	7.09	26.0	
1:45	45	28.21	7.18	26.0	
1:50	50	28.30	7.27	26.0	
2:00	60	28.46	7.43	26.0	

VARIABLE RATE PERFORMANCE TEST

Lotowater
TECHNICAL SERVICES INC.

Well Name: Well E9
Project Number: 148-004
Client: Town of Erin
Date: 12/12/2019
Technician Name: Justin Bickell
Pump: LTS test pump
Water Level Device: LTS water level meter
Pump Inlet: Approx 44.1 m
Water Level Reference: Top of casing
Flow Measuring Device: LTS flow meter
Test Note:

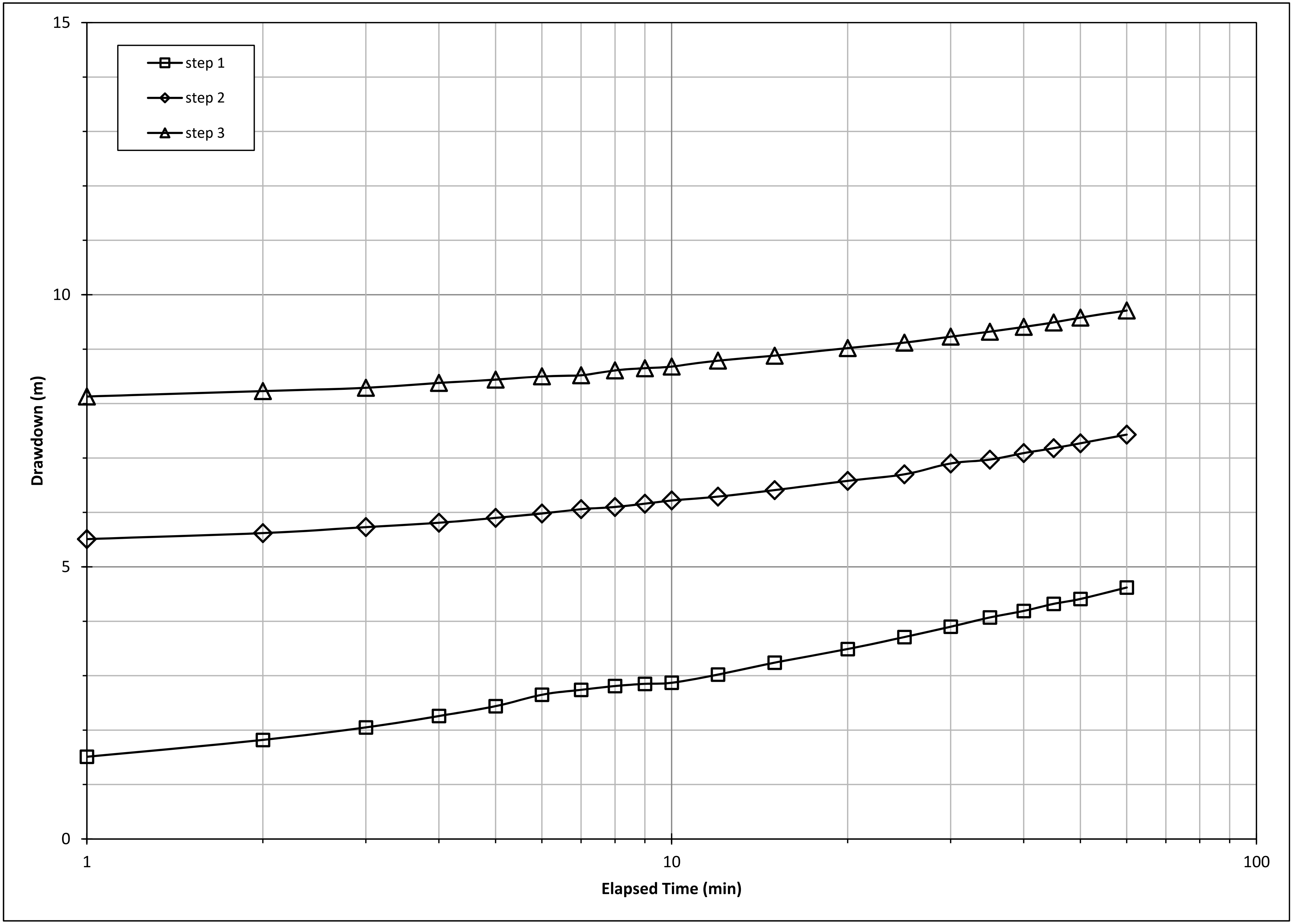
Time *hr:min*	**Elapsed Time** *min*	**Level** *mbtc*	**Drawdown** *m*	**Flow** *L/s*	**Note**
2:01	1	29.16	8.13	34.0	Start Step 3
2:02	2	29.26	8.23	34.0	
2:03	3	29.32	8.29	34.0	
2:04	4	29.41	8.38	34.0	
2:05	5	29.47	8.44	34.0	
2:06	6	29.53	8.50	34.0	
2:07	7	29.55	8.52	34.0	
2:08	8	29.64	8.61	34.0	
2:09	9	29.68	8.65	34.0	
2:10	10	29.71	8.68	34.0	
2:12	12	29.82	8.79	34.0	
2:15	15	29.91	8.88	34.0	
2:20	20	30.05	9.02	34.0	
2:25	25	30.15	9.12	34.0	
2:30	30	30.26	9.23	34.0	
2:35	35	30.35	9.32	34.0	
2:40	40	30.44	9.41	34.0	
2:45	45	30.52	9.49	34.0	
2:50	50	30.61	9.58	34.0	
3:00	60	30.74	9.71	34.0	
3:01	1	28.09	7.06	0.0	Recovery
3:02	2	27.42	6.39	0.0	
3:03	3	27.11	6.08	0.0	
3:04	4	26.79	5.76	0.0	
3:05	5	26.50	5.47	0.0	
3:06	6	26.33	5.30	0.0	
3:07	7	26.13	5.10	0.0	
3:08	8	25.94	4.91	0.0	
3:09	9	25.80	4.77	0.0	
3:10	10	25.67	4.64	0.0	
3:12	12	25.44	4.41	0.0	
3:15	15	25.12	4.09	0.0	
3:20	20	24.78	3.75	0.0	
3:25	25	24.50	3.47	0.0	
3:30	30	24.28	3.25	0.0	
3:35	35	24.08	3.05	0.0	
3:40	40	23.88	2.85	0.0	
3:45	45	23.75	2.72	0.0	
3:50	50	23.61	2.58	0.0	
4:00	60	23.43	2.40	0.0	



Town of Erin
Water Supply EA

Well E9 Step Test Hydrograph

Groundwater Science Corp
Hydrogeological Assessment

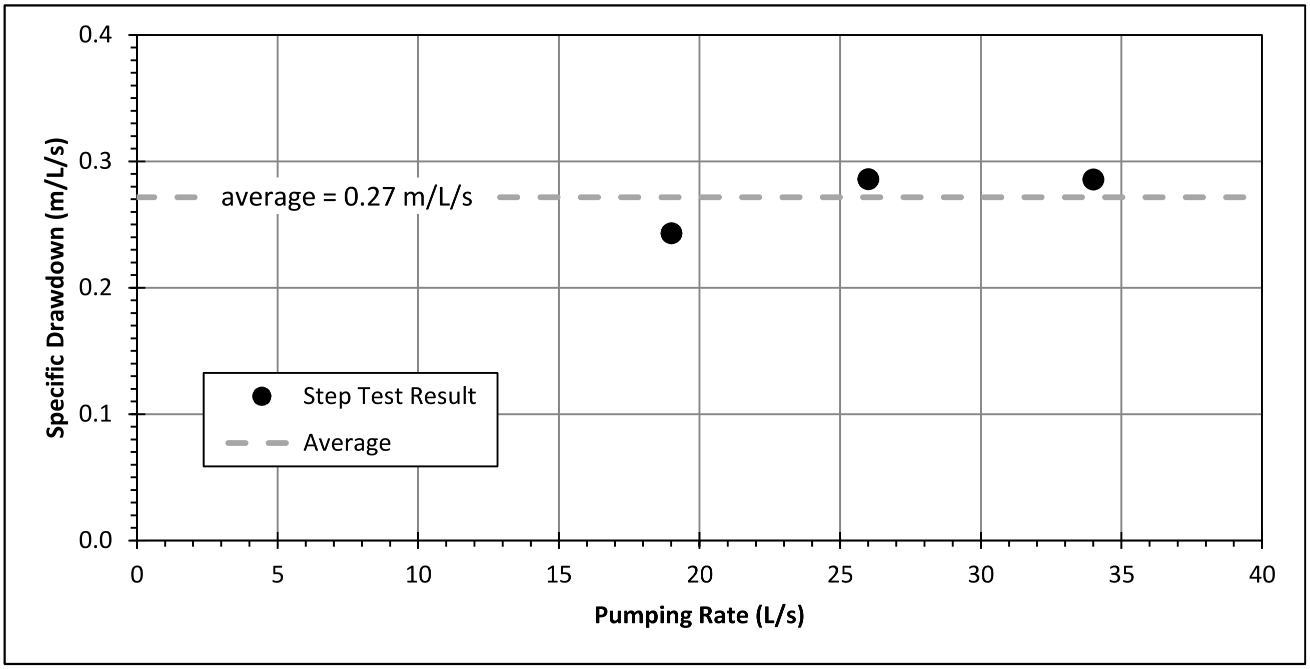


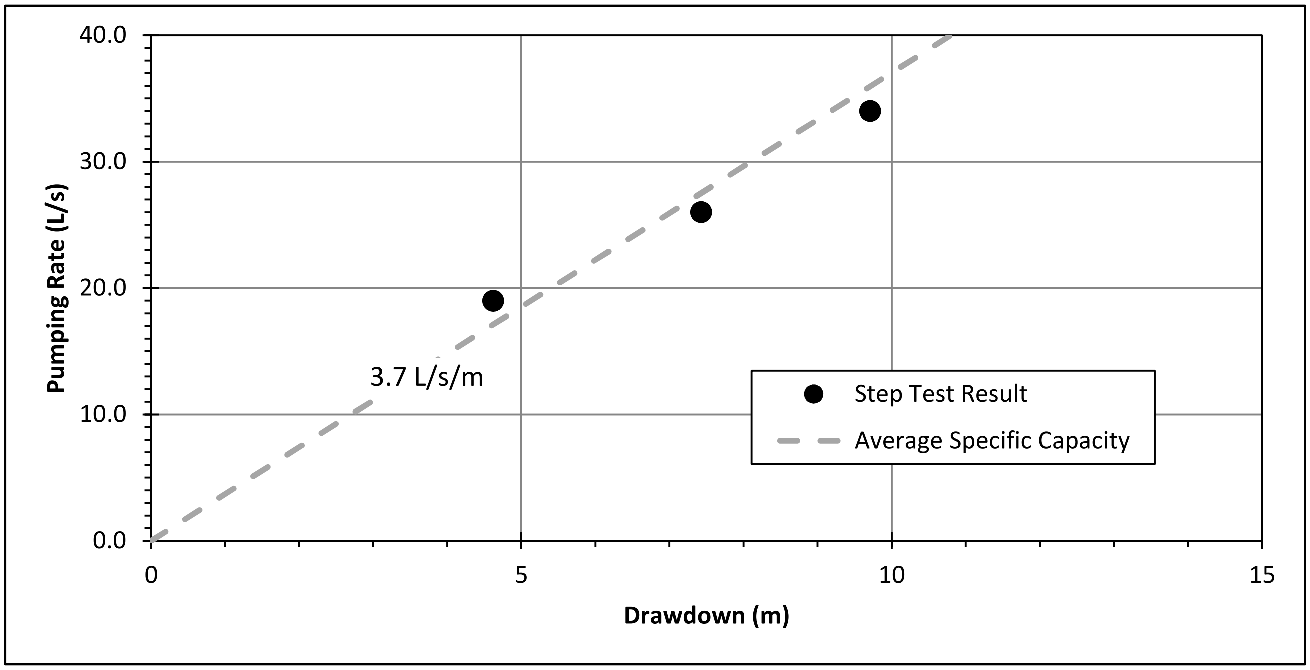
Town of Erin
Water Supply EA

Well E9 Step Test

Groundwater Science Corp
Hydrogeological Analysis

Well	Step	Pumping Rate (Q)			Drawdown (Sw) (m)	Specific Drawdown (Sw/Q) (m/L/s)	Specific Capacity (Q/Sw)	
		L/s	USgpm	IGPM			Step (L/s/m)	Test Average (L/s/m)
Well E9	1	19.0	301.2	250.8	4.62	0.243	4.11	3.70
	2	26.0	412.1	343.2	7.43	0.286	3.50	
	3	34.0	538.9	448.7	9.71	0.286	3.50	





E9 Step Test Analysis

Appendix I

Pumping Test Results: Well E9

Aquifer Test (Pumping Well E9)

Lotowater
TECHNICAL SERVICES INC.

Project Number: 148-004

Location: Town of Erin

Sheet: 1 of 5

Measuring Point: Top of 1.25" flush joint

Pump Type: Submersible 50 hp

Stick-up: 0.74 m above ground level

Pump Inlet: Approx = 44.1 m

SWL:

Technicians: LTS

Pumping Rate: L/s

Transducer Serial #:

Flow Measurement: LTS McCrometer 6" flow meter

Discharge Location: Approximatly 500 m South in roadside ditch

Test Note: Top of casing = 0.44 m above ground level

Top of 1" flush joint = 0.70 m above ground level

WELL NAME: **Well E9**

Date	**Time**	**Elapsed Time**	**Water Level**	**Drawdown**	**Flow Rate**	**Totalizer**	**Comments**
yyyy-mm-dd	***hr:min***	***min***	***mbMP***	***m***	***L/s***	***m3***	
2019-12-12	13:15:00	0	21.38	0.00	34.0	22,102	
	13:16:00	1	24.55	3.17			
	13:17:00	2	25.04	3.66			
	13:18:00	3	25.47	4.09			
	13:19:00	4	25.75	4.37			
	13:20:00	5	26.02	4.64			
	13:21:00	6	26.23	4.85			
	13:22:00	7	26.41	5.03			
	13:23:00	8	26.65	5.27			
	13:24:00	9	26.75	5.37			
	13:25:00	10	26.87	5.49			
	13:27:00	12	27.11	5.73			
	13:29:00	14	27.32	5.94			
	13:31:00	16	27.51	6.13			
	13:33:00	18	27.68	6.30			
	13:35:00	20	27.83	6.45	34.0	22,158	
	13:40:00	25	28.17	6.79			
	13:45:00	30	28.44	7.06			
	13:50:00	35	28.68	7.30			
	13:55:00	40	28.68	7.30			

Aquifer Test (Pumping Well E9)

Top of 1" flush joint = 0.70 m above ground level

WELL NAME: **Well E9**

Sheet: 2 of 5

Date	Time	Elapsed Time	Water Level	Drawdown	Flow Rate	Totalizer	Comments
yyyy-mm-dd	*hr:min*	*min*	*mbMP*	*m*	*L/s*	*m3*	
	14:00:00	45	28.68	7.30			
2019-12-12	14:05:00	50	29.27	7.89			
	14:10:00	55	29.52	8.14			
	14:15:00	60	29.57	8.19			
	14:25:00	70	29.82	8.44			
	14:35:00	80	30.03	8.65			
	14:45:00	90	30.22	8.84	34.0		
	14:55:00	100	30.40	9.02			
	15:05:00	110	30.55	9.17	34.0	22,328	
	15:15:00	120	30.69	9.31			
	15:45:00	150	31.04	9.66	34.0		
	16:15:00	180	31.33	9.95			
	16:45:00	210	31.57	10.19	34.0	22,515	
	17:15:00	240	31.67	10.29	34.0	22,571	
	17:45:00	270	31.82	10.44	34.0	22,630	
	18:15:00	300	31.93	10.55			
	18:45:00	330	31.99	10.61			
	19:15:00	360	32.08	10.70			
	20:15:00	420	32.28	10.90	34.0	22,894	
	21:15:00	480	32.60	11.22	34.0	23,011	
	23:15:00	600	32.76	11.38	34.0	23,233	
2019-12-13	1:15:00	720	32.85	11.47	34.0	23,454	
	3:15:00	840	32.87	11.49	34.0	23,682	
	5:15:00	960	32.87	11.49	34.0	23,904	
	7:15:00	1,080	32.74	11.36	34.0	24,127	
	9:15:00	1,200	32.63	11.25	34.0	24,345	
	11:15:00	1,320	32.54	11.16	34.0	24,566	
	13:15:00	1,440	32.53	11.15	31.0	24,785	
	15:15:00	1,560	33.18	11.80	34.0	25,108	
	17:15:00	1,680	33.28	11.90	34.0	25,237	

Aquifer Test (Pumping Well E9)

Lotowater
TECHNICAL SERVICES INC.

Top of 1" flush joint = 0.70 m above ground level

WELL NAME: **Well E9**

Sheet: 3 of 5

Date	Time	Elapsed Time	Water Level	Drawdown	Flow Rate	Totalizer	Comments
yyyy-mm-dd	*hr:min*	*min*	*mbMP*	*m*	*L/s*	*m3*	
	19:15:00	1,800	33.30	11.92	34.0	25,472	
	21:15:00	1,920	33.31	11.93	34.0	25,697	
	23:15:00	2,040	33.38	12.00	34.0	26,169	
2019-12-14	1:15:00	2,160	33.34	11.96	34.0	26,401	
	3:15:00	2,280	33.28	11.90	34.0	26,634	
	5:15:00	2,400	33.24	11.86	34.0	26,869	
	7:15:00	2,520	33.25	11.87	34.0	27,100	
	9:15:00	2,640	33.25	11.87	34.0		
	11:15:00	2,760	33.23	11.85	34.0	27,333	
	13:15:00	2,880	33.22	11.84	34.0	27,564	
	15:15:00	3,000	33.20	11.82	34.0	27,801	
	17:15:00	3,120	33.21	11.83	34.0	28,031	
	19:15:00	3,240	33.22	11.84	34.0	28,267	
	21:15:00	3,360	33.22	11.84	34.0	28,494	
	23:15:00	3,480	33.22	11.84	34.0	28,725	
2019-12-15	1:15:00	3,600	33.21	11.83	34.0	28,959	
	3:15:00	3,720	33.21	11.83	34.0	29,203	
	5:15:00	3,840	33.19	11.81	34.0	29,428	
	7:15:00	3,960	33.18	11.80	34.0	29,657	
	9:15:00	4,080	33.22	11.84	34.0	29,893	
	11:15:00	4,200	33.22	11.84	34.0	30,124	
	13:15:00	4,320	33.21	11.83		30,359	
	15:15:00	4,440	33.23	11.85	34.0	30,590	
	17:15:00	4,560	33.23	11.85	34.0	30,816	
	19:15:00	4,680	33.21	11.83	34.0	31,052	
	21:15:00	4,800	33.16	11.78	34.0	31,283	
	23:15:00	4,920	33.16	11.78	34.0	31,522	
2019-12-16	1:15:00	5,040	33.15	11.77	34.0	31,754	
	3:15:00	5,160	33.14	11.76	34.0	32,028	
	5:15:00	5,280	33.18	11.80	34.0	32,225	

Top of 1" flush joint = 0.70 m above ground level

WELL NAME: **Well E9**

Sheet: 4 of 5

Date	Time	Elapsed Time	Water Level	Drawdown	Flow Rate	Totalizer	Comments
yyyy-mm-dd	*hr:min*	*min*	*mbMP*	*m*	*L/s*	*m3*	
	7:15:00	5,400	33.11	11.73	34.0	32,459	
	9:15:00	5,520	33.14	11.76	34.0	32,681	
	11:15:00	5,640	33.10	11.72	34.0	32,909	
2019-12-16	13:15:00	5,760	33.09	11.71	34.0	33,140	
	15:15:00	5,880	33.10	11.72	34.0	33,372	
	17:15:00	6,000	33.10	11.72	34.0	33,607	
	19:15:00	6,120	33.08	11.70	34.0	33,839	
	21:15:00	6,240	33.06	11.68	34.0	34,071	
	23:15:00	6,360	33.05	11.67	34.0	34,302	
2019-12-17	1:15:00	6,480	33.06	11.68	34.0	34,535	
	3:15:00	6,600	33.05	11.67	34.0	34,752	
	5:15:00	6,720	33.01	11.63	34.0	34,999	
	7:15:00	6,840	33.02	11.64	34.0	35,231	
	9:15:00	6,960	33.00	11.62	32.0	35,464	
	11:15:00	7,080	33.49	12.11	34.0	35,703	
2019-12-17	13:15:00	7,200	33.53	12.15	34.0	35,942	
2019-12-17	13:15:00	0	33.53	12.15			**Recovery**
	13:16:00	1	30.23	8.85			
	13:17:00	2	29.62	8.24			
	13:18:00	3	29.21	7.83			
	13:19:00	4	28.86	7.48			
	13:20:00	5	28.59	7.21			
	13:21:00	6	28.34	6.96			
	13:22:00	7	28.16	6.78			
	13:23:00	8	27.96	6.58			
	13:24:00	9	27.82	6.44			
	13:25:00	10	27.66	6.28			
	13:27:00	12	27.41	6.03			
	13:29:00	14	27.16	5.78			
	13:31:00	16	26.98	5.60			

Aquifer Test (Pumping Well E9)

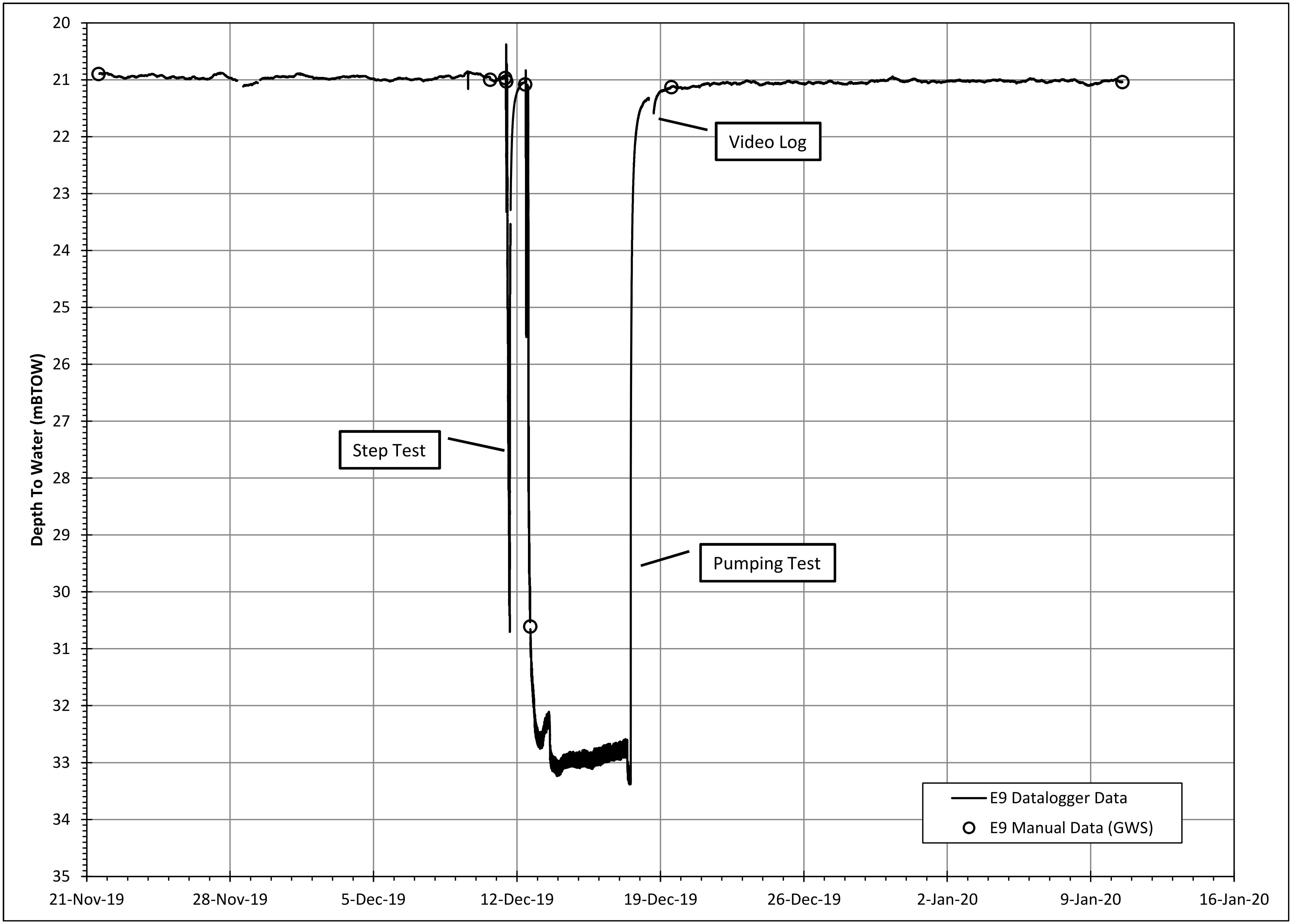
Lotowater TECHNICAL SERVICES INC.

Top of 1" flush joint = 0.70 m above ground level

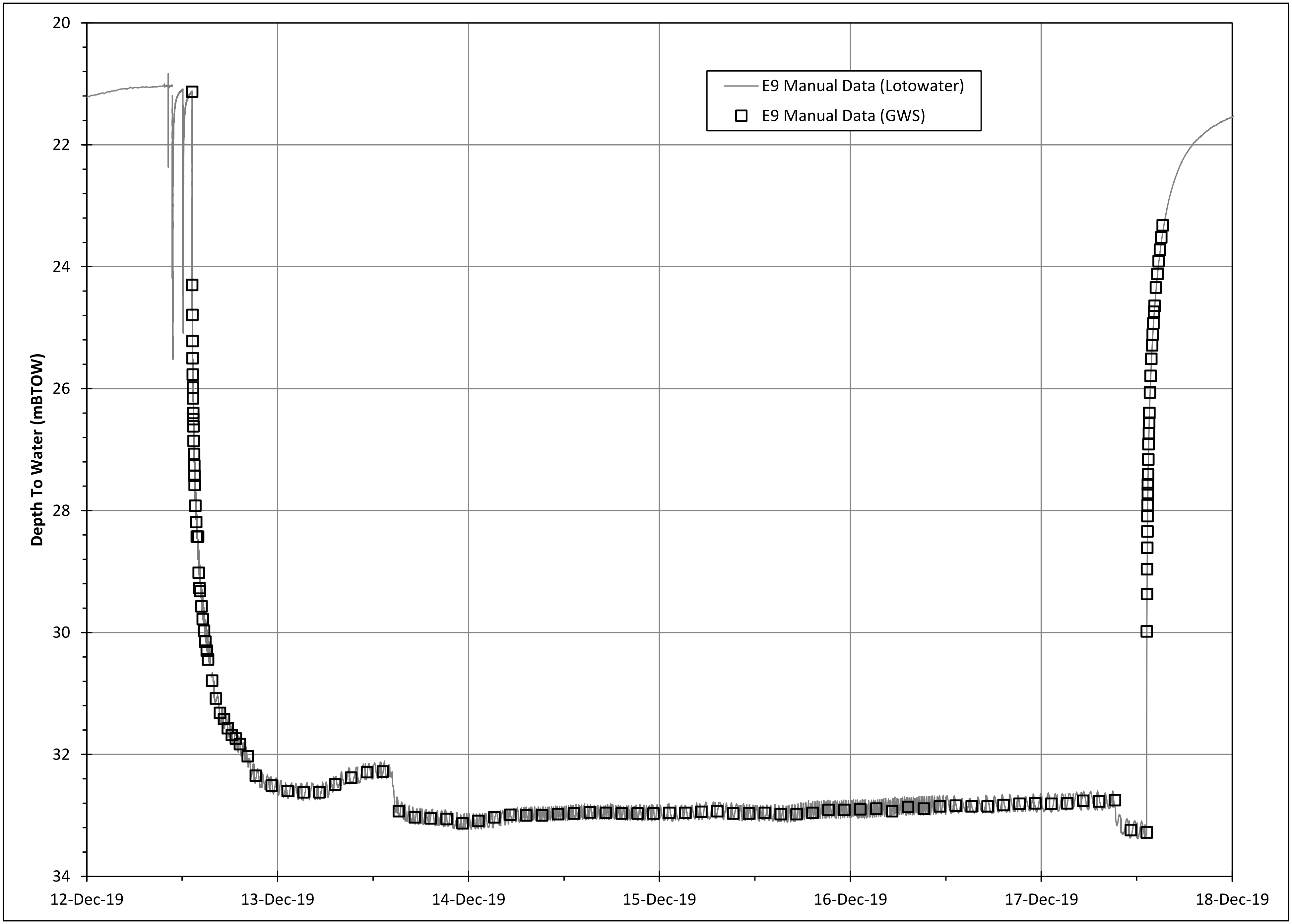
WELL NAME: **Well E9**

Sheet: 5 of 5

Date	**Time**	**Elapsed Time**	**Water Level**	**Drawdown**	**Flow Rate**	**Totalizer**	**Comments**
yyyy-mm-dd	***hr:min***	***min***	***mbMP***	***m***	***L/s***	***m3***	
	13:33:00	18	26.81	5.43			
	13:35:00	20	26.65	5.27			
	13:40:00	25	26.31	4.93			
	13:45:00	30	26.04	4.66			
	13:50:00	35	25.76	4.38			
	13:55:00	40	25.54	4.16			
	14:00:00	45	25.36	3.98			
	14:05:00	50	25.18	3.80			
	14:10:00	55	24.99	3.61			
	14:15:00	60	24.89	3.51			
	14:25:00	70	24.59	3.21			73.6%
	14:35:00	80	24.37	2.99			
2019-12-17	14:45:00	90	24.16	2.78			
	14:55:00	100	23.97	2.59			
	15:05:00	110	23.77	2.39			
	15:15:00	120	23.57	2.19			82.0%
						Test Average Rate	
						22,102	start (m^3)
						35,942	end (m^3)
						13,840	total (m^3)
						7,200	time (min)
						1,922	L/min
						32.0	L/s



Well E9 Long Term Hydrograph



Town of Erin
Water Supply EA

Well E9 Pump Test Hydrograph

Groundwater Science Corp
Hydrogeological Assessment

Appendix J
Water Quality Results

ALS		Sample ID:				E9 START	E9 DEC 15, 2019	E9 END
2/13/2020		ALS ID:				L2395777-1	L2396768-1	L2397456-1
Multiple Work Orders		Date Sampled:				12/12/2019 1:45:00 PM	12/15/2019 1:15:00 PM	12/17/2019 11:30:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water	Water
Colour, Apparent	CU	2	-	5	-	4	5.2	2.2
Colour, True	CU	2	-	-	-	-	-	<2.0
Conductivity	umhos/cm	3	-	-	-	704	727	-
Hardness (as CaCO3)	mg/L	2.4	-	-	100	-	-	380 *
pH	pH units	0.1	-	6.5-8.5	-	8.29	8.04 *	8.01
Redox Potential	mV	-1000	-	-	-	266 *	284 *	-
Total Dissolved Solids	mg/L	20	-	500	-	470 *	509 *	538 *
Turbidity	NTU	0.1	-	5	-	1.21	1.02	-
Alkalinity, Bicarbonate (as CaCO3)	mg/L	2	-	-	-	184	178	-
Alkalinity, Carbonate (as CaCO3)	mg/L	2	-	-	-	<2.0	<2.0	-
Alkalinity, Hydroxide (as CaCO3)	mg/L	2	-	-	-	<2.0	<2.0	-
Alkalinity, Total (as CaCO3)	mg/L	2	-	-	500	186	179	183 *
Ammonia, Total (as N)	mg/L	0.01	-	-	-	0.082	0.072	0.08
Ammonia as N, Dissolved	mg/L	0.01	-	-	-	-	-	0.077
Bromate	ug/L	0.3	10	-	-	-	-	<0.30
Bromide (Br)	mg/L	0.1	-	-	-	<0.10	<0.10	-
Chlorate	mg/L	0.04	1	-	-	-	-	<0.040 *
Chloride (Cl)	mg/L	0.5	-	250	-	2.3	2.56	2.48
Chlorite	mg/L	0.04	1	-	-	-	-	<0.040 *
Computed Conductivity	uS/cm	n/a	-	-	-	748	810	-
Conductivity % Difference	%	n/a	-	-	-	6	11	-
Fluoride (F)	mg/L	0.02	1.5	-	-	0.314	0.31	0.313
Hardness (as CaCO3)	mg/L	n/a	-	-	-	372	414	-
Ion Balance	%	n/a	-	-	-	105	110	-
Langelier Index		n/a	-	-	-	1	1	-
Nitrate and Nitrite as N	mg/L	0.022	10	-	-	-	-	<0.022
Nitrate (as N)	mg/L	0.02	10	-	-	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	0.01	1	-	-	<0.010	<0.010	<0.010
Total Kjeldahl Nitrogen	mg/L	0.15	-	-	-	-	-	<0.15
Total Organic Nitrogen	mg/L	0.15	-	-	-	-	-	<0.15
Total Kjeldahl Nitrogen, Dissolved	mg/L	0.15	-	-	-	-	-	<0.15
Saturation pH	pH	n/a	-	-	-	7.21	7.19	-
Orthophosphate-Dissolved (as P)	mg/L	0.003	-	-	-	<0.0030	<0.0030	-
TDS (Calculated)	mg/L	n/a	-	-	-	463	502	-
Sulfate (SO4)	mg/L	0.3	-	500	-	209	235	228
Sulphide (as S)	mg/L	0.018	-	0.05	-	-	-	<0.018
Sulphide (as H2S)	mg/L	0.019	-	0.05	-	-	-	<0.019
Anion Sum	me/L	n/a	-	-	-	7.53	7.96	-
Cation Sum	me/L	n/a	-	-	-	7.88	8.76	-
Cation - Anion Balance	%	n/a	-	-	-	2	5	-
Cyanide, Weak Acid Diss	mg/L	0.002	-	-	-	-	-	<0.0020
Dissolved Carbon Filtration Location		n/a	-	-	-	-	-	LAB
Dissolved Organic Carbon	mg/L	0.5	-	5	-	-	-	0.59
Chloramines	mg/L	0.05	3	-	-	-	-	<0.050
Chlorine, Free	mg/L	0.05	-	-	-	-	-	<0.050 *
Chlorine, Total	mg/L	0.05	-	-	-	-	-	<0.050 *
Silica Total	mg/L	0.21	-	-	-	13.8	13.6	-
Nonviable oocysts	oocysts	0	-	-	-	-	-	0
Cryptosporidium	oocysts/L	0.1	-	-	-	-	-	<0.1
E. Coli	CFU/100mL	0	0	-	-	0	0	0
Giardia	cysts/L	0.1	-	-	-	-	-	<0.1
Giardia Volume Filtered	L	0.1	-	-	-	-	-	3
Total Giardia	cysts/vol	1	-	-	-	-	-	<1
Nonviable Giardia	cysts	1	-	-	-	-	-	<1
Total Coliform Background	CFU/100mL	0	-	-	-	38	1	-
Total Coliforms	CFU/100mL	0	0	-	-	18	2	2
Viable Cysts	cysts	1	-	-	-	-	-	<1
Viable oocysts	oocysts	0	-	-	-	-	-	0
Sodium Adsorption Ratio	SAR	0.1	-	-	-	0.21	0.22	-
Aluminum (Al) Total	ug/L	10	-	-	100	-	-	<10

ALS	Sample ID:					E9 START	E9 DEC 15, 2019	E9 END
2/13/2020		ALS ID:				L2395777-1	L2396768-1	L2397456-1
Multiple Work Orders	Date Sampled:					12/12/2019 1:45:00 PM	12/15/2019 1:15:00 PM	12/17/2019 11:30:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water	Water
Aluminum (Al)-Total	mg/L	0.01	-	-	0.1	<0.010	<0.010	-
Antimony (Sb) Total	ug/L	0.6	6	-	-	-	-	<0.60
Antimony (Sb)-Total	mg/L	0.0001	0.006	-	-	0.0001	<0.00010	-
Arsenic (As) Total	ug/L	1	10	-	-	-	-	1.6
Arsenic (As)-Total	mg/L	0.0001	0.01	-	-	0.00159	0.00164	-
Barium (Ba) Total	ug/L	10	1000	-	-	-	-	14
Barium (Ba)-Total	mg/L	0.0002	1	-	-	0.014	0.0139	-
Beryllium (Be)-Total	mg/L	0.0001	-	-	-	<0.00010	<0.00010	-
Bismuth (Bi)-Total	mg/L	0.00005	-	-	-	<0.000050	<0.000050	-
Boron (B) Total	ug/L	50	5000	-	-	-	-	<50
Boron (B)-Total	mg/L	0.01	5	-	-	0.036	0.035	-
Cadmium (Cd) Total	ug/L	0.1	5	-	-	-	-	<0.10
Cadmium (Cd)-Total	mg/L	0.00001	0.005	-	-	0.000013	0.00001	-
Calcium (Ca) Total	mg/L	0.5	-	-	-	-	-	104
Calcium (Ca)-Total	mg/L	0.5	-	-	-	101	113	-
Cesium (Cs)-Total	mg/L	0.00001	-	-	-	<0.000010	<0.000010	-
Chromium (Cr) Total	ug/L	1	50	-	-	-	-	<1.0
Chromium (Cr)-Total	mg/L	0.0005	0.05	-	-	<0.00050	<0.00050	-
Cobalt (Co)-Total	mg/L	0.0001	-	-	-	0.00085	0.00079	-
Copper (Cu) Total	ug/L	1	-	1000	-	-	-	<1.0
Copper (Cu)-Total	mg/L	0.001	-	1	-	<0.0010	<0.0010	-
Iron (Fe) Total	ug/L	50	-	300	-	-	-	84
Iron (Fe)-Total	mg/L	0.05	-	0.3	-	0.102	0.108	-
Lead (Pb) Total	ug/L	1	10	-	-	-	-	<1.0
Lead (Pb)-Total	mg/L	0.0001	0.01	-	-	0.00028	0.00028	-
Magnesium (Mg) Total	mg/L	0.5	-	-	-	-	-	29.4
Magnesium (Mg)-Total	mg/L	0.05	-	-	-	29.4	32.4	-
Manganese (Mn) Total	ug/L	1	-	50	-	-	-	44.6
Manganese (Mn)-Total	mg/L	0.0005	-	0.05	-	0.0476	0.0476	-
Molybdenum (Mo)-Total	mg/L	0.00005	-	-	-	0.00532	0.00496	-
Nickel (Ni)-Total	mg/L	0.0005	-	-	-	0.00157	0.00129	-
Phosphorus (P)-Total	mg/L	0.05	-	-	-	<0.050	<0.050	-
Potassium (K)-Total	mg/L	0.05	-	-	-	1.36	1.28	-
Rubidium (Rb)-Total	mg/L	0.0002	-	-	-	0.00139	0.00141	-
Selenium (Se) Total	ug/L	5	50	-	-	-	-	<5.0
Selenium (Se)-Total	mg/L	0.00005	0.05	-	-	<0.000050	<0.000050	-
Silicon (Si)-Total	mg/L	0.1	-	-	-	6.45	6.36	-
Silver (Ag)-Total	mg/L	0.00005	-	-	-	<0.000050	<0.000050	-
Sodium (Na) Total	mg/L	0.5	20	200	-	-	-	9.29
Sodium (Na)-Total	mg/L	0.5	20	200	-	9.1	10.2	-
Strontium (Sr)-Total	mg/L	0.001	-	-	-	1.43	1.54	-
Sulfur (S)-Total	mg/L	0.5	-	-	-	77.8	84.3	-
Tellurium (Te)-Total	mg/L	0.0002	-	-	-	<0.00020	<0.00020	-
Thallium (Tl)-Total	mg/L	0.00001	-	-	-	0.000065	0.00006	-
Thorium (Th)-Total	mg/L	0.0001	-	-	-	<0.00010	<0.00010	-
Tin (Sn)-Total	mg/L	0.0001	-	-	-	<0.00010	0.00021	-
Titanium (Ti)-Total	mg/L	0.0003	-	-	-	<0.00030	<0.00030	-
Tungsten (W)-Total	mg/L	0.0001	-	-	-	<0.00010	<0.00010	-
Uranium (U) Total	ug/L	5	20	-	-	-	-	<5.0
Uranium (U)-Total	mg/L	0.00001	0.02	-	-	0.0011	0.000938	-
Vanadium (V)-Total	mg/L	0.0005	-	-	-	<0.00050	<0.00050	-
Zinc (Zn) Total	ug/L	3	-	5000	-	-	-	33.6
Zinc (Zn)-Total	mg/L	0.003	-	5	-	0.0226	0.0403	-
Zirconium (Zr)-Total	mg/L	0.0003	-	-	-	<0.00030	<0.00030	-
Mercury	ug/L	0.1	1	-	-	-	-	<0.10
Chromium, Hexavalent	mg/L	0.0005	-	-	-	-	-	<0.00050
Acetone	ug/L	20	-	-	-	-	-	<20
Benzene	ug/L	0.5	1	-	-	-	-	<0.50
Bromodichloromethane	ug/L	1	-	-	-	-	-	<1.0
Bromoform	ug/L	1	-	-	-	-	-	<1.0

ALS		Sample ID:				E9 START	E9 DEC 15, 2019	E9 END
2/13/2020		ALS ID:				L2395777-1	L2396768-1	L2397456-1
Multiple Work Orders		**Date Sampled:**				12/12/2019 1:45:00 PM	12/15/2019 1:15:00 PM	12/17/2019 11:30:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water	Water
Bromomethane	ug/L	0.5	-	-	-	-	-	<0.50
Carbon Disulfide	ug/L	1	-	-	-	-	-	<1.0
Carbon tetrachloride	ug/L	0.5	2	-	-	-	-	<0.50
Chlorobenzene	ug/L	0.5	80	30	-	-	-	<0.50
Dibromochloromethane	ug/L	1	-	-	-	-	-	<1.0
Chloroethane	ug/L	1	-	-	-	-	-	<1.0
Chloroform	ug/L	1	-	-	-	-	-	<1.0
Chloromethane	ug/L	1	-	-	-	-	-	<1.0
1,2-Dibromoethane	ug/L	0.2	-	-	-	-	-	<0.20
1,2-Dichlorobenzene	ug/L	0.5	200	3	-	-	-	<0.50
1,3-Dichlorobenzene	ug/L	0.5	-	-	-	-	-	<0.50
1,4-Dichlorobenzene	ug/L	0.5	5	1	-	-	-	<0.50
Dichlorodifluoromethane	ug/L	1	-	-	-	-	-	<1.0
1,1-Dichloroethane	ug/L	0.5	-	-	-	-	-	<0.50
1,2-Dichloroethane	ug/L	0.5	5	-	-	-	-	<0.50
1,1-Dichloroethylene	ug/L	0.5	14	-	-	-	-	<0.50
cis-1,2-Dichloroethylene	ug/L	0.5	-	-	-	-	-	<0.50
trans-1,2-Dichloroethylene	ug/L	0.5	-	-	-	-	-	<0.50
Dichloromethane	ug/L	2	50	-	-	-	-	<2.0
1,2-Dichloropropane	ug/L	0.5	-	-	-	-	-	<0.50
cis-1,3-Dichloropropene	ug/L	0.5	-	-	-	-	-	<0.50
trans-1,3-Dichloropropene	ug/L	0.5	-	-	-	-	-	<0.50
Ethylbenzene	ug/L	0.5	140	2.4	-	-	-	<0.50
n-Hexane	ug/L	0.5	-	-	-	-	-	<0.50
2-Hexanone	ug/L	20	-	-	-	-	-	<20
Methyl Ethyl Ketone	ug/L	20	-	-	-	-	-	<20
Methyl Isobutyl Ketone	ug/L	20	-	-	-	-	-	<20
MTBE	ug/L	0.5	15	-	-	-	-	<0.50
Styrene	ug/L	0.5	-	-	-	-	-	<0.50
1,1,1,2-Tetrachloroethane	ug/L	0.5	-	-	-	-	-	<0.50
1,1,2,2-Tetrachloroethane	ug/L	0.5	-	-	-	-	-	<0.50
Tetrachloroethylene	ug/L	0.5	10	-	-	-	-	<0.50
Toluene	ug/L	0.5	60	24	-	-	-	<0.50
1,1,1-Trichloroethane	ug/L	0.5	-	-	-	-	-	<0.50
1,1,2-Trichloroethane	ug/L	0.5	-	-	-	-	-	<0.50
Trichloroethylene	ug/L	0.5	5	-	-	-	-	<0.50
Trichlorofluoromethane	ug/L	1	-	-	-	-	-	<1.0
Vinyl chloride	ug/L	0.5	1	-	-	-	-	<0.50
o-Xylene	ug/L	0.5	-	-	-	-	-	<0.50
m+p-Xylenes	ug/L	1	-	-	-	-	-	<1.0
Xylenes (Total)	ug/L	1.1	90	300	-	-	-	<1.1
4-Bromofluorobenzene	%	Surrogate	-	-	-	-	-	100.1
1,4-Difluorobenzene	%	Surrogate	-	-	-	-	-	101.9 *
Benzo(a)pyrene	ug/L	0.005	0.01	-	-	-	-	<0.0050
d14-Terphenyl	%	Surrogate	-	-	-	-	-	71
Bromodichloromethane	ug/L	2	-	-	-	-	-	<2.0
Bromoform	ug/L	2	-	-	-	-	-	<2.0
Dibromochloromethane	ug/L	2	-	-	-	-	-	<2.0
Chloroform	ug/L	2	-	-	-	-	-	<2.0
Total THMs	ug/L	4	100	-	-	-	-	<4.0
Dibromoacetic Acid	ug/L	1	-	-	-	-	-	<1.0
Dichloroacetic Acid	ug/L	1	-	-	-	-	-	<1.0
Total Haloacetic Acids 5	ug/L	2.2	80	-	-	-	-	<2.2
Bromoacetic Acid	ug/L	1	-	-	-	-	-	<1.0
Chloroacetic acid	ug/L	1	-	-	-	-	-	<1.0
Trichloroacetic Acid	ug/L	1	-	-	-	-	-	<1.0
2-Bromobutanoic Acid	%	Surrogate	-	-	-	-	-	92.5
N-Nitrosodimethylamine	ng/L	0.5	9	-	-	-	-	0.57 *
N-Nitrosodimethylamine (Surr.)	%	Surrogate	-	-	-	-	-	61
Aroclor 1242	ug/L	0.02	-	-	-	-	-	<0.020

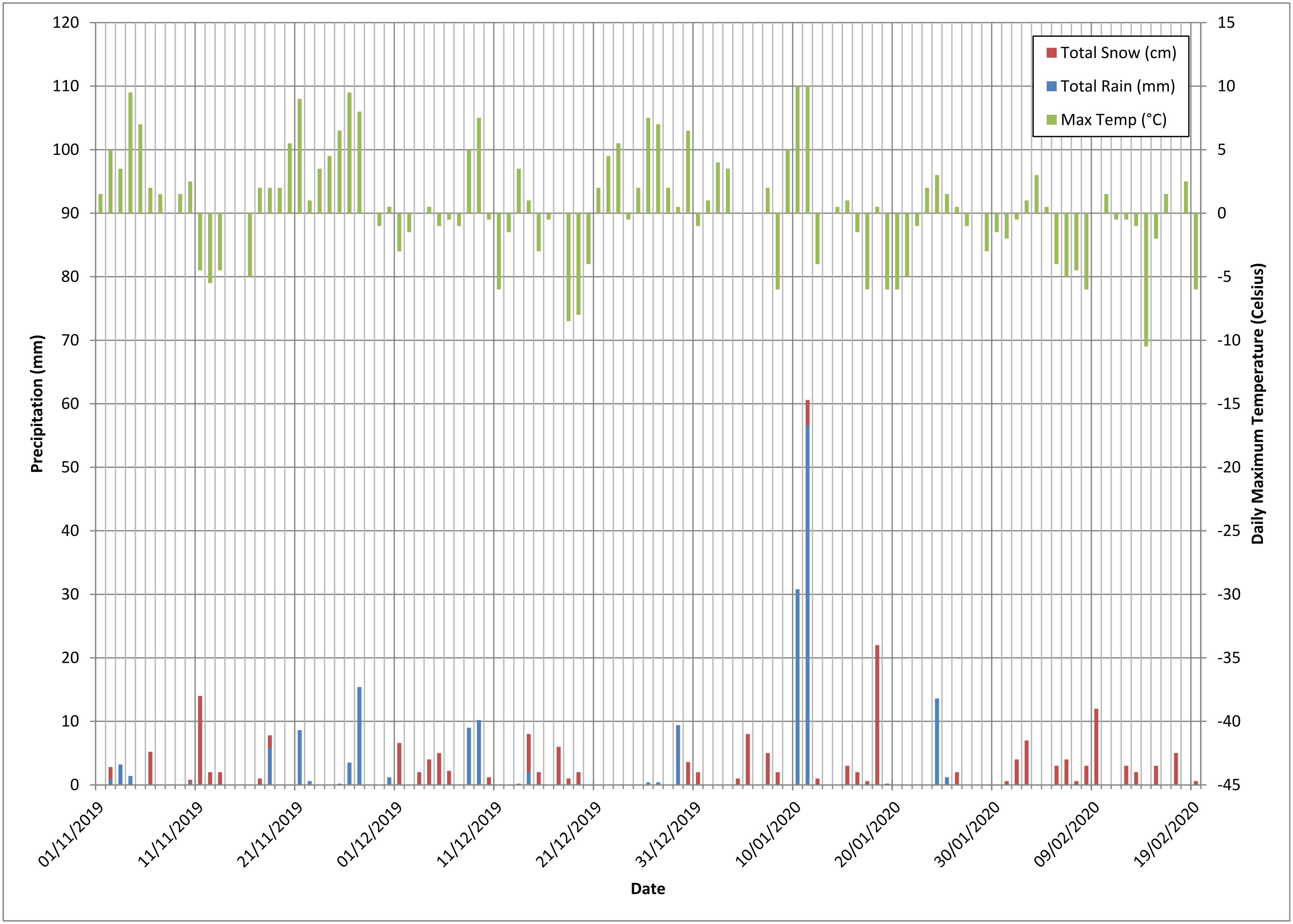
ALS		Sample ID:				E9 START	E9 DEC 15, 2019	E9 END
2/13/2020		ALS ID:				L2395777-1	L2396768-1	L2397456-1
Multiple Work Orders		Date Sampled:				12/12/2019 1:45:00 PM	12/15/2019 1:15:00 PM	12/17/2019 11:30:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water	Water
Aroclor 1254	ug/L	0.02	-	-	-	-	-	<0.020
Aroclor 1260	ug/L	0.02	-	-	-	-	-	<0.020
Total PCBs	ug/L	0.035	3	-	-	-	-	<0.035
d14-Terphenyl	%	Surrogate	-	-	-	-	-	81
alpha-Chlordane	ug/L	0.1	-	-	-	-	-	<0.10
gamma-Chlordane	ug/L	0.1	-	-	-	-	-	<0.10
p,p-DDD	ug/L	0.1	-	-	-	-	-	<0.10
p,p-DDE	ug/L	0.1	-	-	-	-	-	<0.10
o,p-DDT	ug/L	0.1	-	-	-	-	-	<0.10
p,p-DDT	ug/L	0.1	-	-	-	-	-	<0.10
Oxychlordane	ug/L	0.1	-	-	-	-	-	<0.10
d14-Terphenyl	%	Surrogate	-	-	-	-	-	83.6
Bromoxynil	ug/L	0.2	5	-	-	-	-	<0.20 *
2,4-D	ug/L	0.2	100	-	-	-	-	<0.20 *
Dicamba	ug/L	0.2	120	-	-	-	-	<0.20 *
Glyphosate	ug/L	5	280	-	-	-	-	<5.0
MCPA	ug/L	0.2	100	-	-	-	-	<0.20 *
Picloram	ug/L	0.2	190	-	-	-	-	<0.20 *
2,4-Dichlorophenylacetic Acid	%	Surrogate	-	-	-	-	-	96.7
Aldicarb	ug/L	0.9	9	-	-	-	-	<0.90
Alachlor	ug/L	0.1	5	-	-	-	-	<0.10
Atrazine	ug/L	0.1	-	-	-	-	-	<0.10
Atrazine & Metabolites	ug/L	0.2	5	-	-	-	-	<0.20
Azinphos-methyl	ug/L	0.1	20	-	-	-	-	<0.10
Carbaryl	ug/L	0.2	90	-	-	-	-	<0.20
Carbofuran	ug/L	0.2	90	-	-	-	-	<0.20
Chlorpyrifos	ug/L	0.1	90	-	-	-	-	<0.10
Diazinon	ug/L	0.1	20	-	-	-	-	<0.10
2,4-Dichlorophenol	ug/L	0.3	900	0.3	-	-	-	<0.30
Dimethoate	ug/L	0.1	20	-	-	-	-	<0.10
Diquat	ug/L	1	70	-	-	-	-	<1.0
Diuron	ug/L	1	150	-	-	-	-	<1.0
Atrazine Desethyl	ug/L	0.1	-	-	-	-	-	<0.10
Malathion	ug/L	0.1	190	-	-	-	-	<0.10
Diclofop-methyl	ug/L	0.2	9	-	-	-	-	<0.20
Metolachlor	ug/L	0.1	50	-	-	-	-	<0.10
Metribuzin	ug/L	0.1	80	-	-	-	-	<0.10
Paraquat	ug/L	1	10	-	-	-	-	<1.0
Pentachlorophenol	ug/L	0.5	60	30	-	-	-	<0.50
Phorate	ug/L	0.1	2	-	-	-	-	<0.10
Prometryne	ug/L	0.1	1	-	-	-	-	<0.10
Simazine	ug/L	0.1	10	-	-	-	-	<0.10
Terbufos	ug/L	0.2	1	-	-	-	-	<0.20
2,3,4,6-Tetrachlorophenol	ug/L	0.5	100	1	-	-	-	<0.50
Triallate	ug/L	0.1	230	-	-	-	-	<0.10
2,4,6-Trichlorophenol	ug/L	0.5	5	2	-	-	-	<0.50
Trifluralin	ug/L	0.1	45	-	-	-	-	<0.10
2-Fluorobiphenyl	%	Surrogate	-	-	-	-	-	66.7
2,4,6-Tribromophenol	%	Surrogate	-	-	-	-	-	106.7
2,3,7,8-TCDD	pg/L	2.4	-	-	-	-	-	<2.4 *
1,2,3,7,8-PeCDD	pg/L	0.37	-	-	-	-	-	0.73 *
1,2,3,4,7,8-HxCDD	pg/L	0.43	-	-	-	-	-	<0.43 *
1,2,3,6,7,8-HxCDD	pg/L	0.42	-	-	-	-	-	<0.42 *
1,2,3,7,8,9-HxCDD	pg/L	0.42	-	-	-	-	-	0.48 *
1,2,3,4,6,7,8-HpCDD	pg/L	0.48	-	-	-	-	-	<0.48 *
OCDD	pg/L	0.61	-	-	-	-	-	2.02 *
Total-TCDD	pg/L	2.4	-	-	-	-	-	<2.4 *
Total TCDD # Homologues		n/a	-	-	-	-	-	0
Total-PeCDD	pg/L	0.37	-	-	-	-	-	0.73
Total PeCDD # Homologues		n/a	-	-	-	-	-	1

ALS		**Sample ID:**				E9 START	E9 DEC 15, 2019	E9 END
2/13/2020		**ALS ID:**				L2395777-1	L2396768-1	L2397456-1
Multiple Work Orders		**Date Sampled:**				12/12/2019 1:45:00 PM	12/15/2019 1:15:00 PM	12/17/2019 11:30:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water	Water
Total-HxCDD	pg/L	0.43	-	-	-	-	-	0.48
Total HxCDD # Homologues		n/a	-	-	-	-	-	1
Total-HpCDD	pg/L	0.48	-	-	-	-	-	<0.48 *
Total HpCDD # Homologues		n/a	-	-	-	-	-	0
2,3,7,8-TCDF	pg/L	0.48	-	-	-	-	-	<0.48 *
1,2,3,7,8-PeCDF	pg/L	0.35	-	-	-	-	-	<0.35 *
2,3,4,7,8-PeCDF	pg/L	0.26	-	-	-	-	-	<0.26 *
1,2,3,4,7,8-HxCDF	pg/L	0.39	-	-	-	-	-	0.55 *
1,2,3,6,7,8-HxCDF	pg/L	0.4	-	-	-	-	-	0.51 *
1,2,3,7,8,9-HxCDF	pg/L	0.56	-	-	-	-	-	0.85 *
2,3,4,6,7,8-HxCDF	pg/L	0.4	-	-	-	-	-	<0.40 *
1,2,3,4,6,7,8-HpCDF	pg/L	0.37	-	-	-	-	-	0.70 *
1,2,3,4,7,8,9-HpCDF	pg/L	0.42	-	-	-	-	-	0.86 *
OCDF	pg/L	0.47	-	-	-	-	-	1.30 *
Total-TCDF	pg/L	0.48	-	-	-	-	-	<0.48 *
Total TCDF # Homologues		n/a	-	-	-	-	-	0
Total-PeCDF	pg/L	0.35	-	-	-	-	-	<0.35 *
Total PeCDF # Homologues		n/a	-	-	-	-	-	0
Total-HxCDF	pg/L	0.56	-	-	-	-	-	<0.56 *
Total HxCDF # Homologues		n/a	-	-	-	-	-	0
Total-HpCDF	pg/L	0.42	-	-	-	-	-	0.86
Total HpCDF # Homologues		n/a	-	-	-	-	-	1
13C12-2,3,7,8-TCDD	%	Surrogate	-	-	-	-	-	22
13C12-1,2,3,7,8-PeCDD	%	Surrogate	-	-	-	-	-	72
13C12-1,2,3,4,7,8-HxCDD	%	Surrogate	-	-	-	-	-	64
13C12-1,2,3,6,7,8-HxCDD	%	Surrogate	-	-	-	-	-	68
13C12-1,2,3,4,6,7,8-HpCDD	%	Surrogate	-	-	-	-	-	66
13C12-OCDD	%	Surrogate	-	-	-	-	-	62
13C12-2,3,7,8-TCDF	%	Surrogate	-	-	-	-	-	65
13C12-1,2,3,7,8-PeCDF	%	Surrogate	-	-	-	-	-	69
13C12-2,3,4,7,8-PeCDF	%	Surrogate	-	-	-	-	-	71
13C12-1,2,3,4,7,8-HxCDF	%	Surrogate	-	-	-	-	-	63
13C12-1,2,3,6,7,8-HxCDF	%	Surrogate	-	-	-	-	-	68
13C12-2,3,4,6,7,8-HxCDF	%	Surrogate	-	-	-	-	-	66
13C12-1,2,3,7,8,9-HxCDF	%	Surrogate	-	-	-	-	-	61
13C12-1,2,3,4,6,7,8-HpCDF	%	Surrogate	-	-	-	-	-	66
13C12-1,2,3,4,7,8,9-HpCDF	%	Surrogate	-	-	-	-	-	74
37Cl4-2,3,7,8-TCDD (Cleanup)	%	Surrogate	-	-	-	-	-	26.0 *
Microcystin	ug/L	0.2	1.5	-	-	-	-	<0.20
Nitrilotriacetic Acid (NTA)	mg/L	0.2	0.4	-	-	-	-	<0.20
Lower Bound PCDD/F TEQ (WHO 2005)	pg/L	n/a	-	-	-	-	-	0.839
Mid Point PCDD/F TEQ (WHO 2005)	pg/L	n/a	-	-	-	-	-	2.32
Upper Bound PCDD/F TEQ (WHO 2005)	pg/L	n/a	-	-	-	-	-	3.65
* = Result Qualified								

Applied Guideline:
Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON Drinking Water Standards, Objectives and Guidelines

Color Key:	🟩 Within Guideline	🟥 Exceeds Guideline						

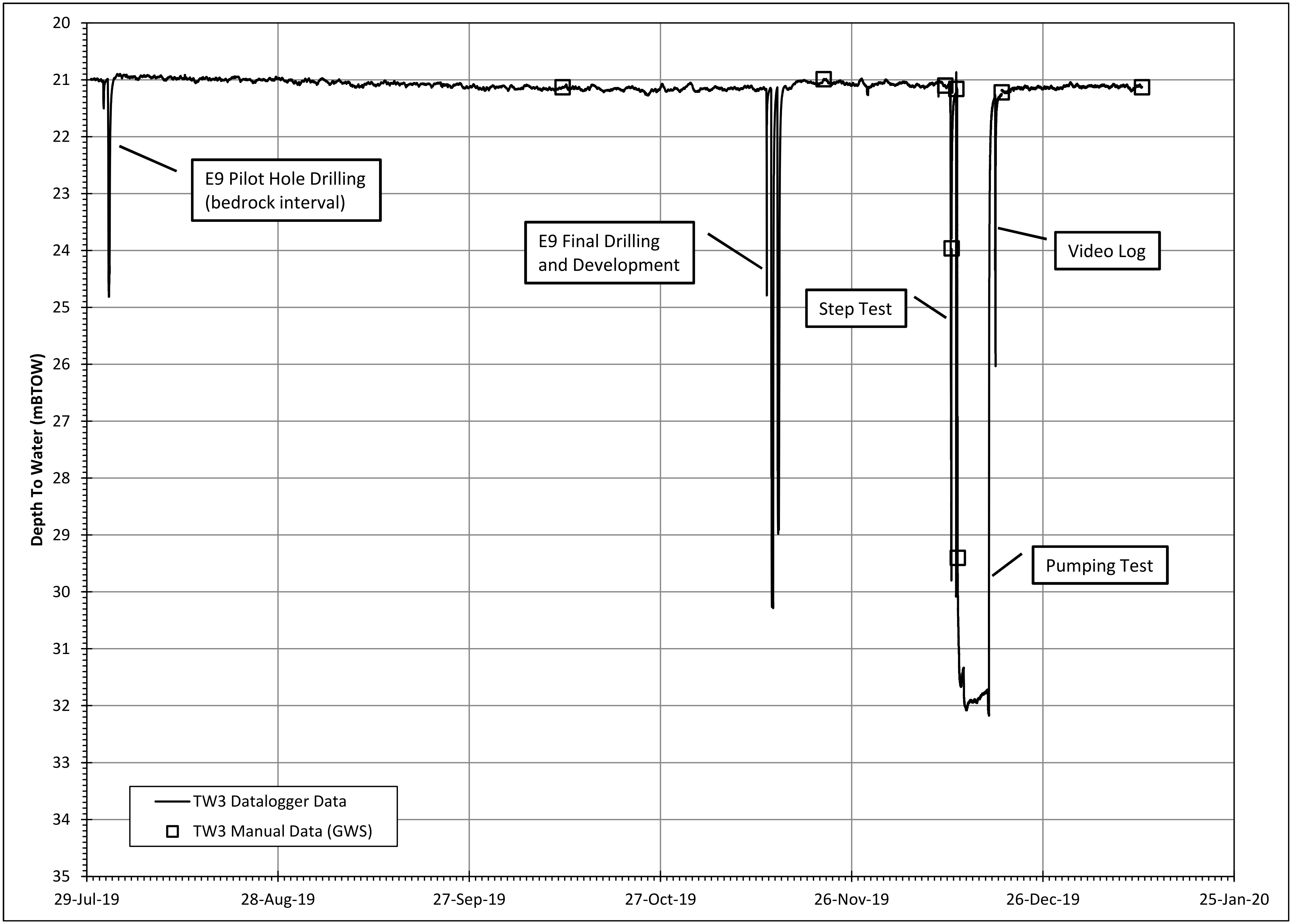
Appendix K
Climate Summary



Climate Summary - Environment Canada Fergus Shand Dam Station

Appendix L

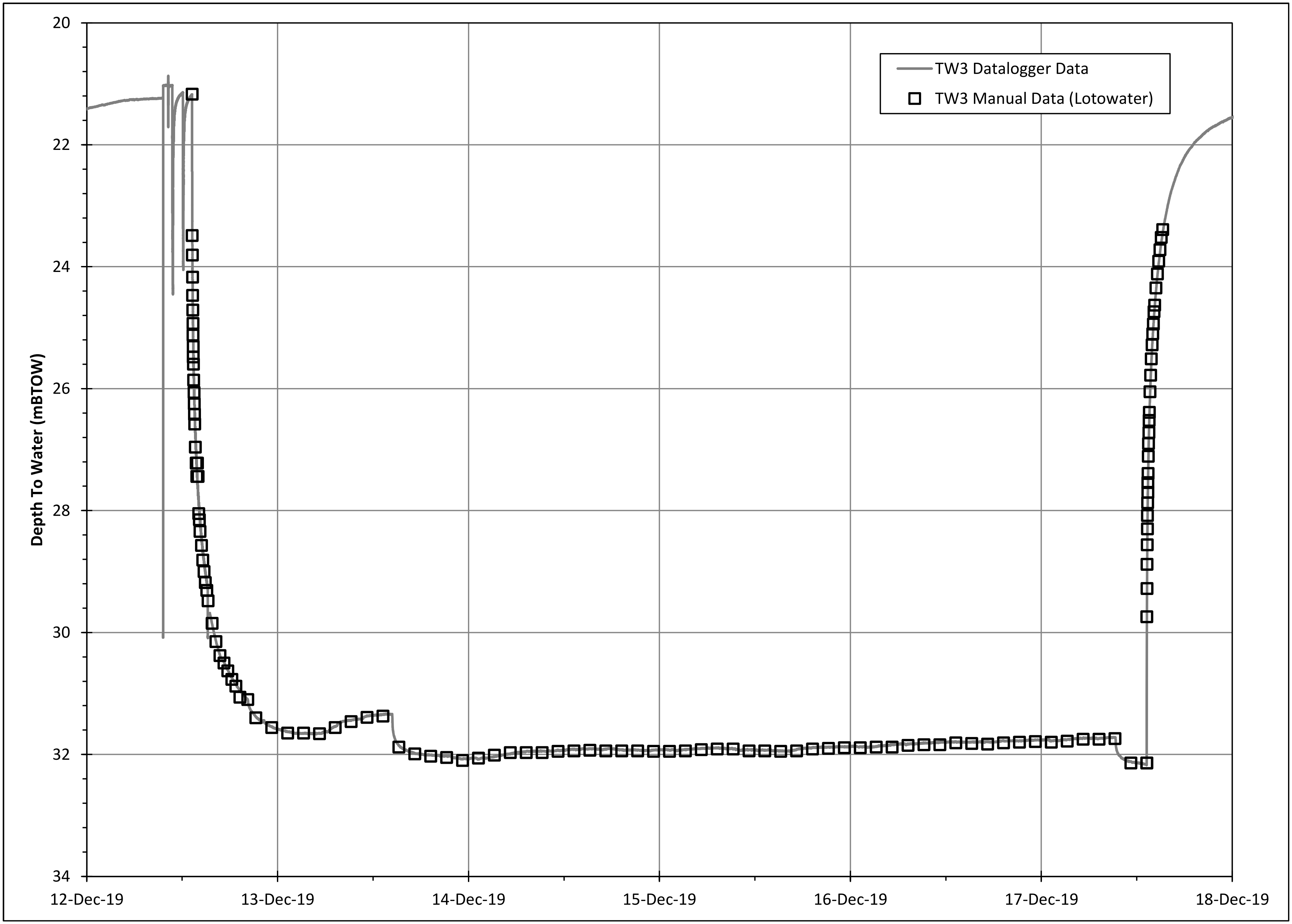
Pump Test Results: Observation Wells



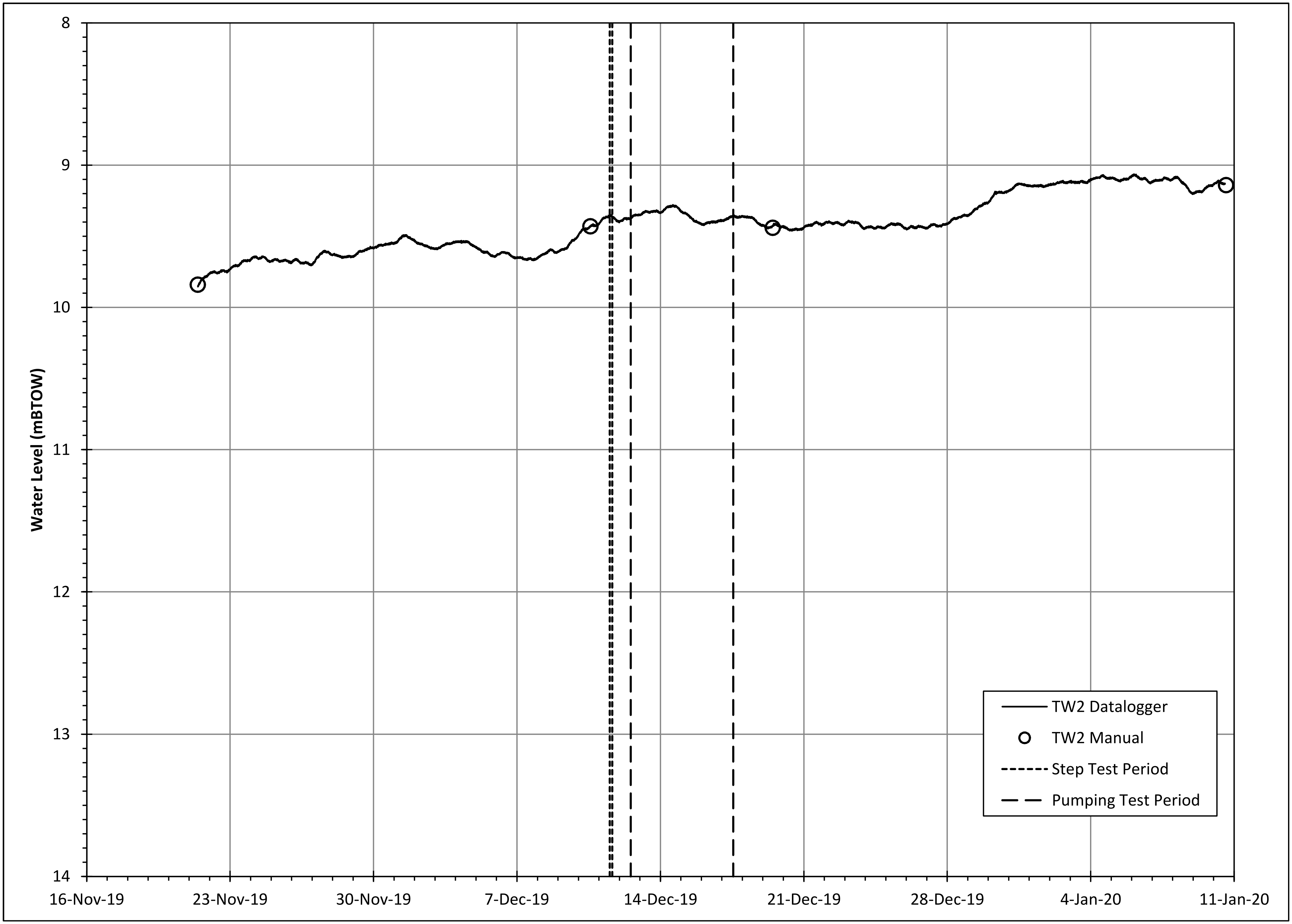
Town of Erin
Water Supply EA

TW3 Long Term Hydrograph

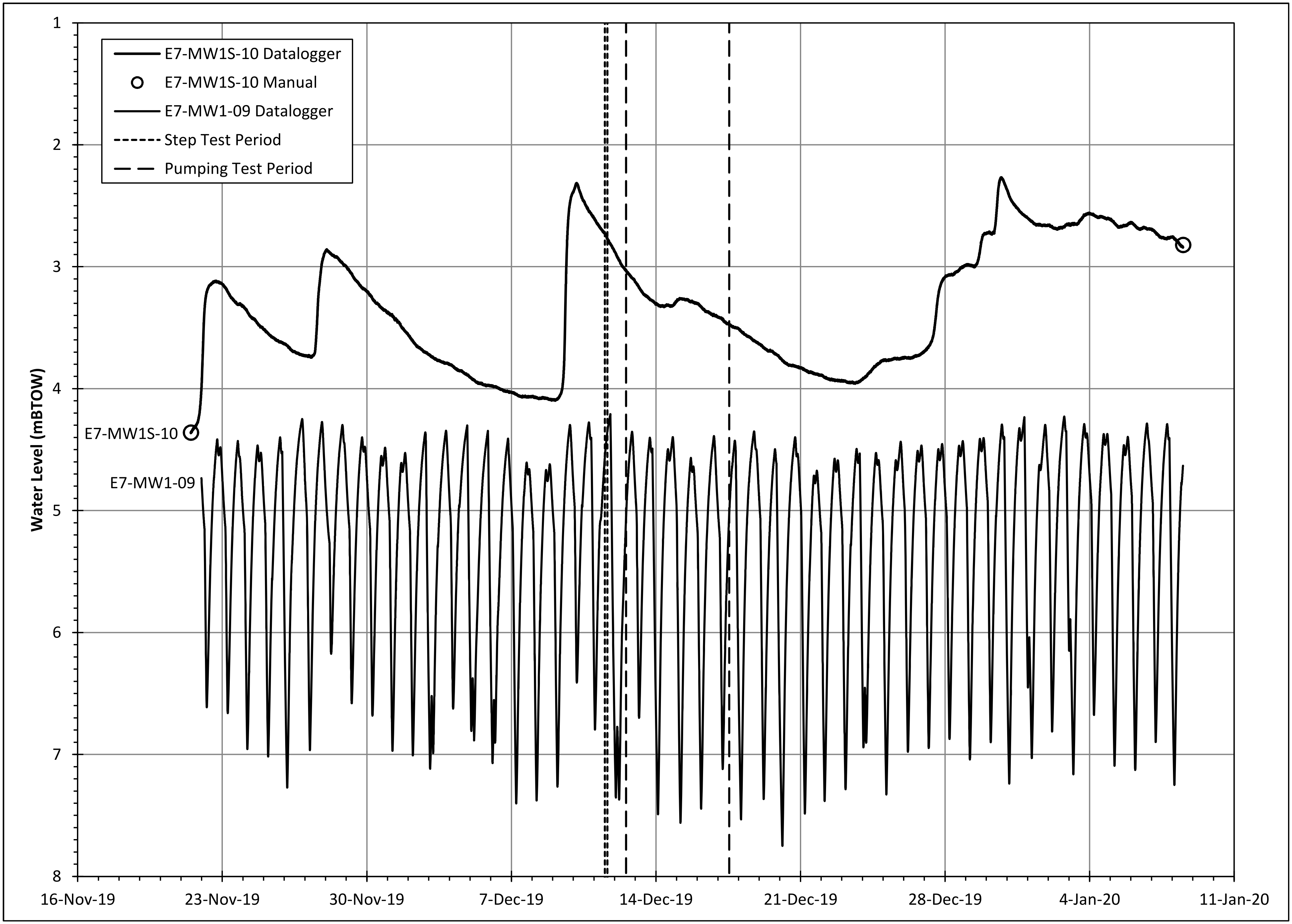
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin	E9 Pumping Test	Groundwater Science Corp
Water Supply EA	TW3 Hydrograph	Hydrogeological Assessment



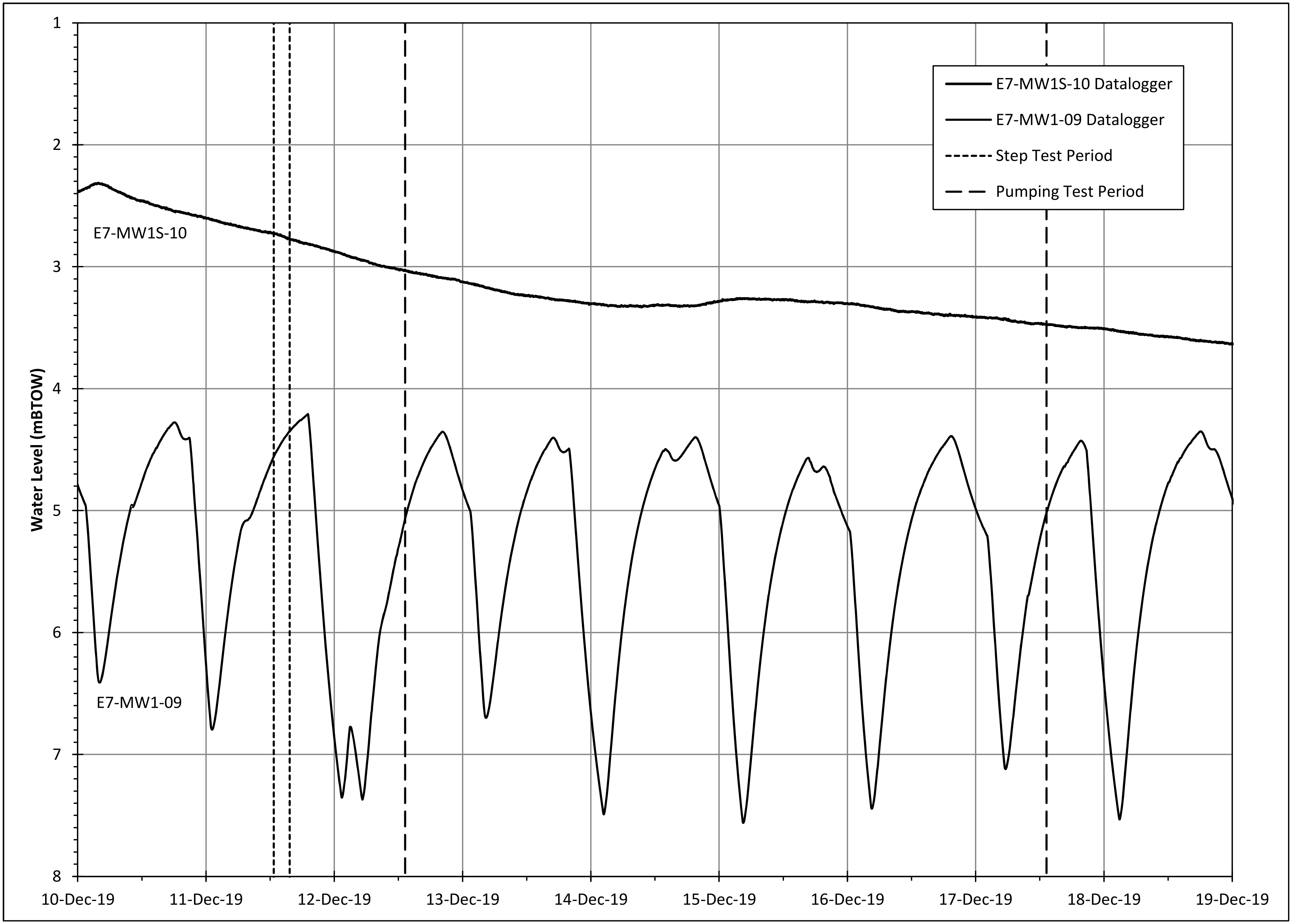
Hydrograph: TW2



Town of Erin
Water Supply EA

Long Term Hydrograph: Well Nest E9-MW1-19 and E9-MW1S-10

Groundwater Science Corp
E9 Pumping Test



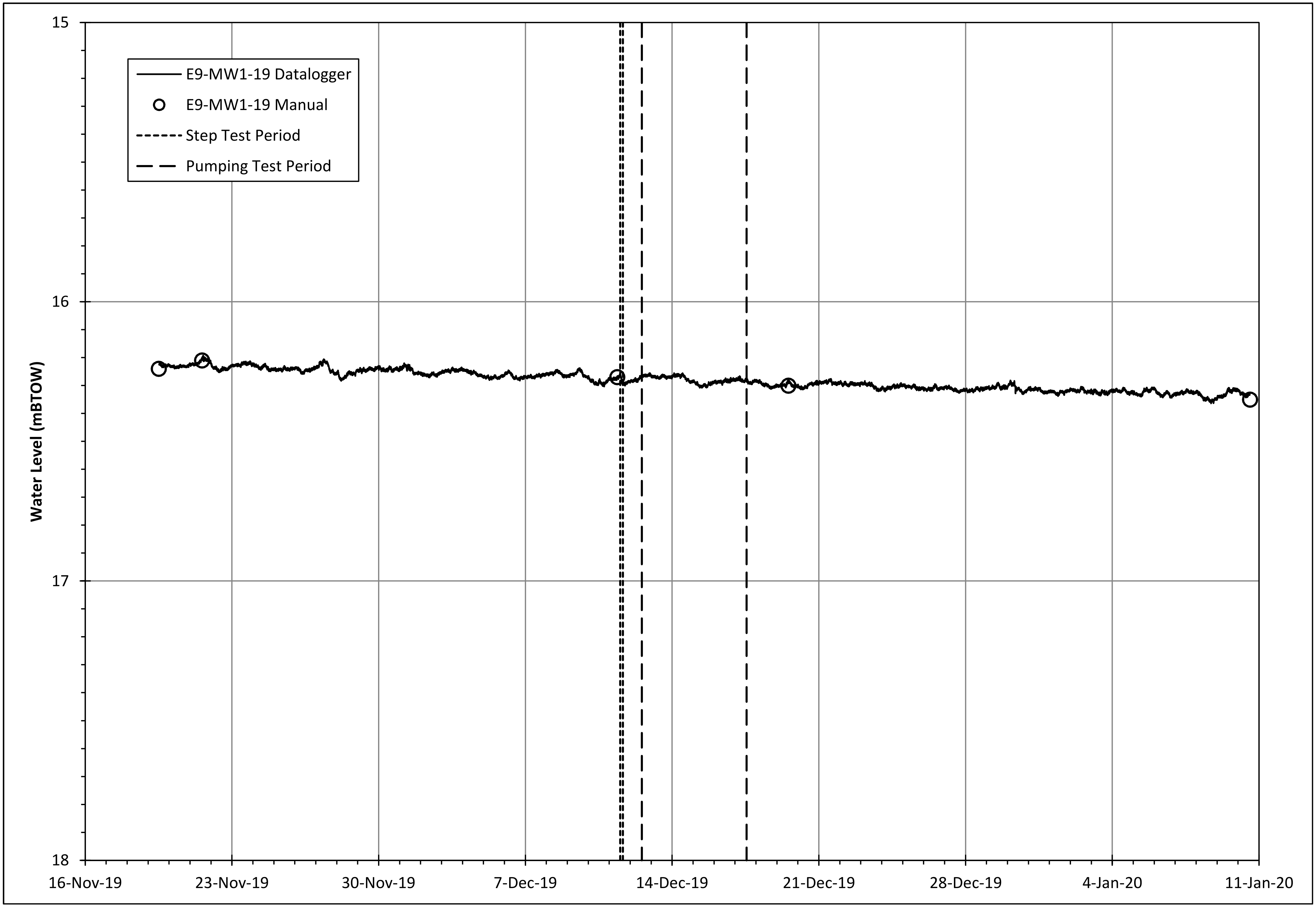
Town of Erin
Water Supply EA

Pumping Test Hydrograph: Well Nest E9-MW1-19 and E9-MW1S-10

Groundwater Science Corp
E9 Pumping Test

Appendix M

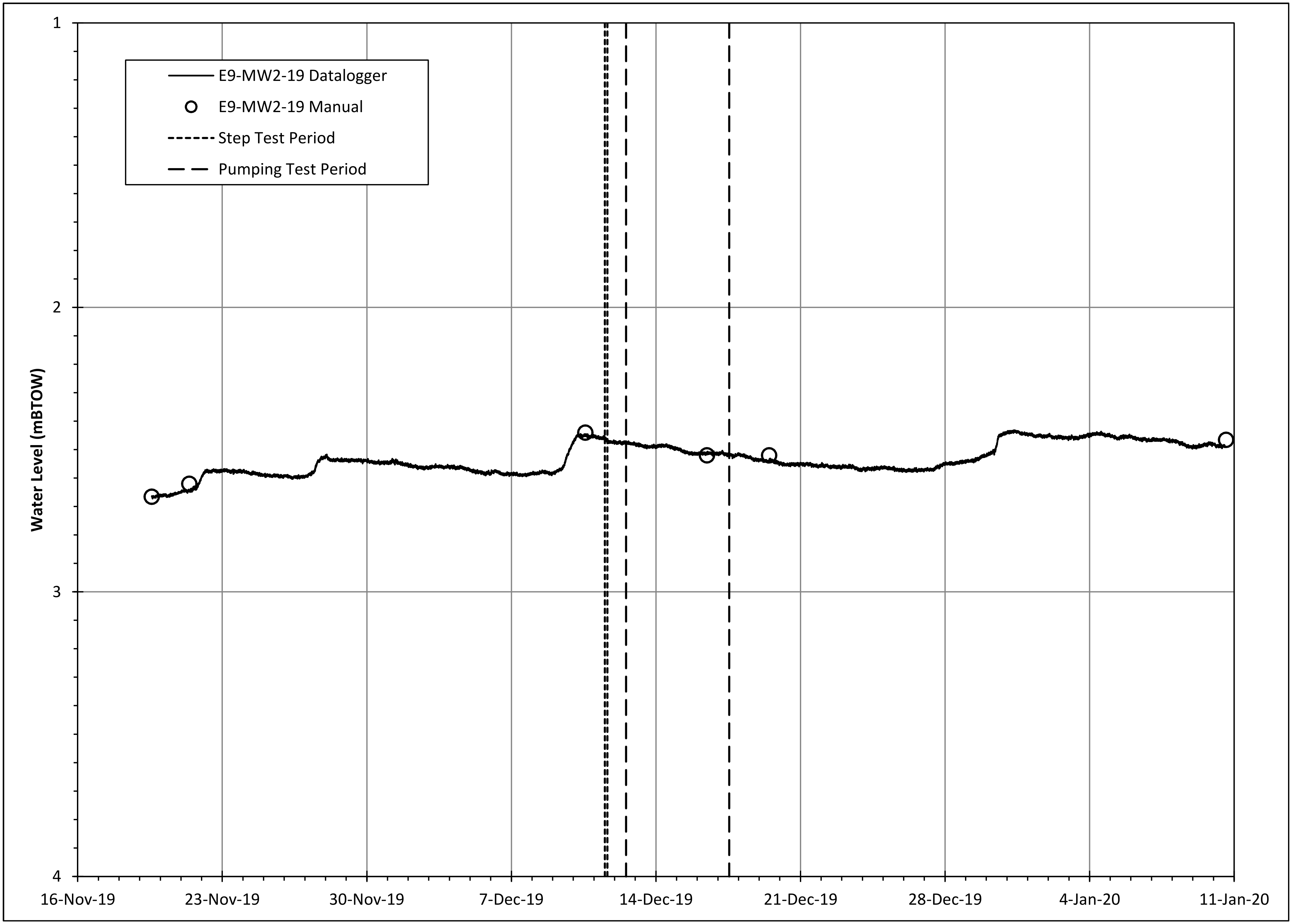
Pump Test Results:
Water Table Monitors



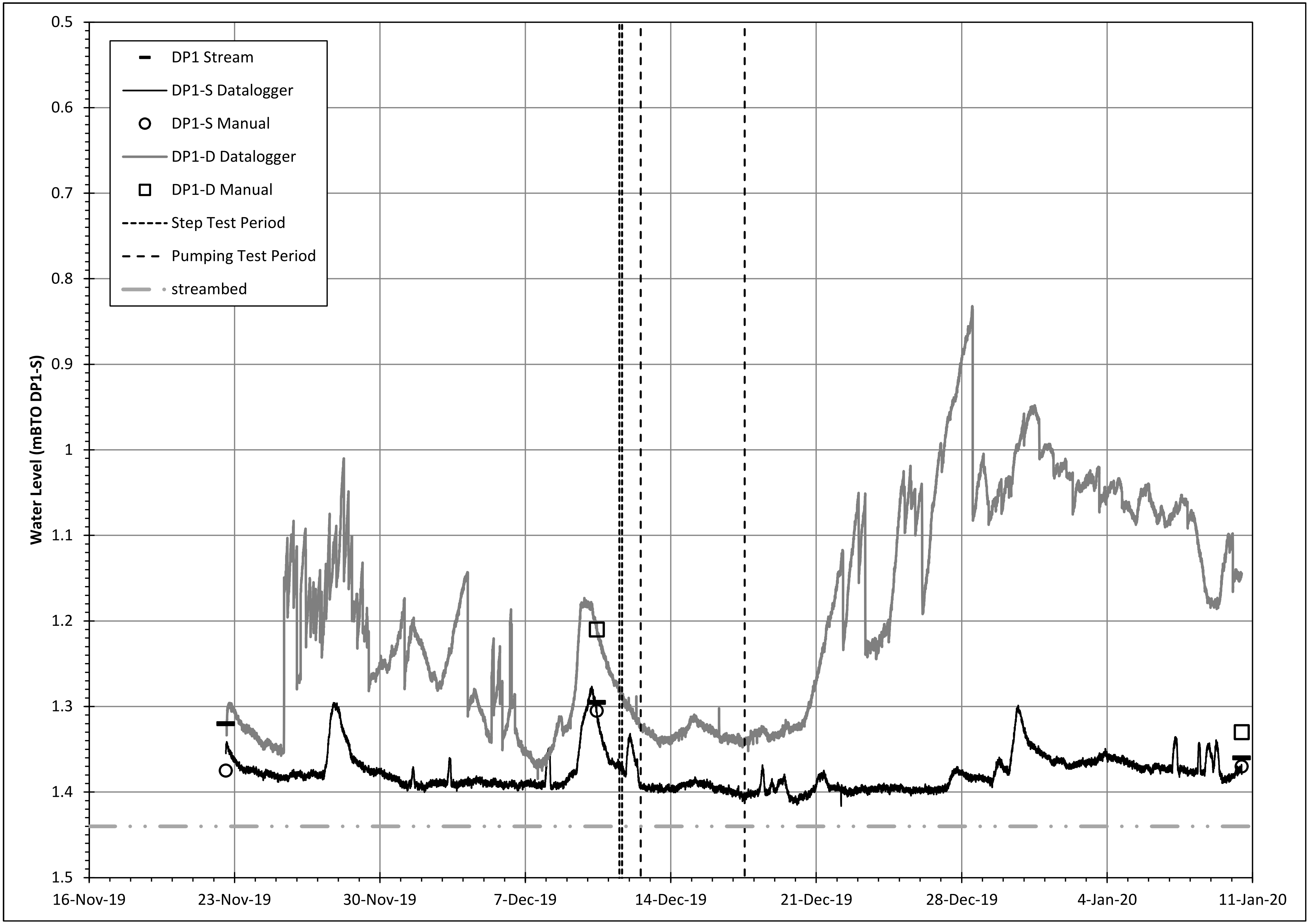
Town of Erin
Water Supply EA

Hydrograph: E9-MW1-19

Groundwater Science Corp
E9 Pumping Test



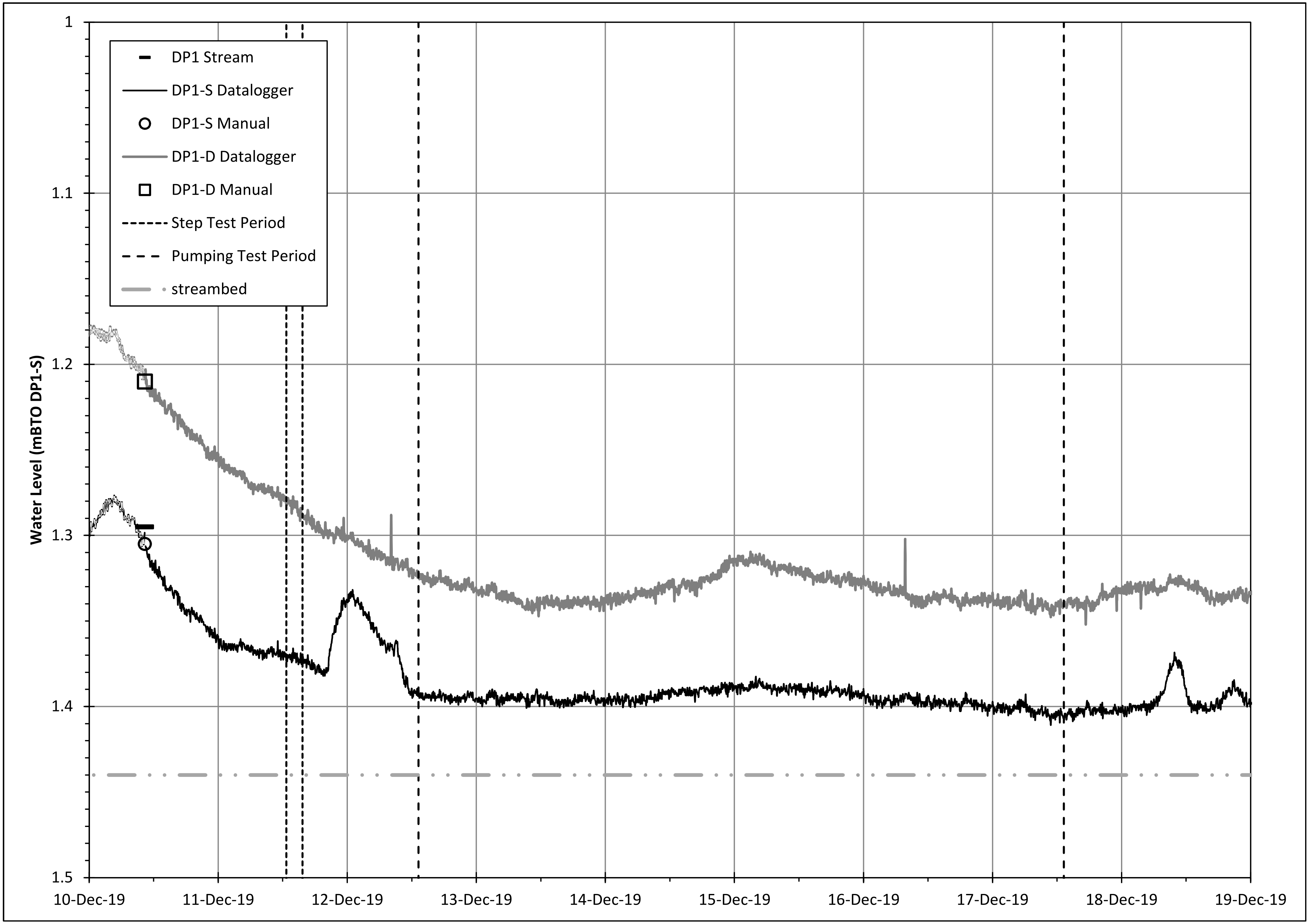
Long Term Hydrograph: E9-MW2-19



Town of Erin
Water Supply EA

Long Term Hydrograph: DP1 Nest

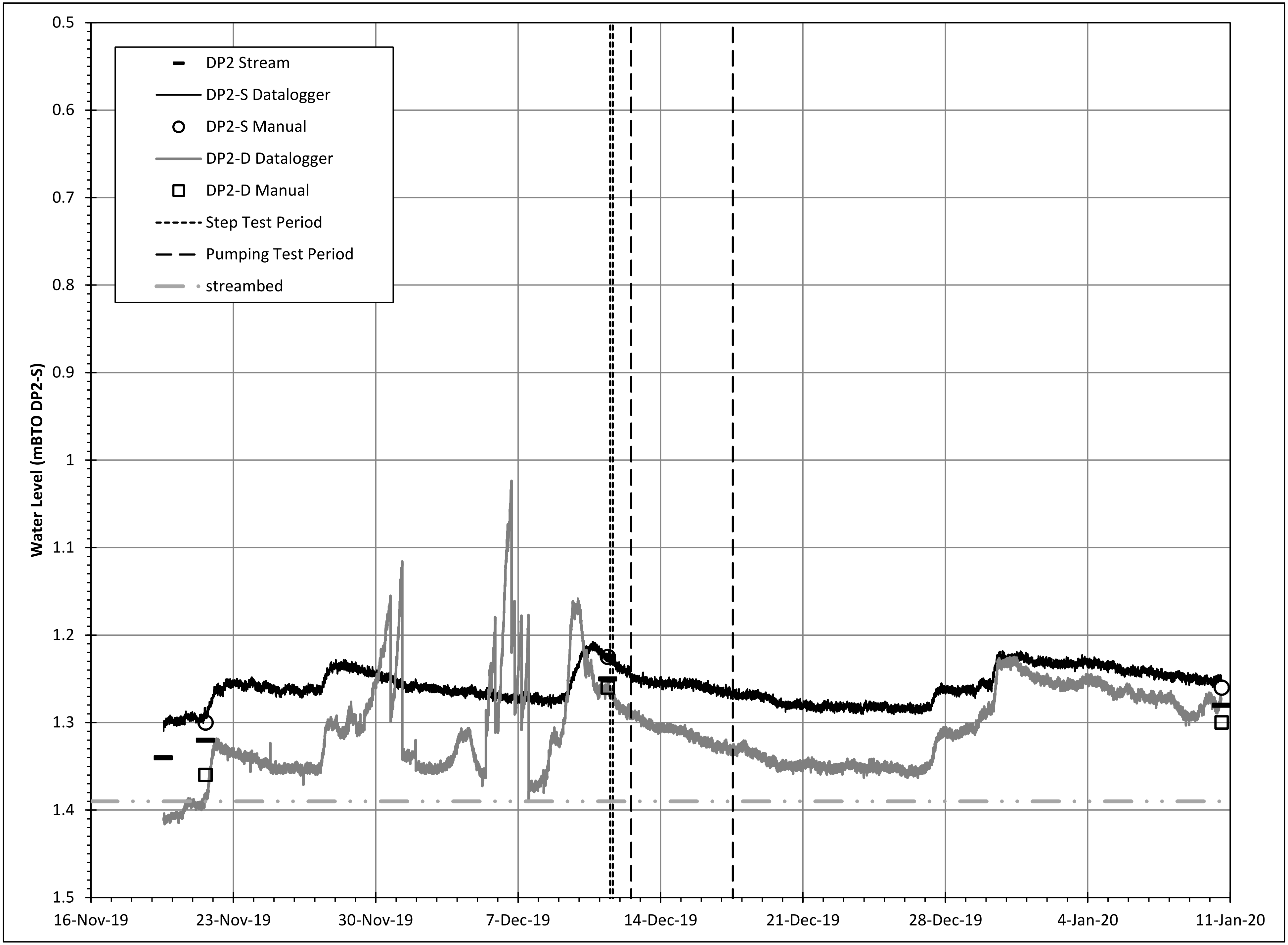
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

E9 Pump Test Period Hydrograph: DP1 Nest

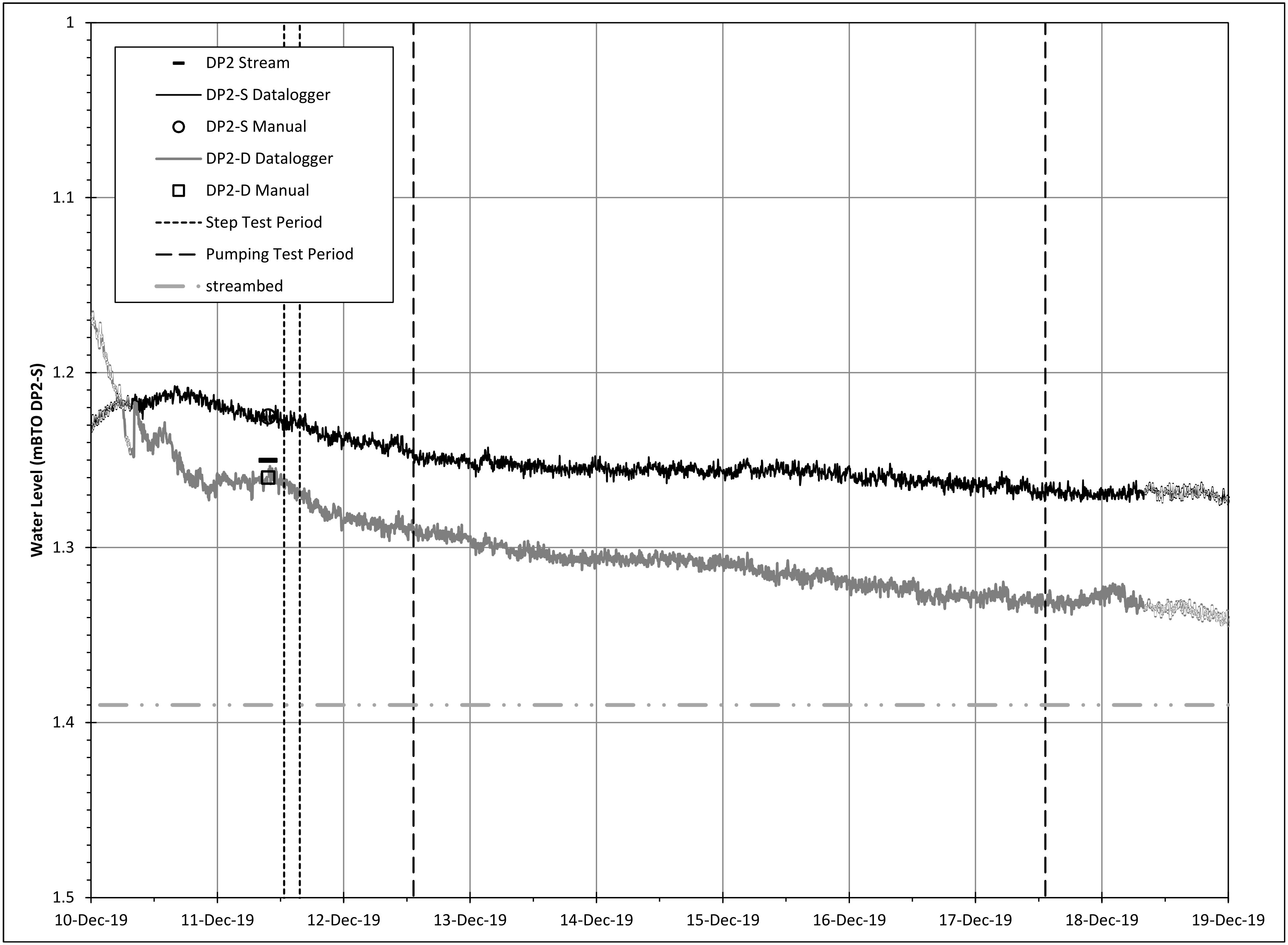
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

Long Term Hydrograph: DP2 Nest

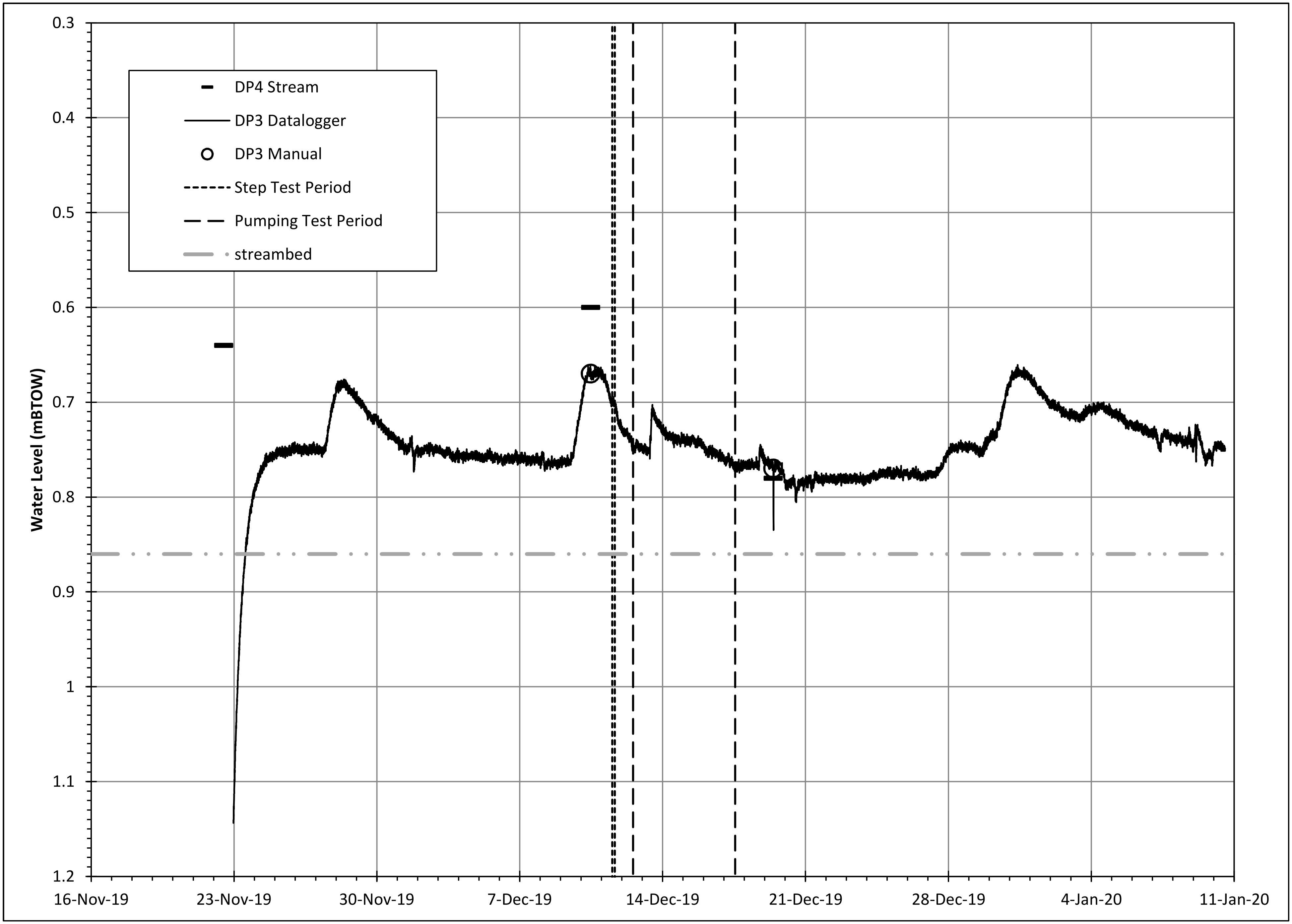
Groundwater Science Corp
Hydrogeological Assessment



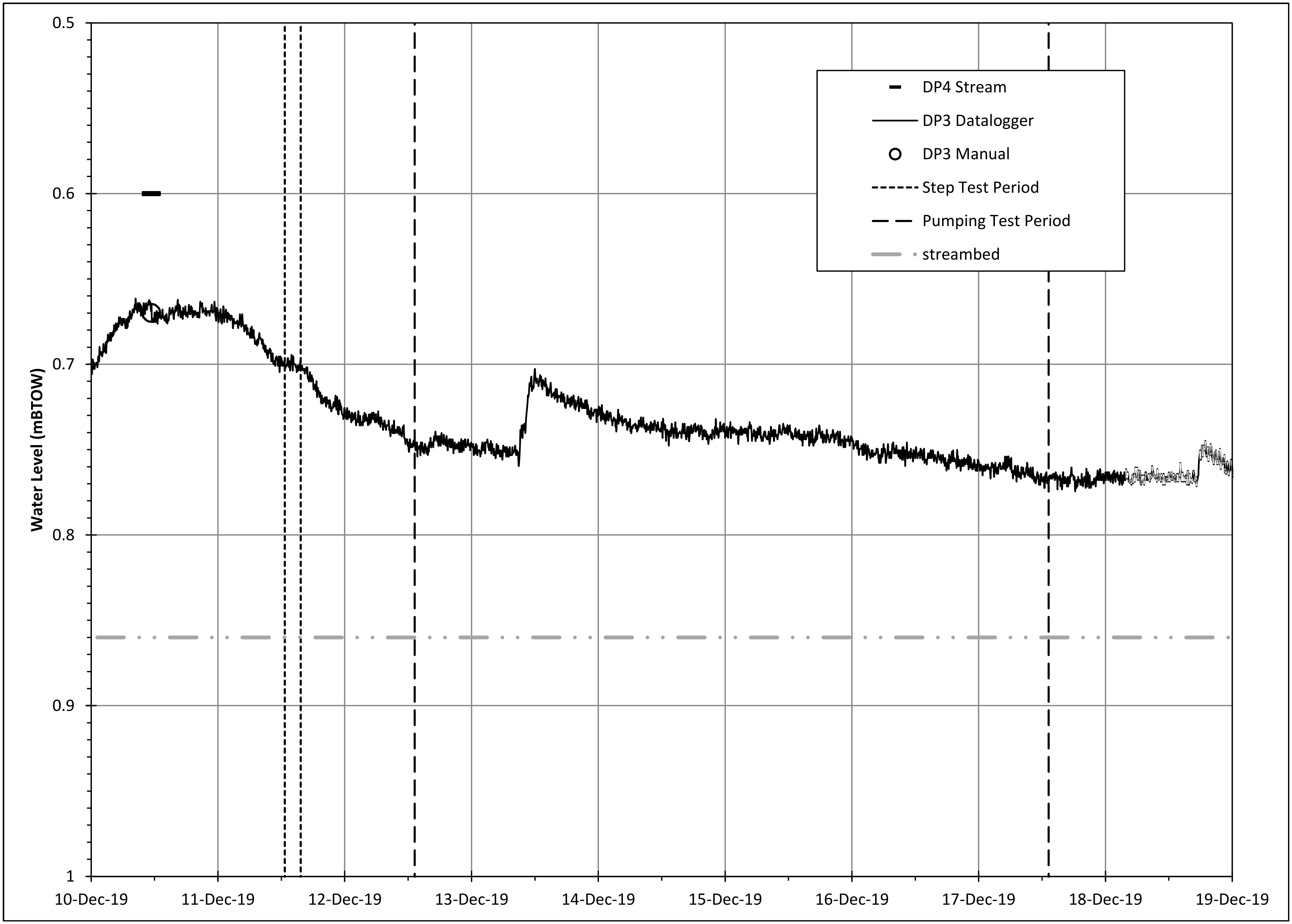
Town of Erin
Water Supply EA

E9 Pump Test Period Hydrograph: DP2 Nest

Groundwater Science Corp
Hydrogeological Assessment



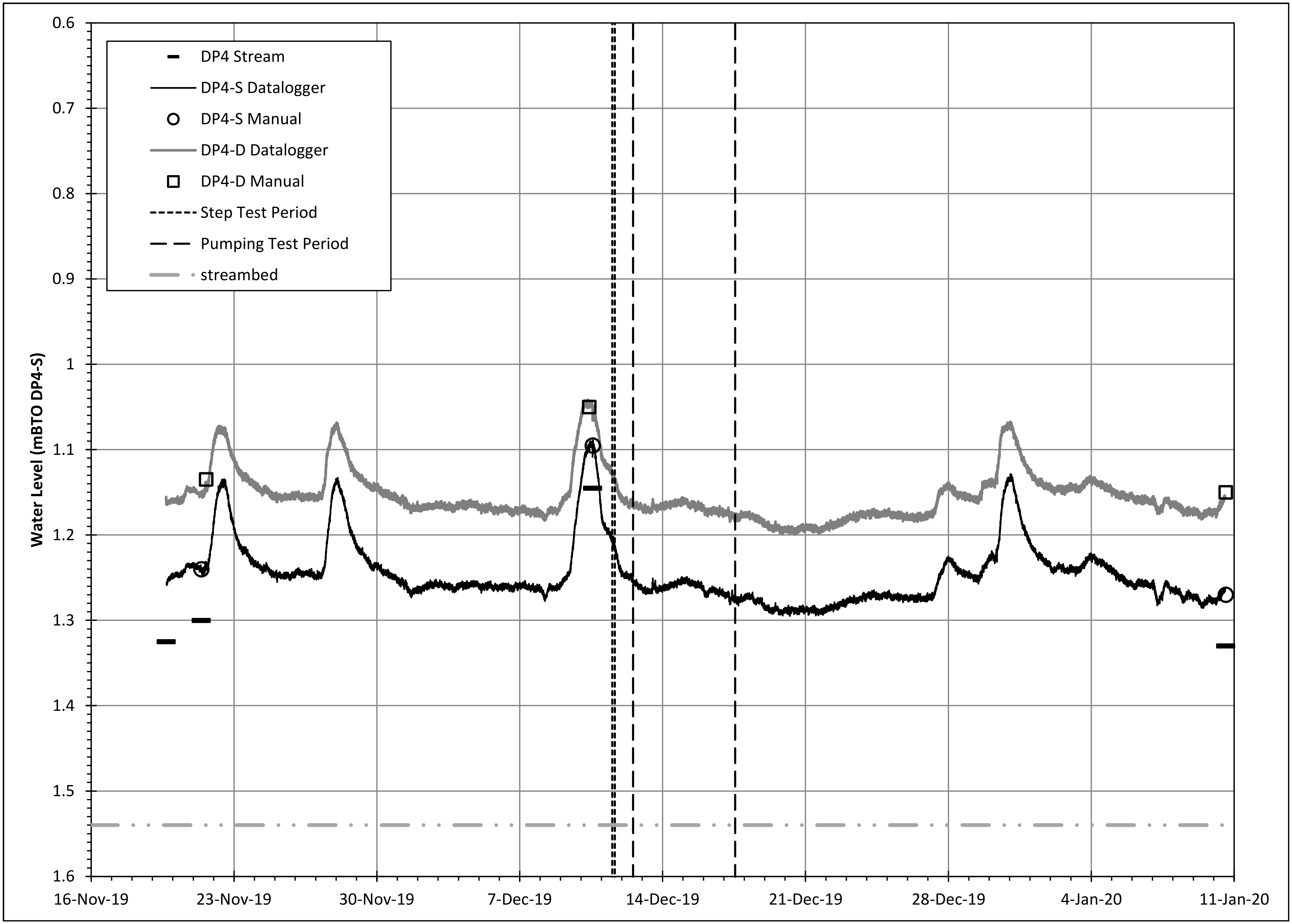
Long Term Hydrograph: DP3



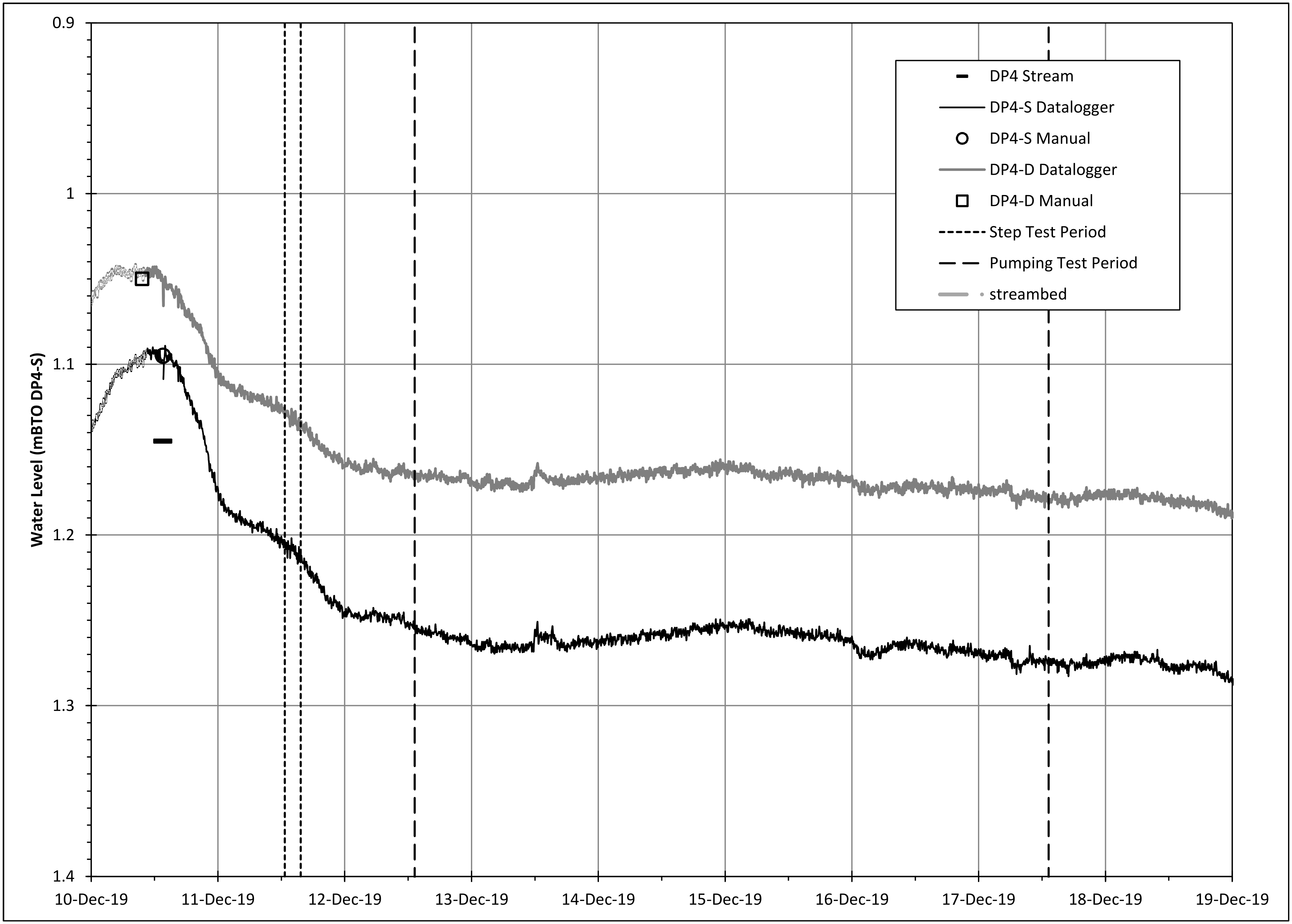
Town of Erin
Water Supply EA

Long Term Hydrograph: DP3

Groundwater Science Corp
Hydrogeological Assessment



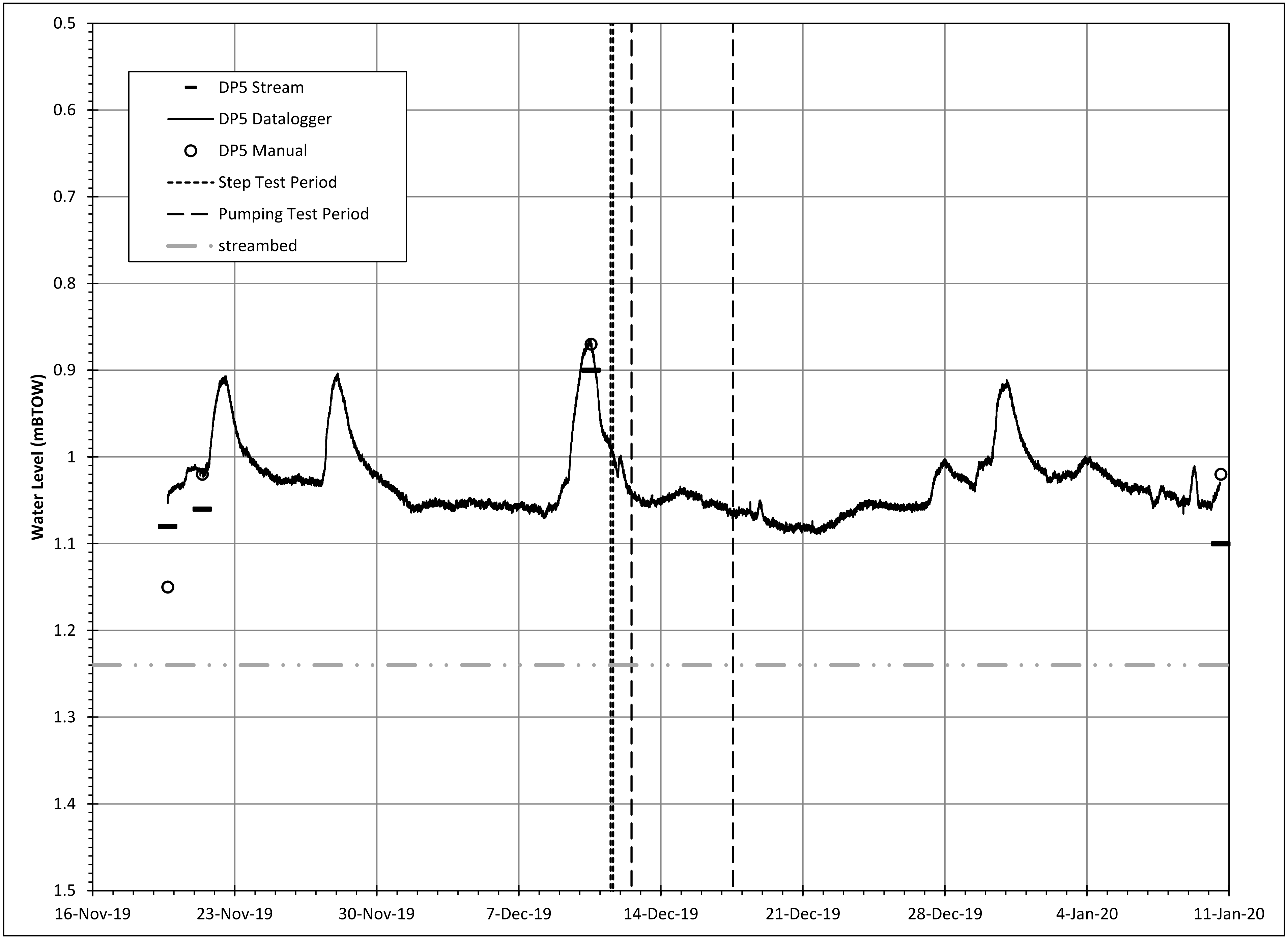
Long Tern Hydrograph: DP4 Nest



Town of Erin
Water Supply EA

E9 Pump Test Period Hydrograph: DP4 Nest

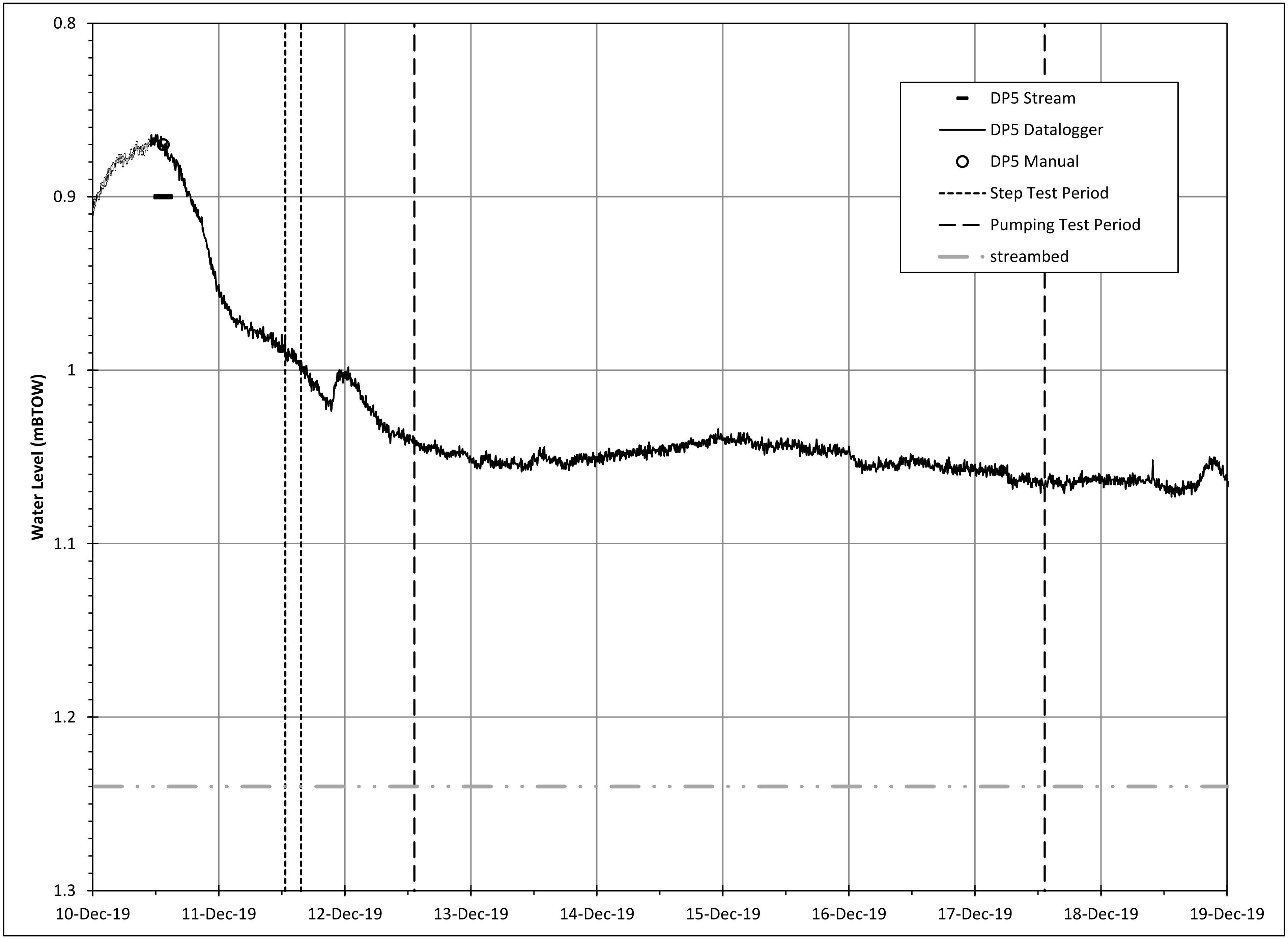
Groundwater Science Corp
Hydrogeological Assessment



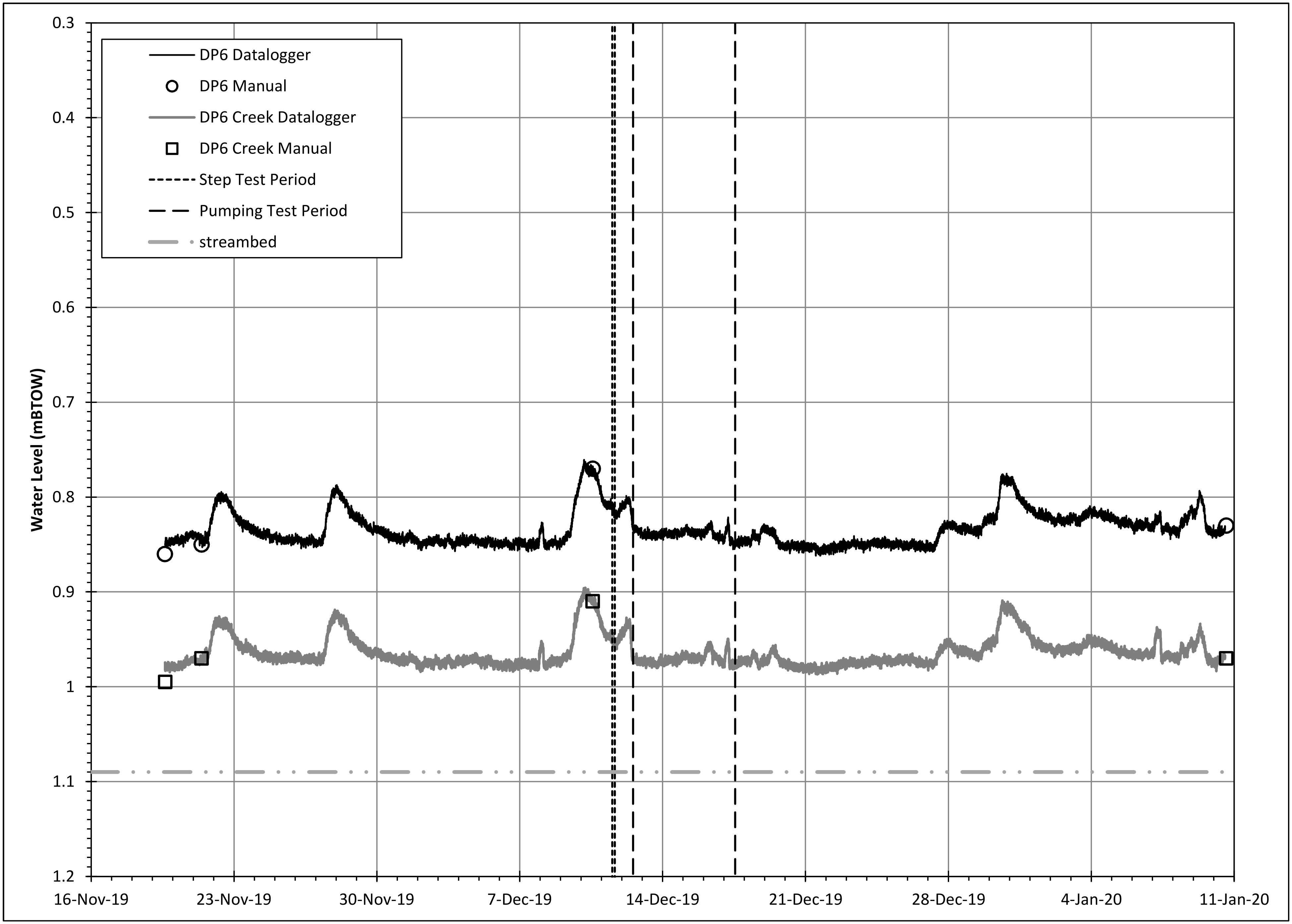
Town of Erin
Water Supply EA

Long Termn Hydrograph: DP 5

Groundwater Science Corp
Hydrogeological Assessment



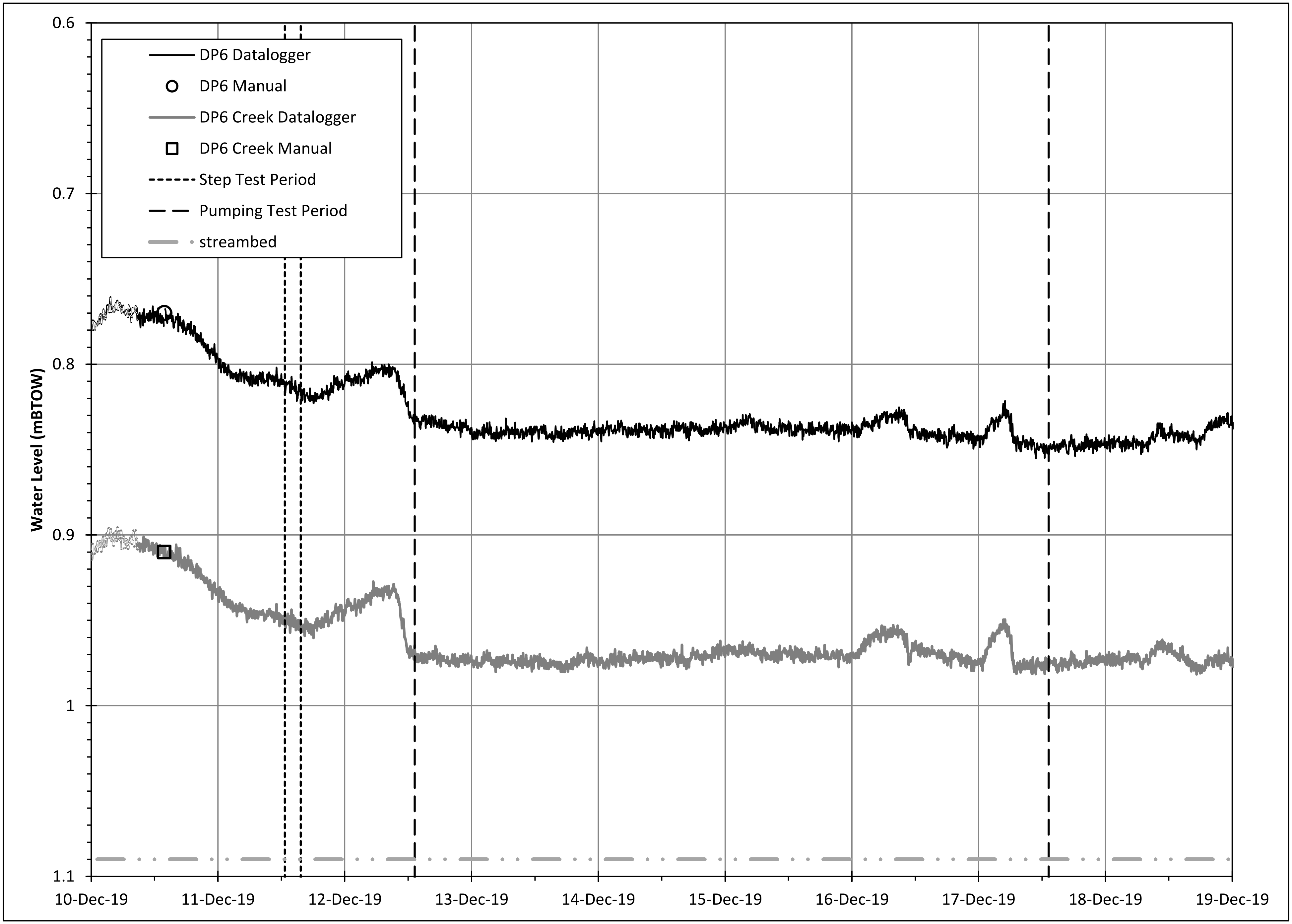
E9 Pump Test Period Hydrograph: DP 5



Town of Erin
Water Supply EA

Long Term Hydrograph: DP6 and Creek

Groundwater Science Corp
Hydrogeological Assessment

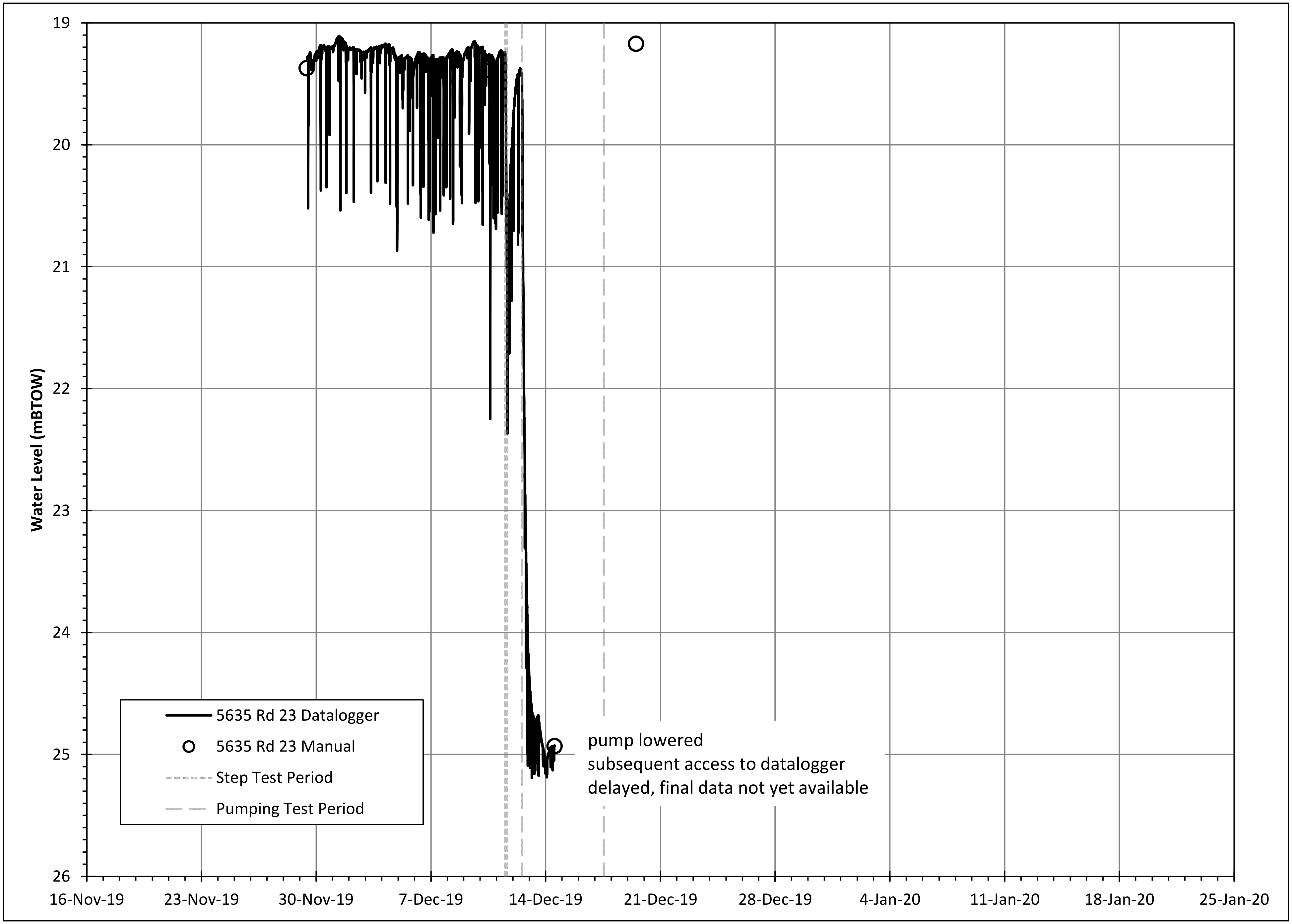


Town of Erin
Water Supply EA

Long Term Hydrograph: DP6 and Creek

Groundwater Science Corp
Hydrogeological Assessment

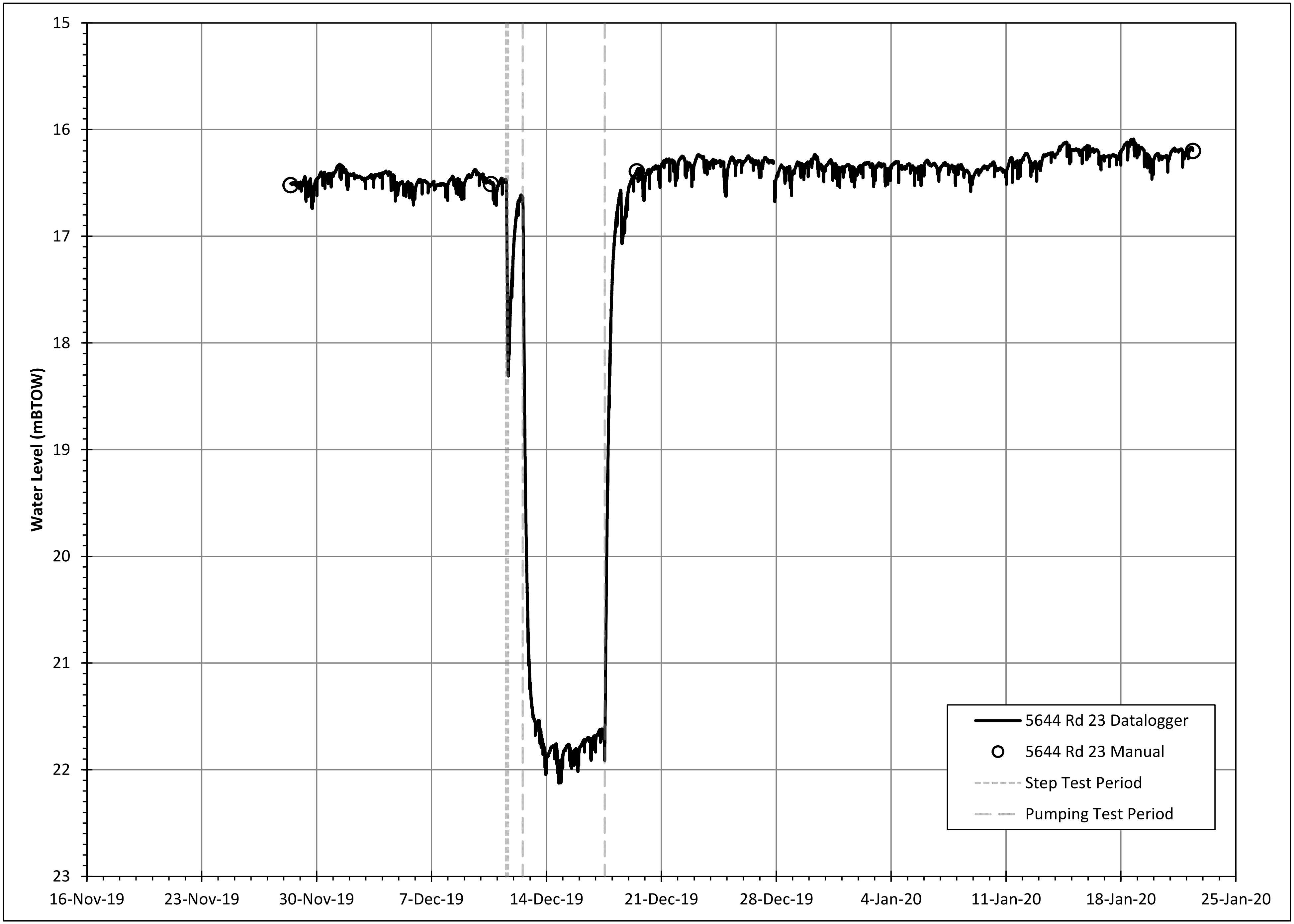
Appendix N
Pump Test Results: Private Wells



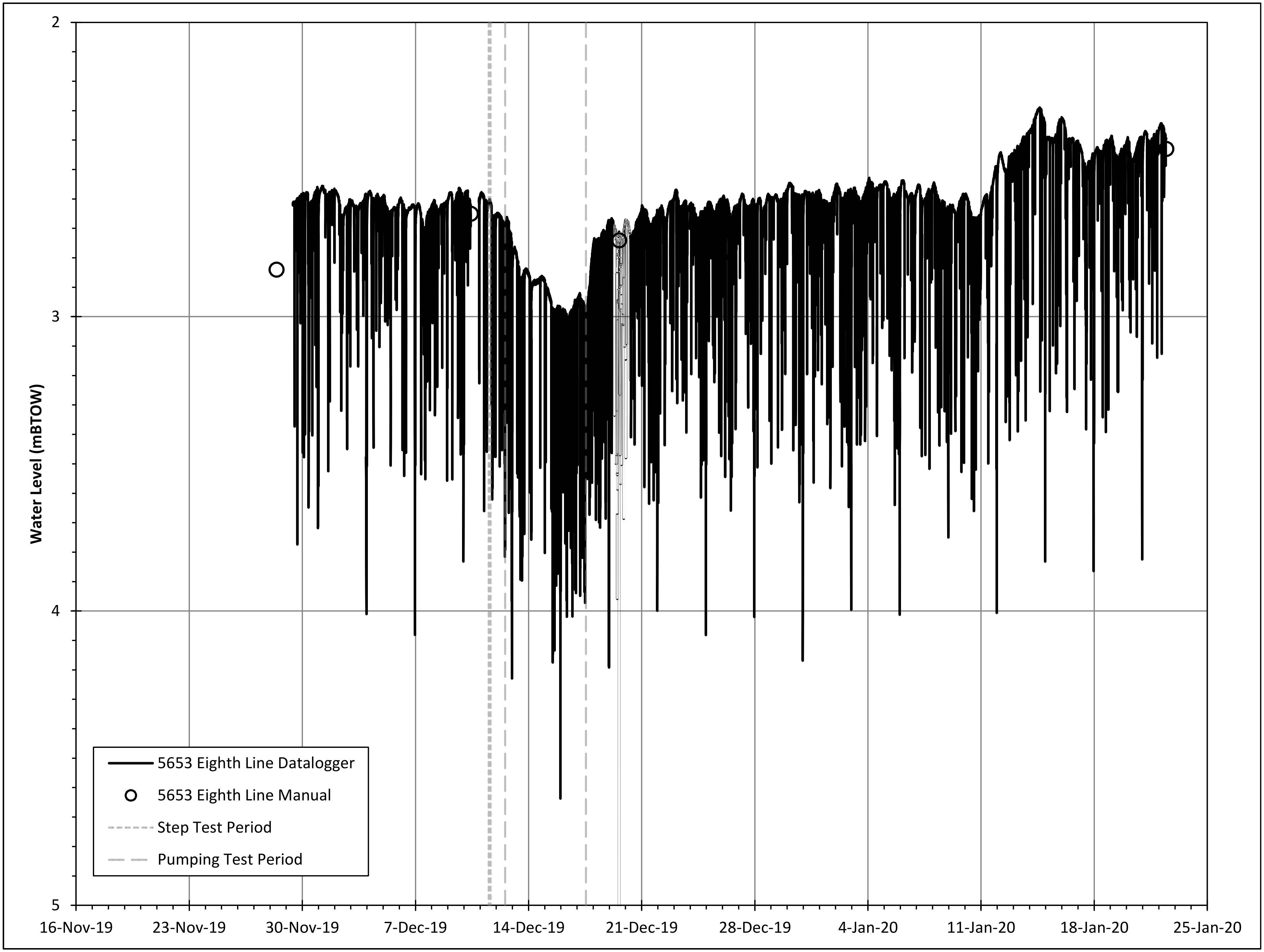
Town of Erin
Water Supply EA

Hydrograph: 5636 Wellington Road 23

Groundwater Science Corp
Hydrogeological Assessment



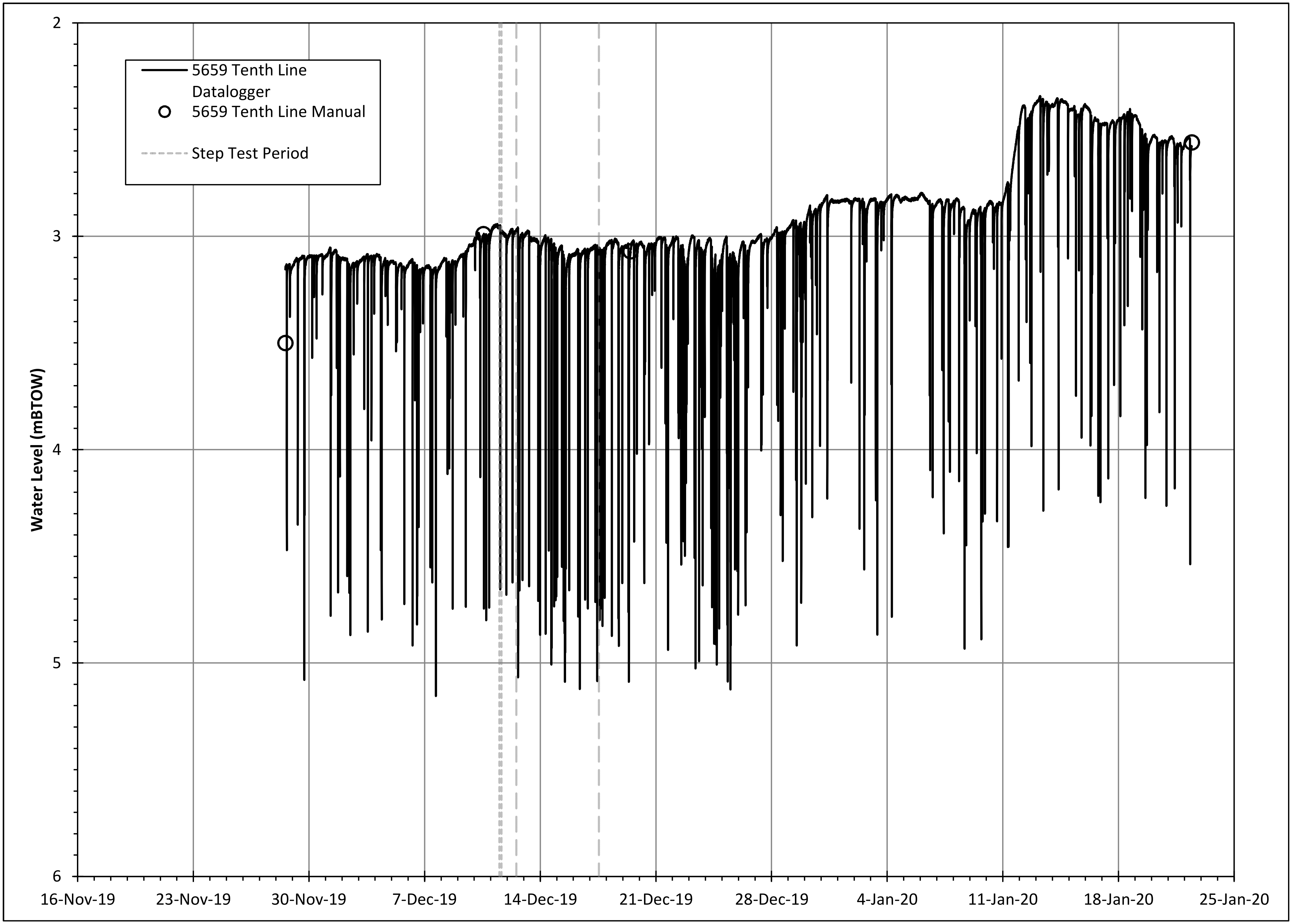
Hydrograph: 5644 Wellington Road 23



Town of Erin
Water Supply EA

Hydrograph: 5653 Eighth Line

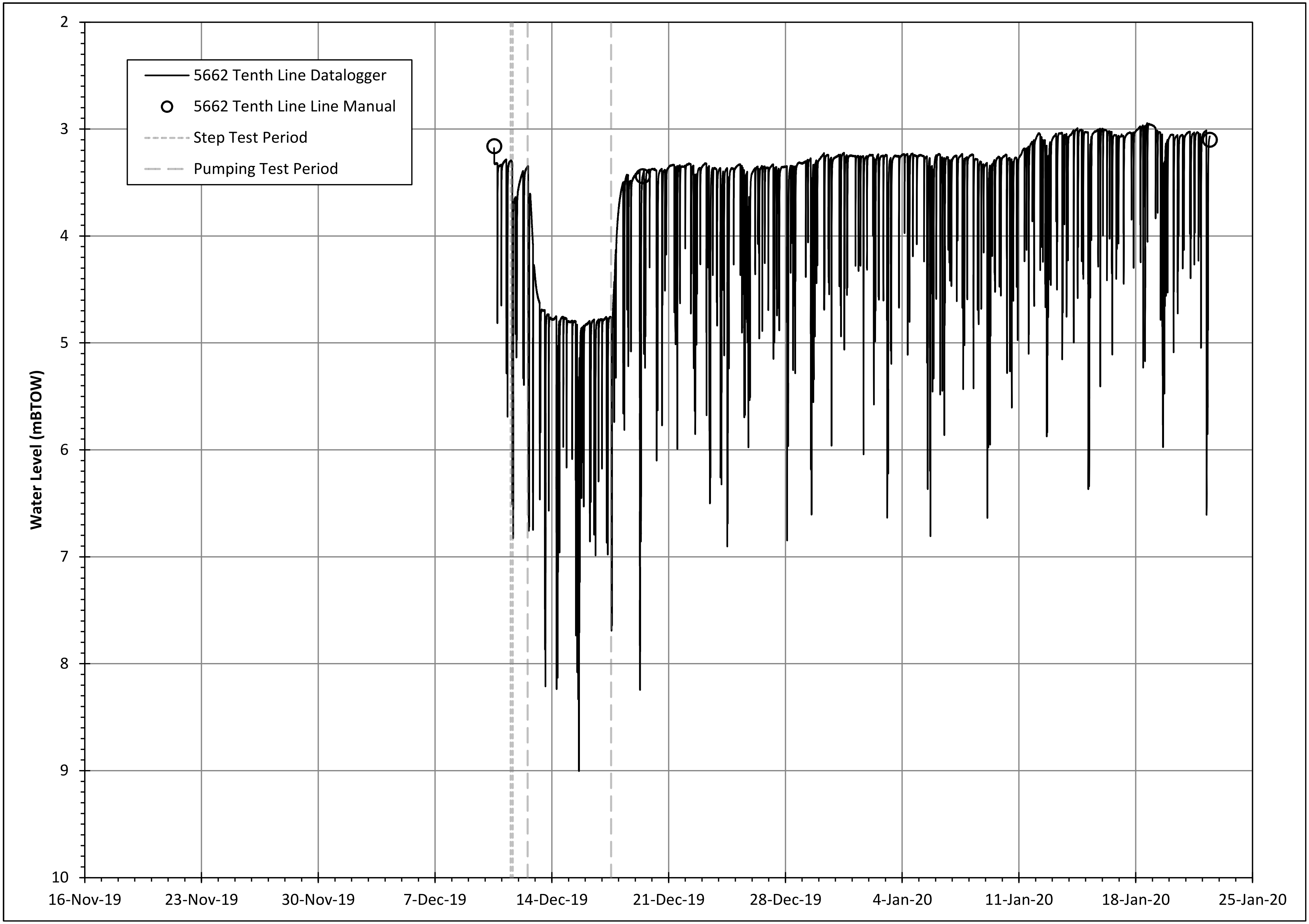
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

Hydrograph: 5659 Tenth Line

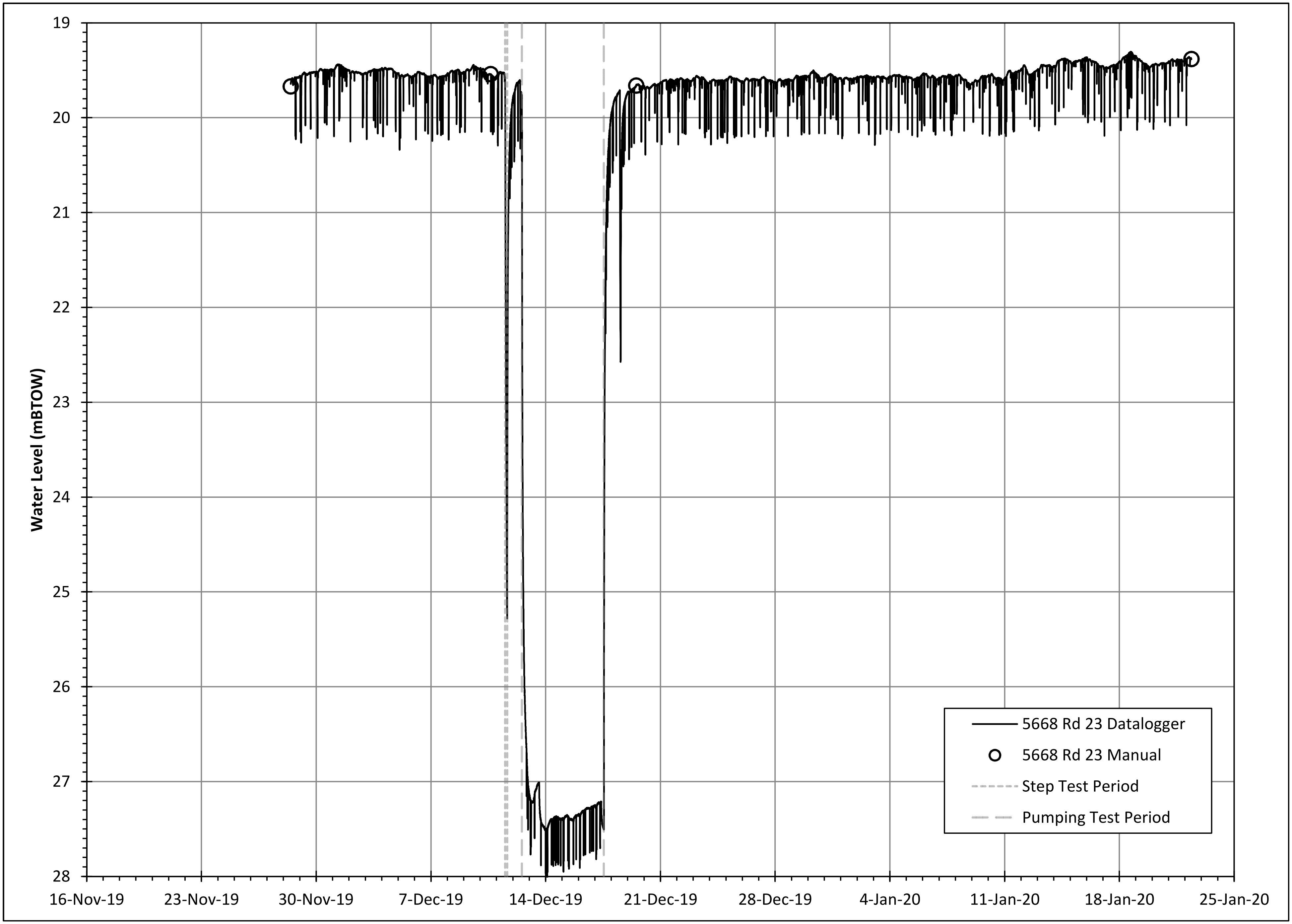
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

Hydrograph: E9-MW1-19

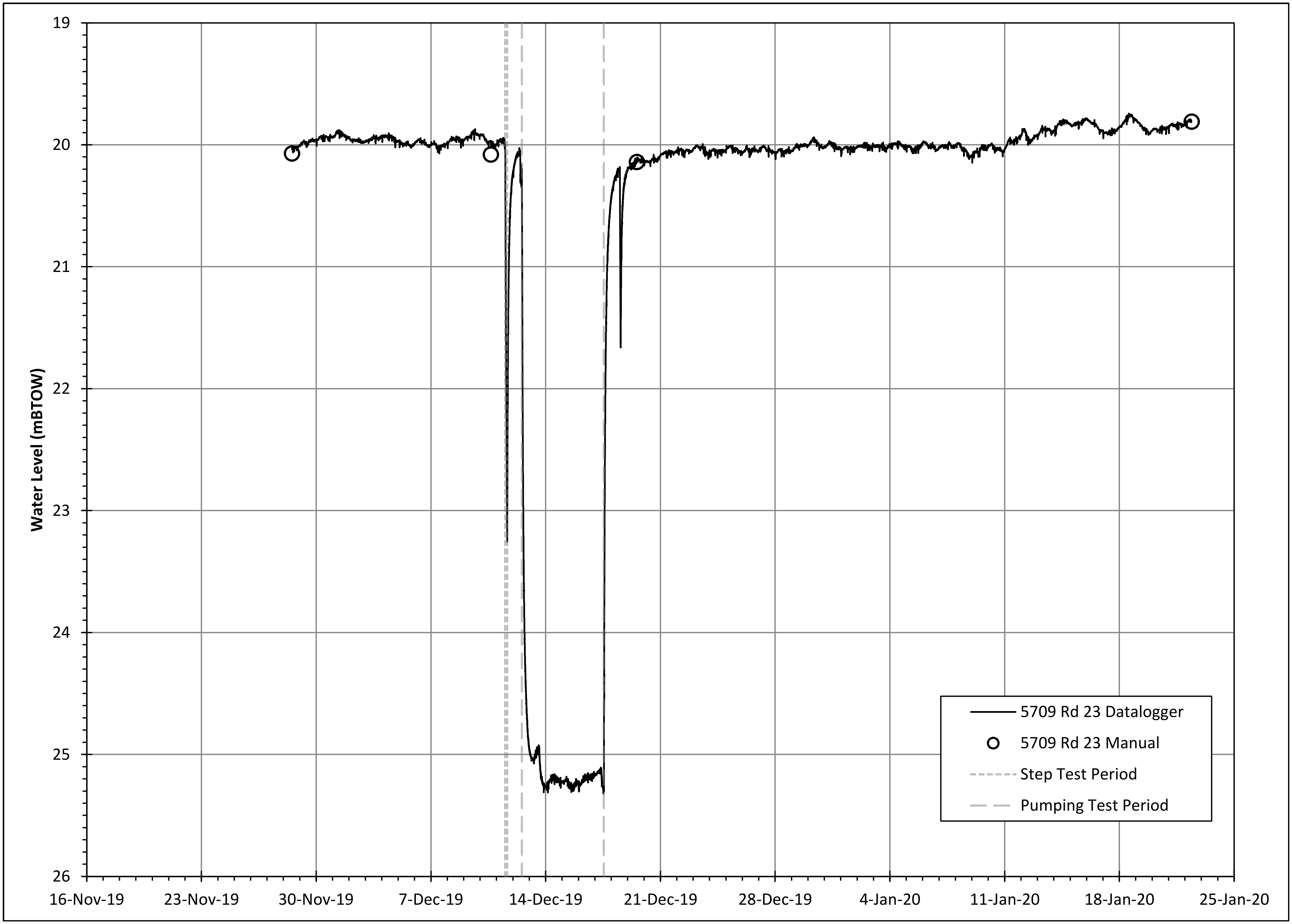
Groundwater Science Corp
E9 Pumping Test



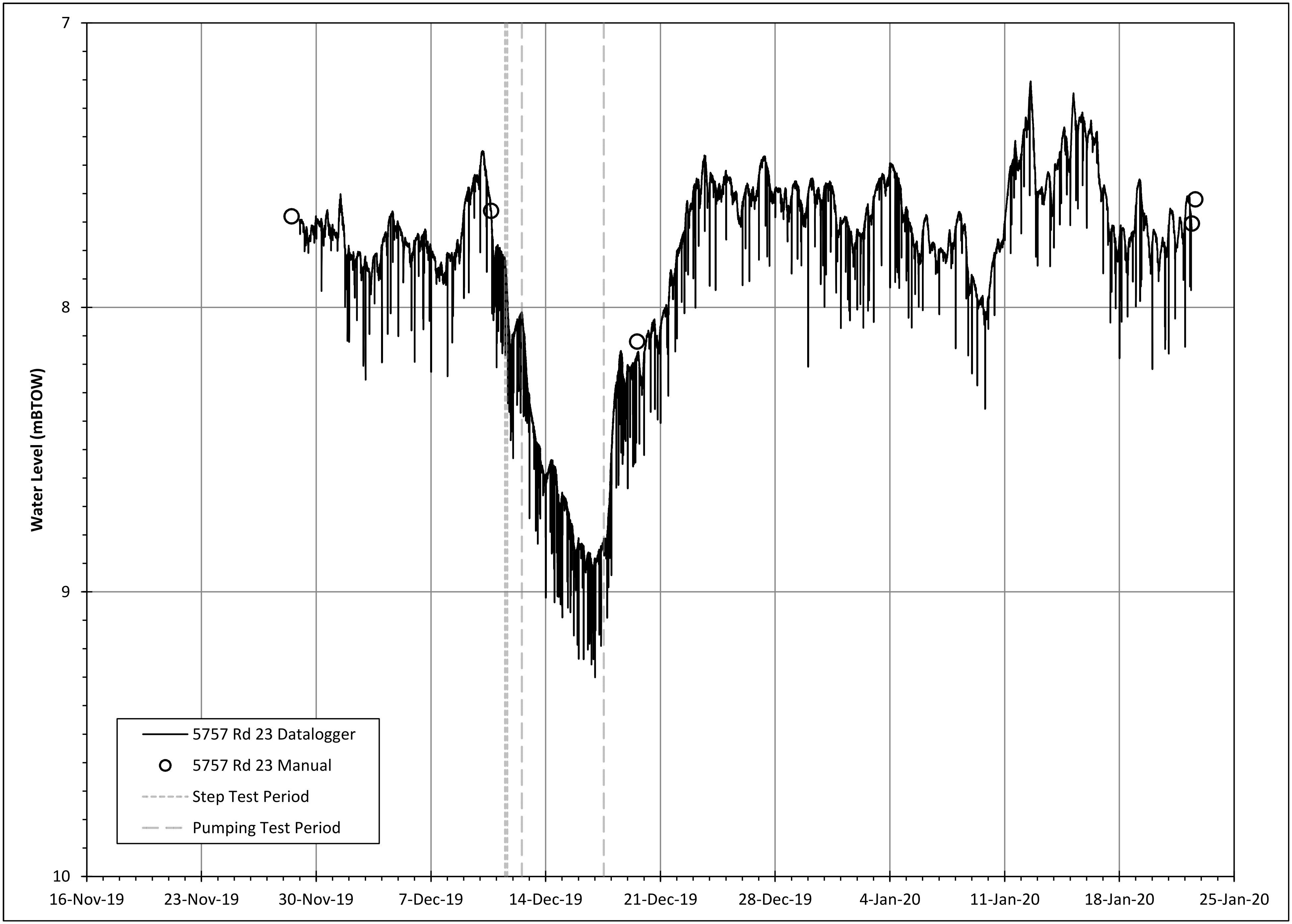
Town of Erin
Water Supply EA

Hydrograph: 5668 Wellington Road 23

Groundwater Science Corp
Hydrogeological Assessment



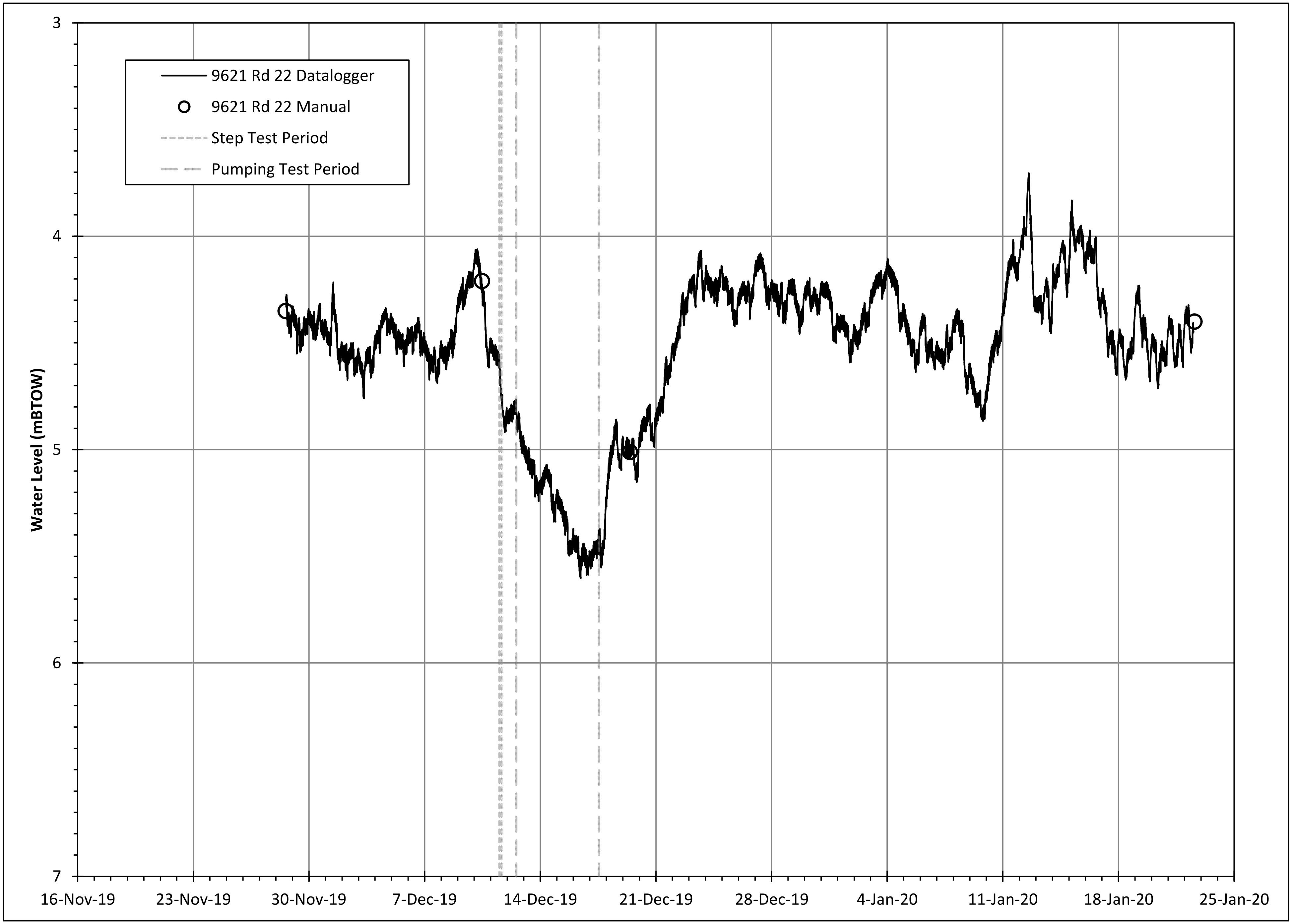
Hydrograph: 5709 Wellington Road 23



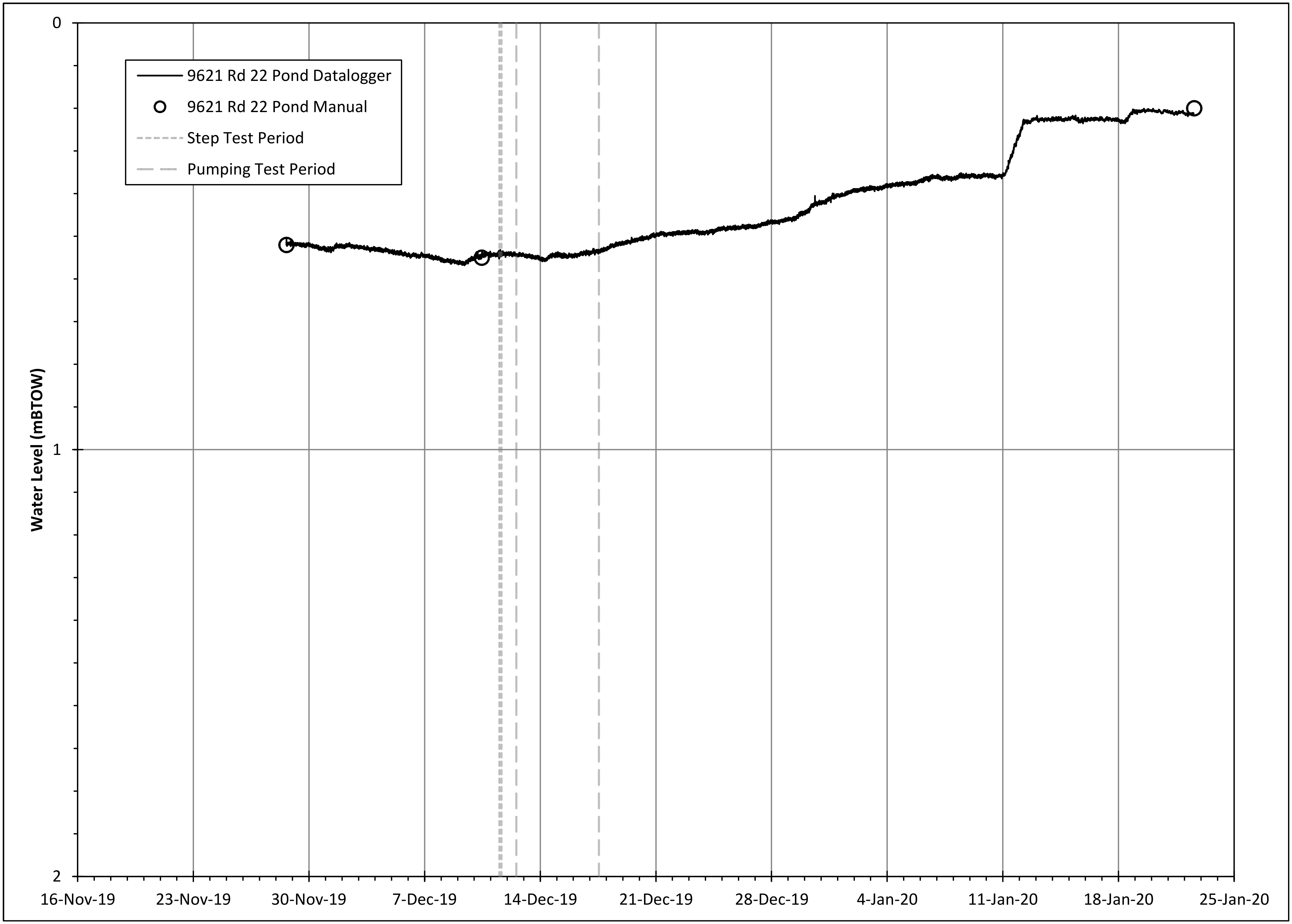
Town of Erin
Water Supply EA

Hydrograph: 5757 Wellington Road 23

Groundwater Science Corp
Hydrogeological Assessment



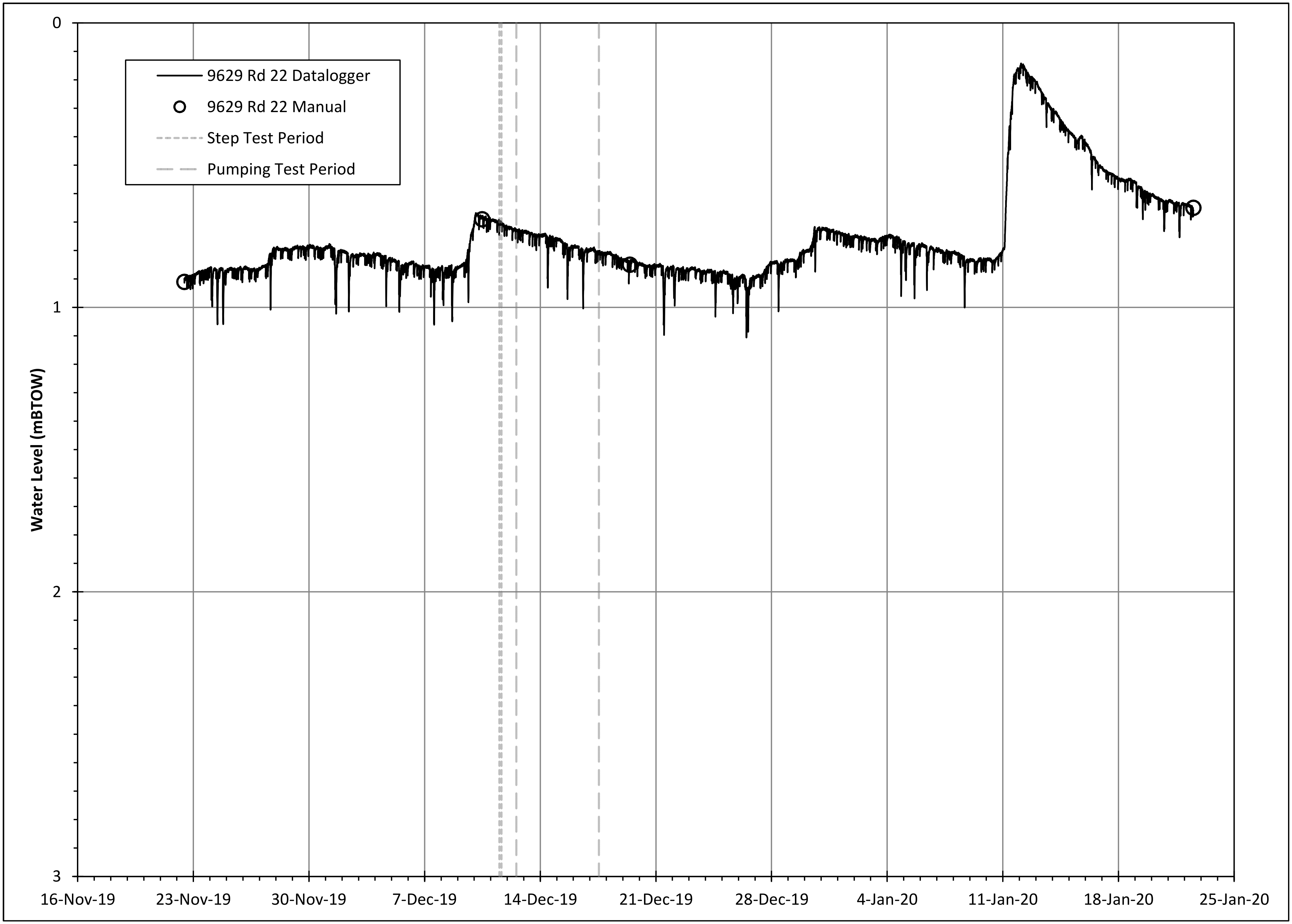
Hydrograph: 9621 Wellington Road 22



Town of Erin
Water Supply EA

Hydrograph: Pond at 9621 Wellington Road 22

Groundwater Science Corp
Hydrogeological Assessment

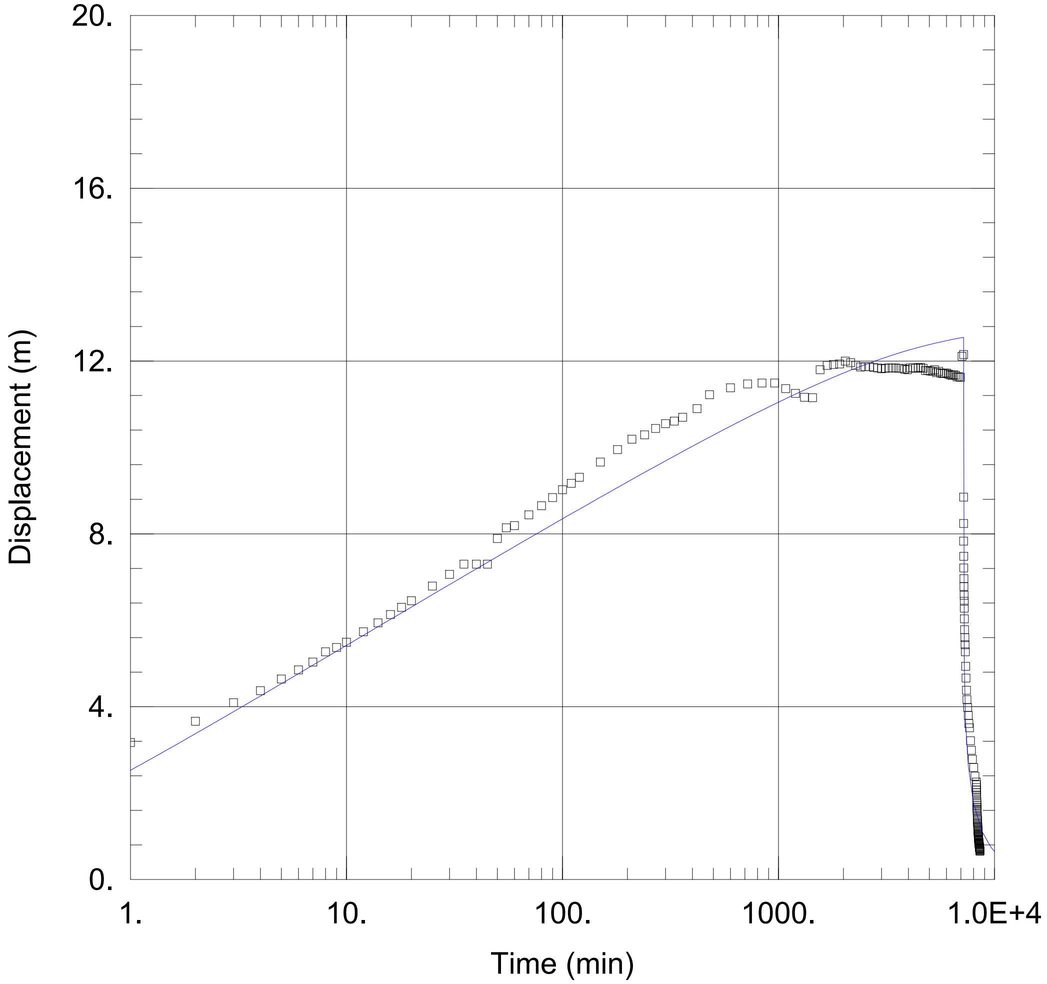


Town of Erin
Water Supply EA

Hydrograph: 9629 Wellington Road 22

Groundwater Science Corp
Hydrogeological Assessment

Appendix O
Pump Test Analysis



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Erin 3 Site
Test Well: E9
Test Date: November 2019

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
E9	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ E9	0	0

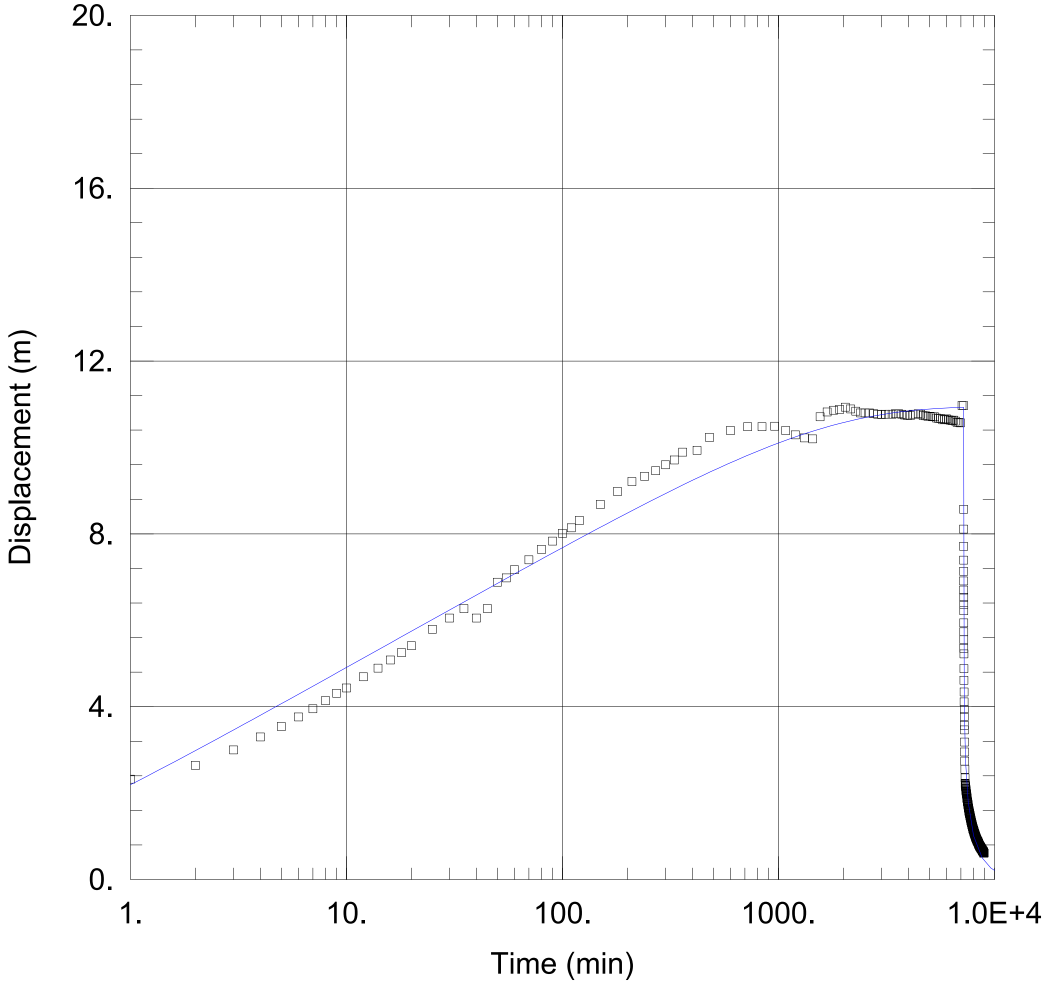
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.002091 m^2/sec
r/B = 0.007629
b = 42. m

S = 2.752
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Erin 3 Site
Test Well: E9
Test Date: November 2019

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
E9	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ TW3	10	0

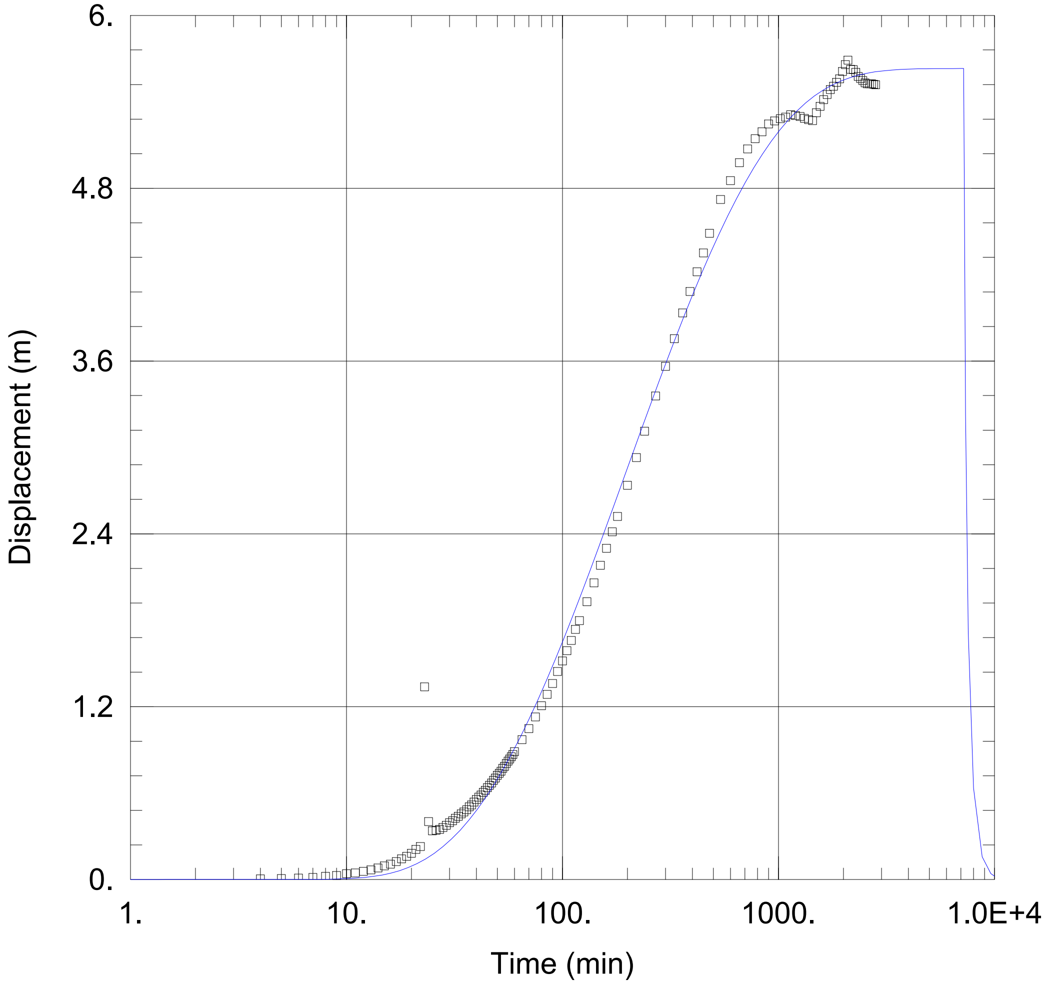
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.002072 m^2/sec
r/B = 0.01323
b = 42. m

S = 0.0005307
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Erin 3 Site
Test Well: E9
Test Date: November 2019

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
E9	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ 5635 Rd 23	515	0

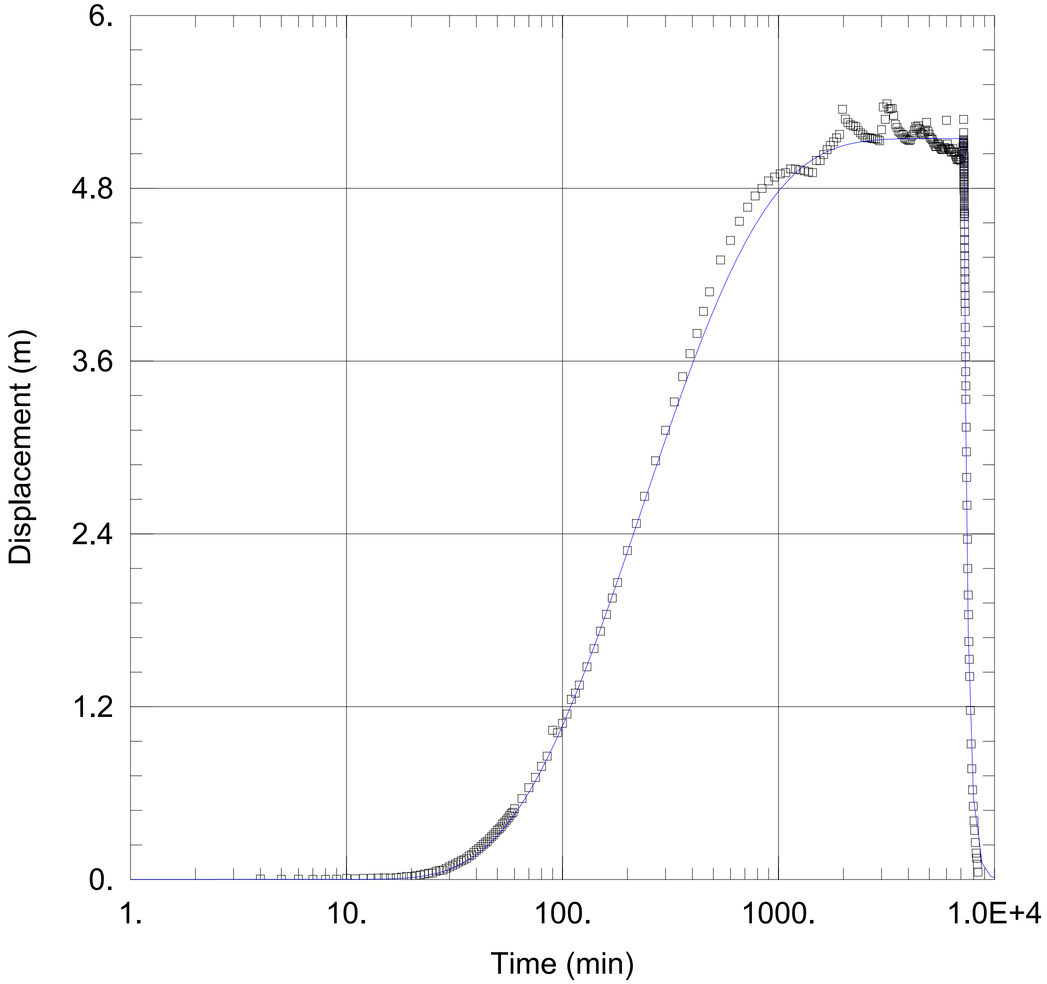
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.0008805 m^2/sec
r/B = 0.4714
b = 42. m

S = 3.67E-5
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Erin 3 Site
Test Well: E9
Test Date: November 2019

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
E9	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ 5644 Rd 23	550	0

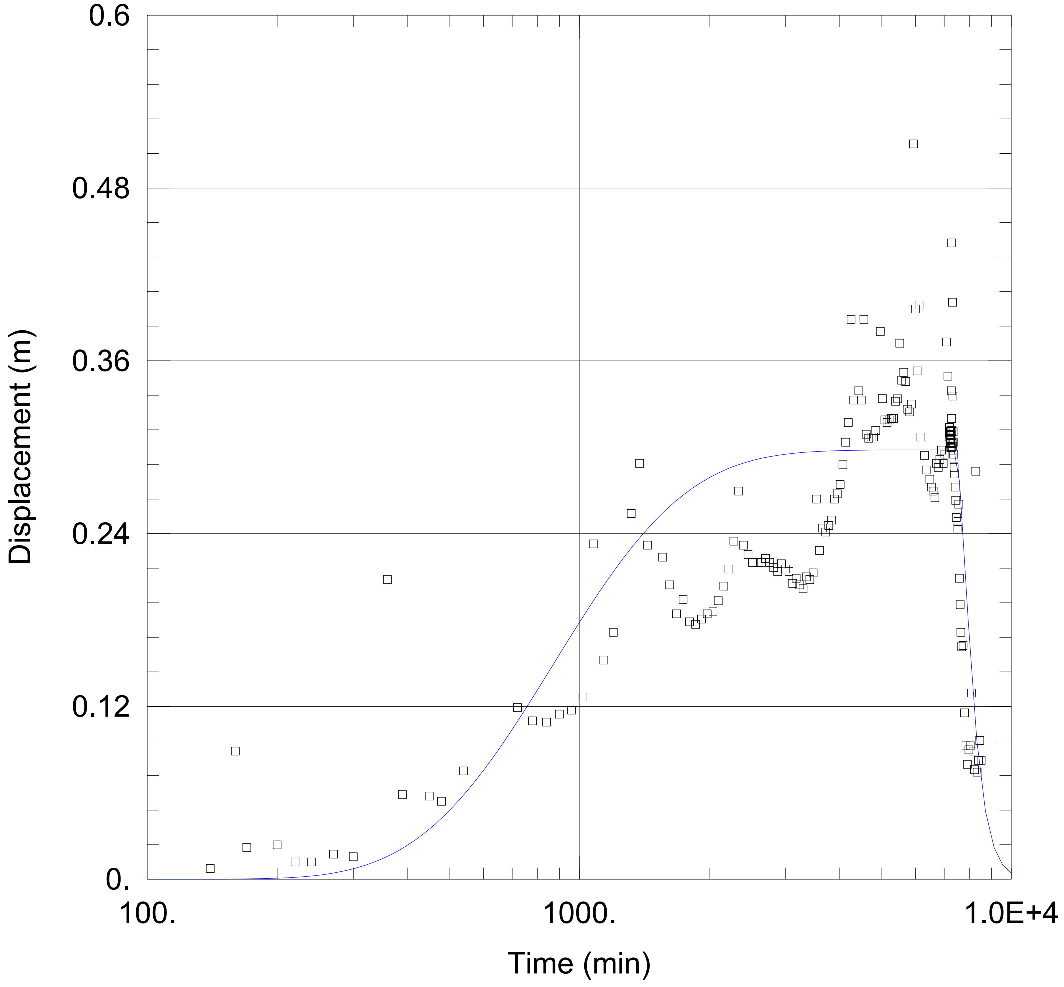
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.0006548 m^2/sec
r/B = 0.6991
b = 42. m

S = 4.237E-5
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Erin 3 Site
Test Well: E9
Test Date: November 2019

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
E9	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ 5653 8th Line	1390	0

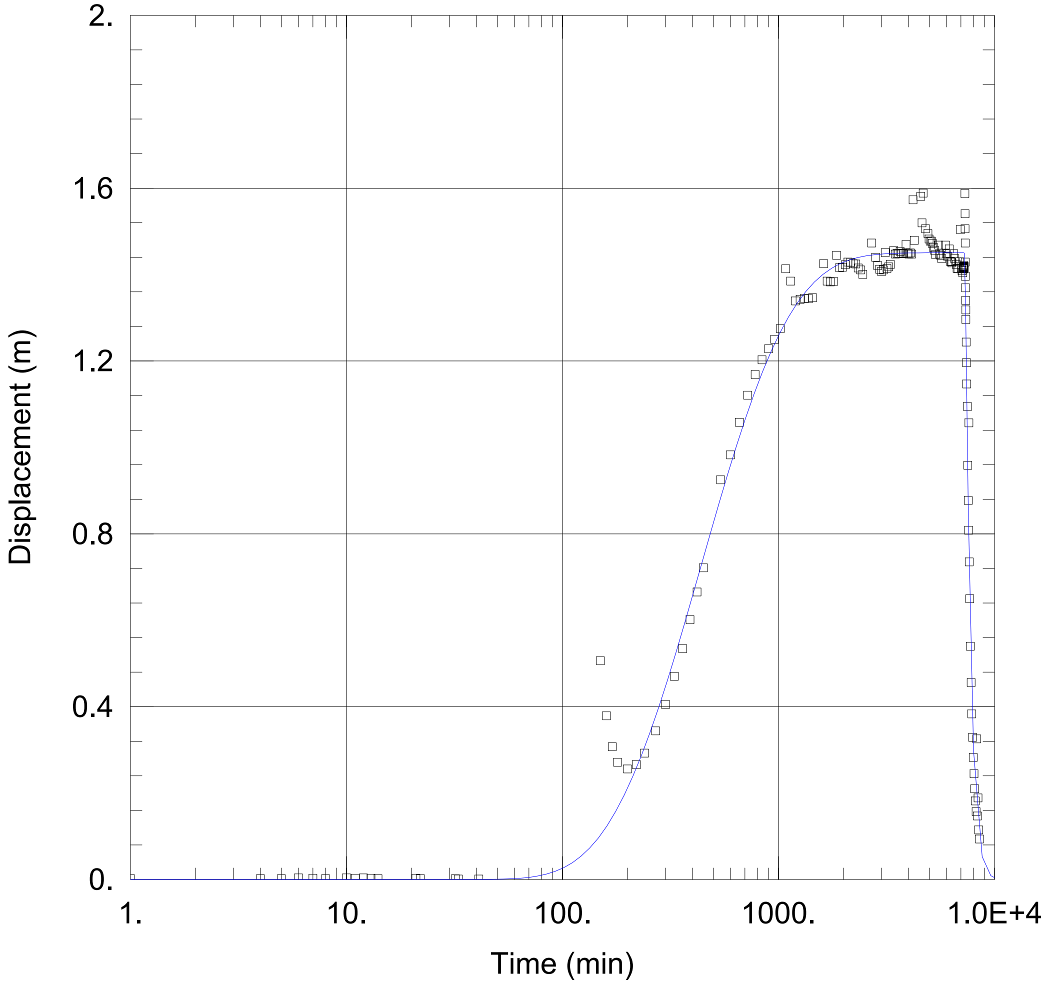
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.0006427 m^2/sec
r/B = 2.931
b = 42. m

S = 0.0001019
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Erin 3 Site
Test Well: E9
Test Date: November 2019

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
E9	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ 5662 10th Line	1050	0

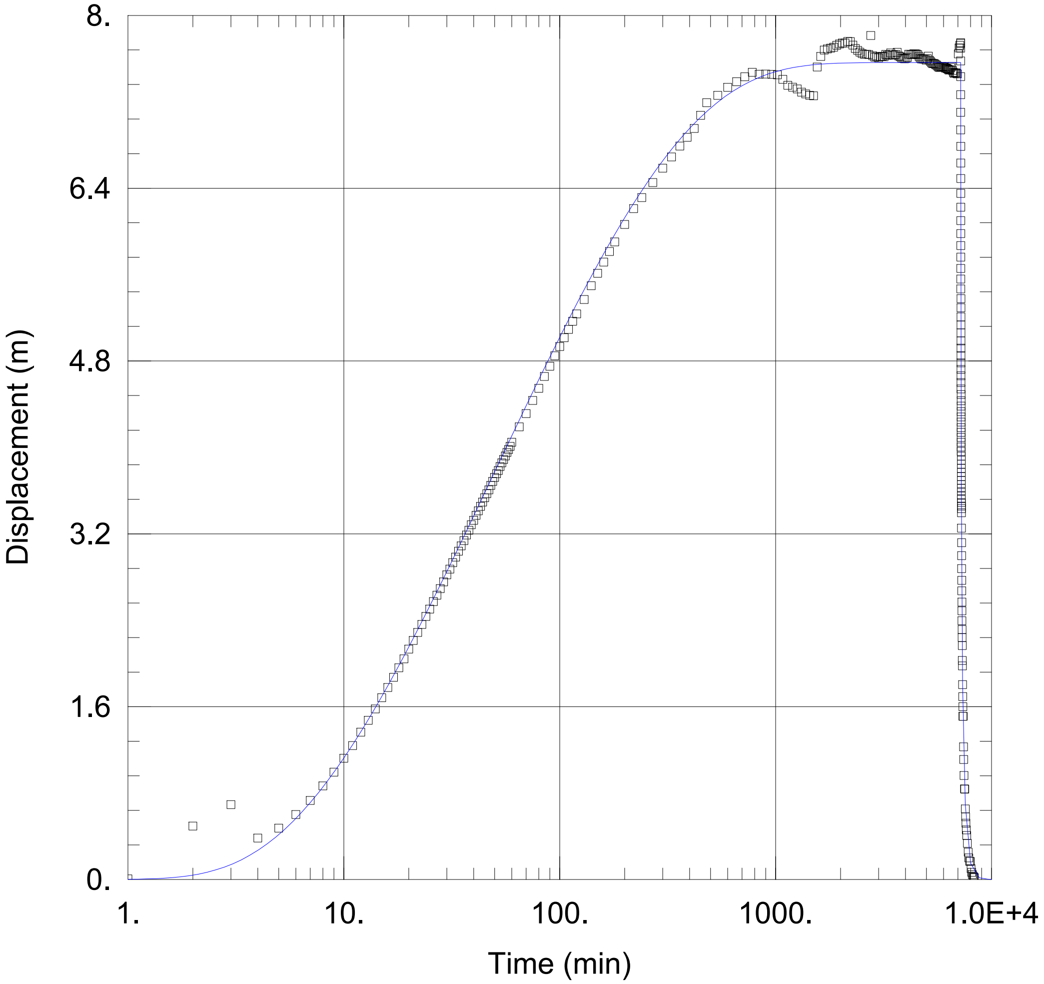
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.0007243 m^2/sec
r/B = 1.528
b = 42. m

S = 5.276E-5
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Erin 3 Site
Test Well: E9
Test Date: November 2019

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
E9	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ 5668 Rd 23	195	0

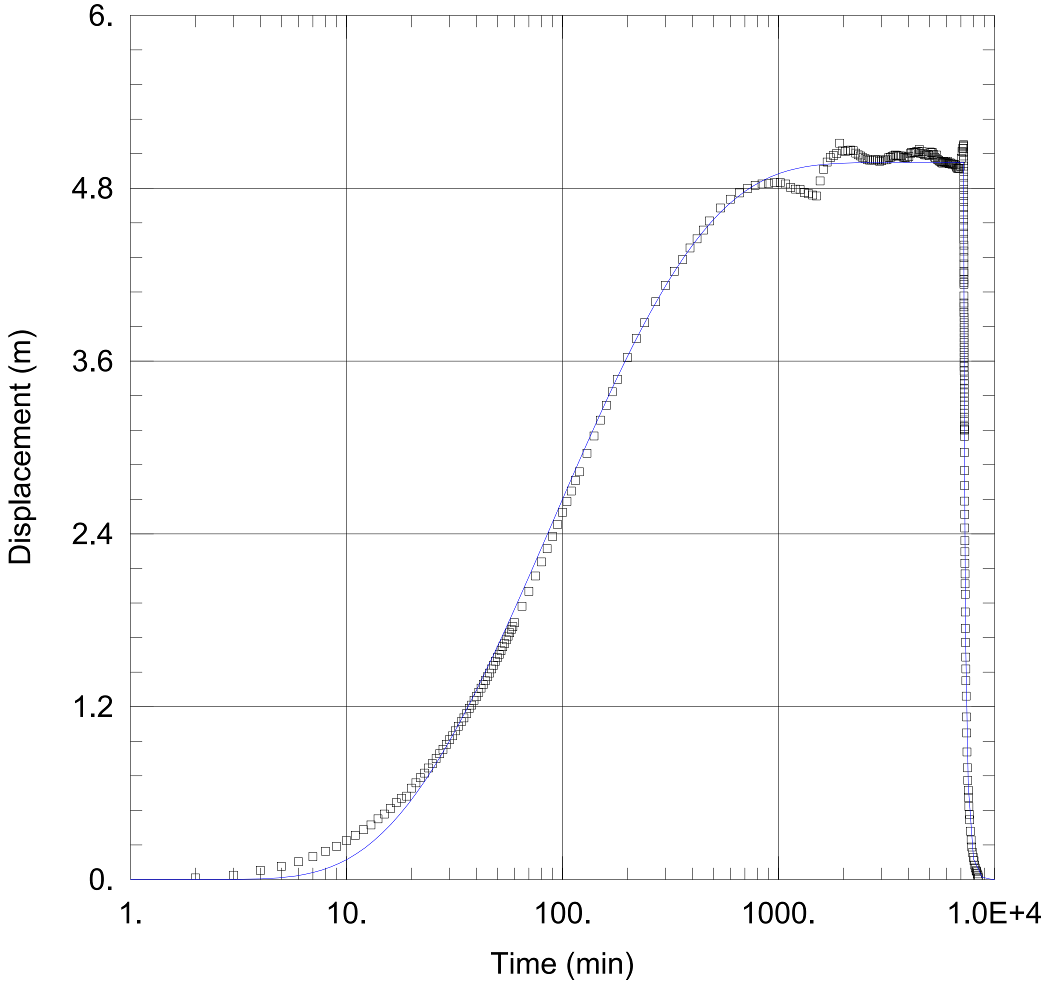
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.001117 m^2/sec
r/B = 0.2207
b = 42. m

S = 3.907E-5
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Erin 3 Site
Test Well: E9
Test Date: November 2019

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
E9	0	0

Observation Wells

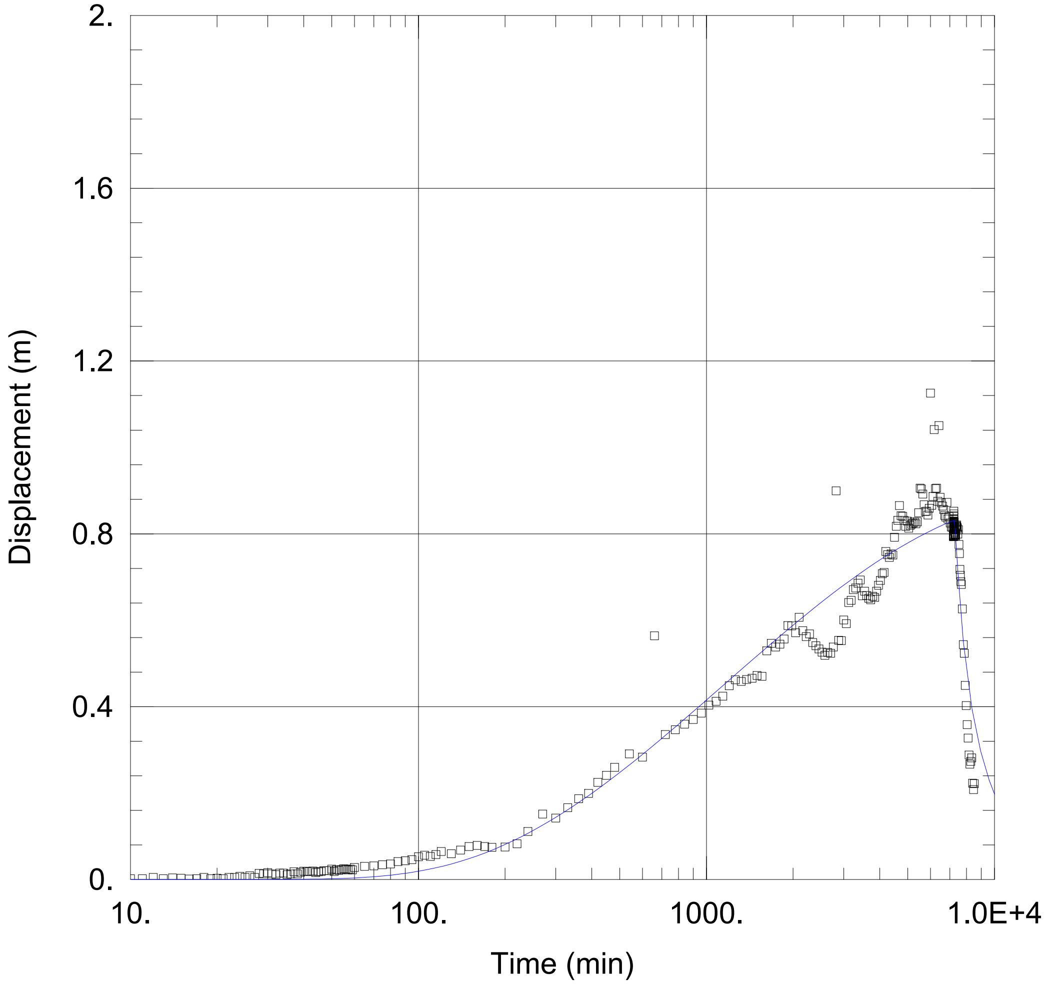
Well Name	X (m)	Y (m)
□ 5709 Rd 23	480	0

SOLUTION

Aquifer Model: Leaky
Solution Method: Hantush-Jacob

T = 0.001129 m^2/sec
r/B = 0.405
b = 42. m

S = 2.157E-5
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Erin 3 Site
Test Well: E9
Test Date: November 2019

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
E9	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ 5757 Rd 23	1320	0

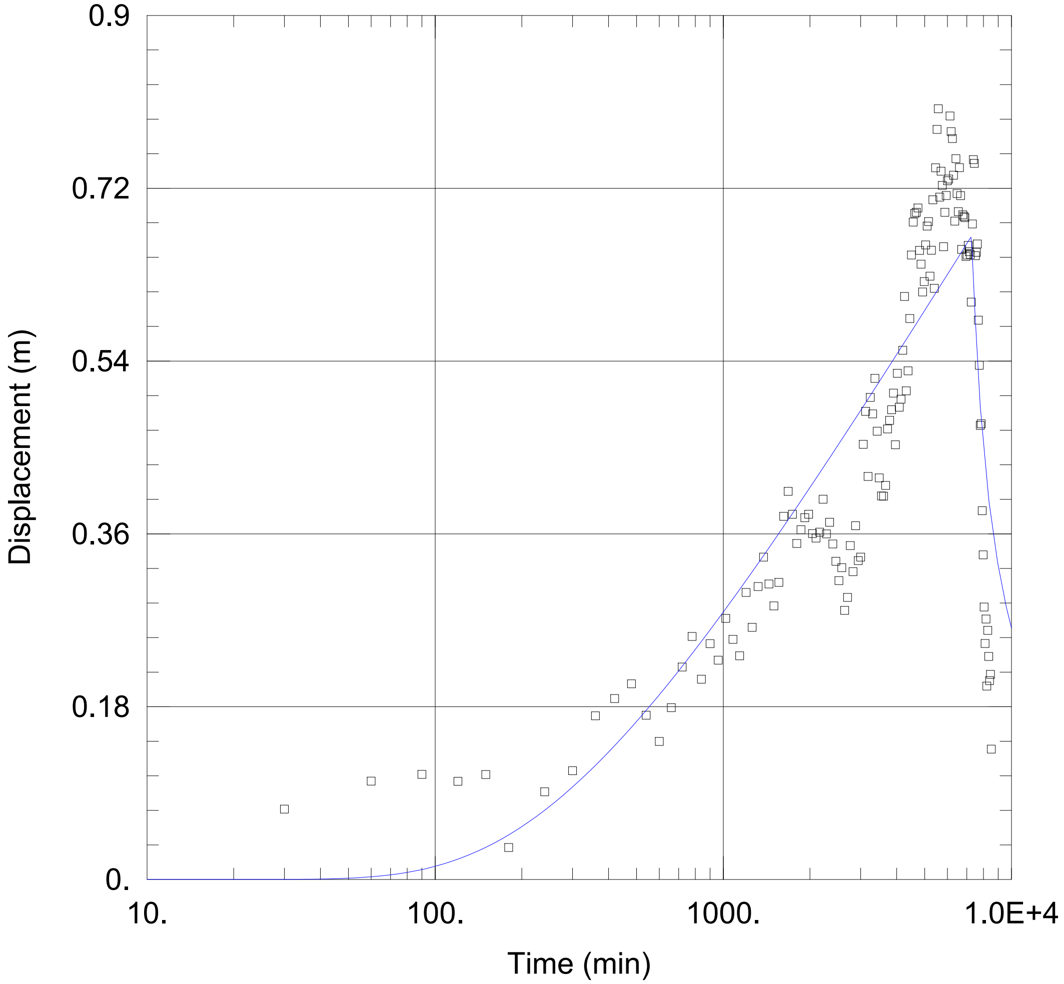
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.007169 m^2/sec
r/B = 0.3365
b = 42. m

S = 0.0001909
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Erin 3 Site
Test Well: E9
Test Date: November 2019

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
E9	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ 9621 Rd 22	1510	0

SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

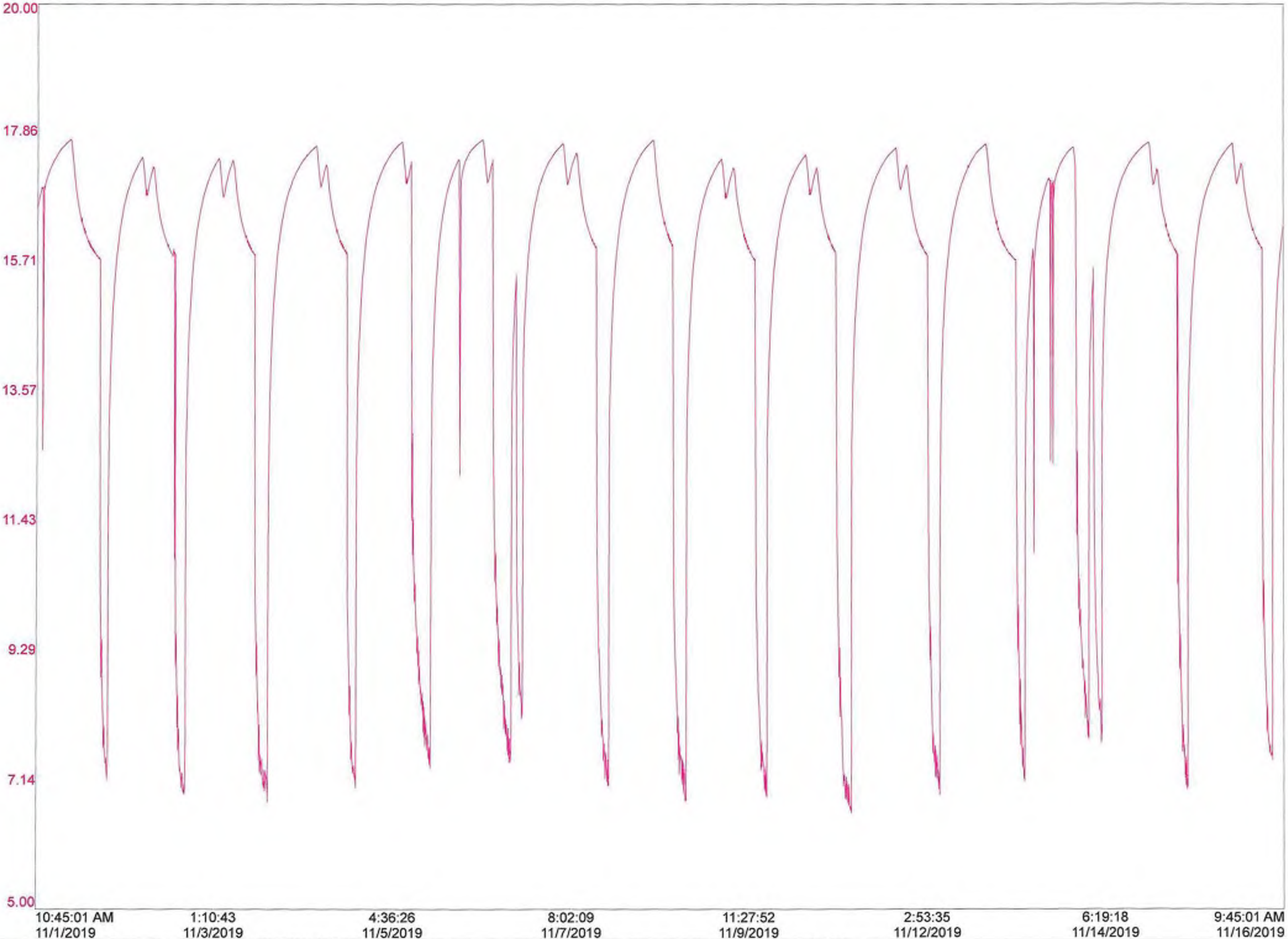
T = 0.01194 m^2/sec
r/B = 1.0E-5
b = 42. m

S = 0.0002274
Kz/Kr = 1.

Appendix P
Well E7 and E8 Water Levels

WELL # 7 NOV

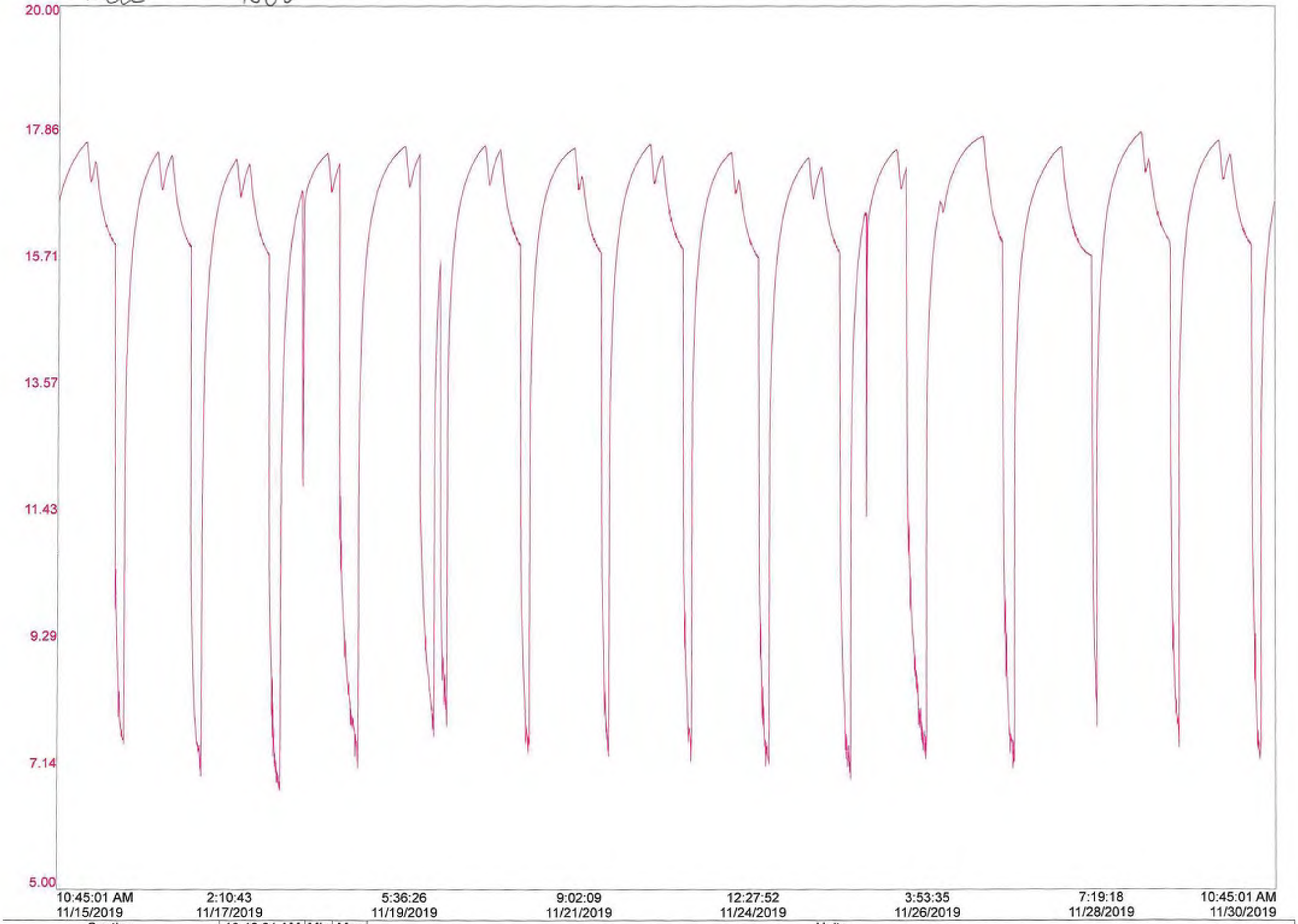
Friday, November 01, 2019 - Saturday, November 16, 2019 - -



	Caption	10:46:11 AM	Min	Max	Units
—	LIT01_W7 - Well No.7 Level	14.73	5.00	20.00	m

WELL #7 NOV

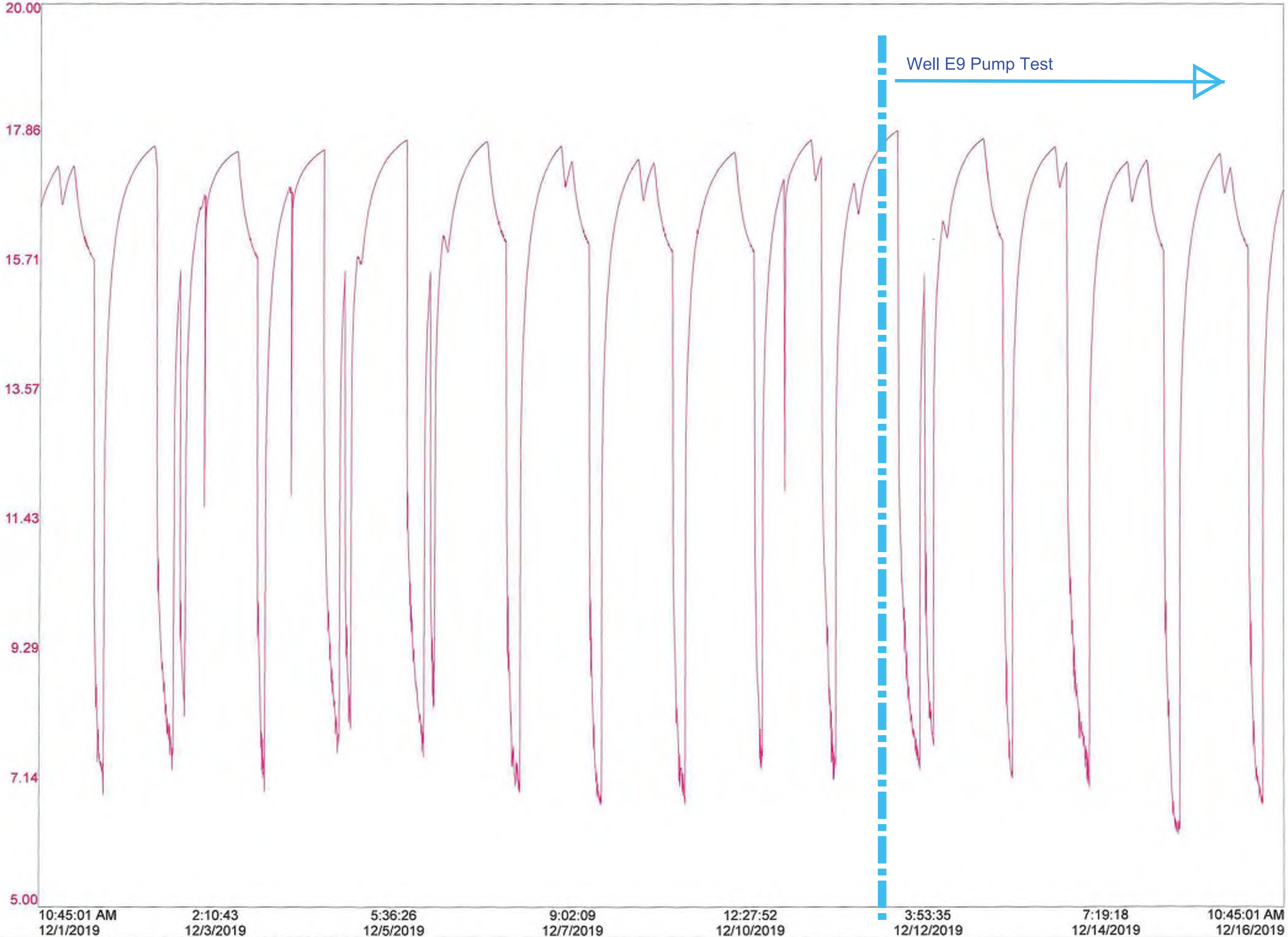
Friday, November 15, 2019 - Saturday, November 30, 2019 - -



Caption	10:46:31 AM	Min	Max	Units
LIT01_W7 - Well No.7 Level	14.74	5.00	20.00	m

Well #7 Dec

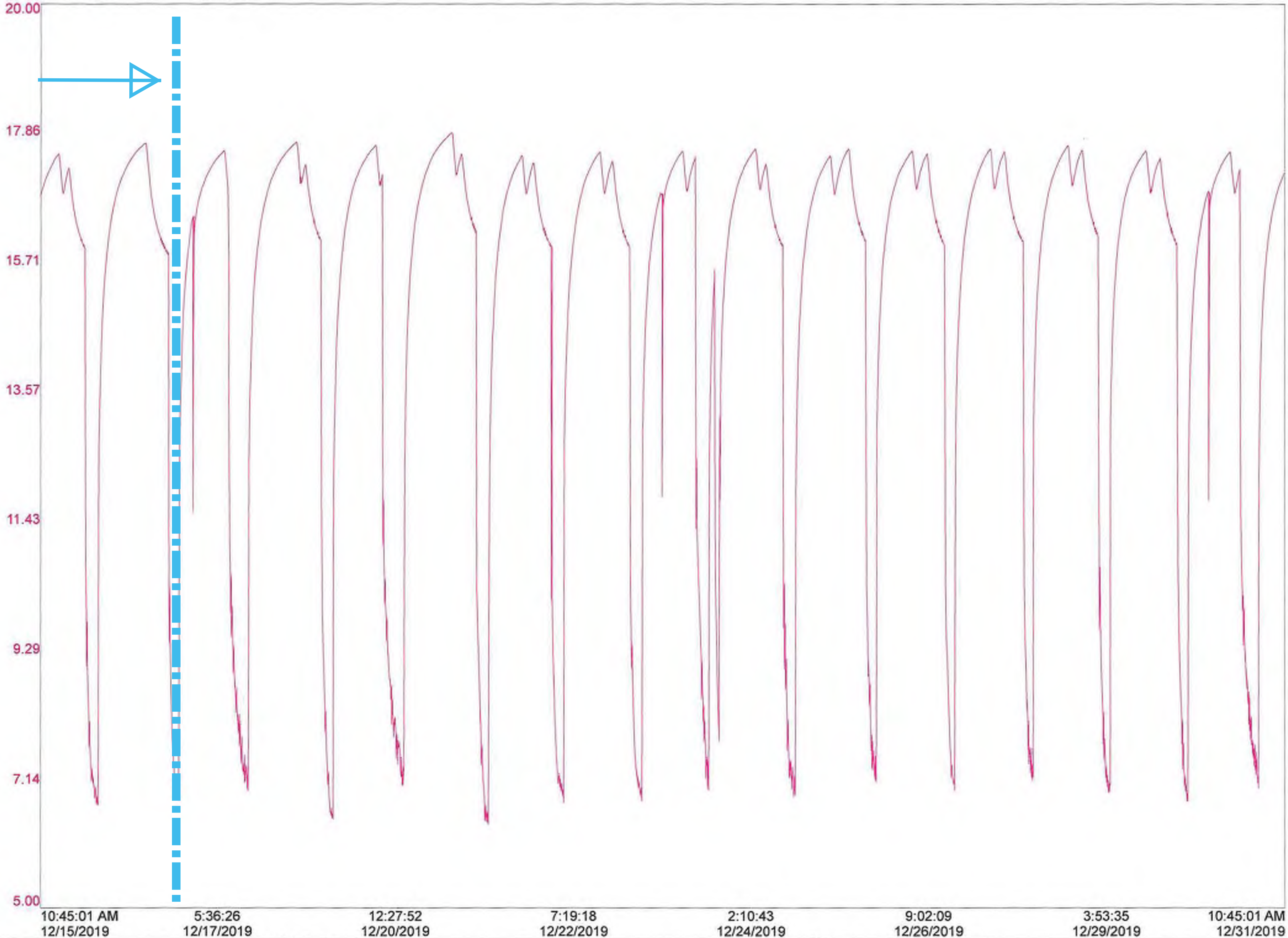
Sunday, December 01, 2019 - Monday, December 16, 2019 - -



Caption	10:46:47 AM	Min	Max	Units
LIT01_W7 - Well No.7 Level	14.75	5.00	20.00	m

WELL #7 DEC

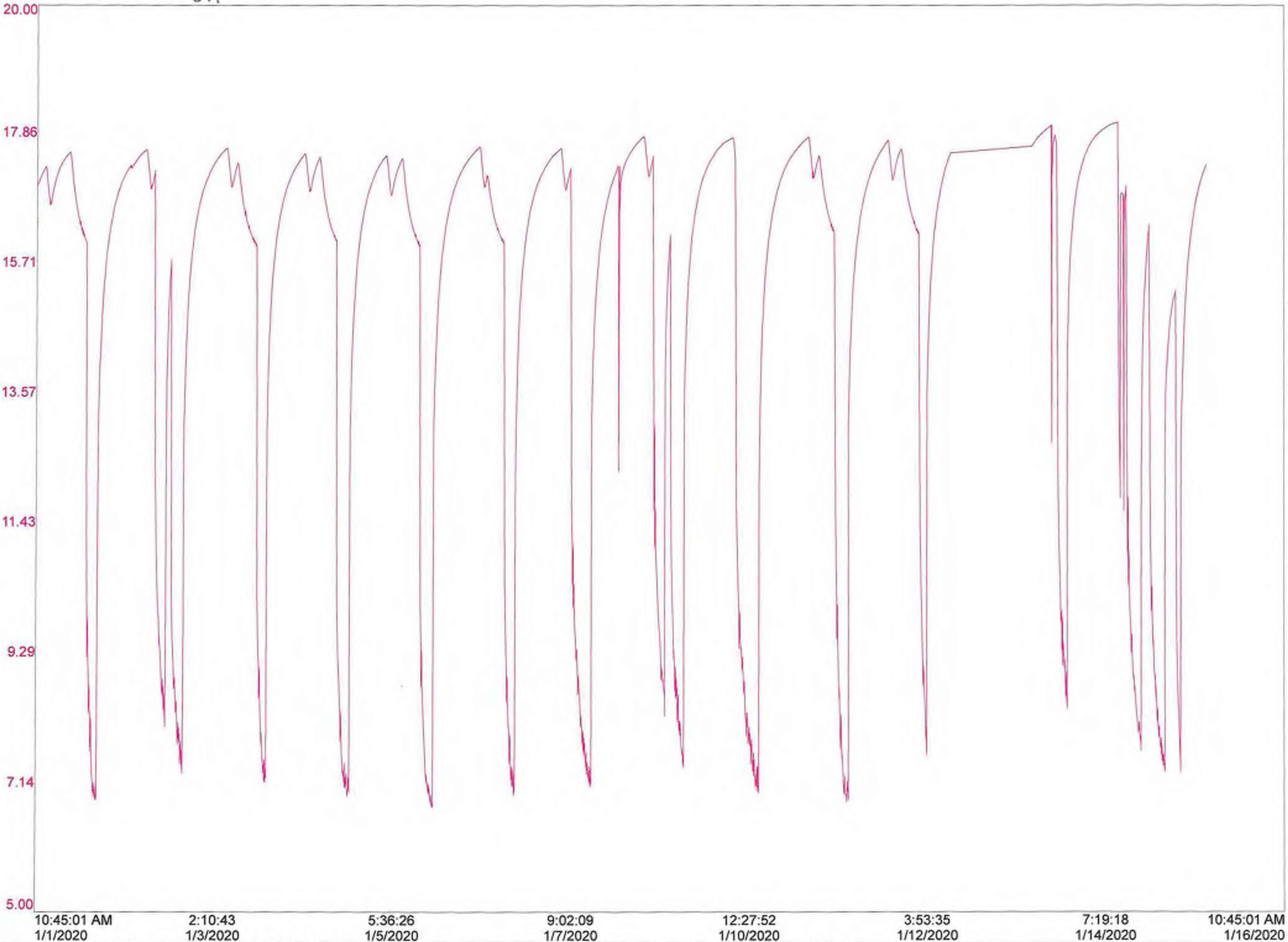
Sunday, December 15, 2019 - Tuesday, December 31, 2019 - -



	Caption	10:47:11 AM	Min	Max	Units
—	LIT01_W7 - Well No.7 Level	14.76	5.00	20.00	m

WELL #7 JAN

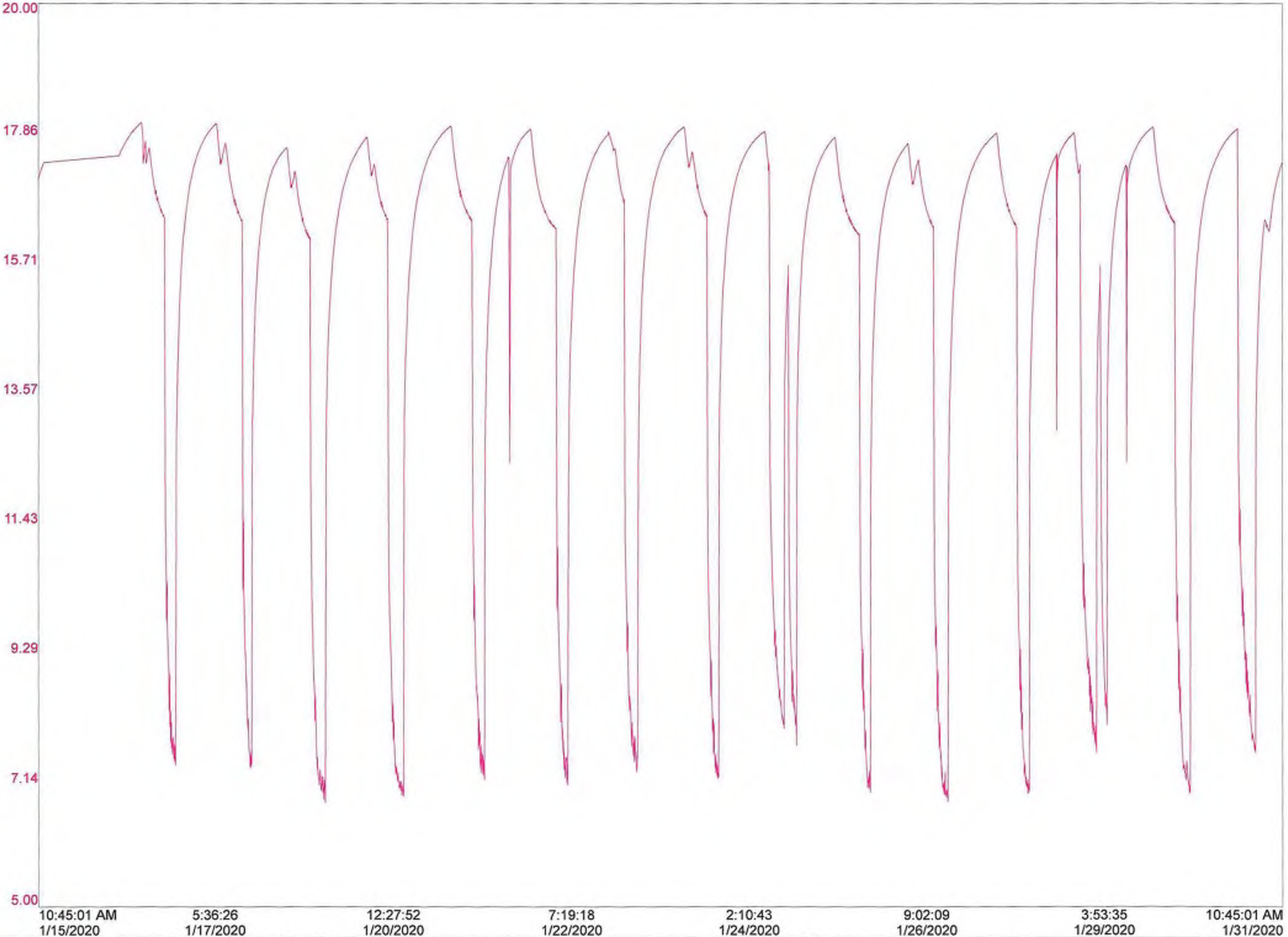
Wednesday, January 01, 2020 - Thursday, January 16, 2020 - -



	Caption	10:47:31 AM	Min	Max	Units
—	LIT01_W7 - Well No.7 Level	14.77	5.00	20.00	m

Well #7 Jan

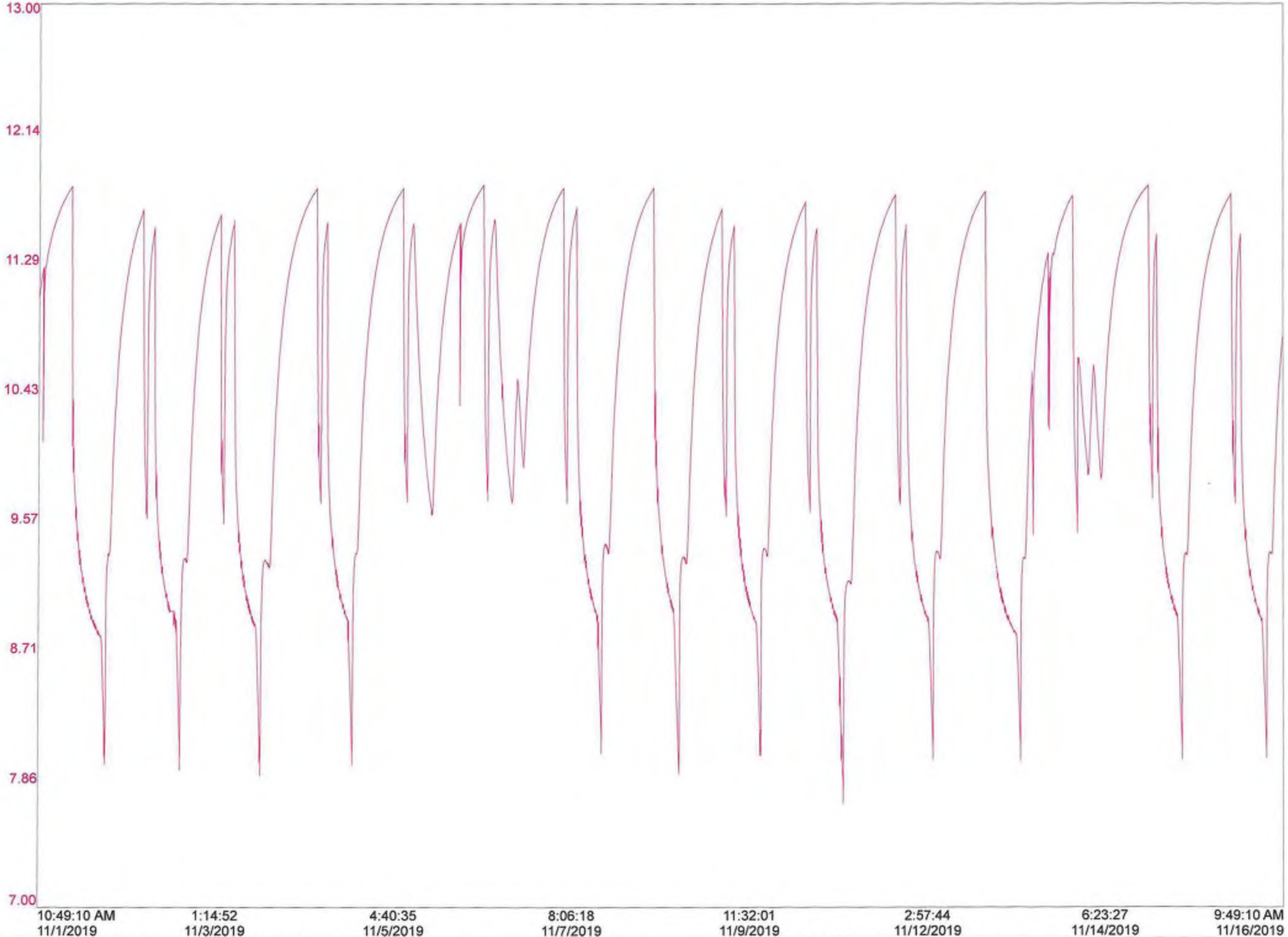
Wednesday, January 15, 2020 - Friday, January 31, 2020 - -



	Caption	10:47:53 AM	Min	Max	Units
—	LIT01_W7 - Well No.7 Level	14.78	5.00	20.00	m

Well *8 Nov

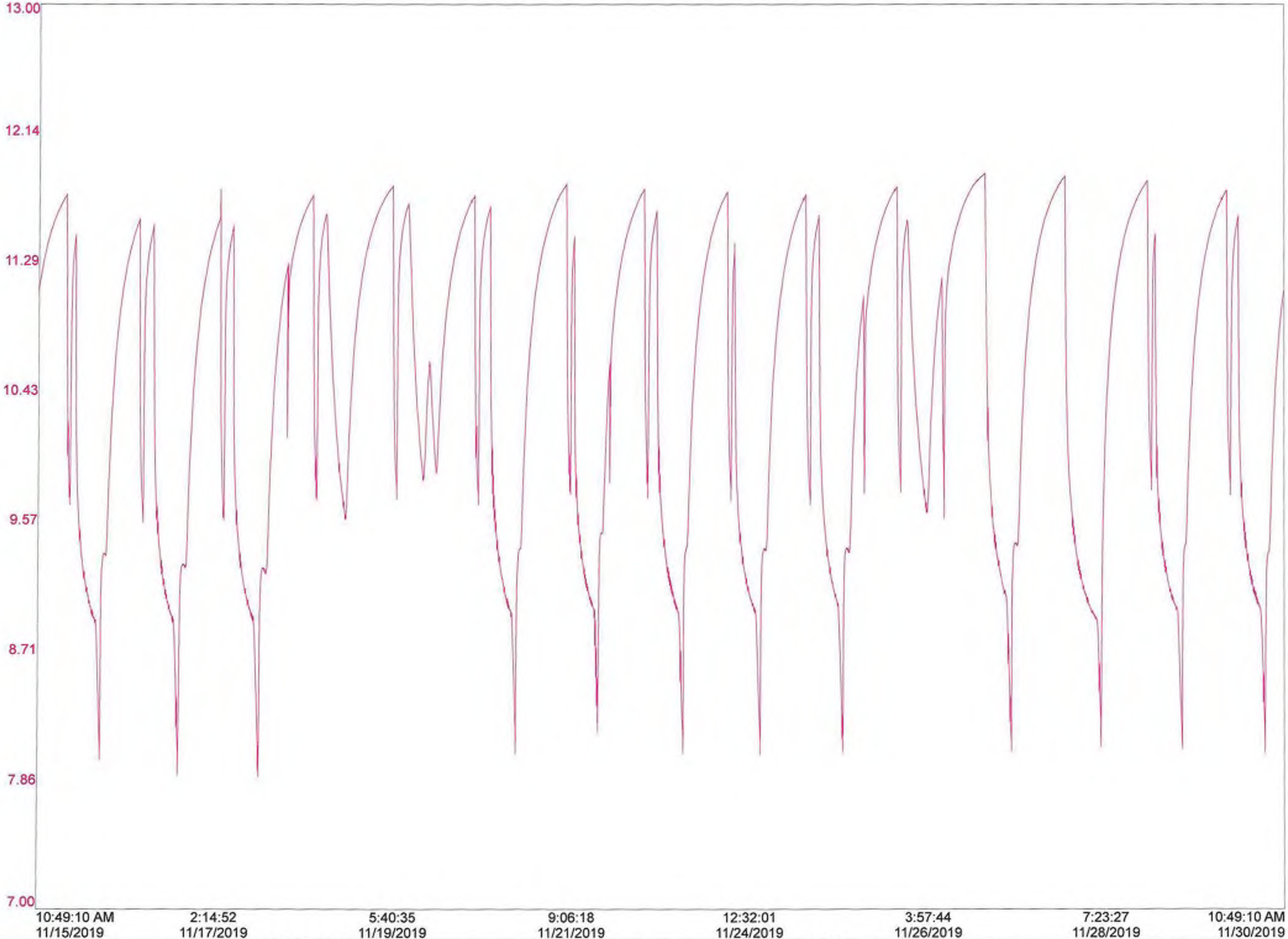
Friday, November 01, 2019 - Saturday, November 16, 2019 - -



Caption	10:50:53 AM	Min	Max	Units
LIT01_W8 - Well No.8 Level	10.14	7.00	13.00	m

WELL #8 NOV

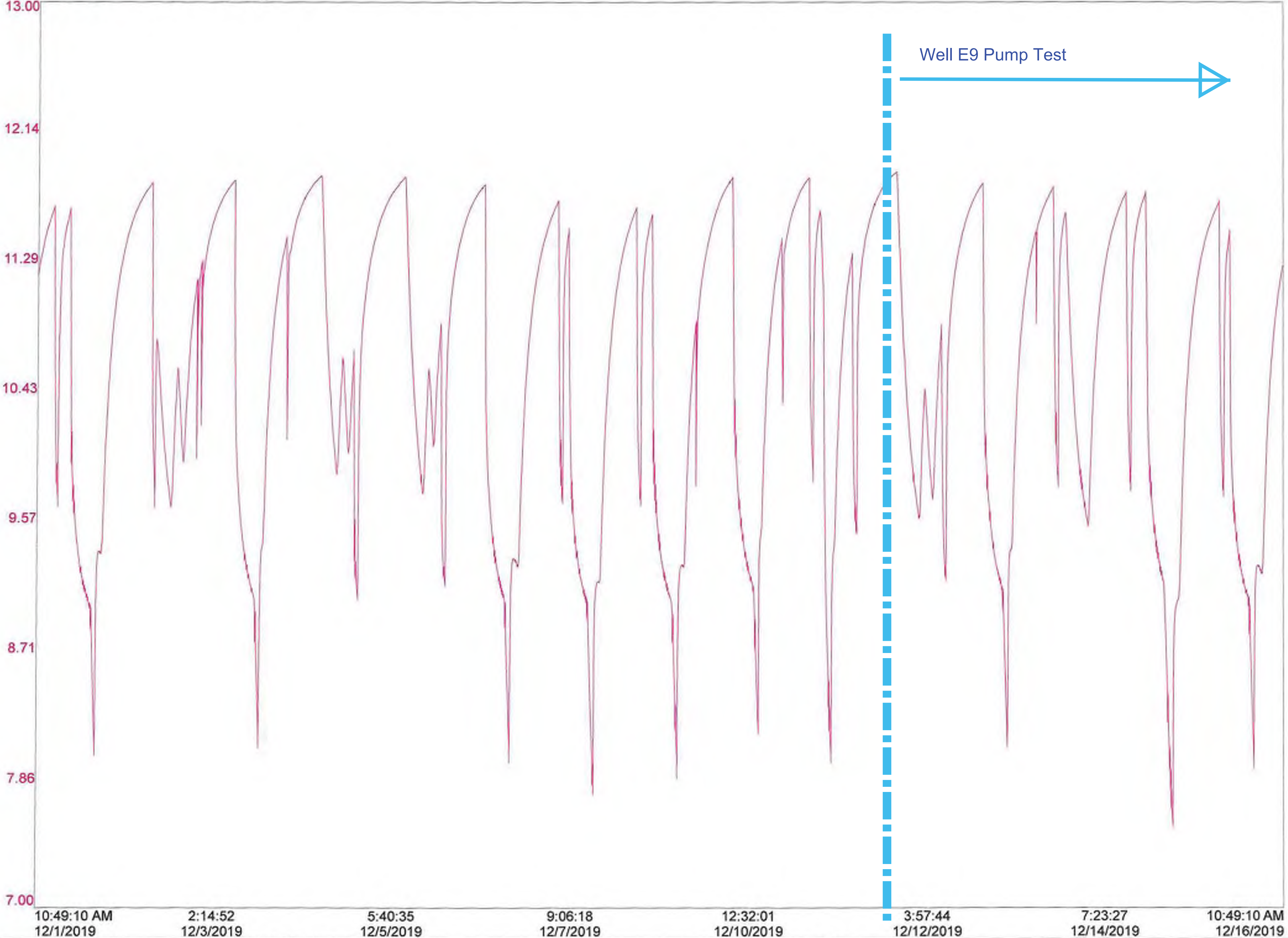
Friday, November 15, 2019 - Saturday, November 30, 2019 - -



Caption	10:51:10 AM	Min	Max	Units
LIT01_W8 - Well No.8 Level	10.14	7.00	13.00	m

WELL #8 DEC

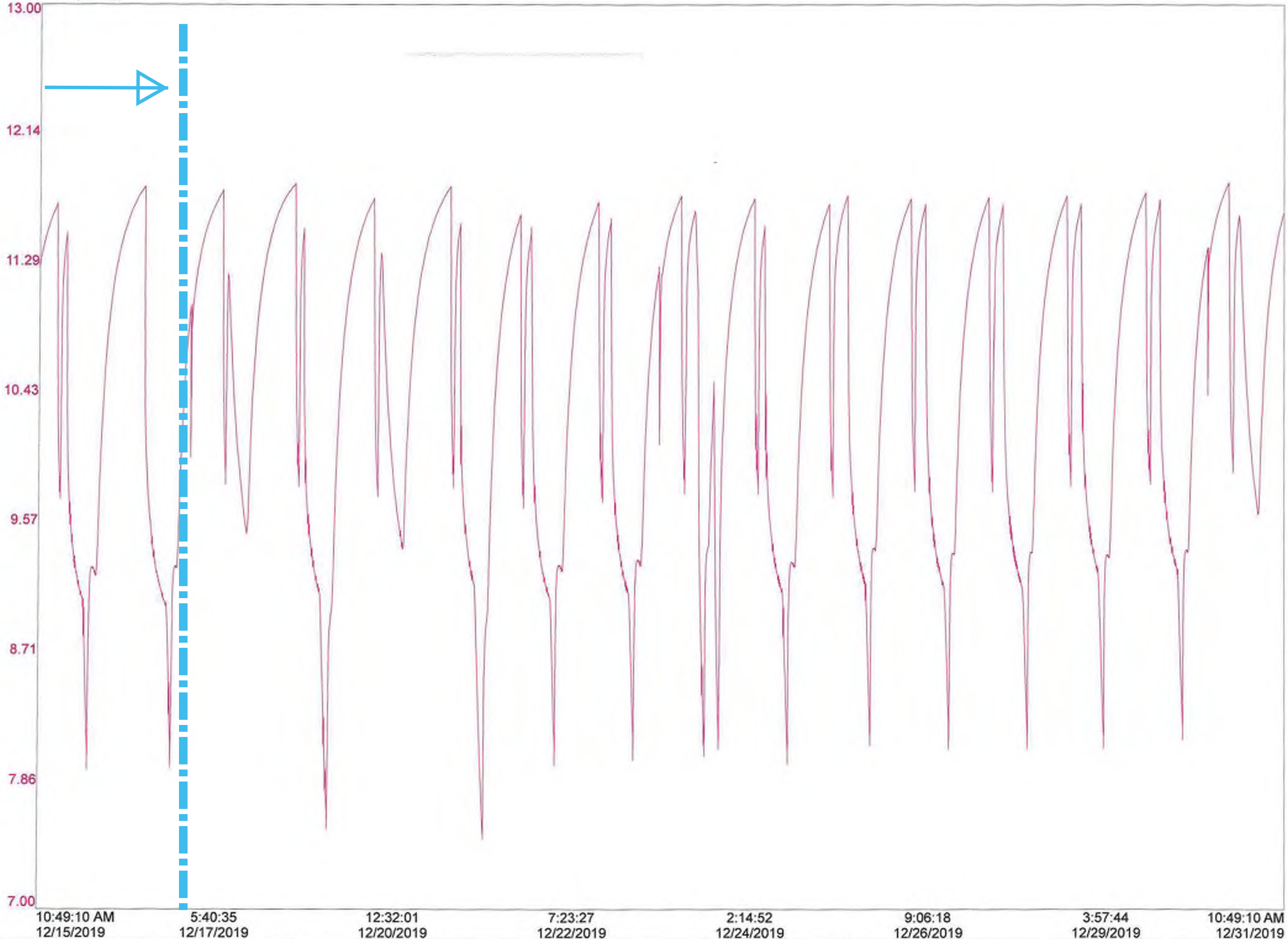
Sunday, December 01, 2019 - Monday, December 16, 2019 - -



Caption	10:51:26 AM	Min	Max	Units
LIT01_W8 - Well No.8 Level	10.15	7.00	13.00	m

WELL #8 DEC

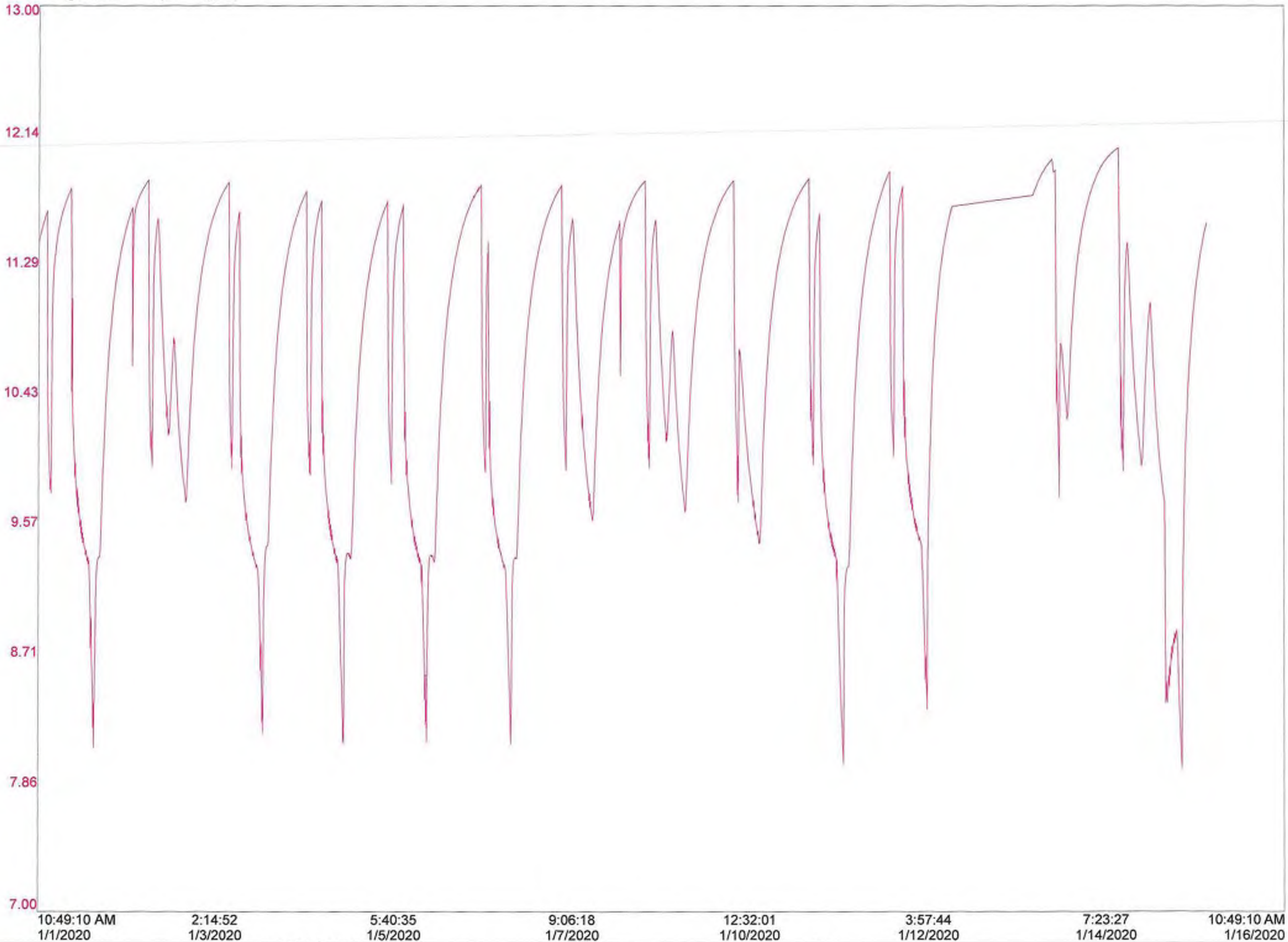
Sunday, December 15, 2019 - Tuesday, December 31, 2019 - -



Caption	10:51:47 AM	Min	Max	Units
LIT01_W8 - Well No.8 Level	10.15	7.00	13.00	m

WELL #8 JAN

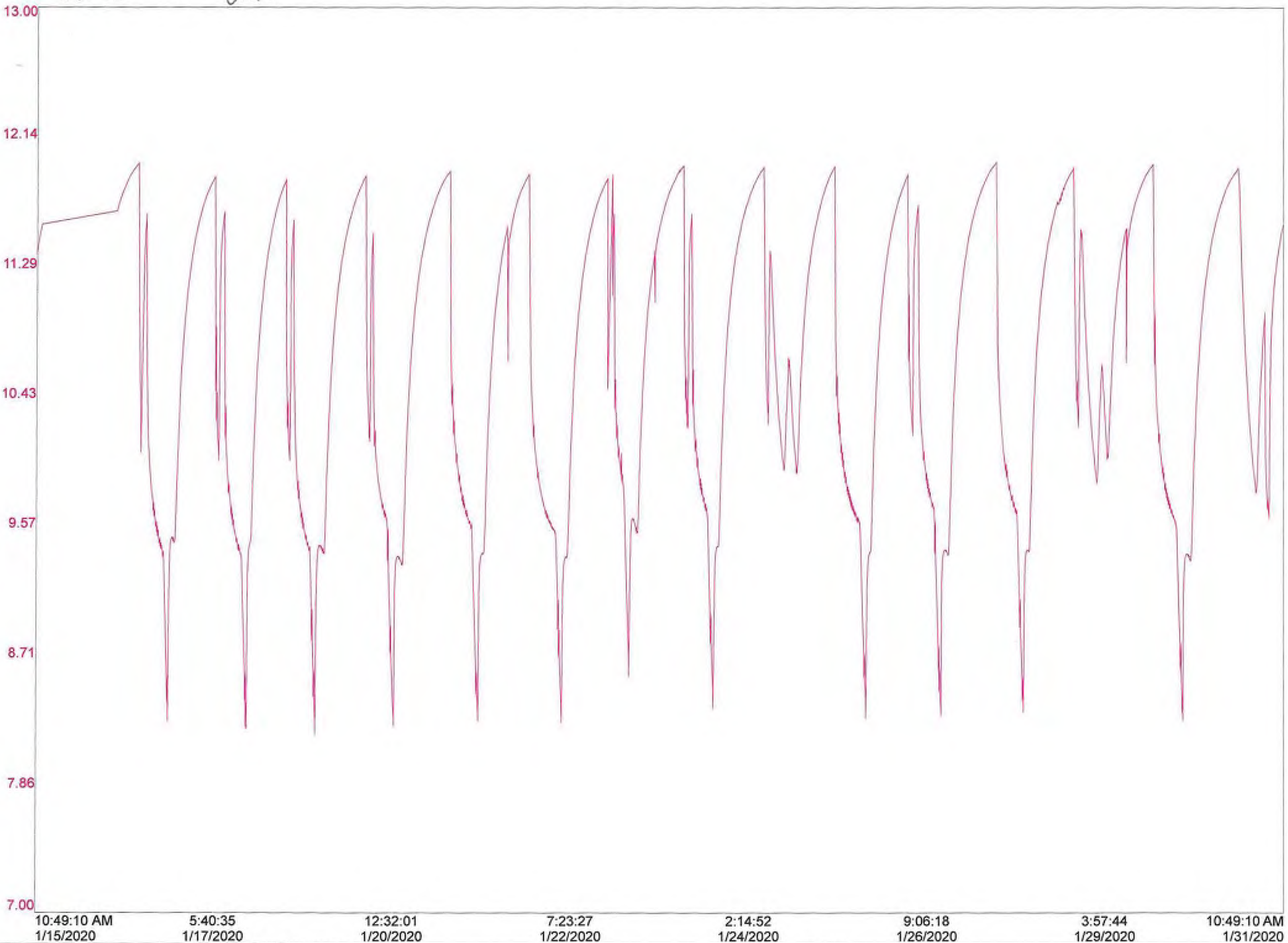
Wednesday, January 01, 2020 - Thursday, January 16, 2020 - -



Caption	10:52:06 AM	Min	Max	Units
LIT01_W8 - Well No.8 Level	10.15	7.00	13.00	m

WELL # 8 JAN

Wednesday, January 15, 2020 - Friday, January 31, 2020 - -



Caption	10:52:24 AM	Min	Max	Units
LIT01_W8 - Well No.8 Level	10.15	7.00	13.00	m

Appendix E.3

Hillsburgh Municipal Well H4 Drilling and Testing Hydrogeological Report

(Groundwater Science Corp., February 2020)

Groundwater
Science Corp.

Unit 2, 465 Kingscourt Drive,
Waterloo, ON N2K 3R5
Phone: (519) 746-6916
groundwaterscience.ca

Town of Erin Water Supply EA
New Water Supply Source Investigation
Hillsburgh Municipal Well H4
Drilling and Testing
Hydrogeological Report

Prepared For:

Corporation of the Town of Erin
5684 Trafalgar Rd.
Hillsburgh, Ontario
N0B 1Z0

February 2020

TABLE OF CONTENTS

Figures

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Appendices

1.0 INTRODUCTION

This report provides a summary of hydrogeological work and assessment undertaken to drill and test a new municipal well, referenced as well H4, for the community of Hillsburgh. This work was completed in support of the Corporation of the Town of Erin (Town) Urban Centre Water Servicing Municipal Class Environmental Assessment (Class EA). The Class EA was initiated in May 2015 and is administered on behalf of the Town by Triton Engineering Services Limited (Triton). Triton is preparing the Project File Reporting for the Class EA, this hydrogeologic assessment is intended as an appendix to the Project File Report.

As part of the overall Class EA assessment, the minimum initial water supply target (maximum daily demand) of 1,615 m^3/d (18.7 L/s over 24 hours) was identified for Hillsburgh, which corresponds to the population growth forecast to year 2031, as outlined in the Final Growth Management Strategy Report (Dillon, October 2019) for the Town..

1.1 INVESTIGATION BACKGROUND

Well H4 is located at a test well drilling site, referenced as Hillsburgh 2 (site). The location of the Hillsburgh 2 site is shown on **Figure 1**.

In December 2018 a nominal 152 mm diameter exploratory test well, referenced as TW4, was drilled and developed by Keith Lang Well Drilling Inc. at the Hillsburgh 2 site. The investigation results (including well record and testing records) for the Hillsburgh 2 site are included in **Appendix A** of this report.

The TW3 drilling results are summarized as follows:

- till overburden extends to a depth of 4.6 m below ground surface;
- sand and gravel overburden encountered from 4.6 to 17.7 m below ground surface (mBGS);
- highly fractured bedrock encountered from 17.7 to 21.9 mBGS
- brown limestone (dolostone), assumed to be Guelph Formation, encountered from 17.7 to 44.2 m depth;
- grey limestone (dolostone), assumed to be former Amabel Formation, encountered from 44.2 to 93.9 m depth;
- shale (base of bedrock aquifer) encountered from 93.9 to 97.5 m depth;
- well casing installed to 20.7 m depth, open hole from 20.7 to 97.5 m; and,
- two significant water producing zones (e.g. fractures) encountered at depths of 21.3 mBGS, and, 86.3 mBGS.

Video well inspection, flow profiling and step testing at TW4 was completed by Lotowater Technical Services Inc. (Lotowater) on January 22, 2019. General water quality sampling was also completed at that time. The test results are summarized as follows:

- TW4 video inspection indicates numerous potential water production zones at reported depths of: 20.8 to 22.6 mBGS (cavern, fractures, vuggs); 24.9 mBGS (fracture); 30.6 to 34 mBGS (fractures, vuggs); and, 76.7 to 82.6 mBGS (cavern, fractures, vuggs);

- flow profiling was inconclusive, with no vertical flow velocities recorded below the pump;
- measured total well depth of 88.5 m, and rock rubble observed at bottom of well;
- TW4 open hole step testing at rates up to 9.5 litres per second (L/s) resulted in 0.8 m drawdown;
- estimated open hole specific capacity of 12.13 L/s/m;
- much of the water produced by the open hole appears to be from the upper highly fractured Guelph Formation;
- projected potential open pumping rate of 121.3 L/s (10,481 m^3/d) based on an assumed operationally sustainable drawdown of 10 m (however projection is very tentative and based on limited data); and,
- generally good water quality results are noted, however elevated hydrogen sulphide is present along with elevated iron and manganese, sodium and chloride are at moderate concentrations, this water quality is expected to be representative of the upper zone (predominantly).

The initial drilling and testing results indicated a highly productive well as constructed. However based on the presence of sand and gravel overburden and highly fractured upper bedrock some concerns with the well as constructed were identified related to connection to surface. It was decided to utilize a packer to test the capacity of the lower zone (only) in order to assess the capacity of the deep bedrock aquifer.

A short term test of the lower aquifer zone was completed by Keith Lang Drilling Inc. on May 3, 2019. General water quality samples were obtained during the test. An inflatable packer was set to approximately 30.5 to 31.5 mBGS and the lower zone pumped at rates of 3.4 and 7.2 L/s. Based on the results a lower zone specific capacity of 1.75 L/s/m was estimated, and a projected pumping rate of 17.5 L/s based on an assumed operationally sustainable drawdown of 10 m. The results are interpreted to be relatively conservative based on the video inspection identification of major water production zones at depth and due to limitations with the packer and pumping configuration.

Water quality results from the lower zone at TW4 are somewhat similar as compared to the open hole results, however based on the pumping time there may be residual characteristics from the upper zone due to the flow of water from the upper to lower zones over time. Sodium, chloride, iron and manganese concentrations are slightly lower than observed from the open hole samples, however sulfate concentrations are slightly higher (but below drinking water guidelines).

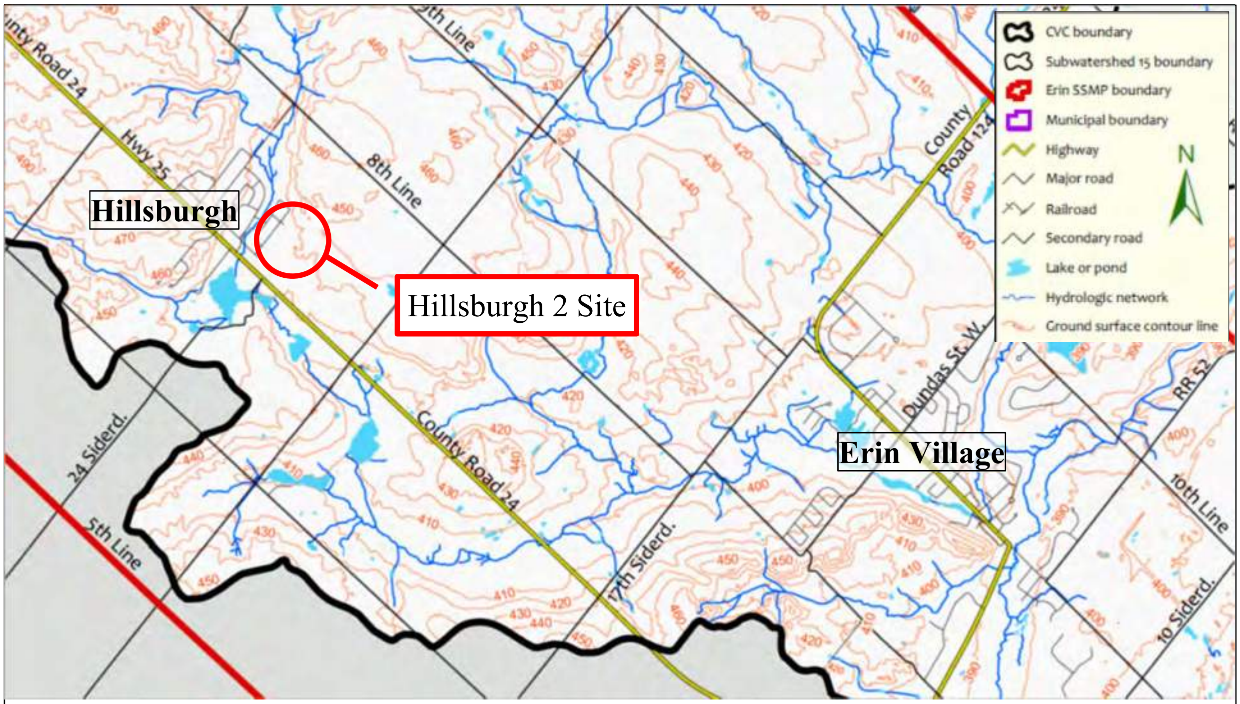
Based on the drilling and testing results a decision was made to proceed to the municipal well construction and testing stage at the Hillsburgh 2 site.

2.0 HYDROGEOLOGIC CONDITIONS

2.1 PHYSICAL SETTING AND DRAINAGE

Considerable background information is available through watershed and subwatershed scale studies completed for the overall study area. For the purposes of this assessment, the *Erin Servicing and Settlement Master Plan Phase 1 - Environmental Component Report – Existing Conditions Report* (SSMP, May 2011; Credit Valley Conservation, Aquafor Beech Inc., Blackport Hydrogeology Inc.) is assumed to provide the most complete and up to date synthesis of local information.

The Hillsburgh 2 site is located within the West Credit River subwatershed. **Figure 1**, modified from the SSMP (May 2011) report, shows general topographic contour elevations, in metres above sea level (mASL), and, surface water systems in the overall study area.



Source: Figure 2.1.1, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 1: Physical Setting

The site is located within an agricultural field, at the south end of Currie Drive. Based on available mapping, ground surface at the site is approximately 439 mASL. Overall topographic slope at the site is west-southwest.

A branch of the West Credit system flows through Hillsburgh, located approximately 230 m southwest of well H4. We note there are some discrepancies between stream channel (reach) delineation in this area between Ministry of Natural Resources (MNRF) mapping and the SSMP report. As noted previously, the SSMP mapping is assumed to represent the best available data at the time of this analysis.

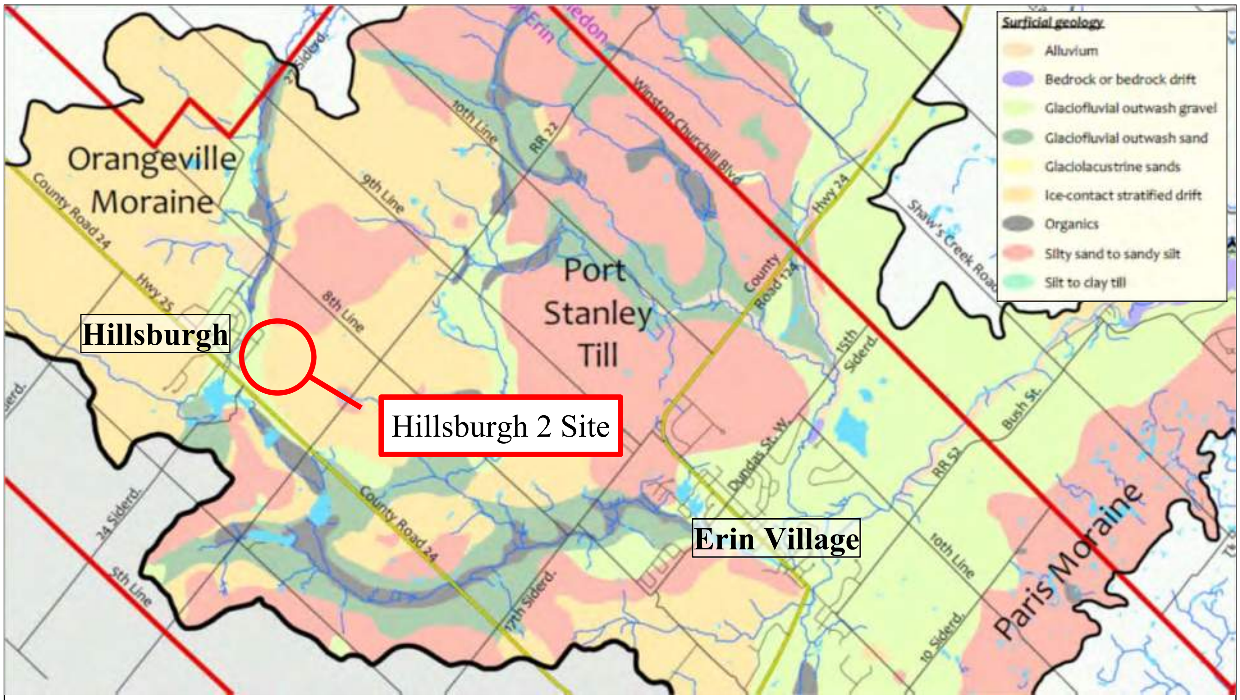
The West Credit in Hillsburgh flows into the study area across 8th Line, about 1.km north of the Hillsburgh 2 drilling site at an estimated elevation of approximately 439 mASL.

From that point the creek flows southwest, and crosses Trafalgar Street (County Road 24). At that point the stream elevation is approximately 433 mASL. The creek flows into reservoir pond above Station Street then flows southeast through an online pond and then exists the study area at County Road 22, about 1.5 km south of the Hillsburgh 2 drilling site and at an elevation of approximately 416 mASL.

A smaller tributary system is mapped as starting at a pond, about 1.1 km southeast of the Hillsburgh 2 drilling site and elevation of approximately 443 mASL then flowing across Wellington Road 22.

2.2 SURFICIAL GEOLOGY

The surficial geology of the study area is shown in **Figure 2**.



Source: Figure 2.1.2, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

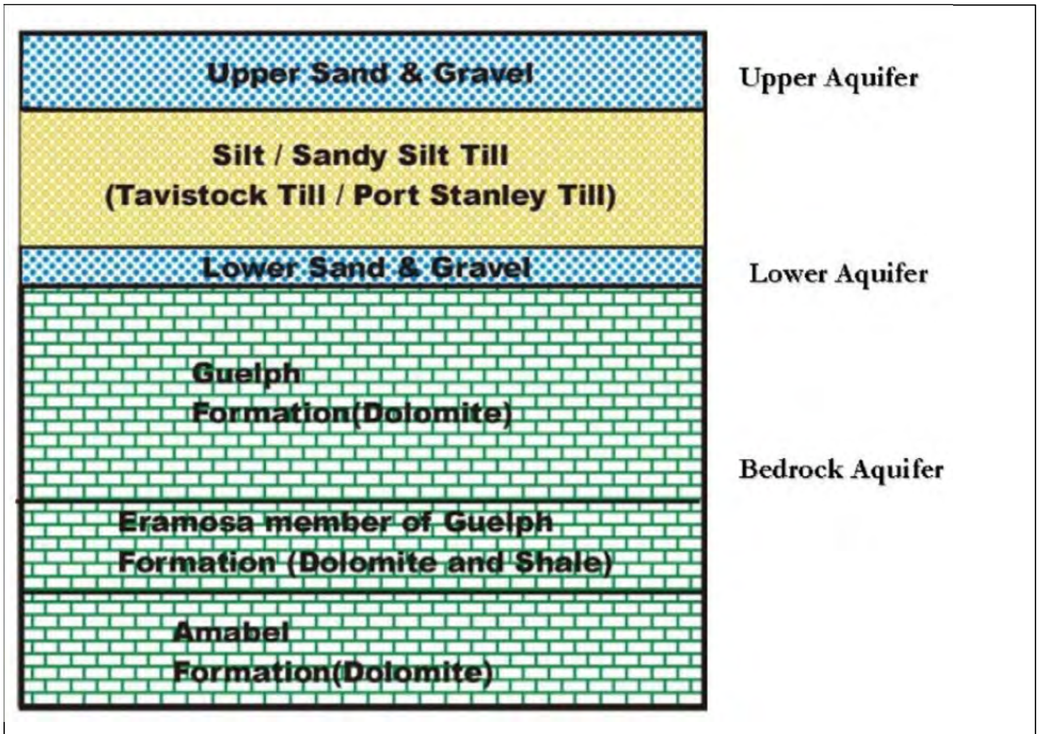
Figure 2: Surficial Geology

As shown, the Hillsburgh 2 site is located within a glaciofluvial outwash deposit, bordered to the south by ice contact stratified drift. Outwash gravel is also mapped along the West Credit River within the study area.

2.3 SUBSURFACE GEOLOGY

A generalized conceptual model of the subsurface geology in the study area, as presented in the SSMP report, is shown in **Figure 3**. As noted in the SSMP report, the geologic units vary in thickness, and may not be continuous in extent through the study area.

The upper sand and gravel layer is comprised of permeable surficial geologic units, primarily associated with kame moraine, till moraine, or ice contact sand and gravel deposits of the Orangeville Moraine and the Paris Moraine. These deposits occur in the Hillsburgh area but are not continuous within the region.



Source: Figure 2.1.3, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011).

Figure 3: Conceptual Geologic Model

The till sequence consists primarily of the two major till deposits identified in this area; the Port Stanley Till; and, the Wentworth Till. Both are described as sandy silt tills. The till units can occur at ground surface, or underlie the upper sand and gravel layer. The till units are interpreted to have a moderate to low permeability and can act as aquitards where present in sufficient thickness.

Underlying the till units, and immediately above bedrock, discontinuous sand and gravel (glaciofluvial) deposits are reported. The lower sand and gravel units can be hydraulically connected to the upper bedrock, and where connected the sand/gravel/bedrock system can act as one aquifer unit.

As noted in the SSMP report, the geologic units vary in thickness, and may not be continuous in extent through the study area.

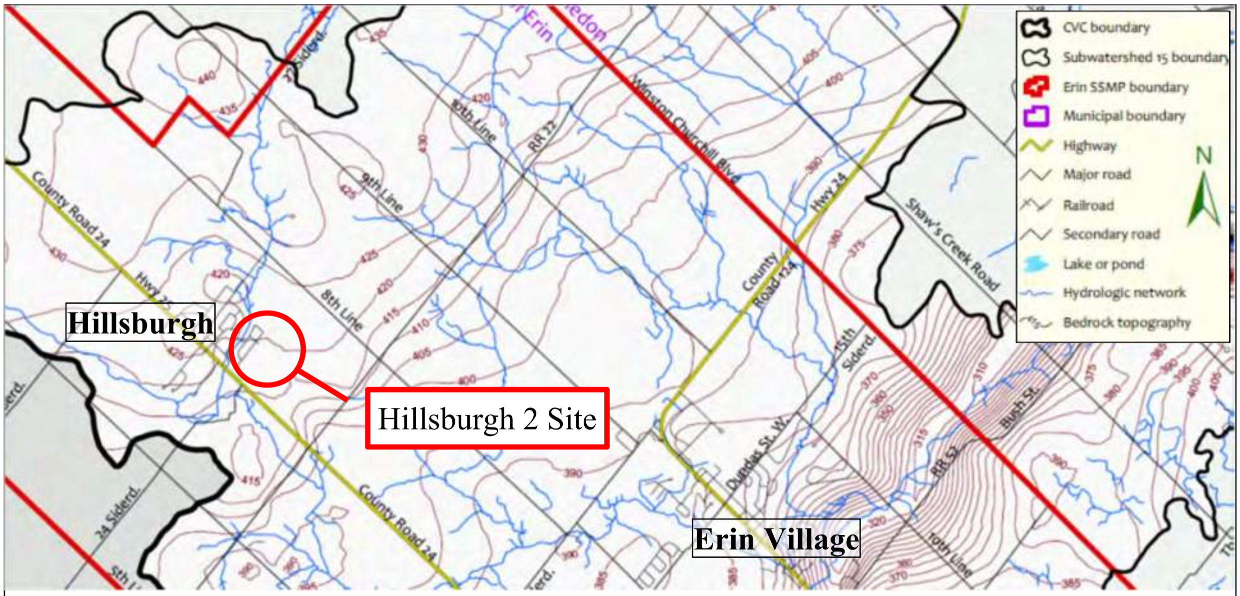
The municipal water systems and majority of private residential wells obtain water from the Silurian dolostone (dolomite) bedrock aquifer system. The dolostone sequence is underlain by shale units that form the base of the bedrock aquifer system.

We note that the stratigraphic characterization and nomenclature of the Silurian bedrock sequence has been revised by the Ontario Geologic Survey (e.g. Brunton and Brintnell, 2001). However for simplicity and consistency with the SSMP and published Source Protection reporting, in this report we will utilize the previous formation references.

Hillsburgh is located just west of the eastern mapped limit of the Guelph Formation, therefore total formation thickness may be variable and is expected to thin from west to east. The Guelph Formation is described as *a cream and brown, porous fine to medium crystalline dolomite* (SSMP, May 2011). The Guelph Formation is a major water bearing unit where present. The upper portion of the Guelph Formation is typically fractured and can produce a considerable quantity of water. Many private wells within the Hillsburgh area are constructed in the upper Guelph Formation.

The Amabel Formation is described as a *gray to blue-gray medium crystalline dolomite* (SSMP, May 2011). The Amabel Formation is also capable of producing substantial quantities of water, typically from major fracture zones reported at depth. Some local private wells and the Hillsburgh municipal obtain water from the Amabel Formation, however few wells penetrate the full formation thickness.

The interpreted bedrock topography (contours in mASL) within the study area is shown in **Figure 4**.



Source: Figure 2.1.6, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

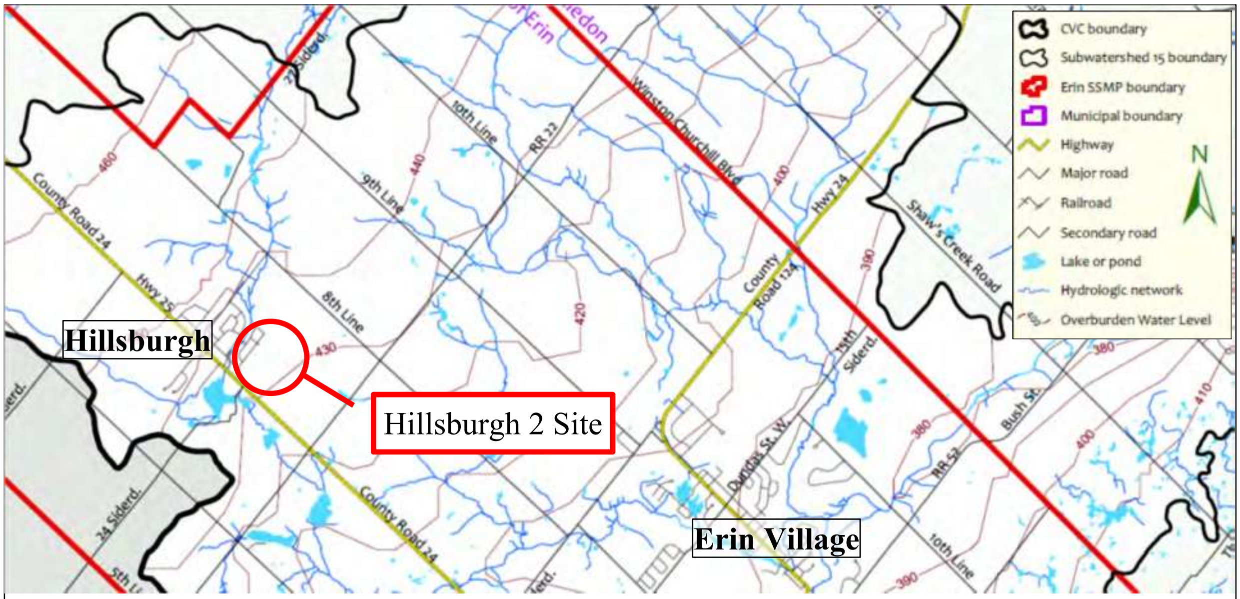
Figure 4: Bedrock Topography

As shown, bedrock elevation estimated to be approximately 420 mASL at the Hillsburgh 2 site, indicating an overburden thickness of 19 m. Based on the bedrock elevations shown and the stream elevations listed in **Section 2.1**, overburden thickness along the West Credit within Hillsburgh varies from approximately 12 to 15 m, and approximately 6 m at Wellington Road 22.

2.4 GROUNDWATER FLOW

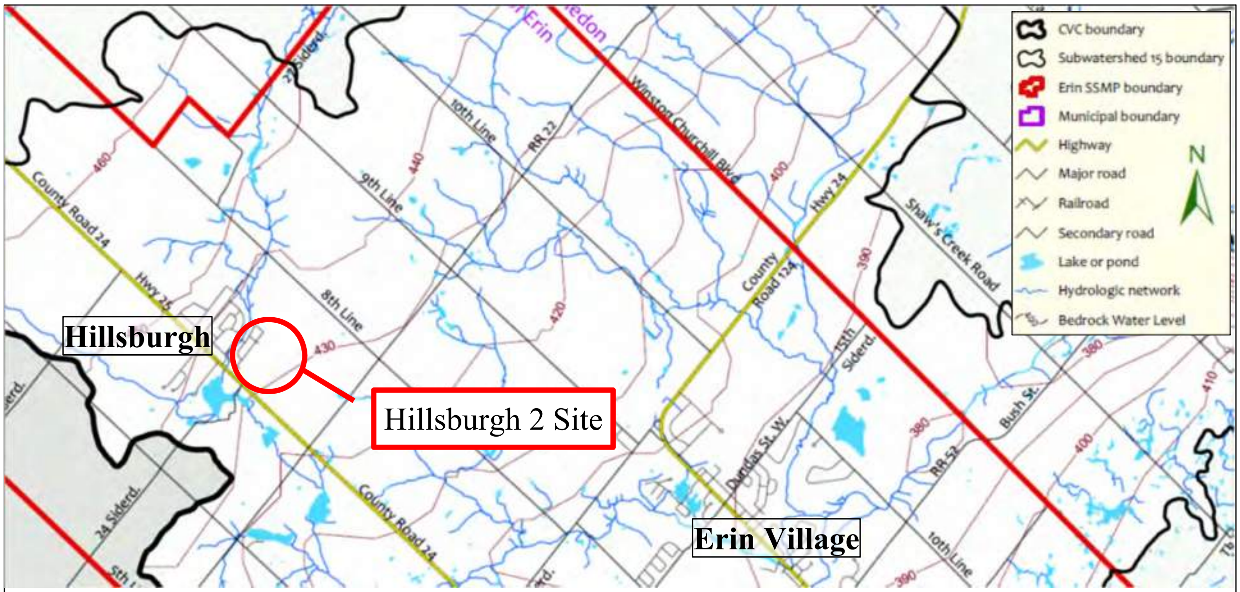
The reported regional shallow (water table) groundwater flow system is shown in **Figure 5**. The reported deeper bedrock aquifer system is shown in **Figure 6**.

Both the regional water table and bedrock groundwater contours generally follow topographic relief, with and interpreted flow direction southeast near the site. Based on the contours shown, water table and bedrock water levels are similar at the site.



Source: Figure 2.1.7, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 5: Water Table Contours



Source: Figure 2.1.8, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 6: Bedrock Water Levels

2.5 GROUNDWATER RECHARGE AND DISCHARGE

Generalized regional groundwater recharge and discharge conditions within the study area, as reported by the SSMP, is shown in **Figure 7**.

Source: Figure 2.1.6, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 7: Groundwater Recharge and Discharge

As shown, much of the area is characterized as having relatively high recharge rates. This recharge supports both local and regional flow systems. Where surface water systems associated with the West Credit, or other natural environment features (e.g. ponds, wetlands, etc.) intercept the water table, groundwater discharge to surface occurs. Groundwater discharge can also be a result of regional flow systems from both the overburden and bedrock.

Additional investigation regarding local conditions within the West Credit system near the Hillsburgh 2 site is provided in **Section 3.3** and assessed later in this report.

2.6 STREAM CLASSIFICATIONS AND WETLANDS

Stream characterization in the area of the site, as related to fish community classification reported by the SSMP, is shown in **Figure 8**.

As shown, fish communities associated with most of the West Credit in Hillsburgh, and tributary systems further southeast, are classified as Cold Water. These reaches are assumed to be supported by groundwater discharge.

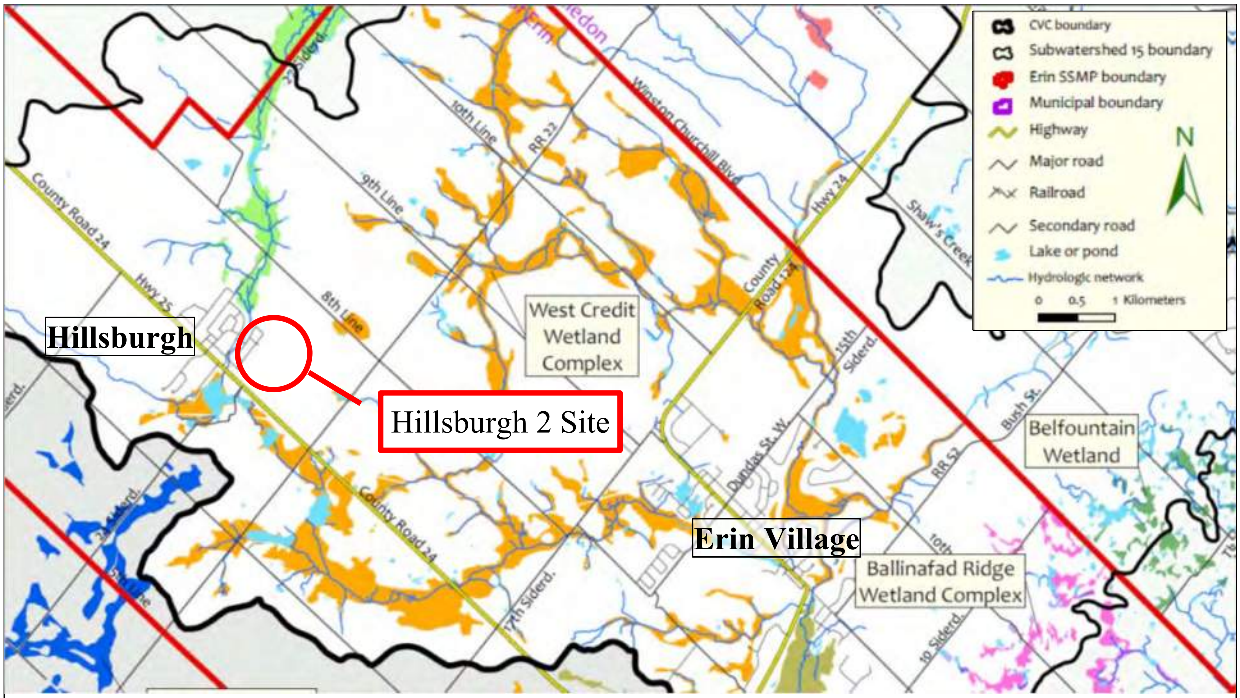
Additional field investigations, coordinated with Credit Valley Conservation staff, were completed for this study in order to guide monitoring program development for the pumping test. The investigations are discussed in **Section 3.3**.

As shown, provincially significant wetlands (PSW) are reported along the tributary systems. Well H4 is located approximately 395 m from the nearest identified PSW (part of the Alton-Hillsburgh Wetland Complex north of the site). MNRF mapping indicates smaller, unclassified wetlands are mapped within 175 m of H4, to the east and southeast.

Source: Figure 2.6.1, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 8: Stream Classification

Mapped wetland areas are shown on **Figure 9**.



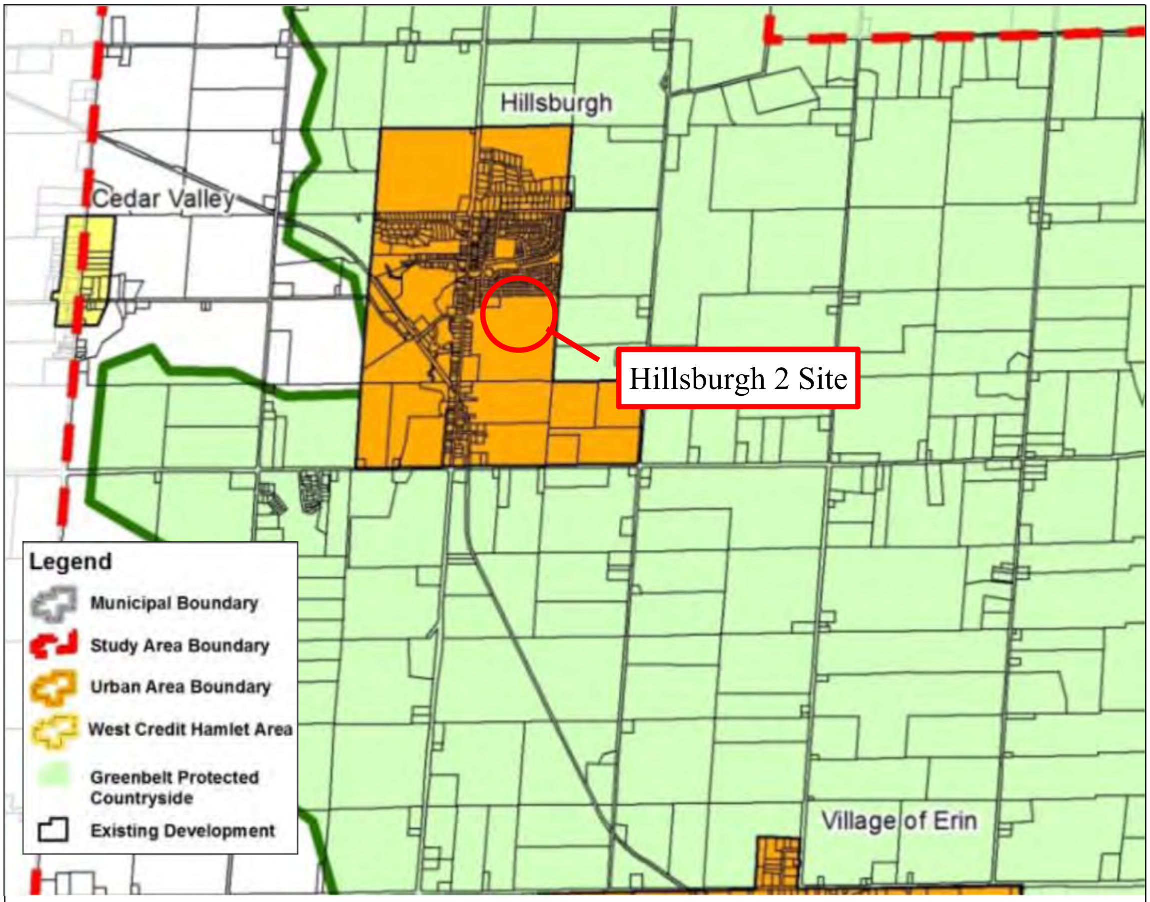
Source: Figure 2.3.3, Erin SSMP Phase 1 - Environmental Component Report – Existing Conditions Report, May 2011 (not to scale)

Figure 9: Wetland Areas

2.7 GROUNDWATER USAGE

As noted in the SSMP reporting, groundwater uses within the subwatershed include municipal drinking water supply, private (e.g. residential) water supply, commercial water taking, aquaculture, agricultural, industrial, institutional and commercial uses.

Figure 10 shows the approximate urban area boundaries for Hillsburgh.



Source: Figure 2-4, Town of Erin Servicing and Settlement Master Plan Final Report, August 2014 (not to scale)

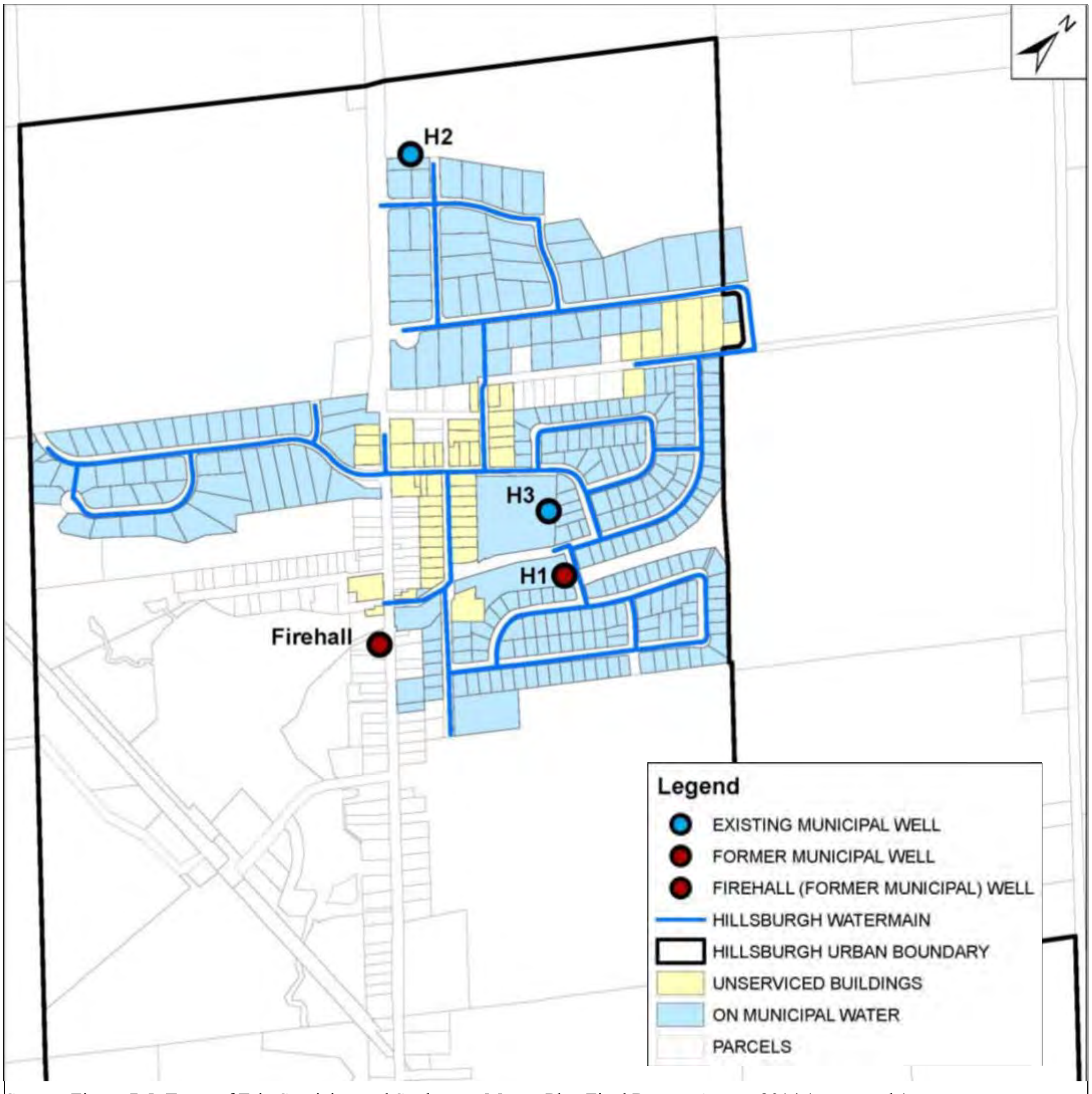
Figure 10: Urban Boundaries

The Town provides municipal water supply within portions of the urban boundaries of Hillsburgh, however the water distribution system does not extend to all properties within the community.

2.6.1 Municipal Water Supply – Hillsburgh

The location of existing and former municipal water supply wells, and the approximate current extent of water distribution system within Hillsburgh is shown on **Figure 11**. Two sources are currently in use in Hillsburgh: well H2 and well H3.

Well H2 (Hillsburgh Heights well) was drilled in September 1988 at the northern edge of the current developed area. Well H2 was completed in bedrock to a total depth of 88 m. Bedrock was encountered at 16 m, and the primary water bearing zones were reported at 85 to 88 m depth. Well H2 has been in operation since 1992 and is currently approved for water taking at rates up to 682 L/min (11.4 L/s) and daily volumes up to 982 m^3/day. Based on Town pumping records, daily use of well H2 averaged approximately 2 hours per day in 2018.



Source: Figure 7-5, Town of Erin Servicing and Settlement Master Plan Final Report, August 2014 (not to scale)

Figure 11: Hillsburgh Water Supply System

Well H3 (referenced as the Glendevon, or, Victoria Park well) is located at Victoria Park, approximately 150 m north of the original Glendevon pumphouse. Well H3 replaced well H1, and was drilled in May 1996. Well H3 was completed in bedrock to a total depth of 57.9 m. Bedrock was encountered at 58 m, and the primary water bearing zones were reported at 37.5 and 52.5 m depth. Well H2 is currently approved for water taking at rates up to 454 L/min (7.6 L/s) and daily volumes up to 655 m^3/day. Based on Town pumping records, daily use of well H3 averaged approximately 6 hours per day in 2018.

Although Well H3 (and original Well H1) are located near the West Credit River, testing at both wells indicated that Well H3 is not hydraulically connected to the surface water system, and, the well is not considered GUDI (Groundwater Under the Direct Influence of surface water).

2.6.2 Local Water Taking

The status of Permit To Take Water (PTTW) locations in the area of the site was reviewed based on information available at the MECP online application: *Map: Permits to take water*, available at: https://www.ontario.ca/environment-and-energy/map-permits-take-water. According to the MECP mapping, there is one PTTW within 1 km of the Hillsburgh 2 drilling site, corresponding to municipal well H3. One additional permit is located just beyond 1 km from the site, corresponding to municipal well H2.

Nestlé Waters Canada (NWC) takes water for water bottling purposes from a bedrock well completed in the Guelph Formation, approximately 1.7 km southwest of the site.

2.6.3 Private Water Supply

Private residences outside of the urban boundaries, and residences inside the urban boundaries that are not connected to the municipal water supply system, rely on private wells for water supply.

The reported well record locations in Hillsburgh are shown on **Figure 12**. We note that some of the locations shown have been corrected based on the well record review (for example, municipal wells are shown in the correct locations).

A review of the well record database indicates that there are 128 well records reported within approximately 1 km of the H4 well location at the Hillsburgh 2 drilling site. Due to the number of wells in this area, well references are not included on **Figure 12**.

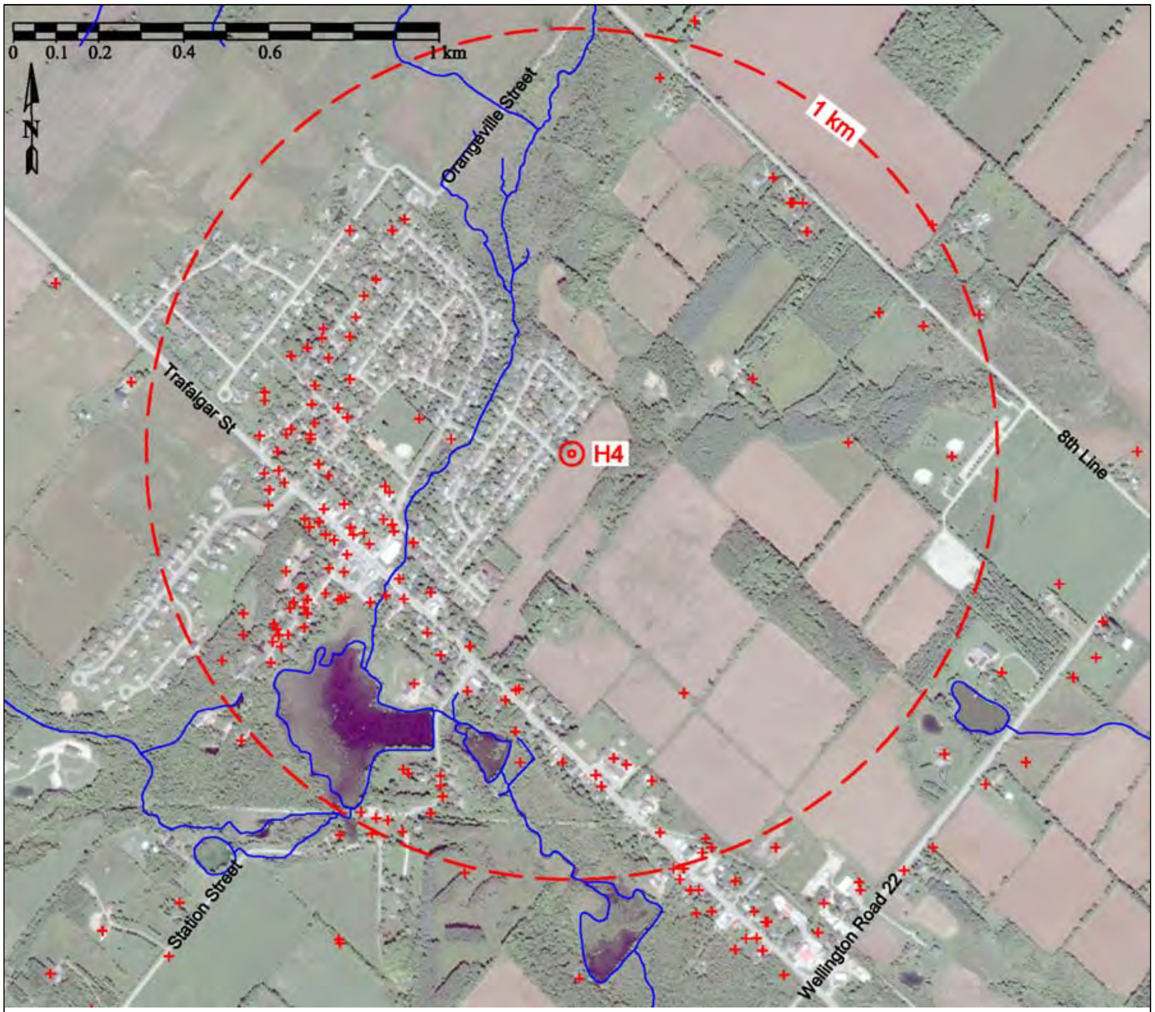
Of the 128 well records, 81 are listed as bedrock wells used for domestic purposes, completed at depths between 15.2 and 74.7 m below ground surface (mBGS). A total of 9 wells are listed as bedrock wells used for public supply, completed at depths between 24.4 and 76.2 mBGS.

There are 12 wells reported as completed in the overburden, of those wells 7 appear to be drilled wells used for domestic purposes (based on casing diameter and reported use) and 1 is a dug well (based on casing diameter and depth) used for domestic purposes. The remaining 4 overburden wells appear to be observation wells (casing diameter of 5 cm or less and no use specified).

There are 26 well records with no geologic information reported. At least 4 of these records appear to be drilled wells and 1 appears to be a dug well (based on casing diameter and depth), all of which are used for domestic purposes. The remaining well records appear to be for observation wells, well alterations or abandonments.

The water well record information indicates that the bedrock is the primary source for private wells in the area. However, a number of residences in town are known to rely on shallow dug or bored (overburden) wells, which are not likely listed in the well record database.

As part of this study a door to door water well survey was completed to further assess private water supply in the area and to request monitoring access. That work is outlined in **Section 3.6** of this report.



Source: OBM, Google Earth, MECP Well records

+ well record location

Figure 12: Well Record Locations

2.8 WELL HEAD PROTECTION AREAS

Selected mapping from the *Approved Source Protection Plan: CTC Source Protection Region* (July 28, 2015) report, showing reported Well Head Protection Area (WHPA) and Significant Groundwater Quality Threat Areas for each of the current Town municipal water supply wells is included in **Appendix B** for reference. There are no WHPA's identified as extending to the Hillsburgh 2 site.

3.0 WELL H4 DRILLING AND TESTING

3.1 WELL DRILLING AND CONSTRUCTION

Drilling and well construction at well H4 was completed by Aardvark Drilling Inc. Drilling began on July 30, 2019 and the last stage of well construction (chlorination and provision of locking well cap and well tag) was completed by January 13, 2020. The location of H4 is shown on **Figure 12**. A copy of the H4 well record is included in **Appendix C**. Well H4 is located approximately 10 m from test well TW4.

As shown on the water well record, bedrock was encountered at 18.6 m depth. Sand and gravel is reported to 16.5 m depth, below which a till unit was encountered to bedrock. A nominal 508 mm diameter hole was drilled to 2.7 m depth and for the final well construction a nominal 406 mm diameter hole advanced to 27.4 m. A nominal 254 mm diameter stainless steel casing was installed to 27.4 m and the entire annular space from surface to bottom of casing sealed using bentonite grout. A nominal 254 mm diameter hole was advanced through bedrock to a final depth of 91.4 m.

After completion of the 254 mm diameter well a video inspection indicated a large fracture just below the bottom of the stainless steel casing, at a depth of approximately 27.4 m. The original well design called for sealing, to the extent possible, the upper fractured bedrock zone in order to reduce the contribution from the shallow zone and ensure the majority of water produced by the well originated from the deeper zones, in addition to reducing potential connection to surface. Therefore a decision was made, in conjunction with the Town and Triton Engineering, to install a nominal 203 mm diameter stainless steel liner casing from surface to a depth of 31.7 m, and, to grout seal the entire length of annular space between the 203 mm diameter liner casing and the 254 mm open hole in rock and/or stainless casing. The casing liner was installed by Lotowater.

The well drilling and construction included a number of phases, including:

- installation of a nominal 508 mm diameter starter casing to 2.7 m depth;
- nominal 152 mm diameter pilot hole drilling and temporary casing installation approximately 8.8 m into bedrock;
- initial well development and production rate estimation through air lifting;
- temporary casing removal and borehole reaming to nominal 406 mm diameter through overburden and approximately 8.8 m into bedrock;
- installation and grouting of nominal 254 mm dimeter stainless steel casing (included removal of starter casing prior to grouting);
- reaming bedrock hole to final nominal diameter of 254 mm;
- well development; and,
- installation and grouting of nominal 203 mm stainless steel casing liner.

The well was largely complete and ready for testing after the installation of the stainless steel casing liner and grout, by December 11, 2019.

3.2 TEMPORARY PERMIT TO TAKE WATER

A Category 2 (temporary) PTTW was obtained from the MECP to allow pump testing well H4. A copy of the permit (#3556-BGDKMZ) is included in **Appendix D**.

The permit allowed water taking from well H4 at a maximum rate of 2,046 L/min, 24 hours per day, for a maximum of 6 days.

3.3 CVC CONSULTATION AND REDD SURVEY

As part of the preparation process for the pump test CVC was consulted regarding test timing, monitoring and assessment. As part of discussions with CVC staff in July 2018, it was determined that trout spawning (redd) records were available for some of the main branch of the West Credit River through Hillsburgh. Some additional locations for stream inspections and a redd survey were also identified in the overall area of the Hillsburgh 2 site. These locations included:

- the river and smaller tributaries upstream of the developed area, to 8th Line;
- the tributary system west and northwest of the Station Street reservoir; and,
- portions of the river system downstream of the rail trail crossing.

The stream inspection and redd survey was intended to identify areas in which groundwater discharge may support both sensitive fish habitat and spawning locations, and thereby guide the pump test monitoring program to assess potential impacts related to water taking.

In order to facilitate the stream inspections a survey request letter was delivered door to door and/ mailed to all properties in which portions of the river system described above are mapped within approximately 1 to 1.5 m of the Hillsburgh 2 site. The properties included residences or ownership parcels on 6th Line, Station Street, Trafalgar Road, Wellington Road 22, and, 8th Line.

A copy of the access permission letter is included in **Appendix E**. The letter was delivered to a total of 6 residences on October 3, 2018, and mailed to an additional 4 land owners on October 4, 2018. A total of 4 responses were received and access permission was obtained at 2 locations in Hillsburgh. They stream surveys were completed at those 2 properties in conjunction with CVC staff on November 8, 2018. The properties in which stream inspection and redd surveys were completed are shown in **Appendix E**.

The stream inspection and redd survey results were recorded by CVC staff. Based on the results, in stream monitoring locations were chosen and instrumented for the pumping test. The stream monitoring locations are summarized in **Section 3.5**.

Further discussions with CVC occurred in September 2019 in preparation for the pumping test implementation. An email string outlining the consultation summary is included in **Appendix E** for reference. The final pumping test monitoring plan incorporated the recommended monitoring and assessment strategies to the extent possible within the scope and time frame of the EA study requirements.

3.4 MONITORING WELL SELECTION AND INSTALLATION

A total of 25 locations were monitored as part of the H4 pumping test. Of those locations, 5 included of shallow and deep monitors (nested). Data from 3 additional locations (including 1 multi-level monitoring site) was also made available to this assessment.

The complete monitoring network is shown on **Figure F1** in **Appendix F**. Monitor details for all locations are provided in **Table F1** (**Appendix F**). The locations include:

observation wells installed for, or available to, this study; stream bed piezometers installed for this study; municipal wells; and, accessible private wells.

The following bedrock observation wells, owned by the Town or available to this study, were incorporated into the pumping test monitoring program:

- Test well TW4 (converted to nested shallow/deep monitor a the Hillsburgh 2 site);
- Glendevon Well (H3);
- The Hillsburgh Arena well; and,
- The Barbour Sports Field well.

We note that the Firehall well is sealed at the well head and not available for monitoring. The following water table observation wells were monitored as part of the pumping test:

- BH1, BH4, BH16-D and BH20 on the proposed Tavares development lands;
- nested location MW25/8 and MW25/18 at the County of Wellington Hillsburgh Closed Landfill; and,
- H4-MW1-19 (installed for this study adjacent to the West Credit River south of Covert Lane).

As noted above, 1 water table monitor was installed in November 2019 as part of this assessment to provide water level information next to sensitive stream habitat as identified through consultations with CVC. Water well records for all of the monitoring wells are included in **Appendix F**.

With the exception of the Glendevon municipal well, water levels at each of the monitoring locations were recorded using both Diver® model water level transducer/dataloggers (dataloggers) and occasional manual measurements using a Heron Instruments® electronic water level meter. Water level data was available for the Glendevon well from the SCADA system and through occasional manual measurements.

3.5 STREAMBED PIEZOMETER INSTALLATION

Stream bed piezometers were installed at 5 locations for this monitoring program (see **Appendix F**). The locations were chosen based on access availability, 2 locations (DP1 and DP3) were installed within an area on private property identified through the redd/habitat survey. Locations D3 and DP4 were located on publicly accessible areas of the river at identified sensitive habitat locations. Location DP5 was installed within a wetland area on the Barbour Field Sports facility property.

Nested piezometers were installed at 2 (DP1 and DP4) of the 5 locations to assess vertical gradients within the groundwater system at the creek. In addition, 1 piezometer location (DP3) is next to water table monitor H4-MW1-19, therefore the combination of piezometer and water table well also provides for an analysis of vertical gradients near the creek. The piezometer locations were chosen based on known habitat and/or the results of the redd/habitat survey to provide an analysis of potential impact to groundwater conditions at the creek to the extent possible given access limitations.

The streambed piezometers consist of nominal 38 mm diameter 0.3 m long stainless steel drive-point screens, threaded steel coupling and 1.8 m long galvanized riser pipe. The piezometer was manually installed (driven) to the desired depth below the stream using a fence post pounder. The piezometer was then pumped and flushed with water until the discharge water and water level response indicated the installation was successful. The installation was considered successful if, for example:

- the discharge water cleared (or was sandy), the piezometer could be pumped continuously, and, an appropriate vertical gradient was observed; or,
- the sediment observed in the discharge water (e.g. silt) indicated that any organic/much encountered during installation had been removed from the screen, and, the appropriate water level response (e.g. slow recovery) was observed to pumping.

The nested monitor at DP4 included a pre-existing shallow 3.8 mm diameter PVC piezometer installed by others. The PVC piezometer was pumped and flushed, similar to the new piezometer installations, to ensure a representative water level response.

Water levels at each of the piezometer locations were recorded using both Diver® model dataloggers and occasional manual measurements using a Heron Instruments® electronic water level meter.

3.6 PRIVATE WELL SURVEY AND MONITORING

In order to augment the MECP database and to obtain monitoring access, a private water well survey was completed. The survey area included residences within approximately 1.5 km of well H4. This area includes portions of the town residential area which are serviced by municipal water (may or may not be serviced by private wells), portions of the town residential area where are not serviced by municipal water (serviced by private wells), and, rural residential areas (serviced by private wells). The survey was completed door to door at rural residential areas (typically have a roadside mailbox) and by mail-out within the residential area (typically Super Box or Post Office mail pick-up).

The door to door survey was completed on October 15, 2019. A total of 70 locations were canvassed. As part of the survey an information and response package was delivered door to door within the survey area. The package included a response form and stamped return envelope, in addition to telephone and email contact information. A copy of the survey letter and response form is included in **Appendix G**.

Within the town residential area the survey package was mailed to all residences within 500 m of well H4, and all residences within 1 km of H4 reported to not have municipal water service. A total of 338 survey packages were mailed out on October 31, 2019.

The water well survey response results are summarized in **Table G1** (**Appendix G**). A total of 15 responses were received from the 2019 survey. We note that a similar door to door survey was completed in Hillsburgh in May 2016 as part of some previous testing. Available information from the 2016 survey has been incorporated into the response summary (15 responses). Two residents from the 2016 survey were also contacted to request monitoring access permission.

Based on the 31 responses to the combined 2016 and 2019 surveys, the locations of 6 dug wells were identified within town. Three locations reported to be serviced by municipal water. The remaining responses reported drilled bedrock wells. Well record matches were available for most of the reported drilled well survey locations.

Based on location, well type and access permission, a total of 12 locations were visited to attempt to install monitoring equipment. Of those locations, 2 wells were determined to be inaccessible due to construction type (well head seals could not be safely opened).

A total of 10 private wells were monitored for the test, including 2 dug wells and 8 drilled bedrock wells (see **Appendix F**). At each private drilled well a temporary access pipe (small diameter flush join PVC pipe, screened at bottom) was suspended in the well to allow measurements to be taken and equipment installed safely without disturbing existing pumping equipment. The access pipe was removed after monitoring was complete. The access pipe was installed and removed by Lotowater (pumping test contractor).

Water levels at each of the private well locations were recorded using both Diver® model dataloggers and occasional manual measurements using a Heron Instruments® electronic water level meter.

Prior to the initiation of the pumping test, a pump test notification letter was distributed on January 6, 2020 using the same method (door to door to rural residence locations and mail-out within town). A copy of the letter notification is provided in **Appendix G**.

3.7 WELL H4 STEP TEST

A step test was competed at H4 by Lotowater on January 8, 2020, starting at 11:30 pm and ending at 1:30 pm. The test consisted of 3 one hour consecutive steps at rates of 19 L/s, 26 L/s and 34 L/s respectively.

The step test water was discharged to the roadside ditch on the east side of Trafalgar Road near the intersection with Station Street, approximately 540 m southwest of H4. Water flow from that point is westward through a culvert under Trafalgar Road and the Station Street Firehall parking lot, then though an established drainage route to the river/pond system downstream of the Station Street reservoir.

Water level measurements were obtained manually by Lotowater using an electronic water level meter over the test period. Full recovery was obtained using a Diver® model datalogger. The results are provided in **Appendix H**.

3.8 WELL H4 PUMPING TEST

Two longer term pumping tests were completed at H4 by Lotowater. The first test began on January 9, 2020 10:30 am and was terminated on January 10, 2020 12:30 pm due to interference at the Glendevon well (H3), which was in use at that time. The first test was completed at a reported average pumping rate of 27.6 L/s. During this pumping test the rate at H4 was also adjusted down from 34 L/s (starting rate) to 20 L/s (end rate) in order to reduce drawdown at the well.

A second (3 day) constant rate test was completed from January 15, 2020 10:00 am to January 18, 2020 10:00 am. During the second test well H3 was not in use. The average pumping rate at H4 during the second test was reported to be 18.4 L/s.

The pumping test water was discharged at the same location used for the Step Test. Water level measurements were obtained manually by Lotowater using an electronic water level meter, and using a Diver® model datalogger, over the test and recovery periods. Pumping rates were measured and recorded by Lotowater using an inline flow meter installed for that purpose. The results are provided in **Appendix I**.

3.9 WATER QUALITY SAMPLING

Water quality samples for general parameters were obtained on January 9, 2020 11:30 am (the start of the first pumping test). A sample for a more complete drinking water suite of parameters was obtained on January 13, 2020 2:45 pm during a brief pumping period undertaken for video profiling. One additional sample for general parameters was obtained on January 16, 2020 10:30 am (after 24 hours pumping) during the 3 day test.

The water quality samples were obtained using sample bottles provided by the laboratory and submitted immediately for analysis to ALS Environmental (ALS Canada Inc.) in Waterloo, Ontario. The water samples were taken at a sample spigot located at the well head prior to the flow meter. The water quality sampling results are summarized in tabular form in **Appendix J** and discussed in **Section 4.7**. Copies of the laboratory analysis certificates were provided to the Town.

3.10 WEATHER CONDITIONS

In order to provide an assessment of weather conditions over the pump test period, Environment Canada reported daily precipitation and temperature data was obtained for the Fergus Shand Dam weather station. The results are provided on a vertical bar graph illustrating reported rainfall and snowfall contributions to daily precipitation, and maximum daily reported temperatures, in **Appendix K**.

Rainfall, or accumulated snowfall melt events, result in increased streamflow and can result in groundwater recharge events. As indicated by the climate graph, precipitation events in November, December and January included both rainfall and snowfall.

One significant event is noted on January 10th and 11th, 2020 which included both rainfall and daily temperatures that would results in a snowmelt event. Smaller events are noted in December 8th and 9th, 2019 (potential accumulated snowfall melt; and January 24th, 2020 (rainfall and accumulated snowfall melt).

4.0 PUMPING TEST RESULTS AND ANALYSIS

Pump test hydrographs for well H4, TW4-S, TW4-D and H3 (Glendevon well) are included in **Appendix H** and **Appendix I**. We note that water levels shown for H3 are based on SCADA print-outs of sensor readings which indicate depth of water (assumed above the pump intake). The graphs show the scanned print-out images rectified to plots which correspond to the reported time and depth axis and shown on the print-outs. Some manual water level measurements at H3, as available during the 3 day test, are overlain for reference on the print-out graphs.

As indicated by the hydrographs, wells H4, TW4-S, TW4-D all respond to regular water taking at H3 (Glendevon well). Wells H4 and TW4-D respond approximately 1 to 1.5 m to regular taking at H3. Well TW4-S responds by approximately 0.5 to 0.75 m to regular taking at H3.

4.1 STEP TEST

The H4 step test hydrograph and analysis is included in **Appendix H**. Based on the pre-test static level and test pump setting, total available drawdown for the step test (and long term aquifer test) was 19.5 m.

The pre-test static level measured at H4 was 9.84 m below the top of well (mBTOW). Total drawdown at the end of the 3 consecutive steps was measured to be 4.80 m, 7.71 m and 10.93 m respectively. By January 8, 2020 9 pm (i.e. after 9.5 hours) 88% recovery had been achieved, after which H4 began to respond to taking at H3 (obscuring continued recovery).

As shown in the analysis, the calculated Specific Drawdown over the 3 pumping steps indicates well loss increase as pumping rate increases. The calculated Specific Capacities at 19, 27 and 34 L/s are 4.0, 3.4 and 3.1 L/s/m of drawdown respectively, with an average Specific Capacity of 3.5 L/s/m.

The step test results indicate H4 is a relatively efficient high capacity well capable of producing water over the short term at rates that meet identified current Town water supply targets, with moderate amounts of drawdown.

Based on the step test results a target pumping rate of 30 L/s was identified for the long term pumping test.

4.2 WELL H4 PUMPING TESTS

The H4 and H3 pumping test hydrographs are included in **Appendix I**.

The H4 long-term hydrograph shows measurements starting on November 21, 2019 (3 weeks prior to testing) and extending to January 10, 2020 (6 weeks after testing). As indicated by the long-term hydrograph, there is no significant or consistent overall seasonal trend within the bedrock system observed. Short-term fluctuations do occur related to pumping at H3.

The H4 short-term hydrographs are provided showing measurements obtained over the two pumping test periods. During the 1 day test the pumping rate was reduced several times (from 30 L/s to 25 L/s to 20 L/s) to moderate drawdown at H4, and ensure water levels remained above the pump over the planned testing period. This variation in pumping rate resulted in short-term water level recovery during the test at H4. On the morning of January 10, 2019 it was determined that the pumping test would need to be terminated due to drawdown at the Glendevon well (H3). Water level recovery within about 8 hours after pumping stopped at H4 allowed the resumption of regular pumping operations at H3. Well H3 was not used during the second (3 day) test in order to assess longer term pumping effects.

As indicated by the 3 day test hydrograph, water levels appeared to stabilize at H4 on the third day of pumping (last 6 hours of the test). Some minor variations occurred over the test period related to small pumping rate adjustments made at the well head. The pre-test static levels measured at H4 and H3 were 9.08 mBTOW and 4.58 mBTOW respectively. Total drawdown at the end of the 3 day (72 hour) test was measured to be 15.58 m at H4, and, 10.92 m at H3. Approximately 90% recovery had been achieved at H4 after about 34 hours. Pumping at well H3 resumed on January 20, 2020 at about 8:00 pm.

No obvious response to the reported rainfall or snowmelt events are noted at H3 and H4.

4.3 OBSERVATION WELLS

The long-term and pumping test hydrographs for the 5 additional bedrock observation wells (TW4-S, TW4-D, the Arena Well, the Barbour Field Well, and, NWC monitors MW01-18 A/B and TW01-18) and the 6 water table observation wells (BH1, BH4, BH16-D, BH20, MW25/8 and MW25/18) monitored as part of this study are included in **Appendix L**. Monitoring results at water table well H4-MW1-19 are discussed in **Section 4.4**.

Well TW4-D responded closely to pumping at H4, as expected given the proximity and construction depth. Drawdown at the end of the 3 day test at TW4-D was 14.77 m. Well TW4-S also responded in a similar pattern, however with a smaller scale response. Drawdown at the end of the 3 day test at TW4-S was 4.26 m. A 0.7 to 0.8 m response to an assumed recharge event from about January 7th to 15th, 2020 is apparent at both TW4-S and TW4-D.

The Arena well is located approximately 475 m southwest of well H4. The Arena well is completed in the (assumed) former Amabel Formation, at a total depth of 74.7 m. The well is in regular use, but also appears to respond by about 0.5 m to regular pumping at H3. Drawdown at the end of the 3 day test at H4 was 3.16 m. An approximate 0.5 m response to an assumed recharge event occurred from about January 8th to 22nd, 2020.

The Barbour Field well is located approximately 890 m east of well H4. The Barbour Field well is completed in the (assumed) former Amabel Formation, at a total depth of 76.2 m. The well is used when the sports facility is open, however was not in use over the monitoring period. A small scale response (decline), on the order of 0.4 m, to H4 pumping is noted. An apparent 0.5 m response to an assumed recharge event occurred between the two H4 pump test periods.

The NWC monitors MW01-18 A/B and TW01-18 are locate approximately 980 m southwest of H4. The MW01-18 A/B series are nested monitors (B = shallow, A = deep) are installed in the upper bedrock unit (assumed Guelph Formation) and the TW01-18 location is installed in the lower bedrock unit (assumed former Amabel Formation). A comparison plot of water levels between the three monitors indicates a strong downward vertical gradient at this location. A response to pumping H4 is observed at TW01-18, total drawdown at the end of the 3 day test is approximately 4.19 m. Monitors MW01-18 A/B respond to the recharge event prior to the 3 day pumping test, and appear to respond slightly (±10 cm) to regular local water taking (assumed private wells). A slight response (<10 cm) to pumping at H4 may have occurred at MW01-18A over the 3 day pumping test, no response is noted at MW01-18B.

Water table monitoring wells BH1, BH4, BH16-D and BH20 are located approximately 460 m south, 40 m southwest, 760 m south, and, 900 m southeast of H4 respectively. The wells were installed as part of a previous development proposal study completed for the property. These 4 water table hydrographs illustrate an obvious response to the recharge event on January 11th and 12th, 2020 (between the pumping tests). Monitor BH20 also indicates water table responses to other recharge events in early December, early January and later January. No recognizable response to pumping at H4 is evident. In addition, no response to pumping at H3 is evident within the water table monitors.

Monitors MW25/8 and MW25/18 are located approximately 530 m east of H4. The wells were installed as part of the assessment and monitoring program at the Hillsburgh Closed Landfill, located approximately 680 m east of H4. The two wells form a monitoring well nest at (approximate) depths of 8 and 18 m. As indicated by the respective hydrographs, a response to the recharge event between H4 pumping test period is evident. However no recognizable response to pumping at H4 is apparent and there is no response to H3 pumping.

4.4 DRIVE-POINT PIEZOMETERS AND H4-MW1-19

The long-term and pumping test hydrographs for the two water table observation wells and 5 drive-point piezometer sites installed for this study included in **Appendix M**. All of these locations were installed to help assess potential impacts to water table conditions near, and potential for groundwater discharge to, the closest tributary systems in the area.

Nested drive-point location DP1 is located approximately 775 m north of H4, within the main river channel upstream of Hillsburgh. The monitoring results indicate a strong (14 to 17 cm) upward gradients from the both the deep and shallow piezometers to the river. However groundwater levels appear to show a downward gradient. Responses to rainfall/snowmelt and related increases in local water table elevations are observed. Water level fluctuations are evident throughout the testing period, however the changes appear to be related to sudden rises and response to precipitation events (rising limb) and subsequent gradual declines (falling limb). No definitive pumping test response is observed, and, patterns of response that would be associated with pumping test response (e.g. recovery when pumping stops) are absent. Changes in both water level and vertical gradients occur outside of, or overlapping, pumping periods (before, during and after). Comparing water level just prior to the 3 day pumping test and the lowest levels recorded during the test period a maximum 3 cm difference is evident. However, water levels begin to rise prior to the end of the pumping test, likely as a result of recharge events.

Drive point DP2 is located approximately 570 m northwest of H4, within a tributary to the river. The monitoring results indicate a strong (12 to 13 cm) upward gradient. Water level measurements over the monitoring period and during the test show a similar pattern to DP1 location. Comparing water level just prior to the 3 day pumping test and the lowest levels recorded during the test period a maximum 3 cm difference is evident.

Drive point DP3 is located approximately 270 m east of H4, within the main river channel. Monitor H4-MW1-19 is a water table well installed adjacent to DP3. Together DP3 and H4-MW1-19 form a multi-level monitoring location. The relative elevations of the two monitors were surveyed for this assessment, the vertical difference between the top DP3 piezometer pipe and H4-MW1-19 top of well is 1.74 m. Both individual and combined hydrographs are shown to illustrate conditions in this area. The combined graph illustrates the existing strong downward gradient at this location. Water levels at DP3 are approximately 1.1 m below the river bed. Water levels at H4-MW1-19 vary from approximately 2.4 to 2.9 m below the river bed. This condition is consistent with findings from previous assessments completed in this area.

The water table at H4-MW1-19 is observed to respond to the recharge event beginning on January 11, 2019. However no response to regular pumping at H3 is evident. The water level response at DP3 to this recharge event is slight, which may indicate that DP3 represents a small local perched layer or zone below the stream. No recognizable response to pumping at H4 is noted at DP3 or H4-MW1-19.

Nested drive-point location DP4 is located approximately 895 m south of H4, within the main river channel near the rail trail crossing. A short-term hydrograph illustrating water level response after DP4-D was installed and purged dry, indicates that full water level recovery required 3 hours. Piezometer installation at this location is very difficult, and DP4-D was installed to refusal at a depth of 1.23 m below the stream bed. This water level response after installation indicates that the stream at this location is underlain by a fine grained (till) unit. Analyzing the water level recovery as a slug test results in an estimated hydraulic conductivity of 1.4×10^{-7} m/s for the till deposit.

The monitoring results at DP4 indicate a small (4 cm) upward gradient to the river. In addition, the vertical gradient between shallow and deep piezometers varies from insignificant to slightly upward (1 cm difference). Responses to rainfall/snowmelt and related increases in local water table elevations are observed. Water level fluctuations are evident throughout the testing period, however the changes appear to be related to sudden rises and response to precipitation events (rising limb) and subsequent gradual declines (falling limb). No definitive pumping test response is observed, and, patterns of response that would be associated with pumping test response (e.g. recovery when pumping stops) are absent. Changes in both water level and vertical gradients occur outside of, or overlapping, pumping periods (before, during and after). Comparing water level just prior to the 3 day pumping test and the lowest levels recorded during the test period a maximum 1 cm difference is evident. However, water levels begin to rise prior to the end of the pumping test, likely as a result of recharge events.

Drive point location DP5 is located approximately 959 m east of H4, within a wetland area at the Barbour Sports Field facility. A short-term hydrograph illustrating water level response after DP5 was installed and purged dry, indicates that full water level recovery required 9 hours. Piezometer installation at this location is relatively easy. This water level response after installation indicates that the wetland at this location is underlain by a fine grained (silt/clay) unit. A similar pattern of responses are noted with respect to rainfall/snowmelt events. No recognizable response to pumping at H4 is observed.

4.5 PRIVATE WELLS

A total of 10 private wells were monitored as part of this study. The water level hydrographs for the private wells monitored for this study are included in **Appendix N**. Private well locations, construction details and water level response are summarized in **Table 1**, and described briefly as follows:

- no water level response was observed at the dug wells;
- bedrock private wells at 1 Barker Street, 2 Queen Street and 23 George Street respond to routine pumping at the Glendevon well (H3); and,
- water level response to the H4 pumping tests occurred in most private bedrock wells, observed drawdown ranged from 4.95 m at a distance of 530 m, to 0.2 m at 1.3 km distance.

Address	Distance From H4 (m)	Well Type	Aquifer	Well Depth (m)	Pre Test Static (mBTOW)	Drawdown (m)
87 Trafalgar Rd	475	dug	water table	5.8	4.83	0
1 Barker St S	530	drilled	bedrock	51.8	8.24	4.95
1 Barker St N	550	drilled	bedrock	30.2	8.07	1.03
96 Trafalgar Rd	555	drilled	bedrock	32.0	3.47	0.48
10 Anne St	620	dug	water table	6.8	5.64	0
2 Queen St	740	drilled	bedrock	38.4	17.05	1.00
23 George St	810	drilled	bedrock	44.8	6.68	2.79
5823 8th Line	1035	drilled	bedrock	53.0	13.42	0.21
19 Trafalgar Rd	1080	drilled	bedrock	26.5	3.00	0.24
9435 Well Rd 22	1285	drilled	bedrock	46.3	17.12	0.28

Table 1: Private Well Drawdown Summary

Three water supply interference complaints were received on January 18, 2020, after pumping had ceased at H4. At two of the locations, 1 Barker Street and 28 Orangeville Street, the residents had noted the disruption in water supply on January 18th and turned power off to the pumps. Water levels were restored through natural aquifer recovery, as confirmed by the residents.

At one location, 26 Orangeville Street, a water supply disruption was noted on the evening of January 15th or morning of the 16th. At that time it is our understanding that the resident contracted Inglewood Pumps Enterprises Inc. (IPEI) to investigate the well issue, however did not notify the Town (or contractors) until approximately 1:40 pm on January 18, 2019. By January 18th IPEI had determined that the pump was no longer functioning; the water level was below the pump; and, had begun to try and remove the pump for replacement. This was unsuccessful, and a temporary potable water supply service (tank and water delivery) was installed. The Town is currently working to connect the household to the municipal water supply, which is available at the property boundary. Once connected, the municipal supply will restore full water service to the residence.

No other well interference complaints were received and no other interference was observed.

4.6 AQUIFER PARAMETER SUMMARY

Aquifer parameter estimation was completed for wells exhibiting a measurable pump test drawdown response. The pump test drawdown data was analyzed using the Hantush-Jacob Leaky Aquifer method within the AQTESOLV® analysis program. The analysis plots are included in **Appendix O**.

The analysis estimated bulk aquifer Transmisivity (T) and Storativity (S). The corresponding aquifer hydraulic conductivity (K) is estimated assuming an aquifer thickness of 76 m (T=Kb), as measured at H4. The results are summarized in **Table 3**.

Location	T (m^2/s)	S	K (m/s)
H4	0.0005793	-	7.62E-06
TW4-S	0.001224	0.02821	1.61E-05
TW4-D	0.0004699	0.01596	6.18E-06
Glendevon Well	0.0004843	0.00006062	6.37E-06
Arena Well	0.001081	0.0001567	1.42E-05
TW01-18	0.0004315	0.00004562	5.68E-06
1 Barker St - S well	0.002296	0.0004292	3.02E-05
1 Barker St - N well	0.0005269	0.00006062	6.93E-06
2 Queen Street	0.001928	0.0003374	2.54E-05
23 George Street	0.0009778	0.00008831	1.29E-05

Table 2: Aquifer Parameter Estimates

The calculated T, S and K values reflect the productive aquifer capacity H4.

4.7 WATER QUALITY

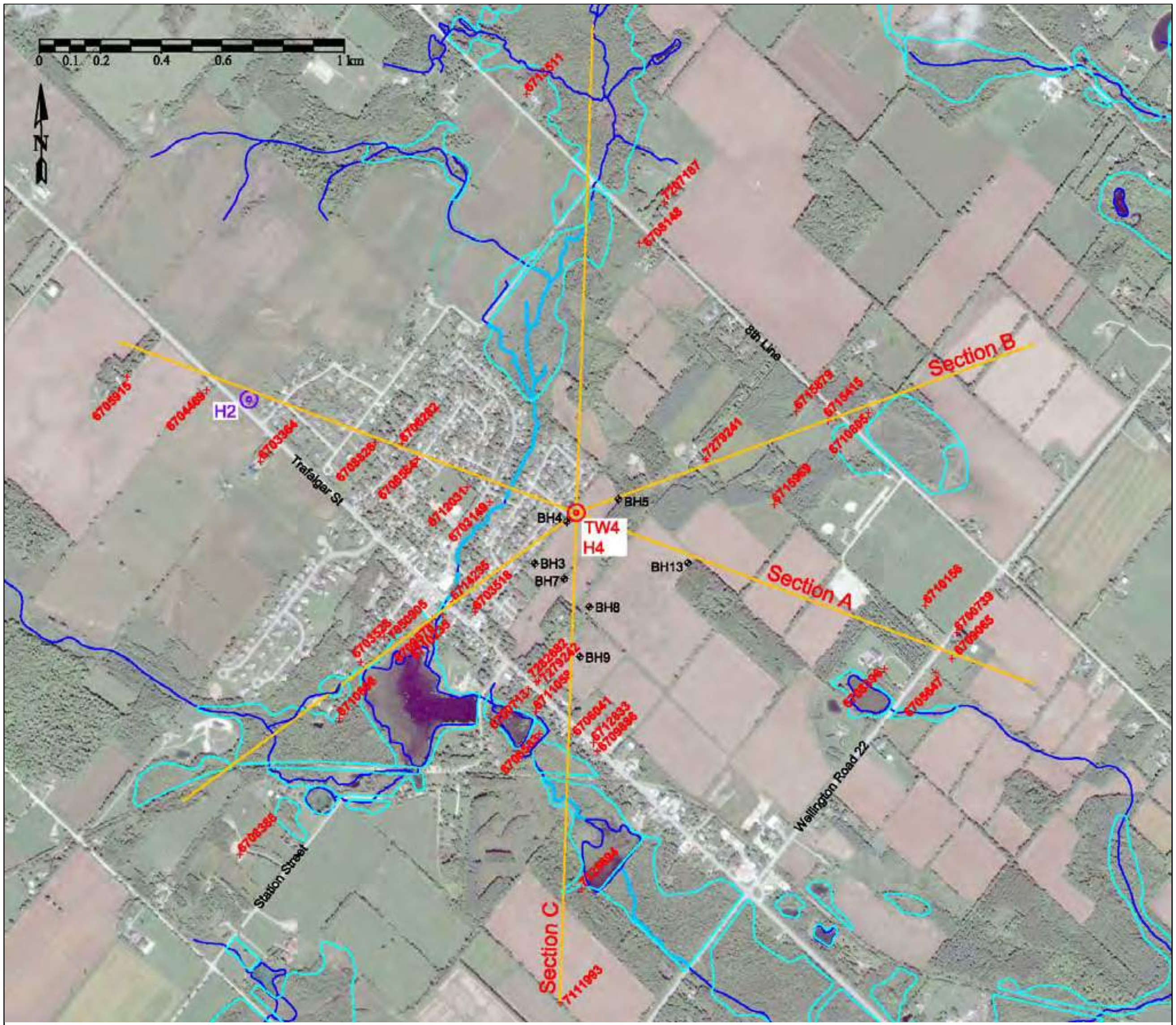
As shown by the results, the only drinking water quality exceedance was Total Coliforms, reported to be approximately 1 CFU/100mL after approximately 1 hour of pumping on January 13, 2019. The presence of Total Coliforms may be indicative of the need for additional development and/or the limited pumping time prior to sampling at that time. We also note that the sample was taken prior to the final well chlorination that was completed as the final stage of well construction. The Total Coliforms is expected to decrease with additional pumping and use.

In general, the water quality as tested was good and there are no treatability or other health related concerns. There is no indication of any direct influence from a surface water source and no indication of any anthropogenic contaminants. For example, concentrations of nitrogen species were low (non-detect), and sodium and chloride concentrations were relatively low. As well, no pesticides or herbicides were detected.

5.0 IMPACT ASSESSMENT

5.1 GEOLOGIC CONDITIONS

In order to provide context to the impact discussion 3 schematic cross-sections were developed illustrating local conditions within the H4 monitoring area (Sections A to C). The cross-section locations are shown on **Figure 13**. The cross-sections are provided as **Figures 14 to 16**.



Source: OBM, Google Earth, MECP Well records

section lines as shown

+ well record location

Figure 13: Section Locations

The sections are based on the drilling and monitoring results obtained by this study and reported drilling results by others, in addition to available topographic mapping and the MECP water well record database. Some of the well record locations shown on **Figure 13** have been corrected based on the water well record review and information obtained through the private well survey.

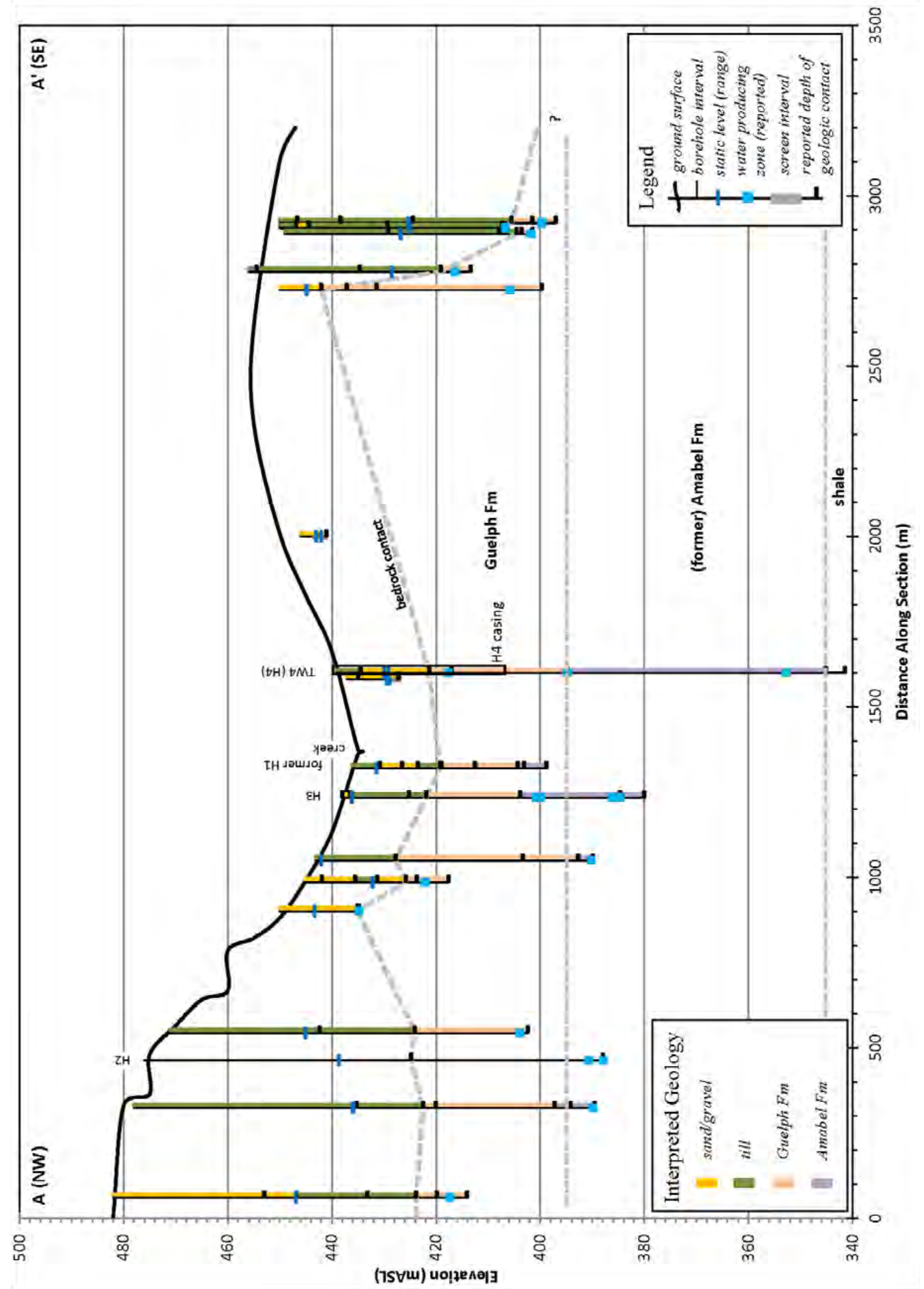


Figure 14: Section A

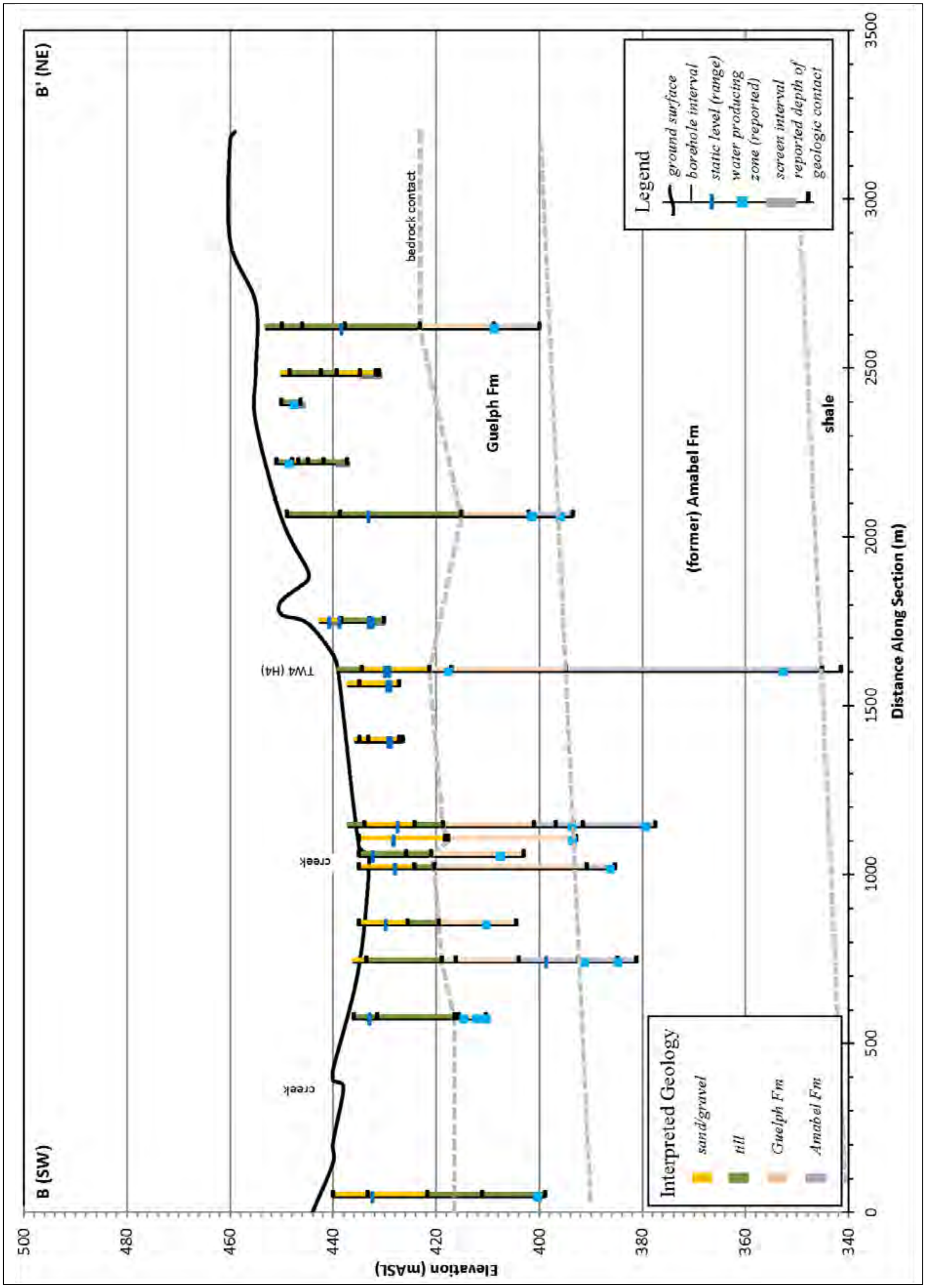


Figure 15: Section B

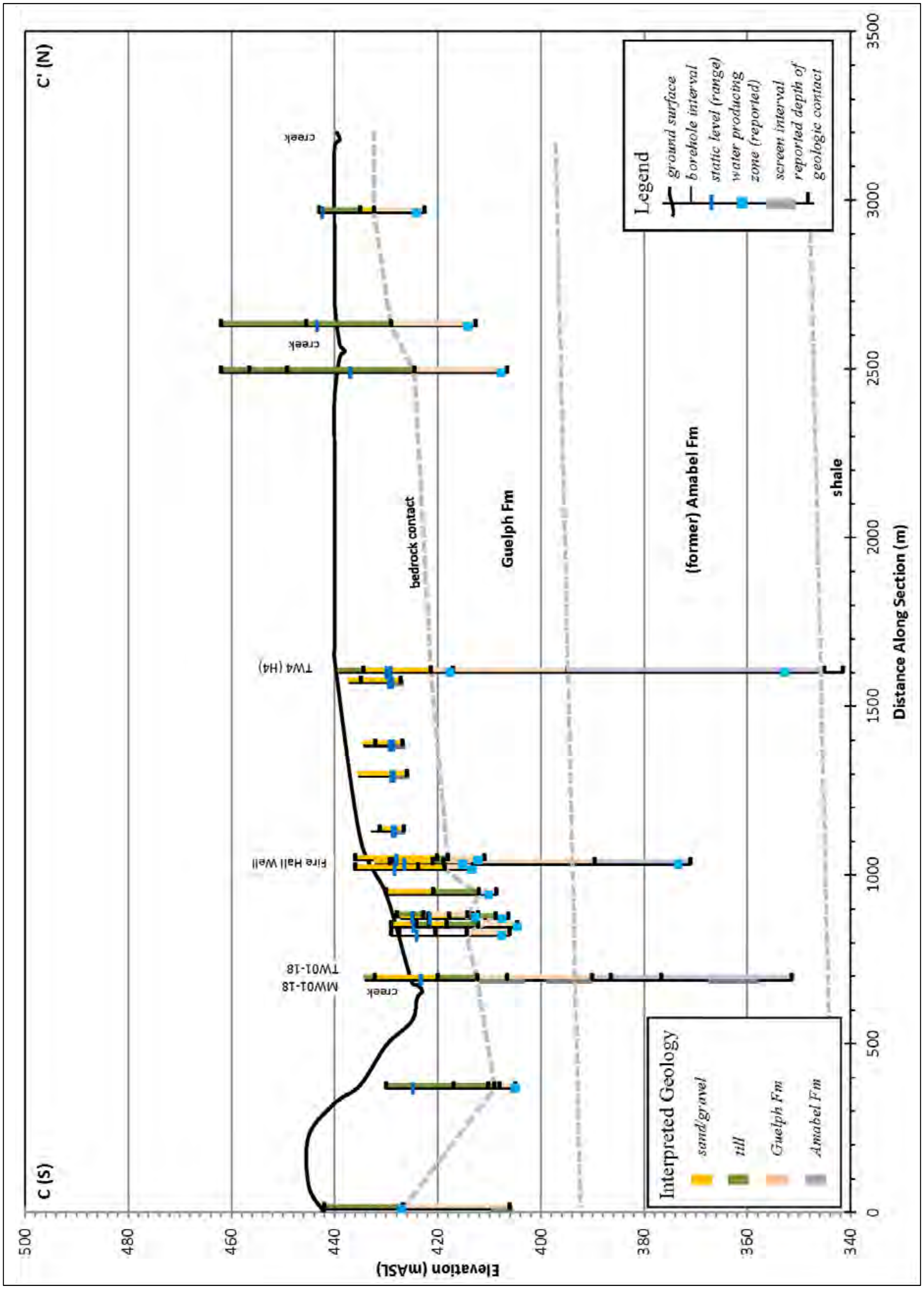


Figure 16: Section C

The geologic conditions shown are based primarily on the water well record information. For simplicity the material descriptions were classified into 5 categories, as follows:

- sand/gravel (aquifer) layers as described on the well record;
- till layers (any material description that included clay/silt, or if listed as hardpan);
- Guelph Formation (light or brown coloured bedrock/dolostone);
- Amabel Formation (grey or darker coloured bedrock/dolostone); and,
- shale.

The sections illustrate the local topography, overburden thickness, overburden geology, bedrock aquifer thickness, and primary water bearing zones within the bedrock system. As shown, H4 was constructed to intercept the lower portion of the Guelph Formation and the entire (former) Amabel Formation, in order to accesses deep high capacity water bearing horizons. Few other wells in the area extend to similar elevations and intercept the deeper zone.

The overburden is variable, with sand and gravel extending to depth in some areas, as well as areas where till is reported to extend to bedrock. Where present the till deposits form a local confining layer for the bedrock aquifer.

5.2 DISTANCE VS DRAWDOWN

Figure 17 shows a distance-drawdown plot showing the extent of pumping test response (after 3 days of continuous pumping).

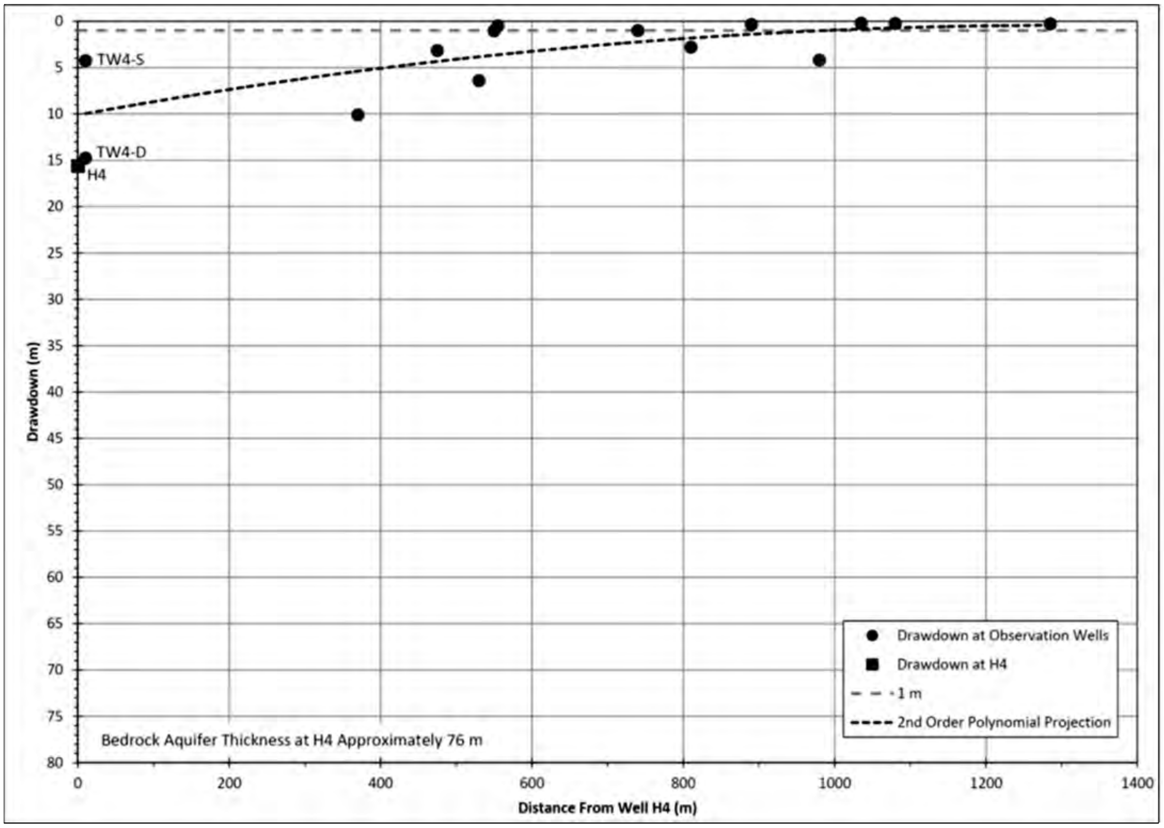


Figure 17: Distance-Drawdown

As shown, pumping effects beyond approximately 1 km from well H4 were limited to less than 1 m, and generally less than 5 m beyond 400 m distance.

5.3 WATER TABLE RESPONSE

No significant water table response was observed due to pumping well H4 during the 3 day test. This may be due to the depth of primary water bearing zones intercepted by H4. We note that there is also no water table response observed due to regular taking at the Glendevon well (H3).

Existing water table conditions at the closest stream reach (at DP3) indicates that there is no groundwater discharge from the underlying sand and gravel unit, or from the bedrock system, in this area. Vertical gradients are downward, and the water table appears fully separated from the river at H4-MW1-19/DP3.

Groundwater discharge does occur upstream of Hillsburgh, and downstream of the Station Street reservoir. This discharge appears to be driven by an underlying till layer promoting horizontal water table flow toward the river. The till unit may provide some isolation from the bedrock aquifer system, and limit local impacts related to water taking in the area.

The pumping test as completed stressed the system for an extended period of time (3 days continuous pumping). Routine average daily pumping for normal municipal demands is typically much less (e.g. 2 hours/day and 6 hours/day at well H2 and H3 respectively), therefore short term impacts will be less than observed over the pumping test.

5.4 BEDROCK AQUIFER RESPONSE

Water levels within the bedrock system around existing well H3 respond to routine regular taking. Water levels in the bedrock system also responded to higher continuous taking at H4 during the pumping test. Drawdown in response to the H4 pumping test was greater than the response to routine taking at H3, due to the higher pumping rates.

Well H4 obtains water from deep bedrock zones, including the lower Guelph Formation and lower (former) Amabel Formation. H4 pumping effects extend into the upper bedrock system, however as observed at TW4-S, are reduced in scale. Significant water level impacts within the bedrock zone were not observed at distance from H4.

Water levels at both the pumping well (H4) and other bedrock wells in the area stabilized toward the end of the 3 day pumping test. The pumping test response is typical of a leaky or semi-confined system, which indicates that recharge from the upper bedrock system, and overburden, moderates drawdown. However this recharge is distributed over a large area therefore local effects at surface are expected to be small.

Most of the water available to well H4 appears to be from deep bedrock zones, and as a result the pumping effect will be distributed within the regional flow system, again indicating that significant local impacts to shallow groundwater systems in the area would not be expected.

5.5 IMPACT TO PRIVATE WELLS

Water taking at H3 has been established over many years. Although taking at H3 does affect water levels at local private wells, based on the current pump settings and individual use, water supply interference does not occur. It is likely that as private wells were installed, and well maintenance has occurred, in the area, pumps have been set low enough to accommodate water level changes associated with both private use and municipal taking.

The current Urban Centre Water Supply Class EA minimum initial water supply target (maximum daily demand) for Hillsburgh is 1,615 m^3/d (18.7 L/s over 24 hours), which corresponds to the population growth forecast to year 2031. While this represents an increase in taking over what is currently occurring at H3, growth and water service expansion will be somewhat incremental. Water taking would be expected to increase slowly over time.

We also note water taking at a maximum daily demand is only needed occasionally each year. Typical daily taking is lower, for example as identified in the *Town of Erin Urban Centre Water Servicing Schedule B Class Environmental Assessment Project File Report* (Triton Engineering Services Limited), based on reported water taking in Hillsburgh, maximum day flows were 531.3 m^3/d and 638.5 m^3/d in 2018 and 2019 respectively. However the average day flows in 2018 and 2019 were 212.1 m^3/d and 218.0 m^3/d respectively. This is reflected by the current daily use of wells H2 and H3 (average of 2 hours and 6 hours per day respectively in 2018).

Based on the test results, well H4 has the capacity to supply the identified Class EA initial water supply target of 18.7 L/s over 24 hours. Pumping effects were observed at local water wells during the 3 day H4 test, and 3 water supply interference reports were received. Therefore water taking at H4 at 18.7 L/s (similar to the 3 day pump test rate) on a continual basis would be expected to affect water levels at local water wells and could result in additional water supply interference within the village. However, as noted above, regular water taking at H4 would not be expected for extended periods. Water taking to supply typical needs would be much less.

We note that no water supply interference complaints were received, and no interference was observed at monitored locations, during the 1 day test (at higher pumping rates). Therefore water level effects at local water wells due to H4 water taking at 18.7 L/s over shorter periods (e.g. 2 to 6 hours per day) would be reduced and may not cause water supply interference issues.

Significant drawdown is not expected at private wells beyond about 600 m from well H4 during regular municipal usage. However, depending on individual pump settings, water supply at some wells beyond 600 m may be susceptible to small drawdown effects. If water supply interruptions do occur due to H4 pumping, remedies are available such as lowering pumps, deepening wells and connection to the municipal supply system. We note that if residences in the village were connected to the municipal supply system no water supply interference would be expected due to taking at H4. It is our understanding that over the long-term all residences in the village are expected to connect to the municipal water supply system.

As noted in **Section 5.7**, simultaneous taking at H3 and H4 should not occur under existing conditions due to mutual interference effects. In the long-term H4 pumping would be expected to gradually increase as existing and new residences connect to the municipal supply system. As taking gradually increases, continued monitoring can occur, and a water supply interference responses policy can be developed and implemented, to ensure water supplies are maintained within the village and surrounding area.

We note that a standard PTTW condition relates to the need to restore water supplies if interference occurs. For example, the Category 2 permit obtained for testing H4 included the following condition:

> *Restoration of Water Supply*
>
> *Where 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 doing so.*

We also propose continued monitoring as part of an eventual permit to take water for H4 at: bedrock monitor TW4 S/D; the Arena Well; H2; and, H3, in order to assess long-term effects on the bedrock system due to the proposed taking, and to provide information that may be needed to assist in responding to any future water well interference complaints that may occur.

5.6 IMPACT TO NATURAL ENVIRONMENT FEATURES

It is recognized that the pumping test occurred in January, which is not representative of typical “dry” annual conditions. Therefore groundwater recharge, and increased streamflow, in response to fall/winter precipitation and snowmelt events could “mask” potential drawdown effects within the shallow zone. Recharge event indicators, including water table and stream level rises, are observed at the drive point and overburden monitoring locations.

However, the monitoring program was designed to include 4 drive-point piezometer locations to provide good coverage in sensitive habitat areas, with most locations consisting of multi-level (nested) monitors. In addition, 6 water table observation wells and 2 private dug (water table) wells in the area surrounding H4 were monitored. detailed monitoring was undertaken using dataloggers at all of these locations, and included extended pre and post-test monitoring.

Monitor locations DP1, DP2, DP3/H4-MW1-19, BH1, BH16-D and DP4 all provide information related to potential impacts on the main branch of the West Credit River, and associated wetland areas, through the village. Monitor locations BH20, MW25 and DP5 provide information related to potential impacts on natural environment features (wetlands and ponds) south and east of H4.

No recognizable effect on local water table levels, or vertical gradients, were observed due to pumping well H4 continuously for 3 days. It is our interpretation that this represents an adequate assessment of potential for the type of short-term impact (daily pumping cycle) that would be expected due to the proposed municipal taking.

Based on the private well monitoring results, water level changes within the bedrock system southeast of H4 (Wellington Road 22 area) due to the 3 day pumping test were small in scale. The geologic sections illustrate that overburden in this area is reported to consist of finer grained (till) units, that tend to reduce potential vertical connections between the bedrock and water table groundwater systems. Therefore no significant related impacts on the shallow groundwater system, and any related natural environment features in that area, are expected.

The drive-point and water table observation wells were left in place for future monitoring, if needed. In order to examine potential for longer term impacts, and to assess potential for impact during dry annual conditions, we propose a monitoring program as part of an eventual permit to take water for H4, to include some of the established locations. The monitoring program should include H4-MW1-09, DP1 nest (as accessible), DP2 (as accessible), DP4, and BH16D (as accessible) and BH20 (as accessible).

5.7 IMPACT TO MUNICIPAL WELLS

Water level changes caused by the H4 pumping tests (both 1 day test and 3 day test) reduced the available drawdown water level at H3 such that continued water taking was not possible at H3. Therefore, under existing conditions water taking at H4 at rates of 18.4 L/s, or more, for extended periods is expected to interfere with the operation of H3.

However, we note that the current available drawdown at H3 is based on the pump intake setting at that well. Well H3 SCADA data indicates that the available drawdown on January 15, 2020 10:00 am (pre-test static) was approximately 12.8 m. The water level was approximately 4.6 mBTOW at that time, indicating a pump intake setting of about 17.4 mBTOW. Based on the H3 well record, the casing extends to approximately 20.1 m below ground surface, and the well is approximately 57.9 m deep. It may be possible to lower the pump at H3 such that mutual interference effects are eliminated.

As noted previously, water taking at H4 would likely gradually increase over time as existing and new residences connect to the municipal supply system. As taking gradually increases, continued monitoring can occur, and adjustments made to pumping rates and/or pump settings at both wells to ensure mutual interference at municipal wells does not impact water supply capacity.

5.8 GUDI CONSIDERATIONS

Based on the well drilling and testing program, well H4 is not interpreted to be a GUDI (Groundwater Under the Direct Influence of surface water) water source. Well H4 is a bedrock well capable of supplying water at a rate greater than 0.58 L/s and although it is located within 500 m of wetlands and a creek, the following is noted:

- Well H4 is a drilled well with a watertight stainless steel casing that extends greater than 6 m below ground surface;
- Long-term testing at high pumping rates indicated no vertical hydraulic connection to, and water level response within, the shallow overburden or surface water systems in the vicinity of the well;
- There are no nearby enhanced recharge or infiltration facilities;
- Water quality testing during the pumping test does not exhibit evidence of contamination by surface water.

It is noted that extensive microbiological related analysis was completed, including: Cryptosporidium; E. Coli; Giardia; Nonviable Cryptosporidium; Nonviable Giardia; Total Coliforms; Viable Cysts; Viable oocysts; Microcystin; and, Nitrilotriacetic Acid (NTA), all of which returned “non-detect” results.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Based on the Town of Erin Water Supply Class EA Well H4 drilling and testing program, the following conclusions are made:

1. The additional firm capacity provided by well H4 will meet the current Urban Centre Water Supply Class EA minimum initial water supply target (maximum daily demand) for Hillsburgh (1,615 m^3/d or 18.7 L/s), which corresponds to the population growth forecast to year 2031, as outlined in the Final Growth Management Strategy Report (Dillon, October 2019) for the Town.
2. A well yield of 27.6 L/s is achievable from well H4 over a 1 day period and 18.4 L/s (or more) is available over extended periods.
3. Based on information available at this time, routine daily use of well H4 at expected typical average daily pumping volumes and daily water taking periods is not expected to interrupt local water supplies. As daily water taking volumes and daily pumping periods gradually increase a water supply interference policy should be developed and implemented to ensure local water supplies are maintained. If impacts do occur after H4 is in service, water supply at private wells can be reestablished through typical routine methods such as lowering pumps, deepening wells, or connection to municipal water supply service.
4. The operation of well H4 can have mutual interference effects at H3, depending on water taking rates and timing. On an initial basis water taking at H3 and H4 should alternate such that simultaneous taking does not occur. Over the long term alternatives such as lowering the existing pump in H3 can be used to mitigate mutual interference effects.
5. Water quality obtained from well H4 is good, and after routine use, and treatment, is expected to meet applicable drinking water standards. There is no evidence of anthropogenic contamination at well H4.
6. Based on the pumping test response and water quality analysis results well H4 is interpreted to be not a GUDI well, primarily due to the depth of primary water bearing zones.

6.1 RECOMMENDATIONS

Based on the results of this study, the following recommendations are made:

1. Well H4 be incorporated into the Hillsburgh Municipal Water Supply System once applicable permits are obtained.
2. A Permit To Take Water should be obtained for a rate of 18.7 L/s and daily maximum taking volume of 1,615 m^3/day at well H4. As part of that process, a pre-consultation with MECP and CVC may be required.
3. A water supply interference policy should be developed and implemented to ensure local water supplies are maintained. The water supply interference policy should include:
    - municipal contact information made publicly available for water supply interference complaints;
    - investigation protocol to determine if water supply interference has occurred and if the interference is due to municipal water taking;
    - a response protocol to reestablished affected water supplies, including established methods such as lowering pumps, deepening wells, or connection to municipal water supply service; and,
    - confirmation that the cost of water supply complaint investigations and response be covered by the municipality if a water supply interference is caused by municipal water taking.
4. A water level monitoring and reporting program should be implemented as part of the Permit To Take Water conditions that includes the following locations:
    - TW4-S and TW4-D
    - H2 and H3
    - The Arena Well
    - H4-MW1-09
    - DP1 and DP2 (as accessible)
    - DP3 and DP4
    - BH16D and BH20 (as accessible)

Sincerely,

Andrew Pentney, P.Geo.
Senior Hydrogeologist
Groundwater Science Corp.

Appendix A
TW4 Drilling and Testing Results

Ontario Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
Tag#:A235584

Well Record

Regulation 903 Ontario Water Resources Act

Page 3 of 3

Well Owner's Information

First Name: TOWN OF ERIN
Last Name / Organization:
E-mail Address:
☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name): 5684 TRAFALGAR RD NORTH
Municipality: ERIN HILLSBURGH ONT
Province:
Postal Code: N0B1Z0
Telephone No. *(inc. area code)*:

Well Location

Address of Well Location (Street Number/Name):
Township: ERIN
Lot: 24
Concession: 8
County/District/Municipality: WELLINGTON
City/Town/Village:
Province: **Ontario**
Postal Code:
UTM Coordinates Zone: NAD 8 3 17 Easting: 569338 Northing: 4849211
Municipal Plan and Sublot Number:
Other:

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	Depth (m/ft) To
BROWN	SILTY CLAY & STONE			0	15ft
GRAY	GRAVEL SAND STONES			15ft	58ft
BROWN	LIMESTONES SOFT			58ft	72ft
BROWN	LIMESTONE MED			72ft	145ft
GRAY BROWN	LIMESTONE LAYERS			145ft	308ft
GRAY	SHALE RED LAYERS			308ft	320ft
		USED CENTRALIZERS			

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	68ft	BENTONITE SLURRY	80gal

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
6½	steel	.188	0	68ft
6in	open hole		68ft	320ft

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 70ft (m/ft) ☐ Gas — Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify
Water found at Depth 283ft (m/ft) ☐ Gas — Kind of Water: ☒ Fresh ☐ Untested ☐ Other, specify
Water found at Depth (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	68ft	8.75in
68ft	320ft	6in

Well Contractor and Well Technician Information

Business Name of Well Contractor: KEITH LANG WELL DRILLING INC
Well Contractor's Licence No.: 7154
Business Address (Street Number/Name): 251 ELDON ST GODERICH
Municipality:
Province: ONT
Postal Code: N7A3R9
Business E-mail Address:
Bus. Telephone No. *(inc. area code)*: 519-524-8159
Name of Well Technician (Last Name, First Name): KEITH LANG
Well Technician's Licence No.: T446
Signature of Technician and/or Contractor: K. Lang
Date Submitted: 2018 12 30

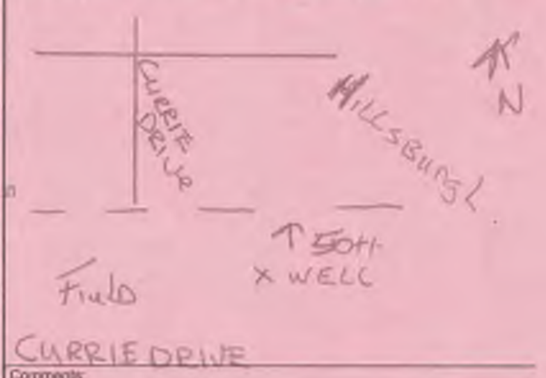
Results of Well Yield Testing

After test of well yield, water was:
☒ Clear and sand free
☐ Other, specify
If pumping discontinued, give reason: pump test to be done later
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)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	37ft		
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:

TW4

Well owner's information package delivered ☐ Yes ☒ No
Date Package Delivered: Y Y Y Y M M D D
Date Work Completed: 2018 12 6

Ministry Use Only
Audit No. Z287089
Received

0506E (2014/11)

Well Owner's Copy

Lotowater
TECHNICAL SERVICES INC.

P.O. Box 451
Paris, ON N3L 3T5

92 Scott Avenue
Paris, ON N3L 3R1
T (519) 442-1749
T (800) 923-6923
F (519) 442 7242
www.lotowater.com

February 8, 2019

Reference: 148-003

Andrew Pentney, P. Geo.
Groundwater Science Corp.
Unit 2, 465 Kingscourt Drive
Waterloo, ON
N2K 3R5

Subject: Erin – Hillsburgh Well Testing and Video

This memo documents testing of four test wells drilled in bedrock in the Erin – Hillsburgh area in Ontario. The four wells tested included the following wells; Solmar (TW1), Solmar (TW2), Erin North (TW3) and Currie (TW4). Testing included video surveys, flow profiles and step test. In addition, groundwater sampling was performed by Groundwater Science Corp. (GSC). Field work was performed over several weeks from January 15 – 28, 2019. The purpose of this testing was to quantify basic well hydraulics and areas flow production from the bedrock.

Testing Procedure

The same general testing procedure was followed at each of the four wells. First, a video was performed using a dual view well video camera. A down scan image was captured first as the camera was run to the bottom of the well and a side scan image was performed on the way up stopping at important features. Video summaries were prepared in **Tables 1A-4A** and copies of the videos have been sent to GSC in DVD.

A step test was performed on each well using a submersible pump. A pump and 5hp motor was selected which could run on a single phase portable generator. This limited production to approximately 10 L/s. Note that Currie Well TW3 had a slightly deeper static water level which required a higher head lower flow pump and limited test flows to 6 L/s. In every case, the pumps were set within or near the base of the well casing. The well was pumped up to its full rate of 10 or 6 L/s for 30 minutes, then the flow reduced to the next 30 minute step. Two to three steps were performed at each well. Flow was measured using a turbine flow meter and levels measured using a manual level tape. Step test details are shown in **Tables 1B-4B** and graphically in **Figures 1A-4A**.

A flow profile was conducted during the step test to quantify the flow distribution in each well. Lotowater uses a spinner device manufactured by Swoffer with custom modifications for application in boreholes and wells. The tool has a small impeller that is oriented vertically.

Vertical flow in the well activates the impeller which transmits a signal to a digital readout at the surface for every ½ revolution of the impeller. The velocity of fluid is directly proportional to the rotational speed of the spinner tool. The spinner tool is regularly calibrated such that its readout is reported as a velocity in metres/second.

Flow profiling was conducted under non-pumping conditions first, to indicate natural water movement in the borehole, as well as under artificially induced pumping conditions. The spinner flow tool has a minimum threshold velocity of 0.03 m/s required to overcome internal friction and activate the tool. In most cases, there is not a strong enough vertical flow in the well to activate the flow tool, so a small submersible pump is installed to induce flow. Note that no ambient (non-pumping) flows were measured in any of the four wells tested.

Each well was flow profiled under the maximum flow obtained from the step test. In all cases, the pump was set entirely within the well casing. The flow tool is then run from the bottom of the well over the entire borehole, into the casing to the bottom of the pump. Flow measurements are recorded at a specified depth interval or whenever a change in flow is indicated. Flow profiles are shown graphically in **Figures 1B-4B**.

A brief summary of some of the important findings for each well are as follows:

Currie Well TW4

- The casing and borehole were generally clear, but many ledges on the borehole were covered with a soft buildup, especially near the bottom of the well.

- There is a strong downward flow in this well with water coming in from a large feature near the base of the well casing at 21.5 m and flowing down the well and out from another large feature at 86.3 m.

- There was no flow recorded in the flow profile under ambient (non-pumping) conditions despite the obvious visual indication of downward flow in the video. This indicates the ambient vertical flow down the well was less than the minimum threshold velocity of the flow tool of 0.03 m/s. This means the ambient flow down the well was less than 0.5 L/s.

- The total depth measured was 89.2 m which is significantly less than the 97.5 m total depth reported in the well record.

- The well was pumped at 10 L/s with approximately 0.77 m drawdown yielding a specific capacity of approximately 13.0 L/s/m. This well has the highest specific capacity of any of the four wells tested.

- The flow profile was performed at 10 L/s. This pumping flow profile was inconclusive. It is believed that under pumping most of the flow is entering the well at the upper feature at 21.5 m. It is suspected that there is no flow shown above this feature as we were very near the base of the pump motor at approximately 20.75 m which did not allow enough room for the flow tool to get a good measurement. Below this there was no measurable flow, indicating any flow contributions from deep in the well were below the minimum threshold of the tool which indicates any flows were less than 0.5 L/s.

- Additional packer testing could be performed here that isolated the deep portion of the well from the shallow feature below 21.5 m to confirm and better quantify the hydraulic conditions of both the deep and shallow portions of the aquifer here.

 **Photo 7:** Looking down at the deep feature where water was seen exiting the well at 86.3 m	 **Photo 8:** Looking down into the expected main flow feature at 21.5 m just below the casing base

Please contact the undersigned if you have any questions.

Respectfully submitted,
Lotowater Technical Services Inc.

Boyd Pendleton, P. Geo.
Vice President

TABLE 4A

TOWNSHIP OF ERIN

Currie Well TW4
Static Video Summary
2019/01/22

Elapsed Time (h:min)	Depth (ft below MP)	Depth (m below MP)	Comments
0:00	2.8'	0.9	Below top of casing
0:02	17.5'	5.3	Casing joint
0:04	30.7'	9.4	Static water level
0:07	37.2'	11.3	Casing joint
0:10	57.1'	17.4	Casing joint
0:12	70'	21.3	Bottom of casing
0:12	70.6'	21.5	Large rock fracture, Flow in
0:13	72.1'	22.0	Vugs, PWPZ
0:13	75.3'	23.0	Vugs, PWPZ
0:14	76.4'	23.3	Vugs, PWPZ
0:14	81.1'	24.7	Vugs
0:15	83.9'	25.6	Horizontal ring feature, PWPZ
0:15	87.2'	26.6	Fractures
0:16	89.8'	27.4	Vugs
0:18	102.8'	31.3	Vugs, Fracture starts, PWPZ
0:20	114'	34.7	Vugs, Fracture ends, PWPZ
0:20	116.7'	35.6	Horizontal ring feature
0:22	128.2'	39.1	Vugs
0:25	144'	43.9	Vugs
0:26	156.8'	47.8	Vugs
0:28	165.5'	50.4	Vugs
0:28	168.8'	51.5	Vugs
0:29	175.6'	53.5	Vugs
0:30	181.5'	55.3	Horizontal ring feature
0:31	187.5'	57.2	Horizontal ring feature
0:34	210.1'	64.0	Horizontal ring feature
0:37	231.7'	70.6	Horizontal ring feature
0:39	252'	76.8	Horizontal ring feature
0:40	254'	77.4	Cavern, PWPZ
0:40	259.2'	79.0	Horizontal ring feature, PWPZ
0:41	262.2'	79.9	Horizontal ring feature, PWPZ
0:42	270.1'	82.3	Horizontal ring feature, Sediment, PWPZ
0:42	271.6'	82.8	Vertical fracture, PWPZ
0:42	273.4'	83.3	Vertical fracture, PWPZ
0:43	275'	83.8	Vugs start, Horizontal ring feature
0:44	282'	86.0	Vugs end, Horizontal ring feature
0:44	283.1'	86.3	Top of large cavern
0:47	289.1'	88.1	Turbidity increasing
0:49	292.7'	89.2	Bottom of well, rock
0:51	287.9'	87.8	Bottom of large cavern, Fractures
0:54	284'	86.6	Top of large cavern, Fracture

TABLE 4A

TOWNSHIP OF ERIN

Currie Well TW4
Static Video Summary
2019/01/22

Elapsed Time (h:min)	Depth (ft below MP)	Depth (m below MP)	Comments
0:57	278.1'	84.8	Vugs, Fracture starts
0:59	273.5'	83.4	Vertical and horizontal fracture
1:00	271.9'	82.9	Vertical and horizontal fracture, Flow in
1:03	262.6'	80.0	Horizontal ring feature, Flow in, Fracture
1:05	259.7'	79.2	Horizontal ring feature, Flow in, Fracture
1:08	254.5'	77.6	Cavern, PWPZ
1:09	257.6'	78.5	Horizontal ring feature, PWPZ
1:14	232.2'	70.8	Horizontal ring feature, PWPZ
1:19	210.6'	64.2	Horizontal ring feature, PWPZ
1:25	187.9'	57.3	Horizontal ring feature, PWPZ
1:26	185.5'	56.5	Vugs, PWPZ
1:31	169.5'	51.7	Horizontal ring feature, PWPZ
1:36	152.5'	46.5	Fractures, PWPZ
1:44	117.7'	35.9	Vugs, PWPZ
1:45	112'	34.1	Vugs start, PWPZ
1:48	102'	31.1	Vugs end, PWPZ
1:52	84.7'	25.8	Horizontal ring feature, PWPZ
1:54	73.2'	22.3	Large vugs, PWPZ
1:55	72.3'	22.0	Horizontal ring feature, PWPZ
1:57	71.6'	21.8	Large cavern, Flow in
1:58	71'	21.6	Bottom of casing
2:00	58.2'	17.7	Casing joint
2:04	38.9'	11.9	End of video

Video survey conducted by Rodney Secor

Notes: Measuring point (MP) is top of casing which is 0.67 m above ground surface
PWPZ = Possible water producing zone

TABLE 4B

VARIABLE RATE PERFORMANCE TEST

Lotowater TECHNICAL SERVICES INC.

Well Name:	Currie Well TW4	**Project Number:**	148-003
Client:	Town of Erin (GSC)	**Date:**	January 22, 2018
Technician Name:	Craig Lawson	**Pump:**	Grundfos 230S200-2 (5hp)
Water Level Device:	LTS water level meter	**Pump Inlet:**	19.8 m
Water Level Reference:	Top of casing (0.67 m agl)	**Flow Measuring Device:**	4" McCrometer Impeller

Test Note: TD = 89.20 mbtc, Base of 150 mm diameter casing 21.6 mbtc

Time ***hr:min***	**Elapsed Time** ***min***	**Level** ***mbtc***	**Drawdown** ***m***	**Flow** ***L/s***	**Note**
12:30	0	9.46	0.00	3.5	Start Step 1
12:31	1	9.56	0.10	3.5	
12:32	2	9.56	0.10	3.5	
12:33	3	9.56	0.10	3.5	30 psi
12:34	4	9.62	0.16	3.5	
12:35	5	9.65	0.19	3.5	
12:36	6	9.66	0.20	3.5	
12:38	8	9.68	0.22	3.5	
12:40	10	9.70	0.24	3.5	
12:42	12	9.71	0.25	3.5	
12:45	15	9.72	0.26	3.5	
12:50	20	9.74	0.28	3.5	
12:55	25	9.75	0.29	3.5	
13:00	30	9.75	0.29	3.5	
13:10	40	9.76	0.30	3.5	
13:20	50	9.76	0.30	3.5	
13:30	60	9.77	0.31	3.5	
13:31	1	9.82	0.36	6.0	Start Step 2
13:32	2	9.84	0.38	6.0	
13:33	3	9.85	0.39	6.0	25 psi
13:34	4	9.86	0.40	6.0	
13:35	5	9.87	0.41	6.0	
13:36	6	9.87	0.41	6.0	
13:38	8	9.88	0.42	6.0	
13:40	10	9.89	0.43	6.0	
13:42	12	9.90	0.44	6.0	
13:45	15	9.90	0.44	6.0	
13:50	20	9.91	0.45	6.0	
13:55	25	9.92	0.46	6.0	
14:00	30	9.93	0.47	6.0	
14:10	40	9.93	0.47	6.0	
14:20	50	9.93	0.47	6.0	
14:30	60	9.93	0.47	6.0	

TABLE 4B

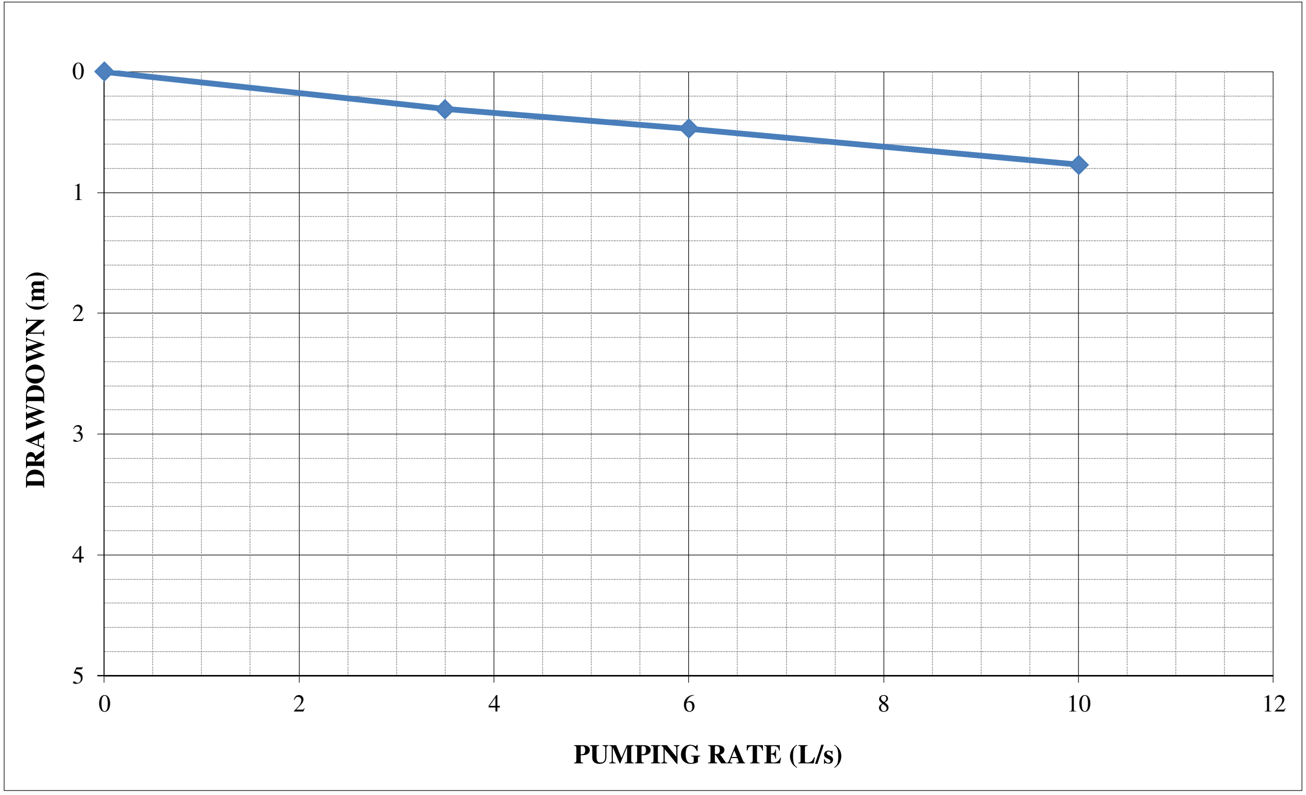
VARIABLE RATE PERFORMANCE TEST

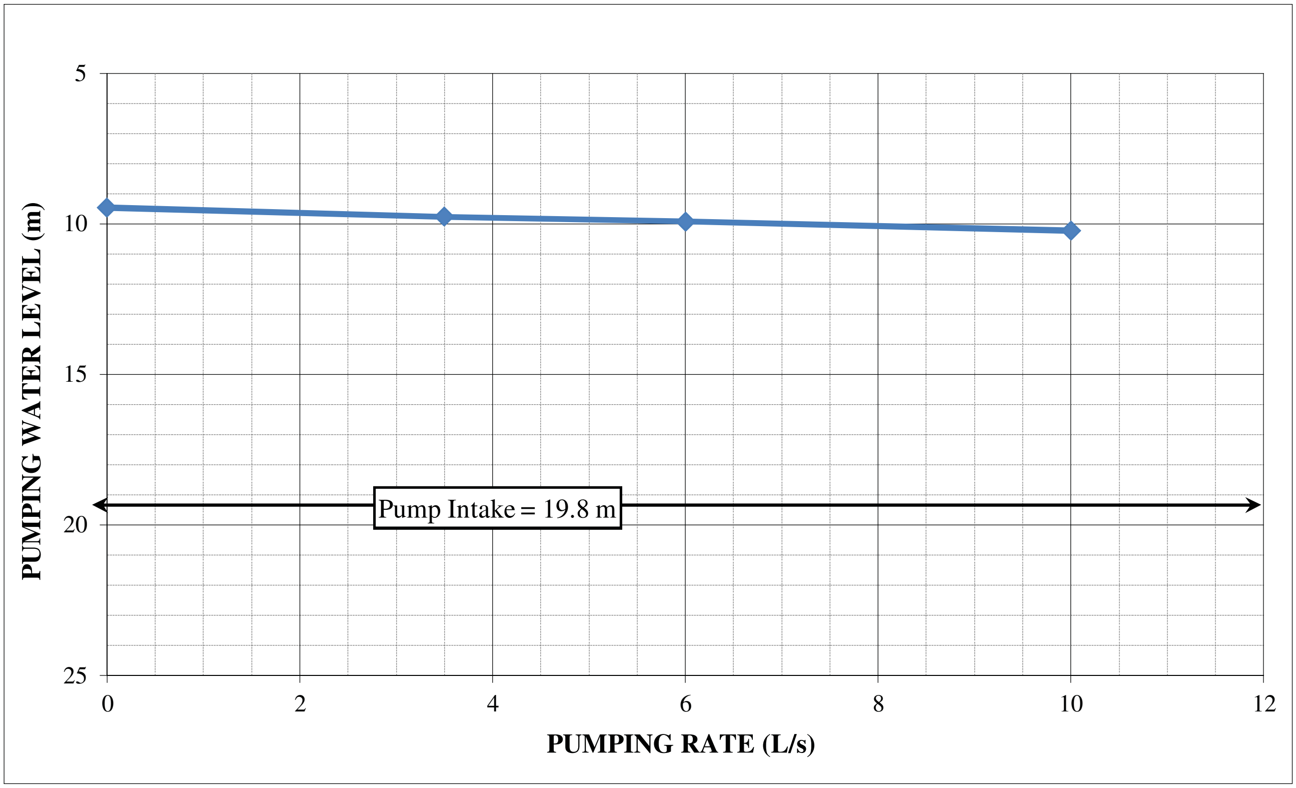
Lotowater
TECHNICAL SERVICES INC.

Well Name: Currie Well TW4
Client: Town of Erin (GSC)
Technician Name: Craig Lawson
Water Level Device: LTS water level meter
Water Level Reference: Top of casing (0.67 m agl)
Test Note: TD = 89.20 mbtc, Base of 150 mm diameter casing 21.6 mbtc

Project Number: 148-003
Date: January 22, 2018
Pump: Grundfos 230S200-2 (5hp)
Pump Inlet: 19.8 m
Flow Measuring Device: 4" McCrometer Impeller

Time *hr:min*	**Elapsed Time** *min*	**Level** *mbtc*	**Drawdown** *m*	**Flow** *L/s*	**Note**
14:31	1	10.02	0.56	9.5	Start Step 3
14:32	2	10.06	0.60	9.5	
14:33	3	10.07	0.61	9.5	20 psi
14:34	4	10.08	0.62	9.5	
14:35	5	10.09	0.63	9.5	
14:36	6	10.10	0.64	9.5	
14:38	8	10.12	0.66	9.5	
14:40	10	10.13	0.67	9.5	
14:42	12	10.14	0.68	9.5	
14:45	15	10.15	0.69	9.5	
14:50	20	10.17	0.71	9.5	
14:55	25	10.18	0.72	9.5	
15:00	30	10.19	0.73	9.5	
15:10	40	10.21	0.75	9.5	
15:20	50	10.23	0.77	9.5	
15:30	60	10.23	0.77	9.5	





Notes:

Test Date = January 22, 2019

All water levels are referenced from top of well casing

Top of casing = 0.67 m above ground surface

Base of well casing = 21.6 m

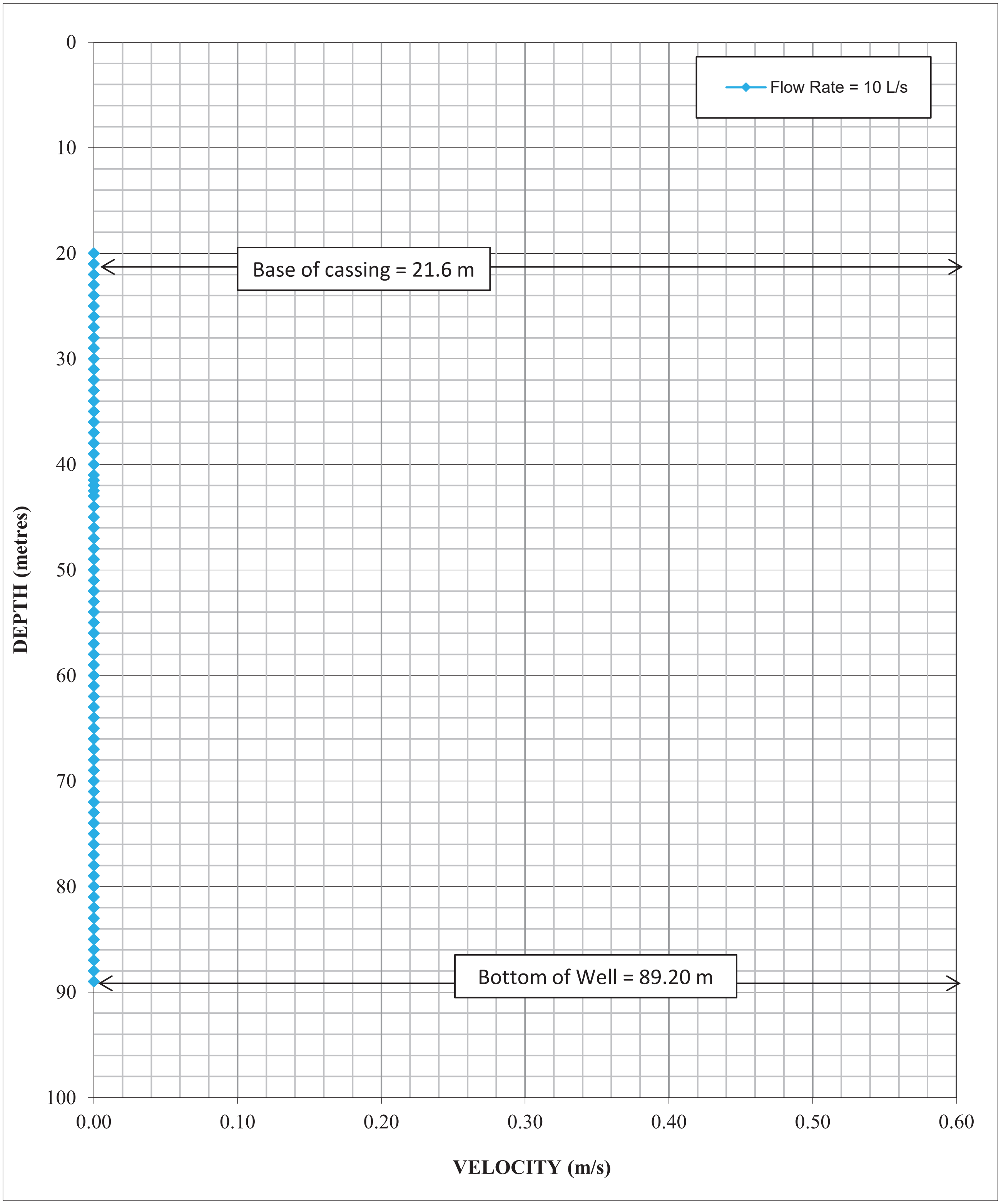
Township of Erin

Currie Well TW4

Comparison of Variable Rate Tests

Lotowater Technical Services Inc. **Figure 4A**

Reference: 148-003 2019-01-23



Notes:
Test Date = January 15, 2019
All water levels are referenced from top of well casing
Top of casing = 0.47 m above ground surface
Bottom of pump motor at 20.75 m

Township of Erin

Currie TW4

Flow Profile

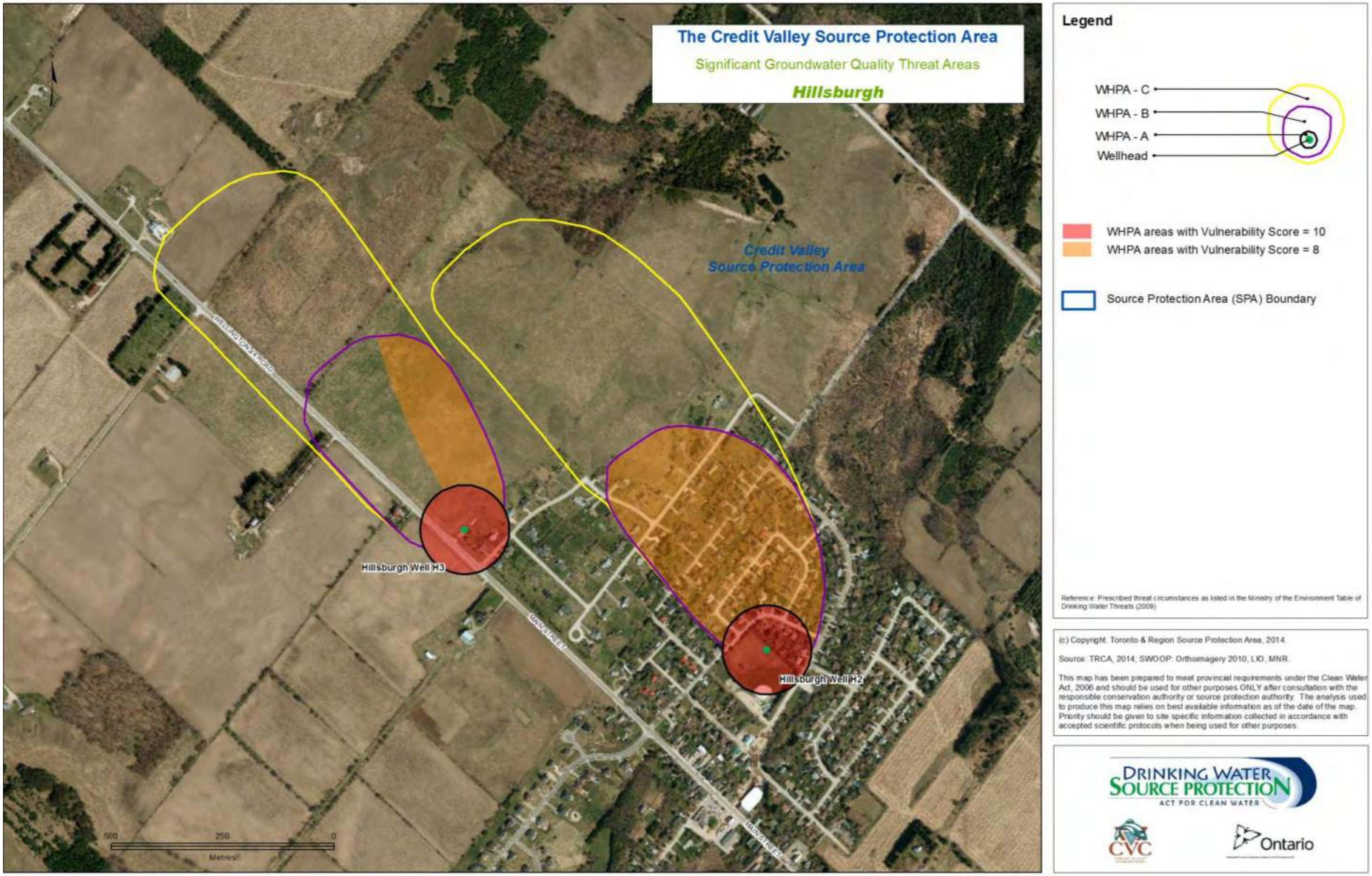
Lotowater Technical Services Inc. **Figure 4B**
Reference: 148-003 2019-02-04

ALS		Sample ID				CURRIE DRIVE TW4	TW4 LOWER ZONE
2/17/2020		ALS ID				L2223735-1	L2240317-1
Multiple Work Orders		Date Sampled				1/22/2019 2:00:00 PM	03/05/2019 12:00:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water
Colour, Apparent	CU	2	-	5	-	82.8	49.7
Conductivity	umhos/cm	3	-	-	-	672	661
pH	pH units	0.1	-	6.5-8.5	-	7.53	7.65
Redox Potential	mV	-1000	-	-	-	233 *	383 *
Total Dissolved Solids	mg/L	20	-	500	-	382 *	396 *
Turbidity	NTU	0.1	-	5	-	0.2	9.27
Alkalinity, Bicarbonate (as CaCO3)	mg/L	10	-	-	-	244	216
Alkalinity, Carbonate (as CaCO3)	mg/L	10	-	-	-	<10	<10
Alkalinity, Hydroxide (as CaCO3)	mg/L	10	-	-	-	<10	<10
Alkalinity, Total (as CaCO3)	mg/L	10	-	-	500	244	216
Ammonia, Total (as N)	mg/L	0.01	-	-	-	0.254	0.134
Bromide (Br)	mg/L	0.1	-	-	-	<0.10	<0.10
Chloride (Cl)	mg/L	0.5	-	250	-	49	31
Computed Conductivity	uS/cm	n/a	-	-	-	625	642
Conductivity % Difference	%	n/a	-	-	-	-7.2	0
Fluoride (F)	mg/L	0.02	1.5	-	-	0.187	0.286
Hardness (as CaCO3)	mg/L	n/a	-	-	-	285	302
Ion Balance	%	n/a	-	-	-	109	110
Langelier Index		n/a	-	-	-	0.4	0
Nitrate (as N)	mg/L	0.02	10	-	-	<0.020	0.023
Nitrite (as N)	mg/L	0.01	1	-	-	<0.010	<0.010
Saturation pH	pH	n/a	-	-	-	7.16	7.2
Orthophosphate-Dissolved (as P)	mg/L	0.003	-	-	-	0.0064	<0.0030
TDS (Calculated)	mg/L	n/a	-	-	-	379	392
Sulfate (SO4)	mg/L	0.3	-	500	-	51.2	103
Sulphide (as S)	mg/L	0.18	-	0.05	-	1.94 *	-
Sulphide (as H2S)	mg/L	0.19	-	0.05	-	2.06	-
Anion Sum	me/L	n/a	-	-	-	6.47	6.58
Cation Sum	me/L	n/a	-	-	-	7.06	6.99
Cation - Anion Balance	%	n/a	-	-	-	4.3	0
Cyanide, Total	mg/L	0.002	-	-	-	<0.0020	-
Dissolved Carbon Filtration Location		n/a	-	-	-	LAB	-
Dissolved Organic Carbon	mg/L	0.5	-	5	-	1.78	-
Silica Total	mg/L	0.21	-	-	-	12.1	11.6
E. Coli	CFU/100mL	0	0	-	-	0	0
Total Coliform Background	CFU/100mL	10	-	-	-	660 *	150 *
Total Coliforms	CFU/100mL	0	0	-	-	0	0
Sodium Adsorption Ratio	SAR	0.1	-	-	-	0.79	0.53
Aluminum (Al)-Total	mg/L	0.01	-	-	0.1	<0.010	<0.010
Antimony (Sb)-Total	mg/L	0.0001	0.006	-	-	<0.00010	0.00013
Arsenic (As)-Total	mg/L	0.0001	0.01	-	-	0.0013	0.00186
Barium (Ba)-Total	mg/L	0.0002	1	-	-	0.0383	0.0311
Beryllium (Be)-Total	mg/L	0.0001	-	-	-	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	0.00005	-	-	-	<0.000050	<0.000050
Boron (B)-Total	mg/L	0.01	5	-	-	0.022	0.024
Cadmium (Cd)-Total	mg/L	0.00001	0.005	-	-	0.000014	0.000017
Calcium (Ca)-Total	mg/L	0.5	-	-	-	80.5	84
Cesium (Cs)-Total	mg/L	0.00001	-	-	-	<0.000010	<0.000010
Chromium (Cr)-Total	mg/L	0.0005	0.05	-	-	<0.00050	<0.00050
Cobalt (Co)-Total	mg/L	0.0001	-	-	-	0.00047	0.0003
Copper (Cu)-Total	mg/L	0.001	-	1	-	0.0042	<0.0010
Iron (Fe)-Total	mg/L	0.05	-	0.3	-	1.73	1.13
Lead (Pb)-Total	mg/L	0.0001	0.01	-	-	0.00432	0.00328
Magnesium (Mg)-Total	mg/L	0.05	-	-	-	20.3	22.4
Manganese (Mn)-Total	mg/L	0.0005	-	0.05	-	0.266	0.143
Mercury (Hg)-Total	mg/L	0.00001	0.001	-	-	<0.000010	-
Molybdenum (Mo)-Total	mg/L	0.00005	-	-	-	0.00201	0.00414
Nickel (Ni)-Total	mg/L	0.0005	-	-	-	0.00066	0.00064
Phosphorus (P)-Total	mg/L	0.05	-	-	-	<0.050	<0.050
Potassium (K)-Total	mg/L	0.05	-	-	-	0.952	0.852
Rubidium (Rb)-Total	mg/L	0.0002	-	-	-	0.0002	0.00045
Selenium (Se)-Total	mg/L	0.00005	0.05	-	-	<0.000050	<0.000050
Silicon (Si)-Total	mg/L	0.1	-	-	-	5.66	5.41
Silver (Ag)-Total	mg/L	0.00005	-	-	-	<0.000050	<0.000050

TW4 Water Quality Analysis Results

Analyte	Units	LOR	Micro & Chemical Standards	AO	Upper Limit	Water	Water
Sodium (Na)-Total	mg/L	0.5	20	200	-	30.5	21.2
Strontium (Sr)-Total	mg/L	0.001	-	-	-	0.224	0.626
Sulfur (S)-Total	mg/L	0.5	-	-	-	17.5	35.2
Tellurium (Te)-Total	mg/L	0.0002	-	-	-	<0.00020	<0.00020
Thallium (Tl)-Total	mg/L	0.00001	-	-	-	0.000024	0.000016
Thorium (Th)-Total	mg/L	0.0001	-	-	-	<0.00010	<0.00010
Tin (Sn)-Total	mg/L	0.0001	-	-	-	0.00053	<0.00010
Titanium (Ti)-Total	mg/L	0.0003	-	-	-	<0.00030	<0.00030
Tungsten (W)-Total	mg/L	0.0001	-	-	-	<0.00010	<0.00010
Uranium (U)-Total	mg/L	0.00001	0.02	-	-	0.000622	0.000561
Vanadium (V)-Total	mg/L	0.0005	-	-	-	0.00095	0.00093
Zinc (Zn)-Total	mg/L	0.003	-	5	-	0.0324	0.0187
Zirconium (Zr)-Total	mg/L	0.0003	-	-	-	0.00038	<0.00030
Acetone	ug/L	20	-	-	-	<20	-
Benzene	ug/L	0.5	1	-	-	<0.50	-
Bromodichloromethane	ug/L	1	-	-	-	<1.0	-
Bromoform	ug/L	1	-	-	-	<1.0	-
Bromomethane	ug/L	0.5	-	-	-	<0.50	-
Carbon Disulfide	ug/L	1	-	-	-	<1.0	-
Carbon tetrachloride	ug/L	0.5	2	-	-	<0.50	-
Chlorobenzene	ug/L	0.5	80	30	-	<0.50	-
Dibromochloromethane	ug/L	1	-	-	-	<1.0	-
Chloroethane	ug/L	1	-	-	-	<1.0	-
Chloroform	ug/L	1	-	-	-	<1.0	-
Chloromethane	ug/L	1	-	-	-	<1.0	-
1,2-Dibromoethane	ug/L	0.2	-	-	-	<0.20	-
1,2-Dichlorobenzene	ug/L	0.5	200	3	-	<0.50	-
1,3-Dichlorobenzene	ug/L	0.5	-	-	-	<0.50	-
1,4-Dichlorobenzene	ug/L	0.5	5	1	-	<0.50	-
Dichlorodifluoromethane	ug/L	1	-	-	-	<1.0	-
1,1-Dichloroethane	ug/L	0.5	-	-	-	<0.50	-
1,2-Dichloroethane	ug/L	0.5	5	-	-	<0.50	-
1,1-Dichloroethylene	ug/L	0.5	14	-	-	<0.50	-
cis-1,2-Dichloroethylene	ug/L	0.5	-	-	-	<0.50	-
trans-1,2-Dichloroethylene	ug/L	0.5	-	-	-	<0.50	-
Dichloromethane	ug/L	2	50	-	-	<2.0	-
1,2-Dichloropropane	ug/L	0.5	-	-	-	<0.50	-
cis-1,3-Dichloropropene	ug/L	0.5	-	-	-	<0.50	-
trans-1,3-Dichloropropene	ug/L	0.5	-	-	-	<0.50	-
Ethylbenzene	ug/L	0.5	140	2.4	-	<0.50	-
n-Hexane	ug/L	0.5	-	-	-	<0.50	-
2-Hexanone	ug/L	20	-	-	-	<20	-
Methyl Ethyl Ketone	ug/L	20	-	-	-	<20	-
Methyl Isobutyl Ketone	ug/L	20	-	-	-	<20	-
MTBE	ug/L	0.5	15	-	-	<0.50	-
Styrene	ug/L	0.5	-	-	-	<0.50	-
1,1,1,2-Tetrachloroethane	ug/L	0.5	-	-	-	<0.50	-
1,1,2,2-Tetrachloroethane	ug/L	0.5	-	-	-	<0.50	-
Tetrachloroethylene	ug/L	0.5	10	-	-	<0.50	-
Toluene	ug/L	0.5	60	24	-	<0.50	-
1,1,1-Trichloroethane	ug/L	0.5	-	-	-	<0.50	-
1,1,2-Trichloroethane	ug/L	0.5	-	-	-	<0.50	-
Trichloroethylene	ug/L	0.5	5	-	-	<0.50	-
Trichlorofluoromethane	ug/L	1	-	-	-	<1.0	-
Vinyl chloride	ug/L	0.5	1	-	-	<0.50	-
o-Xylene	ug/L	0.5	-	-	-	<0.50	-
m+p-Xylenes	ug/L	1	-	-	-	<1.0	-
Xylenes (Total)	ug/L	1.1	90	300	-	<1.1	-
4-Bromofluorobenzene	%	Surrogate	-	-	-	97.7	-
1,4-Difluorobenzene	%	Surrogate	-	-	-	101.6	-
Total THMs	ug/L	2	100	-	-	<2.0	-
* = Result Qualified	**Color Key:**	Within Guideline	Exceeds Guideline				
Applied Guideline:	**Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON Drinking Water Standar**						

Appendix B
Source Protection Mapping



Reference: Prescribed threat circumstances as listed in the Ministry of the Environment Table of Drinking Water Threats (2009)

(c) Copyright. Toronto & Region Source Protection Area, 2014.

Source: TRCA, 2014; SWOOP: Orthoimagery 2010, LIO, MNR.

This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.

Map 1.4: Hillsburgh – Significant Groundwater Quality Threat Areas

Appendix C

Well H4 Drilling Results

19-0147-01

Ontario Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
Tag#:A273292

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
	Corporation of the Town of Erin		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
5684 Trafalgar Rd	Hillsburgh	ON	N0B1Z0	5198554407

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Wellington	Erin		

County/District/Municipality	City/Town/Village	Province	Postal Code
Currie Dr	Hillsburgh	**Ontario**	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	569335	4849204		

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
	Sand & Gravel			0	54
	Till			54	61
	Limestone		Bedrock	61	300

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	90	Bentonite, Cement	2

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
10	steel (Stainless .375		+2	90
	Open		90	300
8	Liner (Stainless Steel .375 (see diagram)		+2	104

Construction Record - Screen

Outside Diameter *(cm/in)*	Material (Plastic, Galvanized, Steel)	Slot No.	Depth *(m/ft)* From	To
	OPEN HOLE			

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*

Water Details

Water found at Depth 30 (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☒ Untested ☐ Other, *specify*
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
90	300	10
9	90	16
0	9	20

Well Contractor and Well Technician Information

7675

Business Name of Well Contractor	Well Contractor's Licence No.
Aardvark Drilling Inc.	7238

Business Address (Street Number/Name)	Municipality
25-C Lewis Road	**Guelph**

Province	Postal Code	Business E-mail Address
ON	N1H1E9	**www.aardvarkdrillinginc.com**

Bus.Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)
5198269340	Liam Franklin, Adrian Richards

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
3594		20200123

0506E (2018/12)

Ministry's Copy

Results of Well Yield Testing

After test of well yield, water was:
☑ Clear and sand free
☐ Other, *specify*

If pumping discontinued, give reason:

See attached log

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.

H4 Well Record

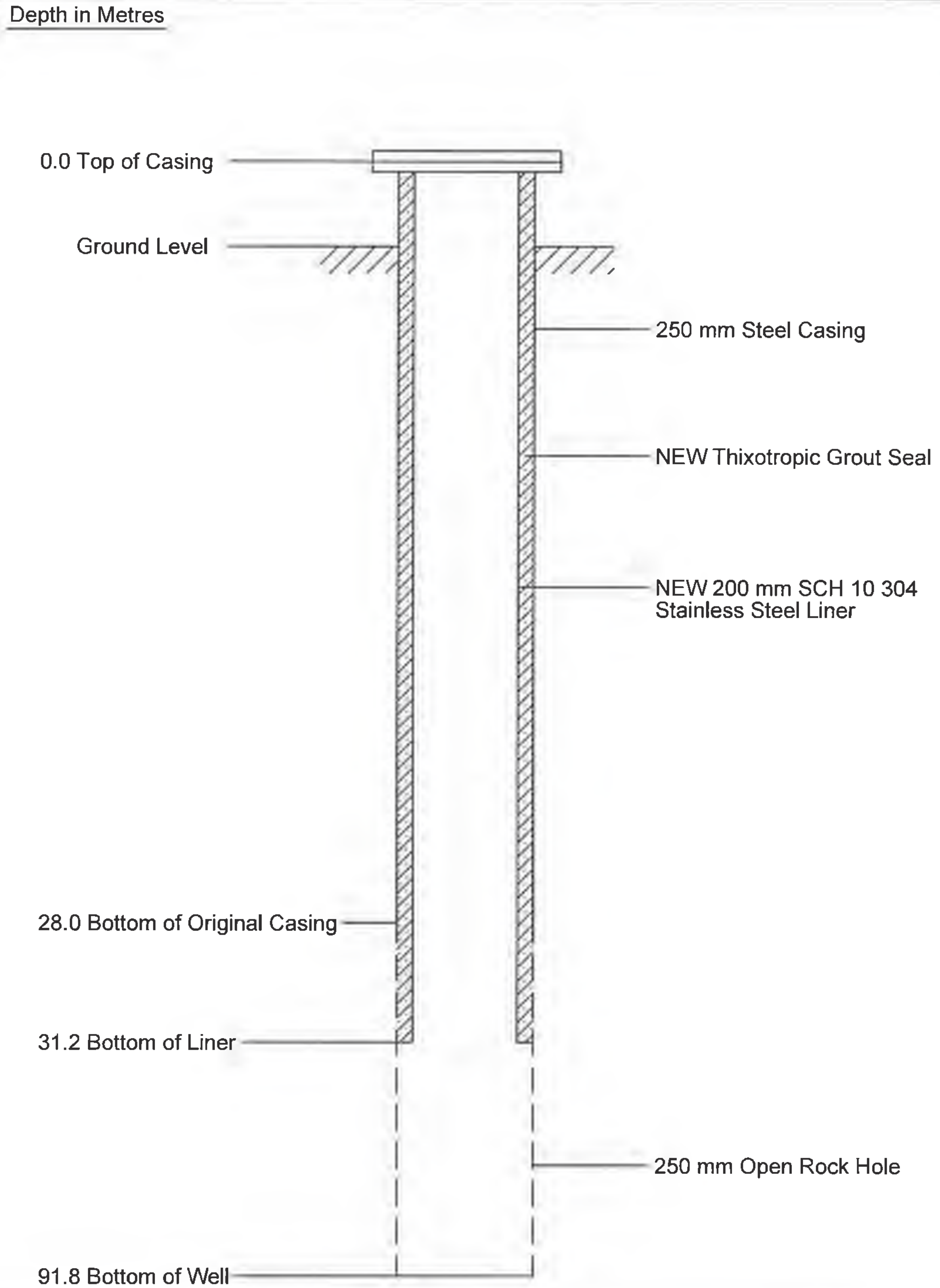
Comments:

See Attached Map H4

Well owner's information package delivered	Date Package Delivered	Ministry Use Only
☐ Yes ☐ No	YYYYMMDD	Audit No. Z323873
	Date Work Completed 20200113	Received


19-0147-01

Legend
Currie Dr
Currie Dr
Douglas Crescent
upgrade A235584
Drilled
Tag#:A273292
Google Earth
Image © 2019 Maxar Technologies
N
200 ft



Lotowater
TECHNICAL SERVICES INC.

CLIENT
TOWN OF ERIN

TITLE
WELL H4
AS-CONSTRUCTED LINER DRAWING

PROJECT #: 148-004

G:\Lotowater Projects\148 Town of Erin\004 Hillsburgh\Liner.dwg

DESIGN	EH	2019/11/20
DRAWN	EH	2019/11/20
CHECKED	BB	2019/11/21

REVISION No.	SCALE	FIGURE
2019-12-12	N.T.S	X

Appendix D
Temporary PTTW

PERMIT TO TAKE WATER
Pumping Test
NUMBER 3556-BGDKMZ

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

The Corporation of the Town of Erin
5684 Trafalgar Rd
Hillsburgh, Ontario
N0B 1Z0

For the water taking from: One drilled well

Located at: 63A Trafalgar Rd
Erin, County of Wellington

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

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.

(b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment, Conservation and Parks.

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

(e) "Permit" means this Permit to Take Water No. 3556-BGDKMZ including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.

(f) "Permit Holder" means The Corporation of the Town of Erin.

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

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

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated August 13, 2019 and signed by Nathan Hyde, 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.

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 **March 31, 2020**. 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:	Zone/ Easting/ Northing:
1	H4	Well Drilled	Pumping Test	Miscellaneous	2,046	24	2,945,808	6	17 569339 4849202
						Total Taking:	2,945,808		

3.3 Water taking under the authorization of this Permit shall only occur for one six (6) consecutive day period between the date of issuance and March 31, 2020.

3.4 Prior to taking of water under this Permit, the Permit Holder shall ensure that any and all applicable permits or authorizations are obtained from Federal and Provincial Agencies having legislative mandates in water resources management.

4. Monitoring

4.1 Notification to Well Owners
Prior to commencement of the pumping test, the Permit Holder shall identify all wells within the area of the anticipated potential cone of influence, or within 500 metres of the test site, whichever is greater. At least 24 hours prior to beginning the pumping test, the Permit Holder shall provide written notification to the owners of the wells identified within the potential cone of influence. The notification shall include the expected date, time and duration of the pumping test, and a contact telephone number that may be used to report any interferences with water supplies.

4.2 Measuring Water Depths
To establish baseline conditions, well depths and depths to water levels for identified representative wells in the area of the water taking shall be recorded by the Permit Holder. During the pumping test, water levels in the identified wells shall be recorded. The pumping test must be of sufficient duration to accurately predict the long term impacts of the proposed water taking. Water levels in the identified wells shall continue to be monitored beyond the water taking period until at least 85% recovery is achieved.

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

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 Restoration of Water Supply
Where 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 doing so.

6. Director May Amend Permit

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

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

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.

2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

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

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

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

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

This notice must be served upon:

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

AND

The Director, Section 34.1,
Ministry of the Environment, Conservation and Parks
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	by Fax at	by e-mail at
(416) 212-6349	(416) 326-5370	www.ert.gov.on.ca
Toll Free 1(866) 448-2248	Toll Free 1(844) 213-3474	

Dated at Hamilton this 30th day of September, 2019.

B. Koblik

Belinda Koblik
Director, Section 34.1
Ontario Water Resources Act , R.S.O. 1990

Appendix E

Stream Survey and CVC Consultation

Groundwater
Science Corp.

Unit 2, 465 Kingscourt Drive,
Waterloo, ON N2K 3R5
Phone: (519) 746-6916
groundwaterscience.ca

October 1, 2018

RE: Creek Inspection and Monitoring Access
Town of Erin Water Supply Environmental Assessment.

Dear Landowner and/or Resident:

Groundwater Science Corp is working for the Town of Erin to assist in developing new municipal water supply wells for Hillsburgh and Erin. This work is part of the Town of Erin Water Supply Environmental Assessment project.

As part of the project, Groundwater Science Corp is arranging inspection and monitoring access to water courses and wetlands in areas surrounding planned test well drilling sites. The inspection and monitoring will help to ensure that natural environment features are protected in the future. A water course or wetland area of interest occurs on your property.

The visual inspections would be completed in conjunction with Credit Valley Conservation (CVC) during the months of October or November 2018, and would determine the need for ongoing monitoring. Monitoring, if needed, would occur through the remainder of 2018 and 2019.

We are going door to door this week to request access to complete inspections, with CVC personnel, of the water courses and/or wetlands on your property in October or November 2018. If ongoing monitoring is needed we would discuss additional access after the inspections are completed.

Please fill out the attached permission form and return either by email/text (scan or photo) to Andrew Pentney using the contact information below, or, by using the included postage paid envelope.

If you have any questions related to this access request, please contact myself by phone or email as follows:

Andrew Pentney P.Geo., Hydrogeologist, Groundwater Science Corp.
Office Phone: 519-746-6916 Mobile Phone: 519-580-7325
Email: apentney@rogers.com

For further information you can also contact the Town of Erin as follows:

Jessica Spina, Communications and Special Projects Officer, Town of Erin
Phone: 519-855-4407 extension 239
Email: jessica.spina@erin.ca

Sincerely,

Andrew Pentney, P.Geo.
Hydrogeologist

APPROVAL FOR ACCESS TO PRIVATE PROPERTY
TOWN OF ERIN WATER SUPPLY CLASS EA

Property Owner's Name: ______________________________

Address: ______________________________

____

Telephone Number: ______________________________

Email: ______________________________

☐ I <u>do not</u> grant permission for consultants with the Town of Erin to access my property to conduct the necessary studies for the above project

☐ I hereby grant permission for consultants with the Town of Erin to access my property to conduct the necessary studies for the above project.

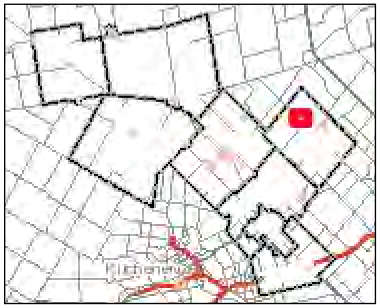
Signature: ______________________________

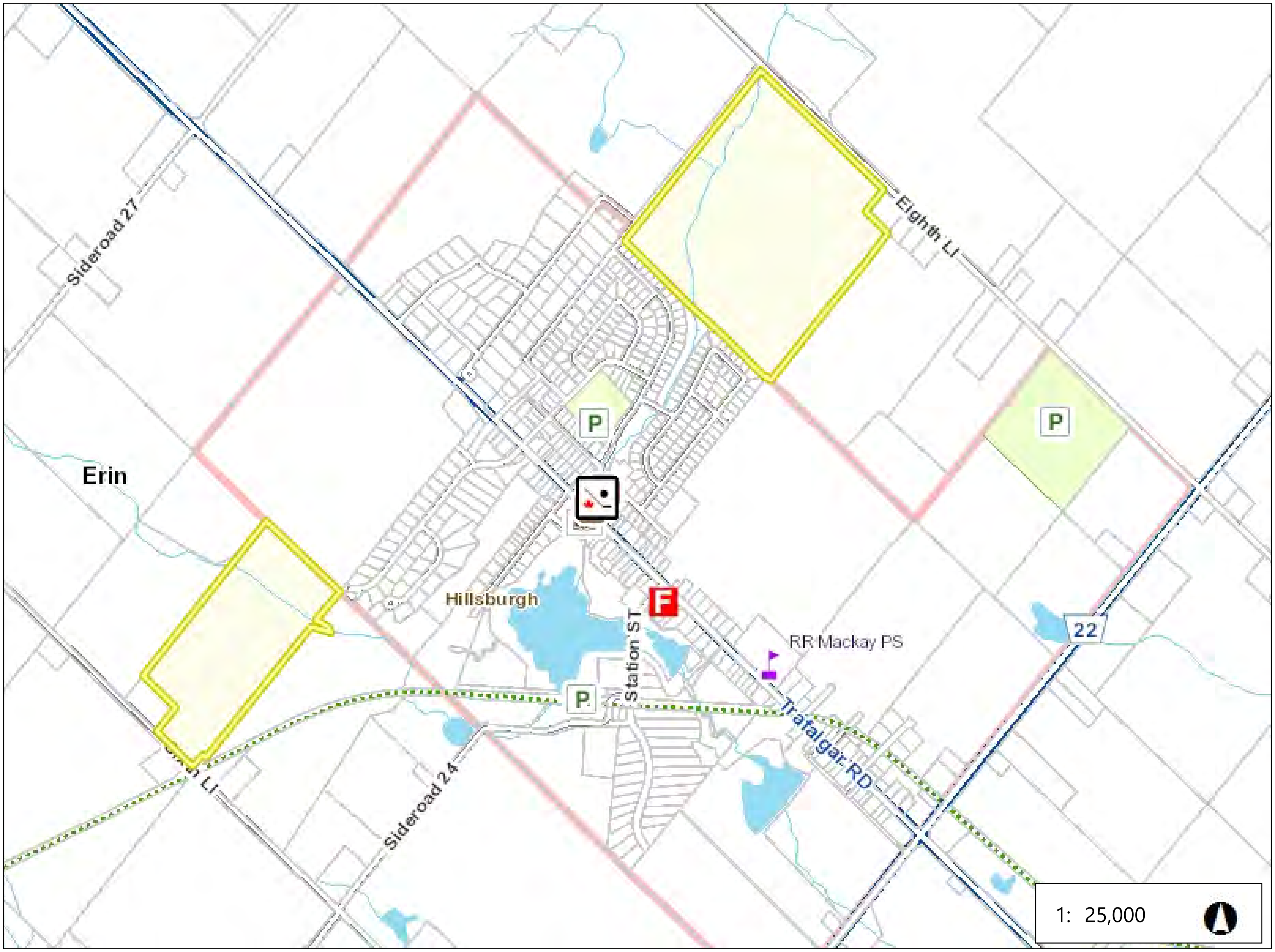
Name *(please print):* ______________________________

Date: ______________________________

Explore Wellington

Map of Wellington County





Legend

- 🏛 Municipal Offices
- OPP Stations
- H Hospitals
- F Fire Stations
- ⓘ Information Centres
- Schools
- ✉ Post Offices
- Arenas
- CC Communinty Centres
- Curling Rinks
- Libraries
- 🏛 Museums
- P Park Parking Lots
- County Garages
- ☐ Parcels
- Roads
  - ═ Local Road
  - ═ County Road
  - ═ Highway
- ++ Railways
- ··· Trails
- 🟦 Waterbodies
- — Watercourses
- 🟩 Parks
- 🟥 Urban Centres and Hamlets
- Municipalities

1.3 0 0.64 1.3 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

THIS IS NOT SURVEY DATA. Parcels - Teranet 2002, Wellington County 2018

Notes

Erin Water Supply EA - Well H4 Testing
Steam Inspection and Redd Survey
Access Permission Ownership Parcels

RE: Erin and Hillsburgh Municipal Well Testing

From: Slaght, Tyler (tyler.slaght@cvc.ca)

To: apentney@rogers.com

Cc: rkirtz@tritoneng.on.ca; nick.colucci@erin.ca

Date: Tuesday, October 1, 2019, 8:47 a.m. EDT

Hi Andrew,

CVC staff have provided feedback on the summary you've provided in red below. Please let me know if you have any questions.

Regards,

Tyler Slaght, RPP

Regulations Officer | Credit Valley Conservation

905-670-1615 ext 406 | C: 647-286-7427 | 1-800-668-5557

tyler.slaght@cvc.ca | cvc.ca

From: Andrew Pentney <apentney@rogers.com>
Sent: Tuesday, September 24, 2019 4:42 PM
To: Slaght, Tyler <Tyler.Slaght@cvc.ca>
Cc: Marray, Liam <Liam.Marray@cvc.ca>; Mulchansingh, Kerry <Kerry.Mulchansingh@cvc.ca>; Ray Kirtz <rkirtz@tritoneng.on.ca>; Nick Colucci <nick.colucci@erin.ca>
Subject: Re: Erin and Hillsburgh Municipal Well Testing

Hi Tyler,

I am providing a point form summary of our meeting (CVC, GWS) last Wednesday regarding the municipal well testing program referenced above.

Can you please review, along with Liam and Kerry, and let me know if you have any edits or additions.

- CVC's primary commenting role will be for the EA assessment and potential future Category 3 Permit application, so we are looking to consult at this time to ensure the monitoring results and impact assessment are thorough. Areas of interest are impacts to PPS significant features (PSW wetlands (focus on organic communities), springs and fish habitat (focus on brook trout spawning areas), CVC staff note that if a decision is eventually taken to move ahead on using either / both wells for municipal supply, then a whole host of technical study requirements will kick in (WHPA delineations, vulnerability work, threats assessment etc.). These studies will have to be completed, introduced into the technical companion to the SPP (called the Assessment Report), checked by CVC, subjected to public consultation, reviewed and then approved by MECP, **BEFORE** Erin can turn on the tap. Please be aware of these requirements (introduced in summer 2018 with new Reg 287),

  for both E9 and H4 pumping tests CVC would like to have the effect of simultaneous pumping at existing municipal wells assessed (e.g. cumulative taking impacts)

  - GWS to consult with Town to plan (if possible) existing well use during test, with the intent to have the nearest existing municipal wells both "on" and "off" over periods of the test

- for both E9 and H4 baseline data (pre and post test) should be used as possible to comment on the potential impact of existing taking

based on the potential timing of the tests (outside of the preferred June to August dry period window), it may be possible to increase the number of monitoring stations (above that proposed) to allow more complete assessment in light of the potential "masking" effects of recharge, higher water tables and higher streamflow. If undertaking pump test outside the preferred time, a trigger should be established to stop the pump test (e.g. reversal of gradient in stream piezometers). Thereby limiting impacts during the pump test.

-

  - GWS to review proposed monitoring locations

- nested piezometers are preferred (at select locations) to assess vertical gradients at creeks, and may help overcome any potential masking effects due to timing

  - GWS to select locations, we note that previous drive-point piezometer installations were very difficult in Hillsburgh, the proposed overburden monitor will assist with the gradient monitoring

- CVC notes that there are surface water features just beyond the identified 1 km radius for both E9 adn H4, and that certain areas appear under-represented, so the assessment should be completed in such a way to be able to comment on impacts on those features and in those areas
- Liam requested a map showing property access availability for the Redd surveys (and drive-point piezometer locations) to better understand how locations were chosen

  - GWS to provide maps

- with regard to E9 test monitoring the need to adequately monitor (as access is available) the shallow+deep groundwater system, and conditions at the creek, near the closest stream reaches was stressed - CVC may be able to facilitate access to some stream reaches, in areas where no creek access exists monitoring of the water table can also help assess potential impacts

  - placement of the two proposed shallow overburden monitoring locations consider the lack

    of access
  - GWS will request additional access on the property immediately west of E9 as part of the intended private water well survey

- with regard to H4 test monitoring suggested additional monitoring locations include the new creek alignment downstream of the reservoir (CVC may be able to facilitate access), the pond/wetland system on Road 22 between Trafalgar Road and 8 Line, and the potential wetland just north of the sports facility on 8 Line in addition, for H4 test the need for adequate number of shallow and deep private wells to the south and east was stressed, and monitoring of potential wells at the sports facility (if wells exist) was suggested - to ensure that the assessment can comment on potential impacts to major discharge areas along the west credit south of Hillsburgh Our records have not confirmed there are any springs or organic soils in this area, so this wetland may be less sensitive to changes in groundwater levels. Discharge location should be outside of and downgradient of the pump-testing radius.

I have attached maps showing access at the time of the Redd survey - John Clayton had ranked the sites in order of inspection "priority" or order.

Thanks for your assistance.

Andrew Pentney P.Geo.
Groundwater Science Corp.
Unit 2, 465 Kingscourt Drive
Waterloo, ON
N2K 3R5

office 519-746-6916
mobile 519-580-7325
groundwaterscience.ca

On Thursday, September 5, 2019, 3:36:16 p.m. EDT, Andrew Pentney <apentney@rogers.com> wrote:

Hi Tyler - that works for me, go ahead and book the room please.

I will plan to attend (in person).

thanks,

Appendix F
Monitoring Network

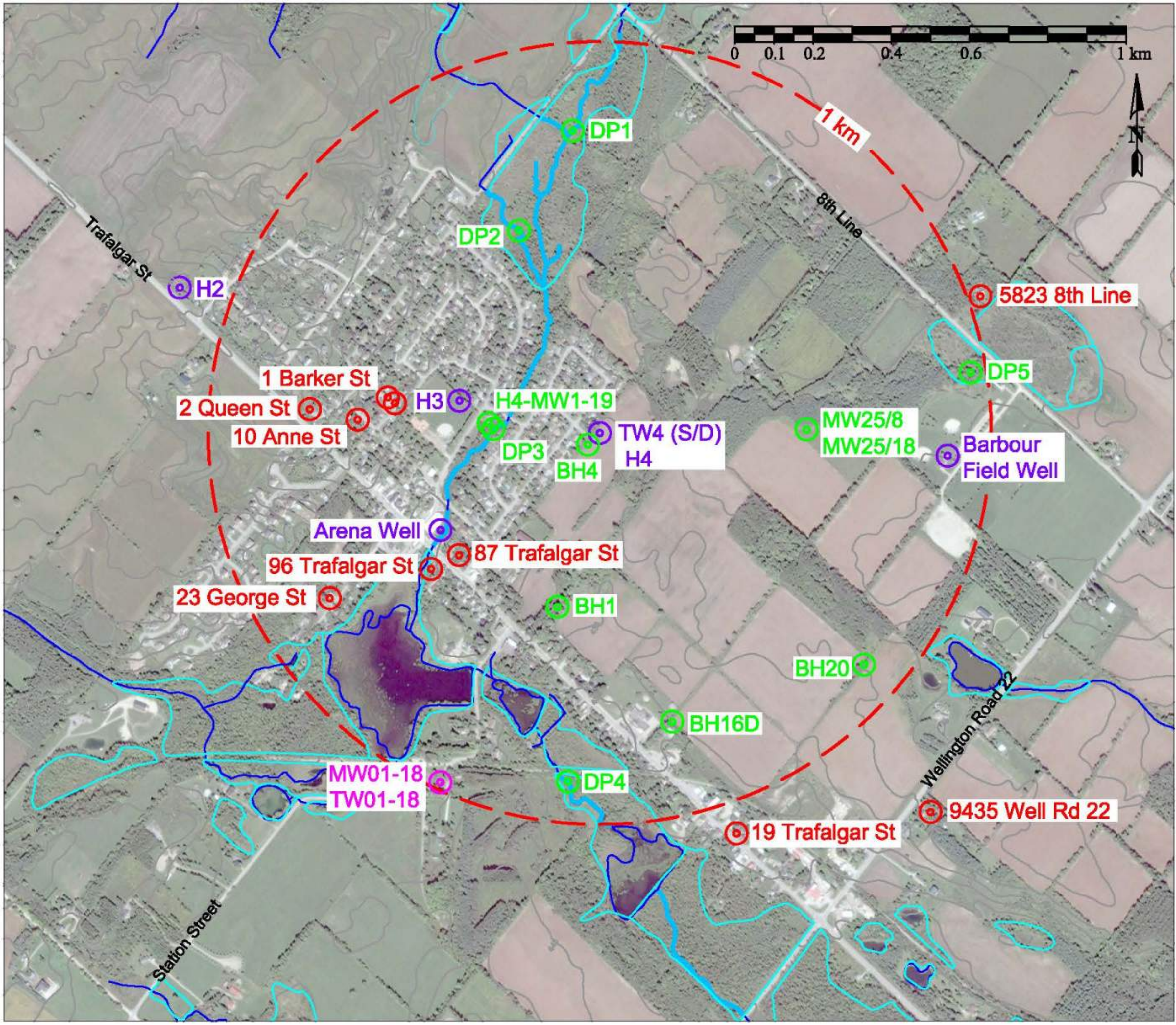


Figure F1

Hillsburgh Well H4

Pump Test Monitoring Network

Location	Well Record Number	Distance From H4 (m)	Estimated Elevation (mASL)	Type	Aquifer	Depth to Bedrock (mBGS)	Total Depth (mBGS)	Screen or OH Interval	
								Top (mBGS)	Bottom (mBGS)
H4	-	0	440	drilled	bedrock	18.6	91.4	31.7	91.4
TW4-S	-	10	440	drilled	bedrock	17.7	97.5	20.7	29.9
TW4-D	-	10	440	drilled	bedrock	17.7	97.5	77.7	86.9
Arena Well	6704913	475	435	drilled	bedrock	15.8	74.7	19.2	74.7
Barbour Field Well	6711507	890	455	drilled	bedrock	35.4	76.2	57.5	76.2
MW01-18 A	-	980	435	drilled	bedrock	20.7	44.2	35.7	43.3
MW01-18 B	-	980	435	drilled	bedrock	20.7	44.2	22.6	30.2
TW01-18	-	980	435	drilled	bedrock	21.6	82.6	67.1	75.6
10 Anne Street	-	620	444	dug	water table	-	2.2	0.0	2.2
2 Queen Street	6714075	745	455	drilled	bedrock	29.9	38.4	31.1	38.4
1 Barker Street	6709157	550	441	drilled	bedrock	18.3	30.2	19.8	30.2
	6709156	530	440	drilled	bedrock	18.6	51.8	19.5	51.8
23 George Street	7118031	810	433	drilled	bedrock	18.0	44.8	18.9	44.8
19 Trafalgar Road	6707144	1,080	426	drilled	bedrock	12.8	26.5	15.8	26.5
87 Trafalgar Road	-	475	436	dug	water table	-	1.8	0.0	1.8
96 Trafalgar Road	6710235	555	435	drilled	bedrock	9.1	32.0	14.9	32.0
5823 8th Line	6710805	1,030	455	drilled	bedrock	29.9	53.0	31.3	53.0
9435 Well Rd 22	6703357	1,290	440	drilled	bedrock	40.2	46.3	40.8	46.3
BH1	-	460	435	drilled	water table	-	5.6	4.0	5.6
BH4	-	40	439	drilled	water table	-	9.9	8.4	9.9
BH16-D	-	760	435	drilled	water table	-	10.5	9.0	10.5
BH20	-	900	440	drilled	water table	-	6.8	5.3	6.8
MW25/8	-	530	455	drilled	water table	-	7.9	4.8	7.9
MW25/18	-	530	455	drilled	overburden	-	18.2	16.7	18.2
H4-MW1-9	-	285	435	drilled	water table	-	10.4	7.3	10.4
DP1-S	-	775	434	drive-point	water table	-	0.5	0.2	0.5
DP1-D	-	77	434	drive-point	water table	-	1.2	0.9	1.2
DP2	-	470	433	drive-point	water table	-	1.1	0.8	1.1
DP3	-	270	432	drive-point	water table	-	1.2	0.9	1.2
DP4-S	-	895	424	piezometer	water table	-	0.7	0.4	0.7
DP4-D	-	895	424	drive-point	water table	-	1.2	0.9	1.2

Table F1: Monitoring Network Summary

19-0147-01

Ontario Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* Well Upgrade - A235584

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
	Corporation of the Town of Erin		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
5684 Trafalgar Rd	Hillsburgh	ON	N0B1Z0	5198554407

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Currie Dr	Erin		

County/District/Municipality	City/Town/Village	Province	Postal Code
Wellington	Hillsburgh	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	569349	4849206		

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
			previously drilled	0	291

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	68	Bentonite/cement	
68	98	Sand	
98	255	Bentonite/cement	
255	285	Sand	
285	291	Bentonite/cement	

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
2	PVC	sch 40	+2	73
2	PVC	sch 80	+2	260

Construction Record - Screen

Outside Diameter *(cm/in)*	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To
	PVC	10	73	93
	PVC	10	260	280

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*

Water Details

Water found at Depth 30 (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☒ Untested ☐ Other, *specify*

Water found at Depth (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Water found at Depth (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	To	Diameter *(cm/in)*
0	291	6

Map of Well Location

Please provide a map below following instructions on the back.

TW4-S and TW4-D

Well Contractor and Well Technician Information 7675

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): AWT - Kielburger, N; WT - Richards, A

Well Technician's Licence No.: 2 5 5 4

Signature of Technician and/or Contractor:

Date Submitted: 2020 01 23

Comments: See Attached Map

Well owner's information package delivered
☐ Yes
☐ No

Date Package Delivered: Y Y Y Y M M D D

Date Work Completed: 2020 01 13

Ministry Use Only

Audit No. Z323874

Received

0506E (2018/12)

Ministry's Copy

19-0147-01

Ontario
Ministry of the Environment, Conservation and Parks

Well Tag No. *(Place Sticker and/or Print Below)*
A273279

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Measurements recorded in: ☐ Metric ☒ Imperial

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Corporation of the Town of Erin		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
5684 Trafalgar Rd	Hillsburgh	ON	N0B1Z0	5198554407

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Covert Lane	Erin		

County/District/Municipality	City/Town/Village	Province	Postal Code
Wellington	Hillsburgh	**Ontario**	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	569052	4849206		

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
	Sand, Gravel			0	25
				25	35

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*
0	29	Hole Plug	
29	35	Sand	

Method of Construction

☐ Cable Tool
☐ Rotary (Conventional)
☐ Rotary (Reverse)
☐ Boring
☐ Air percussion
☒ Other, *specify* HSA
☐ 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
2	PVC		0	30

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To
2.375	PVC	10	30	35

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*

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.

H4-MW1-19

Comments:
See Attached Map

Water Details

Water found at Depth 20 *(m/ft)* ☐ Gas — Kind of Water: ☐ Fresh ☒ Untested ☐ Other, *specify*
Water found at Depth *(m/ft)* ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*
Water found at Depth *(m/ft)* ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	35	8

Well Contractor and Well Technician Information 7675

Business Name of Well Contractor	Well Contractor's Licence No.
Aardvark Drilling Inc.	7238

Business Address (Street Number/Name)	Municipality
25-C Lewis Road	Guelph

Province	Postal Code	Business E-mail Address
ON	N1H1E9	www.aardvarkdrillinginc.com

Bus. Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)
5198269340	Brown, Eric

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
40123	M England	20191202

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☐ Yes ☐ No	Y Y Y Y M M D D	20191106

Ministry Use Only
Audit No. Z323880
Received

0506E (2018/12)

Ministry's Copy

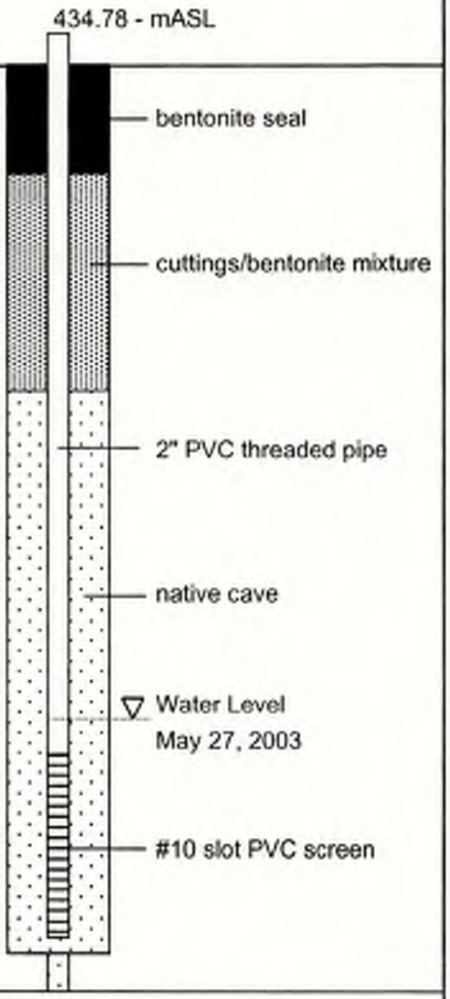
BOREHOLE NO.: BH1

Anderson GeoLogic Limited

Project: **132 - Hillsburgh Development**
Date Drilled/Installed: **May 12, 2003**
Drilling Contractor: **All Terrain Drilling**
Drilling Method: **HSA and Split Spoon Sampler**
Supervisor: **Sandy Anderson**

Geologic Interpretation	Depth (ft)	Depth (m)	Elev. (m)	Sampling Number	Sampling Recovery	Sampling Interval	Sampling Blow Count
			434.06				
Sand and Gravel with abundant cobbles 3' to 12', trace to some silt, brown, dry/moist to 15.5', wet at 20'.	5			1	5"	▯	5,50
	10	3		2	10"	▯	11,50 (5")
- mainly sand at 14.5 to 15.5' sample	15			3	11"	▯	18,18
- becoming siltier	20	6		4	5"	▯	4,30
	25			5	6"	▯	10,30
end of hole			426.3				

Well Installation Details



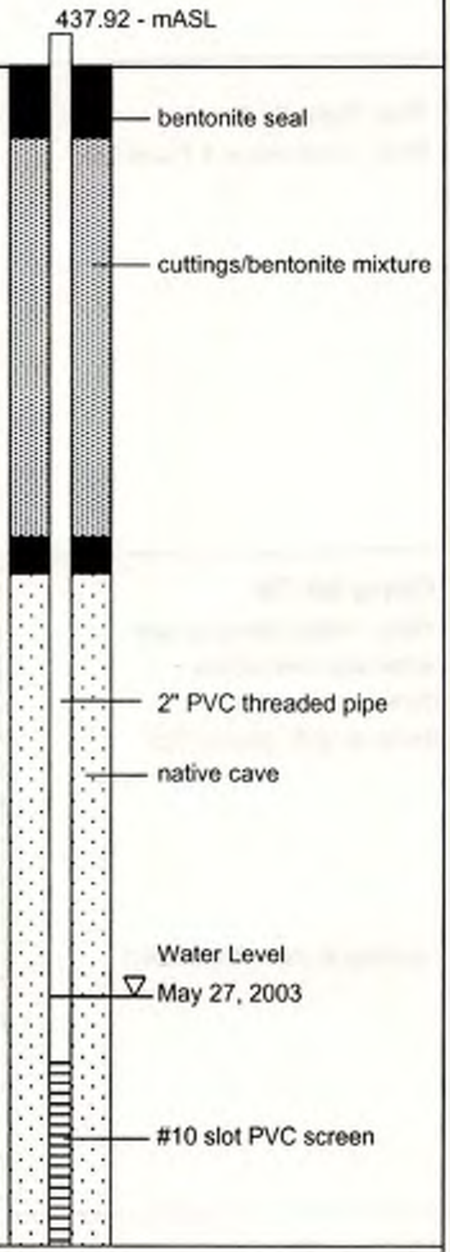
BOREHOLE NO.: BH4

Anderson GeoLogic Limited

Project: **132 - Hillsburgh Development**
Date Drilled/Installed: **May 13, 2003**
Drilling Contractor: **All Terrain Drilling**
Drilling Method: **HSA and Split Spoon Sampler**
Supervisor: **Sandy Anderson**

Geologic Interpretation	Elev. (m)	Sampling Number	Recovery	Interval	Blow Count
	437.07				
Silty Sand some gravel and cobbles, brown, dry.		1	3"	▯	50+ (4")
Sand and Gravel with abundant cobbles to 14' and at 22' trace silt, brown, dry/moist to 25.5', wet below 25.5'.	434.9	2	8"	▯	8,29
		3	11"	▯	2,9
- fine to coarse sand at 20 to 21' sample		4	11"	▯	3,22
		5	8"	▯	12,23
		6	6"	▯	13,21
end of hole	427.2				

Well Installation Details



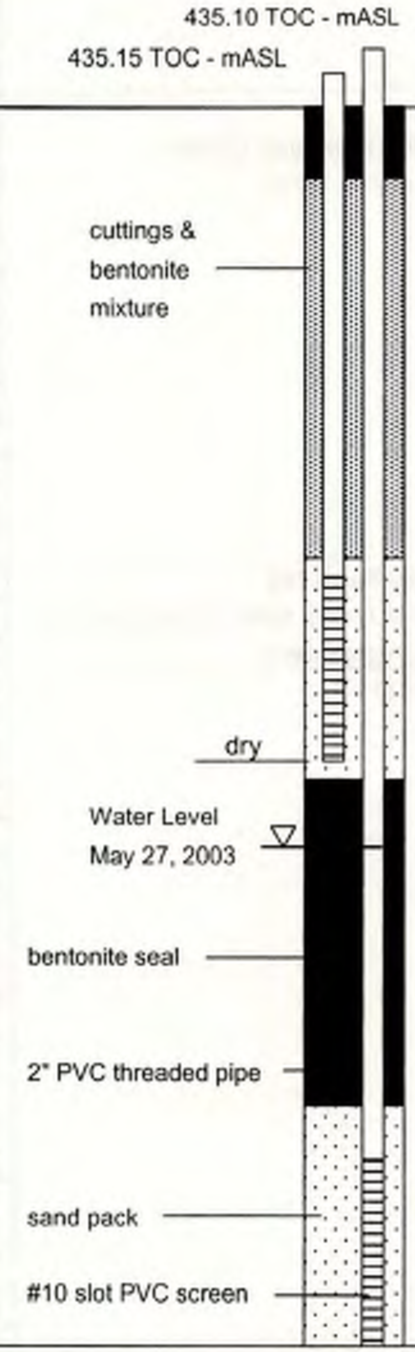
BOREHOLE NO.: BH16

Anderson GeoLogic Limited

Project: **132 - Hillsburgh Development**
Date Drilled/Installed: **May 16, 2003**
Drilling Contractor: **All Terrain Drilling**
Drilling Method: **HSA and Split Spoon Sampler**
Supervisor: **Sandy Anderson**

Geologic Interpretation	Depth (ft)	Depth (m)	Elev. (m)	Sampling Number	Sampling Recovery	Sampling Interval	Sampling Blow Count
			434.17				
Silty Fine Sand trace silt, brown, occassional cobble, dry/moist.		1					
	5		432.9	1	10"	▯	5,9
Sand and Gravel trace silt, brown, occassional cobble, dry/moist.		2					
	10	3		2	9"	▯	5, 25
		4					
	15			3	6"	▯	50
		5					
Silt / Silt Till v. dense, grey, interlayered, trace to some sand, clay and stones, dry to 20', moist from 20'.			429.3				
	20	6		4	18"	▯	6,18,28
		7					
	25			5	12"	▯	12,21
		8					
	30	9					
- sample all clayey silt till, some sand.				6	12"	▯	6,16
		10					
end of hole	35		423.8				
		11					
		12					
	40						

Well Installation Details



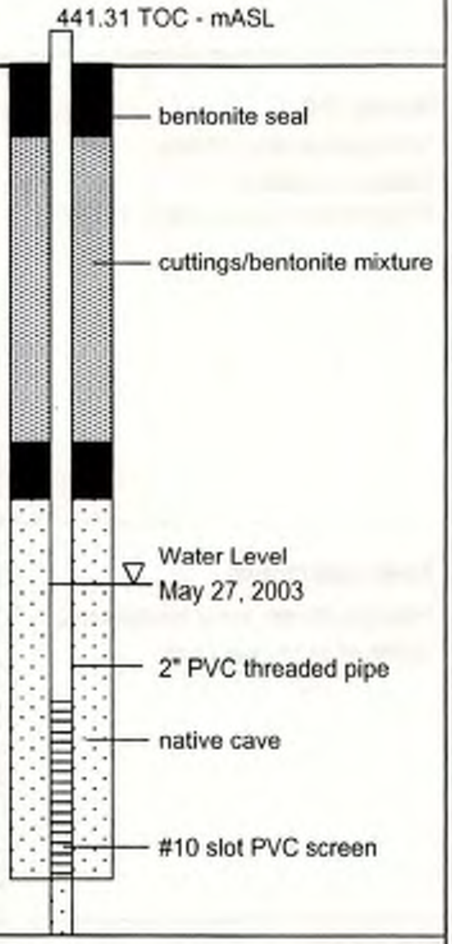
BOREHOLE NO.: BH20

Anderson GeoLogic Limited

Project: **132 - Hillsburgh Development**
Date Drilled/Installed: **May 20, 2003**
Drilling Contractor: **All Terrain Drilling**
Drilling Method: **HSA and Split Spoon Sampler**
Supervisor: **Sandy Anderson**

Geologic Interpretation	Depth (ft)	Depth (m)	Elev. (m)	Sampling Number	Recovery	Interval	Blow Count
			440.39				
Silty Fine Sand brown, trace coarse sand and gravel, moist.		1					
	5						
		2		1	10"		3,9
	10	3					
				2	19"		5,9,9,11
		4					
			436.3				
Sand and Gravel trace silt, brown, wet at 15'.	15						
		5		3	3"		7,9,35
	20	6		no sample possible			
			433.8				
Clayey Silt Till very dense, grey, moist.		7					
				4	15"		6,14,7
end of hole	25		433.1				
		8					
	30	9					
		10					
	35	11					
		12					
	40						

Well Installation Details



DRILLING LOG

Logged By: J.Jacyk	Reviewed By: D.Dickson	Sheet Number: 1 of 1	Borehole Number: MW25/8	
Drilling Company: Lantech Drilling Services Inc.	Drilling Equipment: CME 75	Drilling Method: HSA	Start Date: 22 Aug 06	End Date: 22 Aug 06
Final Hole Depth (m): 8.23	Final Well Depth (m): 8.23	Hole Diameter (m): 0.2	Well Diameter (m): 0.051	Pipe Stickup (m): 0.79
Ground Elevation (m): 449.78	TOC Elevation (m): 450.57	Depth to Water BTOC (m): 3.36	Depth to Water BGS (m): 2.57	Groundwater Elevation (m): 446.42 (29 Aug 06)

Sample Type Legend:

SS	Split Spoon Sample	AU	Auger Sample
PS	Pionjar Sample	VA	Vane Test Interval
GR	Grab Sample	SP	Standard Penetration Test
RX	Core Sample	SH	Shelby Tube Sample

Borehole Location Description/Notes:

Sample Type, No., and Interval	Blow Counts (#/15 cm)	N-Value	Sample Recovery	Elevation (m) Depth (m)	Depth Scale (m)	Material	Stratigraphic Description	Well Materials	Well Construction Details
					1				
					2				
				▼					bentonite seal
					3				
					4		FOR STRATIGRAPHY SEE MW25/18		
					5				
					6				sand pack 10' slotted screen
					7				
					8				
				441.55 8.23			**END OF BOREHOLE at 8.2 m**		

SNC·LAVALIN
Engineers & Constructors

2200 Lakeshore Blvd. West
Toronto, Ontario, M8V 1A4
Phone: 416-252-5311
FAX: 416-231-5356

Project Name: Hillsburgh Waste Transfer Facility
Project Location: Hillsburgh, Ontario

Project Number: 331148

DRILLING LOG

Logged By: J.Jacyk
Reviewed By: D.Dickson
Sheet Number: 1 of 2
Borehole Number: MW25/18
Drilling Company: Lantech Drilling Services Inc.
Drilling Equipment: CME 75
Drilling Method: HSA
Start Date: 22 Aug 06
End Date: 22 Aug 06
Final Hole Depth (m): 19.1
Final Well Depth (m): 18.18
Hole Diameter (m): 0.2
Well Diameter (m): 0.051
Pipe Stickup (m): 0.80
Ground Elevation (m): 449.83
TOC Elevation (m): 450.63
Depth to Water BTOC (m): 11.69
Depth to Water BGS (m): 10.89
Groundwater Elevation (m): 438.14 (29 Aug 06)

Sample Type Legend:

SS	Split Spoon Sample	AU	Auger Sample
PS	Pionjar Sample	VA	Vane Test Interval
GR	Grab Sample	SP	Standard Penetration Test
RX	Core Sample	SH	Shelby Tube Sample

Borehole Location Description/Notes:

Sample Type, No., and Interval	Blow Counts (#/15 cm)	N-Value
GR-0		n.a.
SS-1	9 29 11 16	40
SS-2	8 16 20 23	36
SS-3	16 28 46 50	74
SS-4	18 24 34 36	58
SS-5	20 24 28 20	52
SS-6	12 40 48 50	88
SS-7	12 24 30 39	54
SS-8	12 30 46 50	76
SS-9	36 75	n.a.

Elevation (m) Depth (m)	Stratigraphic Description	Well Construction Details
	SILTY SAND - fine grained - brown - moist	concrete seal
	- trace gravel, rapid dilatency - wet	
	- grading towards sandy silt	
445.83 4.00	**SANDY SILT** - fine grained sand with trace gravel - grey/brown - wet	
	- stratified layers 5 to 15 cm in thickness of sand, sandy silt and clayey si - grey - wet	bentonite seal
440.83 9.00	**CLAYEY SILT** - trace fine sand - grey - moist	

BOREHOLE_OR_MONITOR MONITOR.GPJ FAGWGN01.GDT 24/04/07

SNC·LAVALIN
Engineers & Constructors

2200 Lakeshore Blvd. West
Toronto, Ontario, M8V 1A4
Phone: 416-252-5311
FAX: 416-231-5356

Project Name: Hillsburgh Waste Transfer Facility
Project Location: Hillsburgh, Ontario

Project Number: 331148

DRILLING LOG

Logged By:	Reviewed By:	Sheet Number:	Borehole Number:
J.Jacyk	D.Dickson	2 of 2	MW25/18

Sample Type Legend:

SS	Split Spoon Sample	AU	Auger Sample
PS	Pionjar Sample	VA	Vane Test Interval
GR	Grab Sample	SP	Standard Penetration Test
RX	Core Sample	SH	Shelby Tube Sample

Borehole Location Description/Notes:

Sample Type, No., and Interval	Blow Counts (#/15 cm)	N-Value	Sample Recovery	Elevation (m) Depth (m)	Depth Scale (m)	Stratigraphic Description	Well Construction Details
				438.40 11.43		**CLAYEY SILT TILL** - trace coarse gravel - grey - damp	
SS-1	10 31 60	91					
					12		
SS-1	16 36 45 45	81					
					13		
SS-1	16 20 31 45	51			14		
SS-1	20 48 60	108					
					15		
					16		
SS-1	50 85	n.a.			17		sand pack
				432.33 17.50		**CLAYEY SILT** - grey - moist	
					18		5' slotted screen
SS-1	26 48 50	98					
				430.73 19.10	19	**END OF BOREHOLE at 19.1 m**	

SNC•LAVALIN
Engineers & Constructors

2200 Lakeshore Blvd. West
Toronto, Ontario, M8V 1A4
Phone: 416-252-5311
FAX: 416-231-5356

Project Name: Hillsburgh Waste Transfer Facility
Project Location: Hillsburgh, Ontario

Project Number: 331148

MINISTRY OF THE ENVIRONMENT
The Ontario Water Resources Act

WATER WELL RECORD

40P/16E

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 | 6704913 | MUNICIP 67003 | CON. CON | 08

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, ~~TRACT, SURVEY~~, ETC.	
WELLINGTON	ERIN	~~7~~ VIII	025

[redacted] Hillsburg

DATE COMPLETED DAY 25 MO ~~OCT~~ 10 YR 73

	ELEVATION	RC.	BASIN CODE		
848794 4	1401	5	24	MAR 20, 1975	49

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
BROWN	CLAY - GRAVEL - Rocks			0	52
GREY	AND BROWN	LIMESTONE		52	245

31 0052605 1126 0245 215
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0078	1 ☒ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
0130	1 ☒ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
0235	1 ☒ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
05"	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	.188	0	~~63~~ 0063
05	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		63	~~245~~ 0245
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER	LENGTH
	INCHES	FEET

MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN
	FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER

PUMPING RATE: 0040 GPM

DURATION OF PUMPING: 02 HOURS 00 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING 15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
015 FEET	045 FEET	045 FEET	045 FEET	045 FEET	045 FEET

WATER LEVELS DURING: 1 ☒ PUMPING 2 ☐ RECOVERY

IF FLOWING GIVE RATE: GPM

PUMP INTAKE SET AT: FEET

WATER AT END OF TEST: 1 ☑ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP

RECOMMENDED PUMP SETTING: 100 FEET

RECOMMENDED PUMPING RATE: 0040 GPM

001.3 GPM / FT. SPECIFIC CAPACITY

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☐ UNFINISHED

WATER USE 12

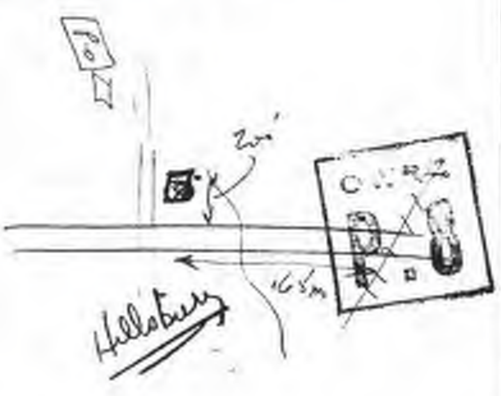
1 ☒ DOMESTIC
2 ☒ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☐ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF DRILLING

1 ☐ CABLE TOOL
2 ☒ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☐ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS

CONTRACTOR

NAME OF WELL CONTRACTOR: LADCO DRILLING — LICENCE NUMBER 3316

ADDRESS: Hillsburg R.R. #1

NAME OF DRILLER OR BORER: THOMAS LANG — LICENCE NUMBER 3316

SIGNATURE OF CONTRACTOR: T. Lang

SUBMISSION DATE: DAY 25 MO OCT YR 73

OFFICE USE ONLY

DATA SOURCE: 1
CONTRACTOR: 3316
DATE RECEIVED: 180174
DATE OF INSPECTION:
INSPECTOR:
REMARKS:
P
WI

Arena Well

MINISTRY OF THE ENVIRONMENT COPY

FORM 7 07-091

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 6711507 MUNICIP 67003 CON. CON 08

COUNTY OR DISTRICT [redacted]

TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: ERIN

CON., BLOCK, TRACT, SURVEY, ETC.: VIII

LOT: 23

HILLSBRUGH ONT N0B 1Z0

DATE COMPLETED: DAY 27 MO 07 YR 94

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
BR.	CLAY	STONES		0	28
	SAND	CLAY		28	45
GR.	CLAY	STONES		45	65
GR.	CLAY			65	92
GR.	CLAY	STONES		92	116
BR.	LIMESTONE			116	160
DK. BR	ROCK			160	172
GR.	LIMESTONE			172	200
LT. GR.	LIMESTONE			200	250

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
150-175	☒ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS
240-250	☒ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
6	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC	.188	0	118'6"
6	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☒ OPEN HOLE ☐ PLASTIC		118'6"	250
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

MATERIAL AND TYPE

DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: AIR ☐ PUMP ☐ BAILER

PUMPING RATE: 20 GPM

DURATION OF PUMPING: 1 HOURS 30 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
95 FEET	100 FEET	100 FEET	100 FEET	100 FEET	100 FEET

WATER LEVELS DURING ☒ PUMPING ☐ RECOVERY

IF FLOWING GIVE RATE: GPM

PUMP INTAKE SET AT: FEET

WATER AT END OF TEST: ☒ CLEAR ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP

RECOMMENDED PUMP SETTING: 130 FEET

RECOMMENDED PUMPING RATE: 20 GPM

FINAL STATUS OF WELL

☒ WATER SUPPLY
☐ OBSERVATION WELL
☐ TEST HOLE
☐ RECHARGE WELL
☐ ABANDONED, INSUFFICIENT SUPPLY
☐ ABANDONED, POOR QUALITY
☐ UNFINISHED
☐ DEWATERING

WATER USE

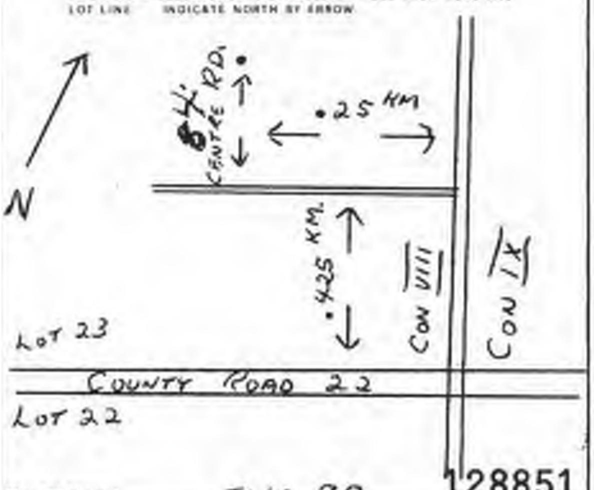
☐ DOMESTIC
☐ STOCK
☐ IRRIGATION
☐ INDUSTRIAL
☐ OTHER
☐ COMMERCIAL
☐ MUNICIPAL
☒ PUBLIC SUPPLY
☐ COOLING OR AIR CONDITIONING
☐ NOT USED

METHOD OF CONSTRUCTION

☐ CABLE TOOL
☒ ROTARY (CONVENTIONAL)
☐ ROTARY (REVERSE)
☐ ROTARY (AIR)
☒ AIR PERCUSSION
☐ BORING
☐ DIAMOND
☐ JETTING
☐ DRIVING
☐ DIGGING
☐ OTHER

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS: TWC 80

128851

CONTRACTOR

NAME OF WELL CONTRACTOR: LANG WELL DRILLING LTD.

WELL CONTRACTOR'S LICENCE NUMBER: 3317

ADDRESS: RR1 HILLSBURGH ONT

NAME OF WELL TECHNICIAN: ROY LANG

WELL TECHNICIAN'S LICENCE NUMBER: T-0158

SIGNATURE OF TECHNICIAN/CONTRACTOR: R. Lang

SUBMISSION DATE: DAY 23 MO 08 YR 94

OFFICE USE ONLY

DATA SOURCE

CONTRACTOR: 3317

DATE RECEIVED: AUG 30 1994

DATE OF INSPECTION

INSPECTOR

REMARKS

Barbour Field Well

CSS.ES

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

Appendix G

Private Well Survey and Notification

Groundwater
Science Corp.

Unit 2, 465 Kingscourt Drive,
Waterloo, ON N2K 3R5
Phone: (519) 746-6916
groundwaterscience.ca

October 31, 2019

RE: Hillsburgh Well Testing - Private Water Well Survey for the Town of Erin

Dear Resident:

The Town of Erin (Town) Servicing and Settlement Master Plan (SSMP) identified municipal water supply and storage deficiencies for the urban centre of Hillsburgh. The Town initiated a Class Environmental Assessment (Class EA) in May 2015 to address the current limitations of the water system and the needs for future development. For Hillsburgh, there is a need for an additional water supply source to provide redundancy in the system (e.g. to ensure peak water demand and fire flow requirements can be met if one of the two existing wells is out of service), and to allow some growth.

As part of the water supply Class EA, a new water supply well has been drilled near the south end of Currie Drive. The new well extends into the deep bedrock aquifer (91 m depth). The well has been tested over short periods and shown to produce a substantial volume of water. However, a longer term test is required to determine the current and sustainable capacity, and to determine the potential for impact on surrounding water users and local ecological features.

The Town has obtained a temporary Permit To Take Water (PTTW) from the Ontario Ministry of the Environment Conservation and Parks (MECP) to conduct this testing. The test is anticipated to occur in November. The well is to be pumped for several days and water levels will be monitored in a number of private wells selected for that purpose. In addition, groundwater levels adjacent to the West Credit River and other surface water features will also be monitored. If the well is shown to be acceptable, for both water quantity and water quality, this information will be used to help obtain the required approvals to add the well to the Hillsburgh municipal water supply system.

The temporary PTTW requires water level monitoring at a representative number of private wells (i.e. wells at various depths and geographic locations). Prior to conducting the pumping test Groundwater Science Corp. is completing a survey and inventory of private water wells in the area, on behalf of the Town of Erin. Many properties in the survey area may be serviced by the municipal water system, however, older (used or unused) wells may also occur within the serviced area.

The survey will collect information on existing local water supplies, such as type, location and depth of the wells, in addition to general comments on water quantity and quality. The survey results will augment available public information (water well records) obtained from the MECP regarding local water supply wells. Based on the survey results private wells representing a variety of aquifer depths and geographic locations in the area will be selected for monitoring. Monitoring will include baseline conditions prior to the test.

A notice will be distributed to residents prior to the actual test with additional details. However, please note that as a condition of the PTTW, the Town and the study team are required by MECP regulations to respond to, and address, any well interference complaint arising from the water taking.

Participation in the private water well survey and monitoring program is voluntary. This letter is to inform you of the testing, as well as provide you with an opportunity to complete the well survey and to indicate if you are interested in having your well monitored during the test. If you do not have a well on your property please use this opportunity to confirm your water supply status.

Based on the number of survey responses, representative wells will be selected from within local areas for monitoring. For example, if there are five wells of similar depth in one area, only one or two of those wells may be selected for monitoring. Testing results and general summaries of the information gathered will be available to all local residents as part of the Class EA reporting. **No personal information will be disclosed or referenced in the reporting**.

Once the survey results are reviewed and representative wells selected, we will contact the owners of the selected wells to arrange monitoring access. As part of that work **we would request permission to measure the water levels at your well for up to 4 weeks before the test, during the test and up to 4 weeks after the test.** The well monitoring would include the installation of a measurement instrument in your well. This work would be completed by a MECP Licensed Water Well Contractors and Technicians.

Attached to this letter is a survey response and monitoring authorization form. **If you are interested in participating** please complete and return the survey/authorization form in the self-addressed stamped envelope (retain this letter for your information). Those residents interested in participating in the monitoring program will be contacted at a later date to arrange the well monitoring.

If you require assistance with the form, or have any questions about well monitoring, please call the Andrew Pentney of Groundwater Science Corp. at (519) 580-7325, or email apentney@rogers.com. We would like to have the forms completed and returned by **November 8th**, as we are hoping to commence the test later in November.

Thank you in advance for your consideration in this matter.

Sincerely,

Andrew Pentney, P.Geo.
Groundwater Science Corp.
Hydrogeologist

Water Well Inventory	Project: **Erin Municipal Well Testing**	Date:

Some personal information (name, address and phone number) is collected as part of this survey for the sole purpose of identifying and communicating with the respondent. There will be no electronic copy made of this information and the data will not be disclosed to third parties or referenced in the environmental study report.

☐ I consent to the collection and use of the following personal information for the above stated purpose.

Respondent: Emergency Locate (Road) No.:

Mailing Address: Telephone No.:

1. How old is the house? **2. How old is the well?**

3. Water Use:
Domestic ☐ Pool ☐ Livestock ☐ Garden ☐ other:

Well Water Treatment (filter, softener, etc.):

4. Alternative Water Sources Used:
Bottled ☐ Cistern ☐ Bulk Delivery ☐ other:

5. Well Water Quality and Quantity Comments:

Quality (colour, odour, taste, staining, etc.)

Quantity (eg. does the well go dry?)

Has the well ever been tested for quality or quantity?
Results of testing:

6. Water Well Record:

Do you have a copy of the MECP Water Well Record? Well Record #:
Who drilled the well?

7. **Sketch Map of Well Location** (show road, driveway, house and septic bed)

8. Well Construction:

Well Type Drilled ☐ Dug ☐

Well Casing Cement Tile ☐ Steel ☐ Buried ☐ **Diameter:**

Well Depth (feet): Describe well access (easy / not easy):

9. Pump Details:
Type: jet ☐ submersible ☐ other ☐ pump (intake) depth:

10. Monitoring:

Would you agree to water level monitoring at your well?

Requested by: Date:

Survey Response Summary								MOECC Water Well Record Match			
Address		Survey	Date Well	Well	Well	Pump	Pump	MOECC	Well	Source	Note
#	Street	Date	Constructed	Type	Depth	Type	Depth	Number	Depth		(well record match information, etc.)
14	George St	2016	1987	drilled	190 ft	submersible	n/a	-	-	-	
16	George St	2016	n/a	drilled	n/a	submersible	89 ft	6703528	54.9	bedrock	location match
1	Spruce St	2016	n/a	dug	n/a	jet	n/a	-	-	-	
6	Station St	2016	1984	drilled	n/a	submersible	n/a	6709532	23.5	bedrock	location and driller match
8	Station St	2016	1988	drilled	n/a	jet	n/a	6709530	30.5	bedrock	location and driller match
9	Station St	2016	n/a	drilled	n/a	jet	n/a	7292103	61.0	bedrock	new well drilled July, 2017 (older well abandoned)
42	Trafalgar Rd	2016	n/a	dug	n/a	jet	n/a	-	-	-	
64	Trafalgar Rd	2016	1996	drilled	n/a	submersible	n/a	6711058	21.3	bedrock	location match
68	Trafalgar Rd	2016	n/a	drilled	n/a	submersible	90 ft				
70	Trafalgar Rd	2016	n/a	dug	n/a	n/a	n/a	-	-	-	
74	Trafalgar Rd	2016	1940's	dug	24 ft	jet	22 ft	-	-	-	
76	Trafalgar Rd	2016	1986	drilled	82 ft	submersible	n/a	6706911	21.3	bedrock	address listed on record
87	Trafalgar Rd	2016	n/a	dug	n/a	submersible	n/a	-	-	-	
96	Trafalgar Rd	2016	1991	drilled	90 ft	submersible	90 ft	6710235	32.0	bedrock	location and driller match
98A	Trafalgar Rd	2016	1989	drilled	180 ft	submersible	n/a	6709578	49.7	bedrock	
5823	8th Line	2019	n/a	drilled	n/a	n/a	n/a	6710805	53.0	bedrock	location match
5837	8th Line	2019	n/a	drilled	130 ft	submersible	n/a	-	-	-	
10	Anne St	2019	n/a	dug	20 ft	jet	n/a	-	-	-	
1	Barker St	2019	1987	drilled	99 ft	submersible	n/a	6709157	30.2	bedrock	location match, used occassionally
				drilled	170 ft	submersible	40 ft	6709156	51.8	bedrock	location match, primary well
6	Barker St	2019	n/a	drilled	98 ft	jet	75 ft	-	-	-	
2	Church St	2019	on town water								
49	Douglas Cr	2019	on town water								
3	George St	2019	n/a	drilled	n/a	jet	n/a	-	-	-	
23	George St	2019	2008	drilled	147 ft	submersible	60 ft	7118031	44.8	bedrock	location match
27	Mill St	2019	on town water								
2	Queen St	2019	n/a	drilled	n/a	submersible	5 ft	6714075	38.4	bedrock	location match
6	Queen St	2019	6707858	drilled	120 ft	submersible	80 ft	6707858	36.6	bedrock	
19	Trafalgar Rd	2019	1979	drilled	n/a	submersible	n/a	6707144	27.1	bedrock	address listed on record
57	Trafalgar Rd	2019	n/a	drilled	n/a	n/a	n/a	-	-	-	
9435	Well Rd 22	2019	n/a	drilled	n/a	submersible	n/a	6703357	46.3	bedrock	location match

Town of Erin

5684 Trafalgar Rd.
Hillsburgh, Ontario N0B 1Z0
Tel: (519) 855-4407
Fax: (519) 855-4821
E-mail: communications@erin.ca
www.erin.ca

RE: Hillsburgh Municipal Well Testing

Dear Resident: January 6, 2020

This letter is to inform you that the Town of Erin (Town) is planning a 6 day pumping test at the new water supply well (constructed by the Town), located at the south end of Currie Drive. The testing is planned to **begin on January 8, 2020** and **end on January 14, 2020.** Over most of that period, water will be pumped from the well on a continuous basis.

The test is required to determine the sustainable well capacity, and, to determine the potential for impact on surrounding water users and local ecological features. Water level measurements at the pumping well and observation locations are used to determine the potential for impact. If the well is shown to produce acceptable water quantity without undue impacts, and, have acceptable water quality, this information will be used to help obtain the required approvals to add the well to the Town's municipal water supply system for Hillsburgh.

The Town has obtained a temporary Permit To Take Water (PTTW) from the Ontario Ministry of the Environment, Conservation and Parks (MECP) to conduct this testing. Water levels will be monitored in a number of private wells selected for that purpose. In addition, groundwater levels will also be monitored within dedicated observation wells, and, locations at the West Credit River and other surface water features.

As a condition of the PTTW, the Town and the study team are required by MECP to respond to, and address, well interference complaints arising from the water taking.

If you have, any questions regarding the testing program please contact:

Andrew Pentney (Project Hydrogeologist, Groundwater Science Corp): (519) 580 -7325
or,
Nick Colucci (Town of Erin, Director of Infrastructure Services): (519) 855-4407 Ext. 227

If you require assistance with your well over the testing period, please contact one of the following:

Andrew Pentney (Groundwater Science Corp): (519) 580-7325

Dave Nahrgang (Groundwater Science Corp): (519) 501-1446

Town of Erin: (519) 855-4407

Lotowater Technical Services: (519) 717-3070

Appendix H
Step Test Results

VARIABLE RATE PERFORMANCE TEST

Lotowater
TECHNICAL SERVICES INC.

Well Name: Well H4
Project Number: 148-004
Client: Town of Erin
Date: 08/01/2020
Technician Name: Alex O'Hearn
Pump: LTS test pump
Water Level Device: LTS water level meter
Pump Inlet: Approx 29.3 m
Water Level Reference: Top of casing (0.47 mags)
Flow Measuring Device: LTS flow meter
Test Note:

Time ***hr:min***	**Elapsed Time** ***min***	**Level** ***mbtc***	**Drawdown** ***m***	**Flow** ***L/s***	**Note**
0:00	0	9.84	0.00	19.0	Start Step 1
0:01	1	11.10	1.26	19.0	
0:02	2	11.30	1.46	19.0	
0:03	3	11.44	1.60	19.0	
0:04	4	11.60	1.76	19.0	
0:05	5	11.72	1.88	19.0	
0:06	6	11.84	2.00	19.0	
0:08	8	12.10	2.26	19.0	
0:10	10	12.24	2.40	19.0	
0:12	12	12.42	2.58	19.0	
0:15	15	12.63	2.79	19.0	
0:20	20	12.97	3.13	19.0	
0:25	25	13.23	3.39	19.0	
0:30	30	13.48	3.64	19.0	
0:35	35	13.67	3.83	19.0	
0:40	40	13.97	4.13	19.0	
0:50	50	14.32	4.48	19.0	
1:00	60	14.64	4.80	19.0	
1:01	1	15.12	5.28	26.0	Start Step 2
1:02	2	15.18	5.34	26.0	
1:03	3	15.27	5.43	26.0	
1:04	4	15.33	5.49	26.0	
1:05	5	15.40	5.56	26.0	
1:06	6	15.47	5.63	26.0	
1:08	8	15.56	5.72	26.0	
1:10	10	15.70	5.86	26.0	
1:12	12	15.77	5.93	26.0	
1:15	15	15.95	6.11	26.0	
1:20	20	16.12	6.28	26.0	
1:25	25	16.36	6.52	26.0	
1:30	30	16.56	6.72	26.0	
1:35	35	16.72	6.88	26.0	
1:40	40	16.92	7.08	26.0	
1:50	50	17.27	7.43	26.0	
2:00	60	17.55	7.71	26.0	

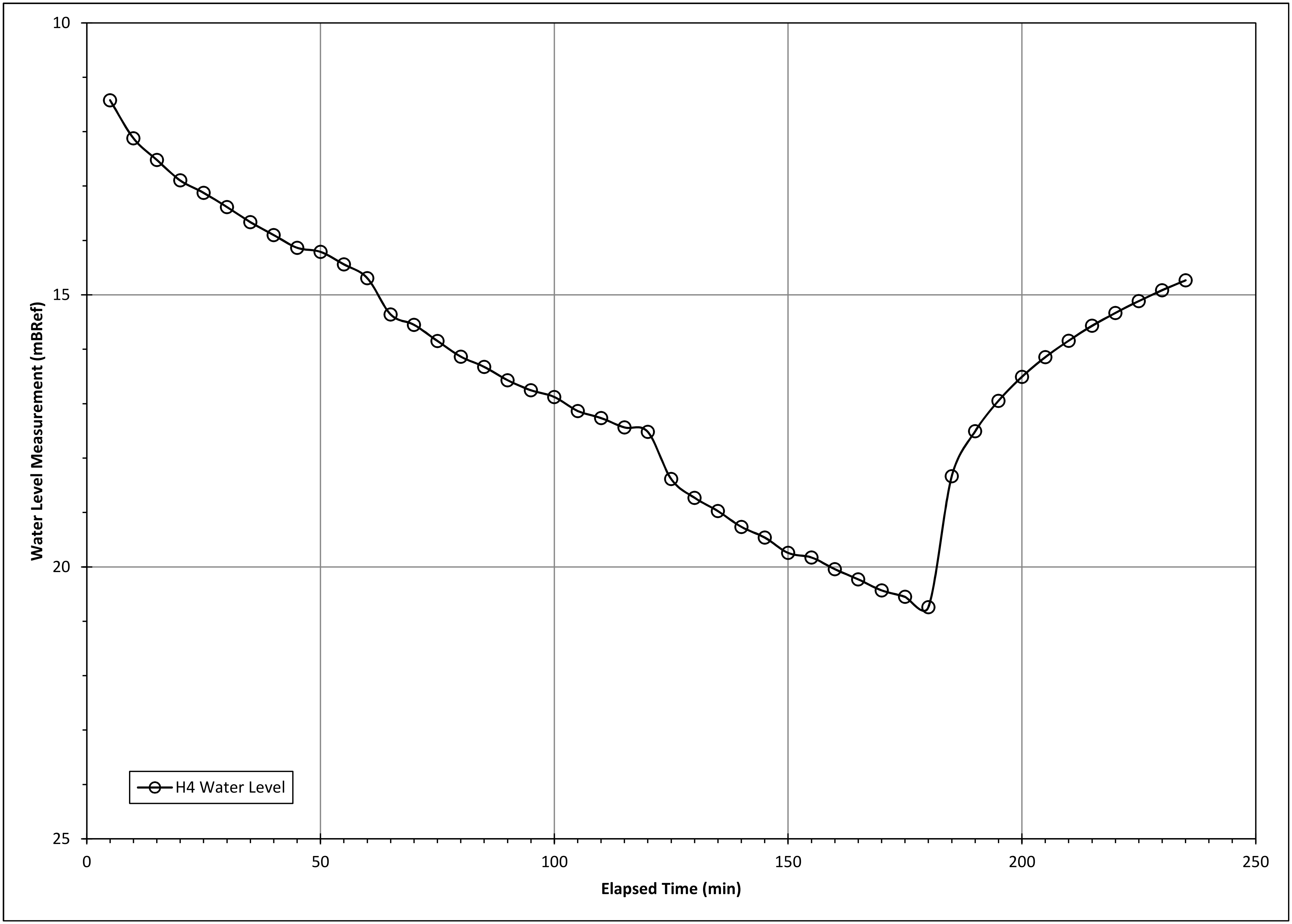
VARIABLE RATE PERFORMANCE TEST

Lotowater
TECHNICAL SERVICES INC.

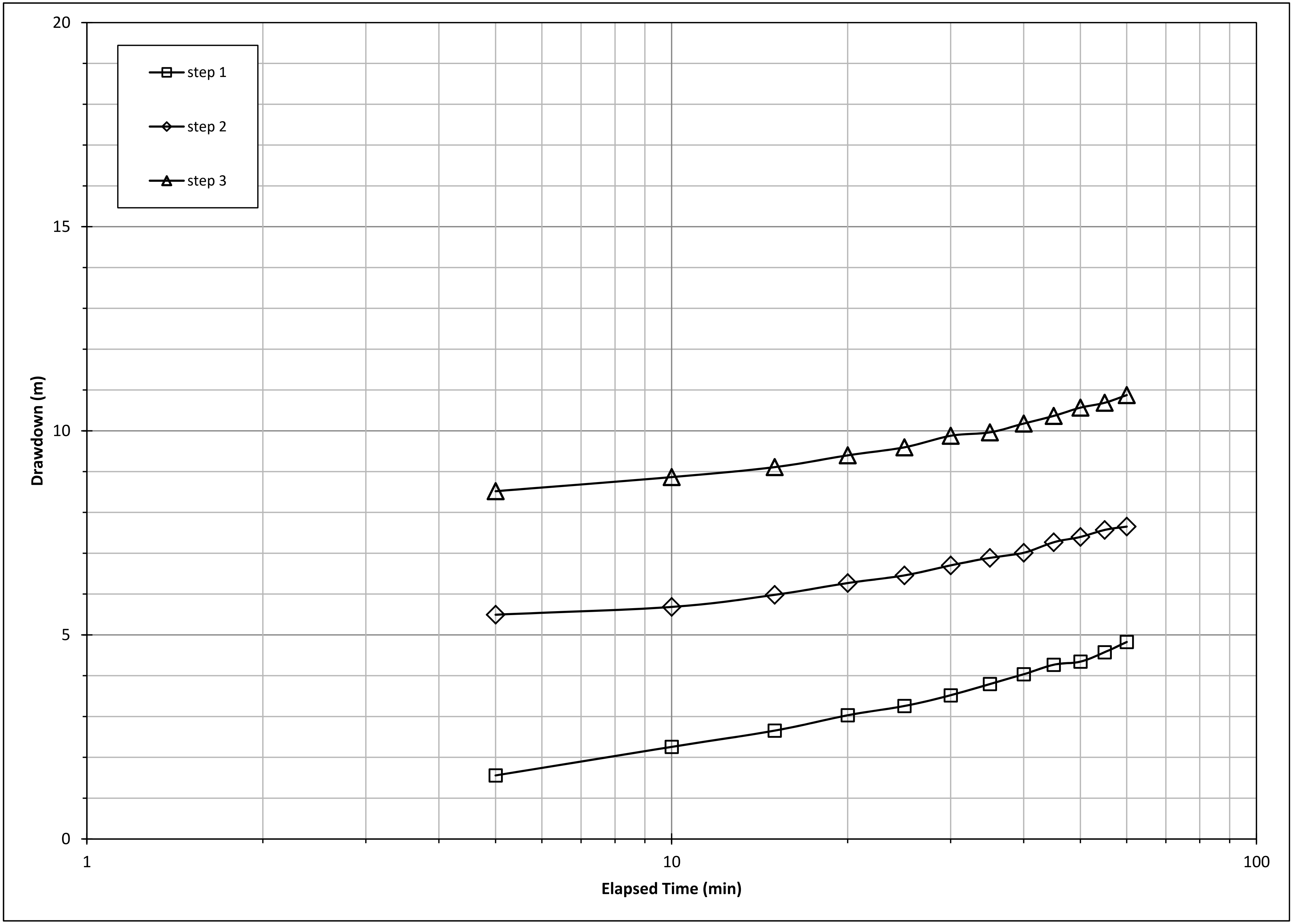
Well Name: Well H4
Client: Town of Erin
Technician Name: Alex O'Hearn
Water Level Device: LTS water level meter
Water Level Reference: Top of casing (0.47 mags)
Test Note:

Project Number: 148-004
Date: 08/01/2020
Pump: LTS test pump
Pump Inlet: Approx 29.3 m
Flow Measuring Device: LTS flow meter

Time *hr:min*	**Elapsed Time** *min*	**Level** *mbtc*	**Drawdown** *m*	**Flow** *L/s*	**Note**
2:01	1	18.24	8.40	34.0	Start Step 3
2:02	2	18.35	8.51	34.0	
2:03	3	18.42	8.58	34.0	
2:04	4	18.48	8.64	34.0	
2:05	5	18.55	8.71	34.0	
2:06	6	18.64	8.80	34.0	
2:08	8	18.76	8.92	34.0	
2:10	10	19.13	9.29	34.0	
2:12	12	19.38	9.54	34.0	
2:15	15	19.44	9.60	34.0	
2:20	20	19.53	9.69	34.0	
2:25	25	19.62	9.78	34.0	
2:30	30	19.76	9.92	34.0	
2:35	35	19.96	10.12	34.0	
2:40	40	20.12	10.28	34.0	
2:50	50	20.46	10.62	34.0	
3:00	60	20.77	10.93	34.0	
3:01	1	18.58	8.74	0.0	Recovery
3:02	2	18.39	8.55	0.0	
3:03	3	18.17	8.33	0.0	
3:04	4	17.98	8.14	0.0	
3:05	5	17.83	7.99	0.0	
3:06	6	17.68	7.84	0.0	
3:08	8	17.58	7.74	0.0	
3:10	10	17.15	7.31	0.0	
3:12	12	16.94	7.10	0.0	
3:15	15	16.69	6.85	0.0	
3:20	20	16.26	6.42	0.0	
3:25	25	15.94	6.10	0.0	
3:30	30	15.70	5.86	0.0	
3:35	35	15.39	5.55	0.0	
3:40	40	15.19	5.35	0.0	
3:50	50	14.76	4.92	0.0	
4:00	60	14.51	4.67	0.0	

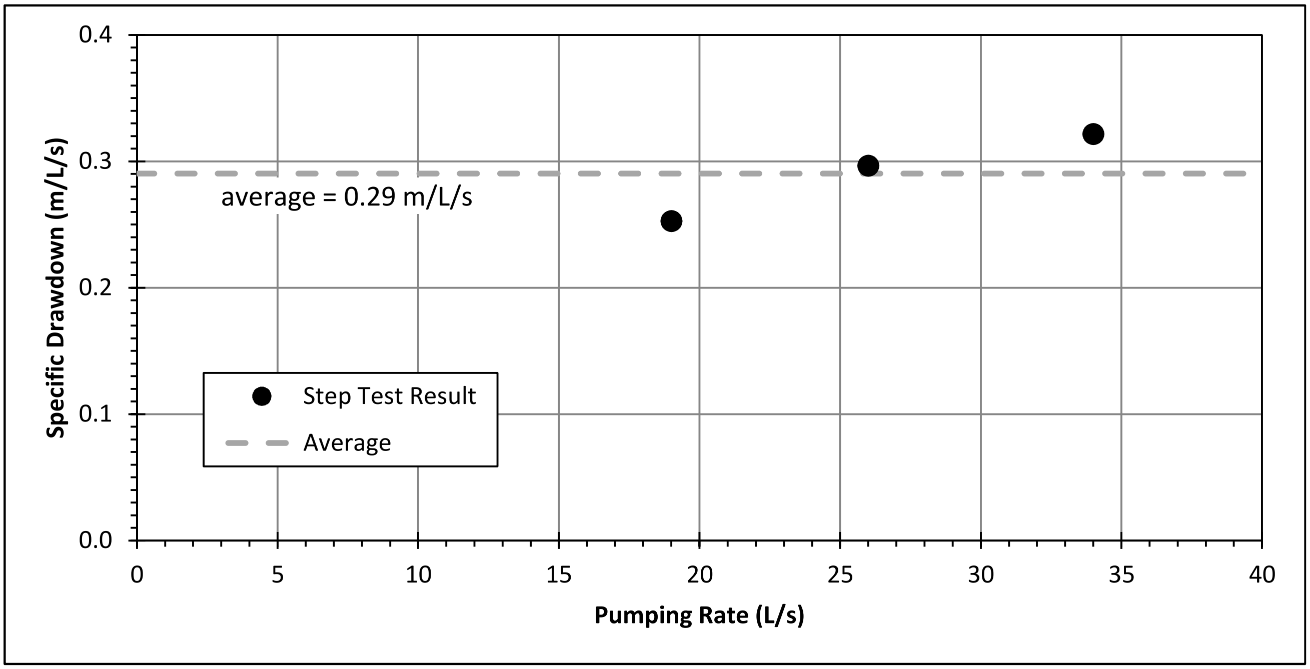


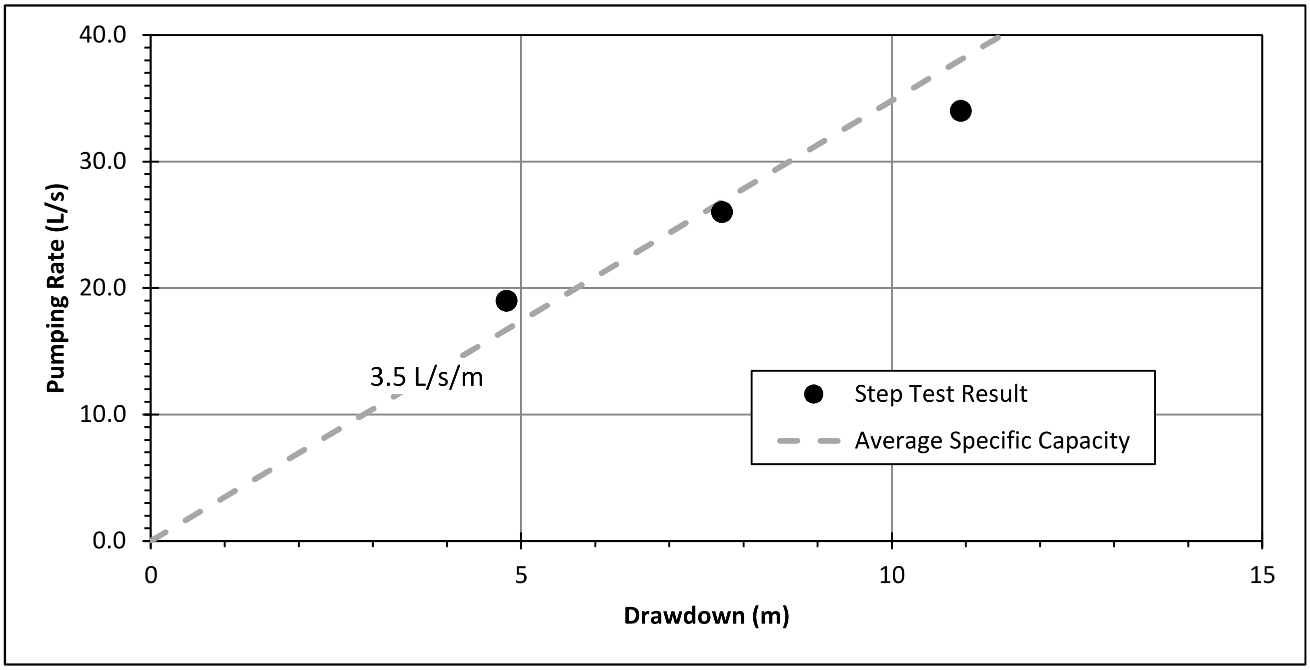
H4 Step Test Hydrograph



H4 Step Test Drawdown

Well	Step	Pumping Rate (Q)			Drawdown (Sw)	Specific Drawdown (Sw/Q)	Specific Capacity (Q/Sw)	
		L/s	USgpm	IGPM	(m)	(m/L/s)	Step (L/s/m)	Test Average (L/s/m)
Well E9	1	19.0	301.2	250.8	4.80	0.253	4.0	3.5
	2	26.0	412.1	343.2	7.71	0.297	3.4	
	3	34.0	538.9	448.7	10.93	0.321	3.1	





Appendix I

Pumping Test Results: Well H3 and H4

Aquifer Test (Pumping Well H4)

Lotowater
TECHNICAL SERVICES INC.

Project Number: 148-004

Location: Town of Erin

Sheet: 1 of 4

Measuring Point: Top of flush joint = 1.09 magl

Pump Type: Submersible 50 hp

Stick-up: Casing = 0.52 magl

Pump Inlet: Approx = 29.3 m

SWL: 10.26 m

Technicians: LTS

Pumping Rate: 20 - 30 L/s

Transducer Serial #:

Flow Measurement: LTS flow McCrometer flow meter

Discharge Location: Culvert under road approximatly 500 m west of site

Test Note: Shut down early after Glendevon well impacted

WELL NAME: **Well H4**

Date	Time	Elapsed Time	Water Level	Drawdown	Flow Rate	Totalizer	Comments
yyyy-mm-dd	*hr:min*	*min*	*mbMP*	*m*	*L/s*	*m3*	
2020-01-09	10:30:00	0	10.26	0.00	30.0	36,316	
	10:31:00	1	12.43	2.17			
	10:32:00	2	12.76	2.50			
	10:33:00	3	12.98	2.72			
	10:34:00	4	13.16	2.90			
	10:35:00	5	13.35	3.09			
	10:36:00	6	13.48	3.22			
	10:37:00	7	13.62	3.36			
	10:38:00	8	13.81	3.55			
	10:39:00	9	13.95	3.69			
	10:40:00	10	14.07	3.81			
	10:42:00	12	14.31	4.05			
	10:44:00	14	14.51	4.25			
	10:46:00	16	14.69	4.43			
	10:48:00	18	14.89	4.63			
	10:50:00	20	15.03	4.77			
	10:55:00	25	15.84	5.58			
	11:00:00	30	15.98	5.72			
	11:05:00	35	16.25	5.99			
	11:10:00	40	16.49	6.23			

WELL NAME: **Well H4**

Sheet: 2 of 4

Date	Time	Elapsed Time	Water Level	Drawdown	Flow Rate	Totalizer	Comments
yyyy-mm-dd	*hr:min*	*min*	*mbMP*	*m*	*L/s*	*m3*	
	11:15:00	45	16.49	6.23			
2020-01-09	11:20:00	50	16.76	6.50			
	11:25:00	55	17.08	6.82			
	11:30:00	60	17.24	6.98			
	11:40:00	70	17.71	7.45			
	11:50:00	80	18.11	7.85			
	12:00:00	90	18.45	8.19			
	12:10:00	100	18.78	8.52			
	12:20:00	110	19.14	8.88			
	12:30:00	120	19.41	9.15			
	13:00:00	150	20.18	9.92			
	13:30:00	180	20.86	10.60			
	14:00:00	210	21.47	11.21		36,616	
	14:30:00	240	21.82	11.56			
	15:00:00	270	22.24	11.98			
	15:30:00	300	22.57	12.31			
	16:00:00	330	23.42	13.16		36,858	
	16:30:00	360	23.95	13.69			
	17:30:00	420	24.71	14.45			
	18:30:00	480	24.24	13.98			
	20:30:00	600	23.85	13.59			
	22:30:00	720	24.37	14.11		37,467	
2020-01-10	0:30:00	840	24.93	14.67		37,660	
	2:30:00	960	25.31	15.05		37,832	
	4:30:00	1,080	25.43	15.17		38,010	
	6:30:00	1,200	25.45	15.19		38,199	
	8:30:00	1,320	25.90	15.64		38,382	Flow decreased to 20L/s
	10:30:00	1,440	25.50	15.24			
	12:30:00	1,560	25.22	14.96		38,900	Test shut down

WELL NAME: Well H4

Sheet: 3 of 4

Date	Time	Elapsed Time	Water Level	Drawdown	Flow Rate	Totalizer	Comments
yyyy-mm-dd	*hr:min*	*min*	*mbMP*	*m*	*L/s*	*m3*	
RECOVERY							% Recovery
2020-01-10	12:30:00	0	25.22	14.96			0%
	12:31:00	1	24.02	13.76			8%
	12:32:00	2	23.85	13.59			9%
	12:33:00	3	23.64	13.38			11%
	12:34:00	4	23.53	13.27			11%
	12:35:00	5	23.42	13.16			12%
	12:36:00	6	23.28	13.02			13%
	12:37:00	7	23.20	12.94			14%
	12:38:00	8	23.09	12.83			14%
	12:39:00	9	22.98	12.72			15%
	12:40:00	10	22.89	12.63			16%
	12:42:00	12	22.71	12.45			17%
	12:44:00	14	22.56	12.30			18%
	12:46:00	16	22.41	12.15			19%
	12:48:00	18	22.26	12.00			20%
	12:50:00	20	22.12	11.86			21%
	12:55:00	25	21.79	11.53			23%
	13:00:00	30	21.52	11.26			25%
	13:05:00	35	21.28	11.02			26%
	13:10:00	40	21.05	10.79			28%
	13:15:00	45	20.83	10.57			29%
	13:20:00	50	20.62	10.36			31%
	13:25:00	55	20.43	10.17			32%
	13:30:00	60	20.24	9.98			33%
	13:40:00	70	19.97	9.71			35%
	13:50:00	80	19.56	9.30			38%
	14:00:00	90	19.27	9.01			40%
	14:10:00	100	19.02	8.76			41%

Aquifer Test (Pumping Well H4)

WELL NAME: **Well H4**

Sheet: 4 of 4

Date	Time	Elapsed Time	Water Level	Drawdown	Flow Rate	Totalizer	Comments
yyyy-mm-dd	*hr:min*	*min*	*mbMP*	*m*	*L/s*	*m3*	
	14:20:00	110	18.76	8.50			43%
	14:30:00	120	18.51	8.25			45%

	36316	Start m^3	
	38900	End m^3	
	2584	2584000	Litres
Minutes		1560	
		1656.41	L/min
Total		27.6	L/s

Aquifer Test (Pumping Well H4)

Lotowater
TECHNICAL SERVICES INC.

Project Number: 148-004

Location: Town of Erin

Sheet: 1 of 4

Measuring Point: Top of flush joint = 1.09 magl

Pump Type: Submersible 50 hp

Stick-up: Casing = 0.52 magl

Pump Inlet: Approx = 29.3 m

SWL: 9.08 m

Technicians: LTS

Pumping Rate: 20 L/s

Transducer Serial #:

Flow Measurement: LTS flow McCrometer flow meter

Discharge Location: Culvert under road approximatly 500 m west of site

Test Note:

WELL NAME: **Well H4**

Date	Time	Elapsed Time	Water Level	Drawdown	Flow Rate	Totalizer	Comments
yyyy-mm-dd	*hr:min*	*min*	*mbMP*	*m*	*L/s*	*m3*	
2020-01-15	10:00	0	9.08	0.00	20.0	38,900	
	10:01	1	9.77	0.69			
	10:02	2	10.49	1.41			
	10:03	3	10.65	1.57			
	10:04	4	10.83	1.75			
	10:05	5	10.99	1.91			
	10:06	6	11.16	2.08			
	10:07	7	11.27	2.19			
	10:08	8	11.39	2.31			
	10:09	9	11.52	2.44			
	10:10	10	11.60	2.52			
	10:12	12	11.78	2.70			
	10:14	14	11.96	2.88			
	10:16	16	12.10	3.02			
	10:18	18	12.25	3.17			
	10:20	20	12.40	3.32			
	10:25	25	12.69	3.61			
	10:30	30	12.97	3.89			
	10:35	35	13.22	4.14			
	10:40	40	13.43	4.35			

Aquifer Test (Pumping Well H4)

Lotowater
TECHNICAL SERVICES INC.

WELL NAME: **Well H4**

Sheet: 2 of 4

Date	Time	Elapsed Time	Water Level	Drawdown	Flow Rate	Totalizer	Comments
yyyy-mm-dd	*hr:min*	*min*	*mbMP*	*m*	*L/s*	*m3*	
	10:45	45	13.65	4.57			
2020-01-15	10:50	50	13.84	4.76			
	10:55	55	14.04	4.96			
	11:00	60	14.29	5.21			
	11:10	70	14.57	5.49			
	11:20	80	14.89	5.81			
	11:30	90	15.19	6.11			
	11:40	100	15.48	6.40			
	11:50	110	15.71	6.63			
	12:00	120	15.97	6.89		39,043	
	12:30	150	16.57	7.49			
	13:00	180	17.09	8.01	20.0	39,111	19.54
	13:30	210	17.52	8.44			
	14:00	240	17.91	8.83			
	14:30	270	18.27	9.19			
	15:00	300	18.56	9.48	20.0	39,244	19.11
	15:30	330	18.88	9.80		39,281	19.24
	16:00	360	19.14	10.06			
	17:00	420	19.56	10.48	20.0	39,832	36.98
	18:00	480	19.97	10.89		39,449	19.06
	20:00	600	20.64	11.56		39,583	18.97
	22:00	720	21.17	12.09		39,715	18.87
2020-01-16	0:00	840	21.61	12.53		39,849	18.83
	2:00	960	21.94	12.86		39,980	18.75
	4:00	1,080	22.22	13.14		40,113	18.72
	6:00	1,200	22.46	13.38		40,249	18.74
	8:00	1,320	22.62	13.54		40,372	18.59
	10:00	1,440	22.88	13.80		40,506	18.59
	12:00	1,560	22.98	13.90		40,637	18.56
	14:00	1,680	23.12	14.04		40,768	18.53

Aquifer Test (Pumping Well H4)

WELL NAME: Well H4

Sheet: 3 of 4

Date	Time	Elapsed Time	Water Level	Drawdown	Flow Rate	Totalizer	Comments
yyyy-mm-dd	*hr:min*	*min*	*mbMP*	*m*	*L/s*	*m3*	
	16:00	1,800	23.27	14.19		40,898	18.50
	18:00	1,920	23.40	14.32		41,033	18.50
	20:00	2,040	23.53	14.45		41,167	18.52
	22:00	2,160	23.71	14.63		41,298	18.50
2020-01-17	0:00	2,280	23.90	14.82		41,428	18.48
	2:00	2,400	24.05	14.97		41,559	18.47
	4:00	2,520	24.19	15.11		41,695	18.49
	6:00	2,640	24.27	15.19		41,827	18.48
	8:00	2,760	24.32	15.24		41,960	18.48
	10:00	2,880	24.38	15.30		42,095	18.49
	12:00	3,000	24.40	15.32		42,233	18.52
	14:00	3,120	24.41	15.33		42,361	18.49
	16:00	3,240	24.42	15.34		42,493	18.48
	18:00	3,360	24.46	15.38		42,625	18.48
	20:00	3,480	24.48	15.40		42,754	18.46
	22:00	3,600	24.50	15.42		42,886	18.45
2020-01-18	0:00	3,720	24.57	15.49		43,108	18.85
	2:00	3,840	24.62	15.54		43,176	18.56
	4:00	3,960	24.73	15.65		43,280	18.43
	6:00	4,080	24.75	15.67		43,410	18.42
	8:00	4,200	24.70	15.62		43,541	18.42
	10:00	4,320	24.66	15.58		43,670	18.40
RECOVERY							
2020-01-18	10:00	0	25.66	16.58			% Recovery
	10:01	1	23.73	14.65			12%
	10:02	2	23.40	14.32			14%
	10:03	3	23.18	14.10			15%
	10:04	4	23.10	14.02			15%

Aquifer Test (Pumping Well H4)

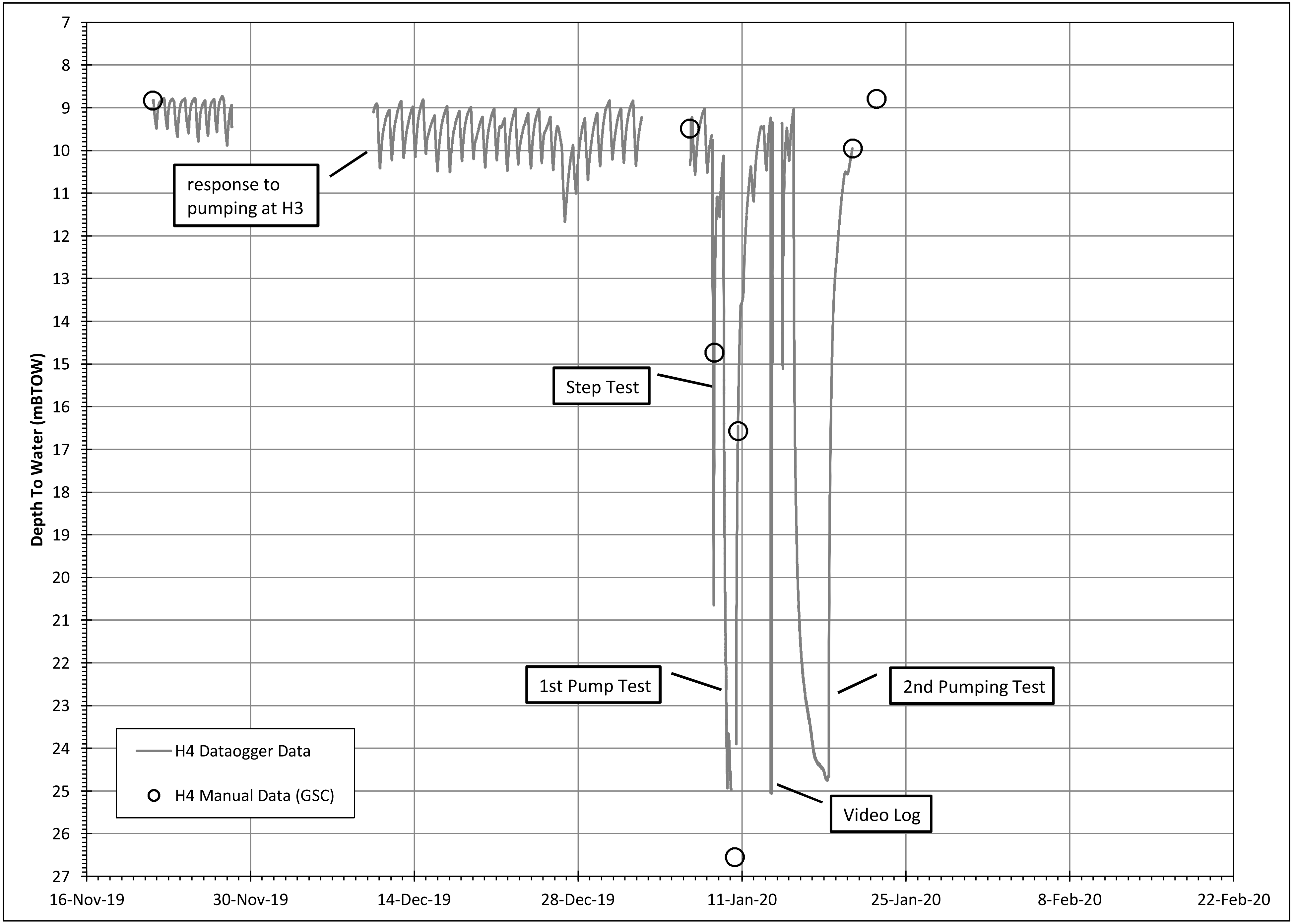
Lotowater
TECHNICAL SERVICES INC.

WELL NAME: **Well H4**

Sheet: 4 of 4

Date	Time	Elapsed Time	Water Level	Drawdown	Flow Rate	Totalizer	Comments
yyyy-mm-dd	*hr:min*	*min*	*mbMP*	*m*	*L/s*	*m3*	
	10:05	5	22.95	13.87			16%
	10:06	6	22.81	13.73			17%
	10:07	7	22.72	13.64			18%
2020-01-18	10:08	8	22.63	13.55			18%
	10:09	9	22.58	13.50			19%
	10:10	10	22.51	13.43			19%
	10:12	12	22.33	13.25			20%
	10:14	14	22.12	13.04			21%
	10:16	16	21.99	12.91			22%
	10:18	18	21.89	12.81			23%
	10:20	20	21.81	12.73			23%
	10:25	25	21.53	12.45			25%
	10:30	30	21.27	12.19			26%
	10:35	35	21.00	11.92			28%
	10:40	40	20.79	11.71			29%
	10:45	45	20.58	11.50			31%
	10:50	50	20.37	11.29			32%
	10:55	55	20.20	11.12			33%
	11:00	60	20.02	10.94			34%
	11:10	70	19.68	10.60			36%
	11:20	80	19.38	10.30			38%
	11:30	90	19.12	10.04			39%
	11:40	100	18.84	9.76			41%
	11:50	110	18.61	9.53			43%
	12:00	120	18.40	9.32			44%

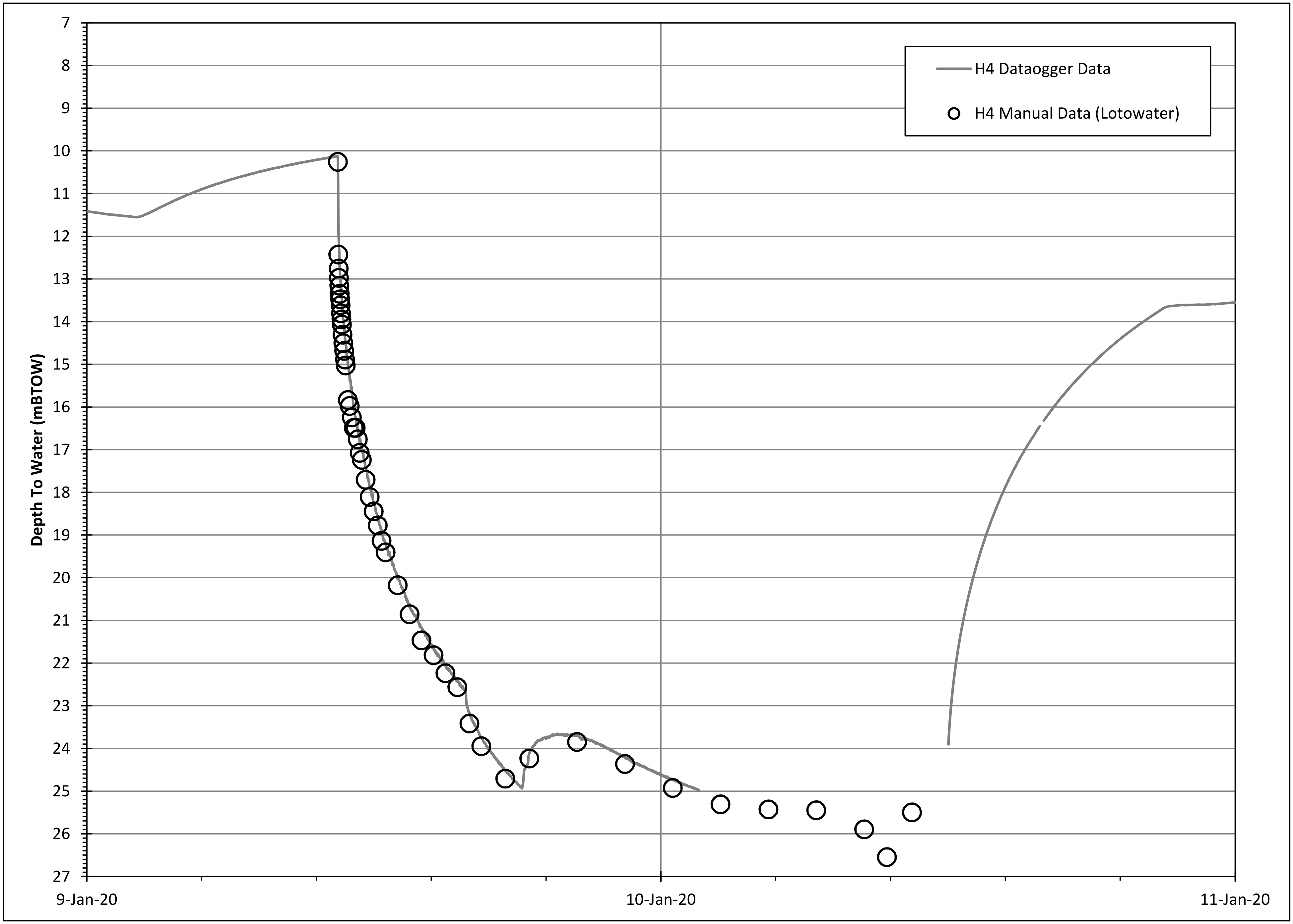
38900 Start m^3
43670 End m^3
4770 4770000 Litres
Minutes 4320
1104.2 L/min
Total 18.4 L/s



Town of Erin
Water Supply EA

H4 Long Term Hydrograph

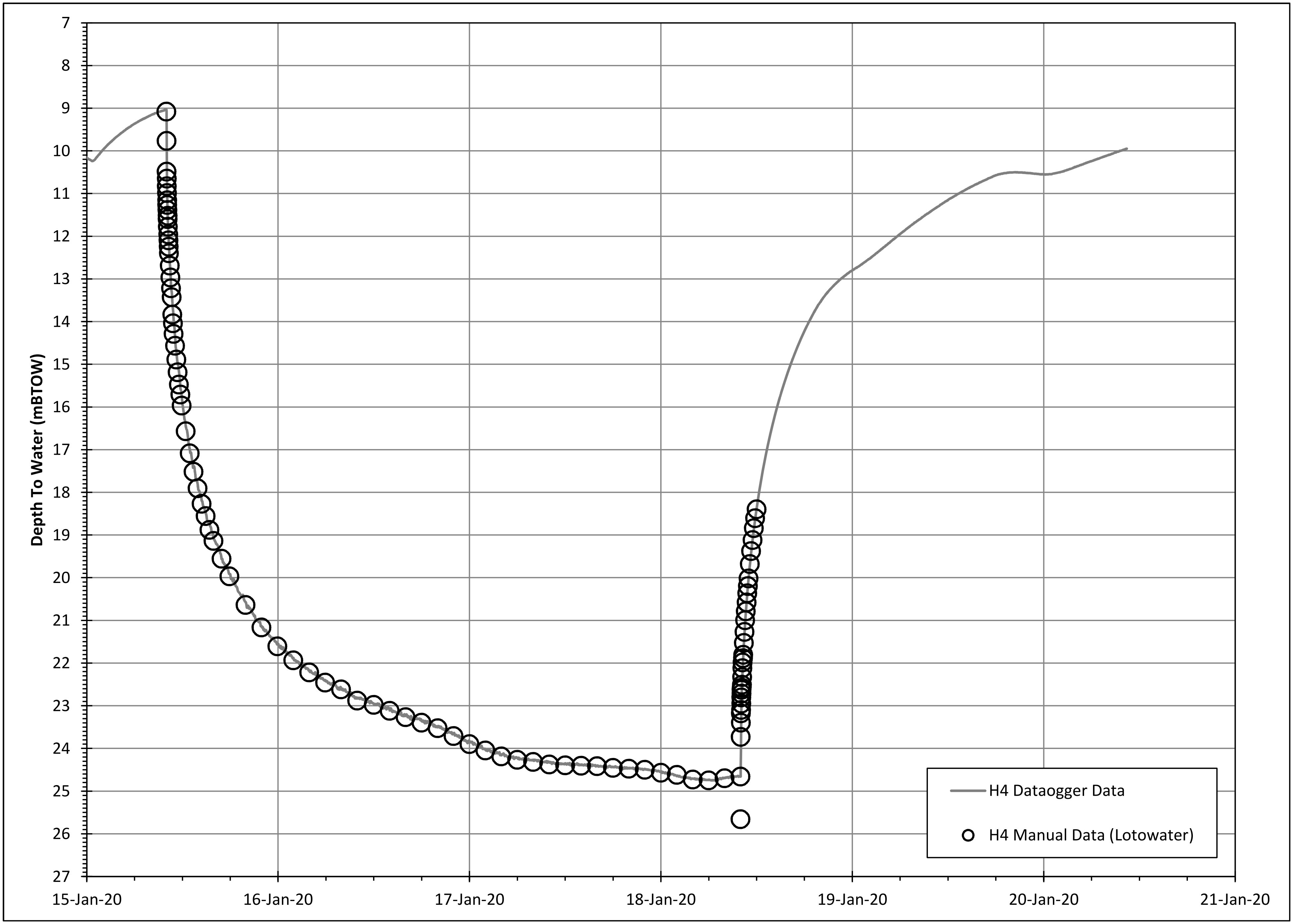
Groundwater Science Corp
Hydrogeological Assessment



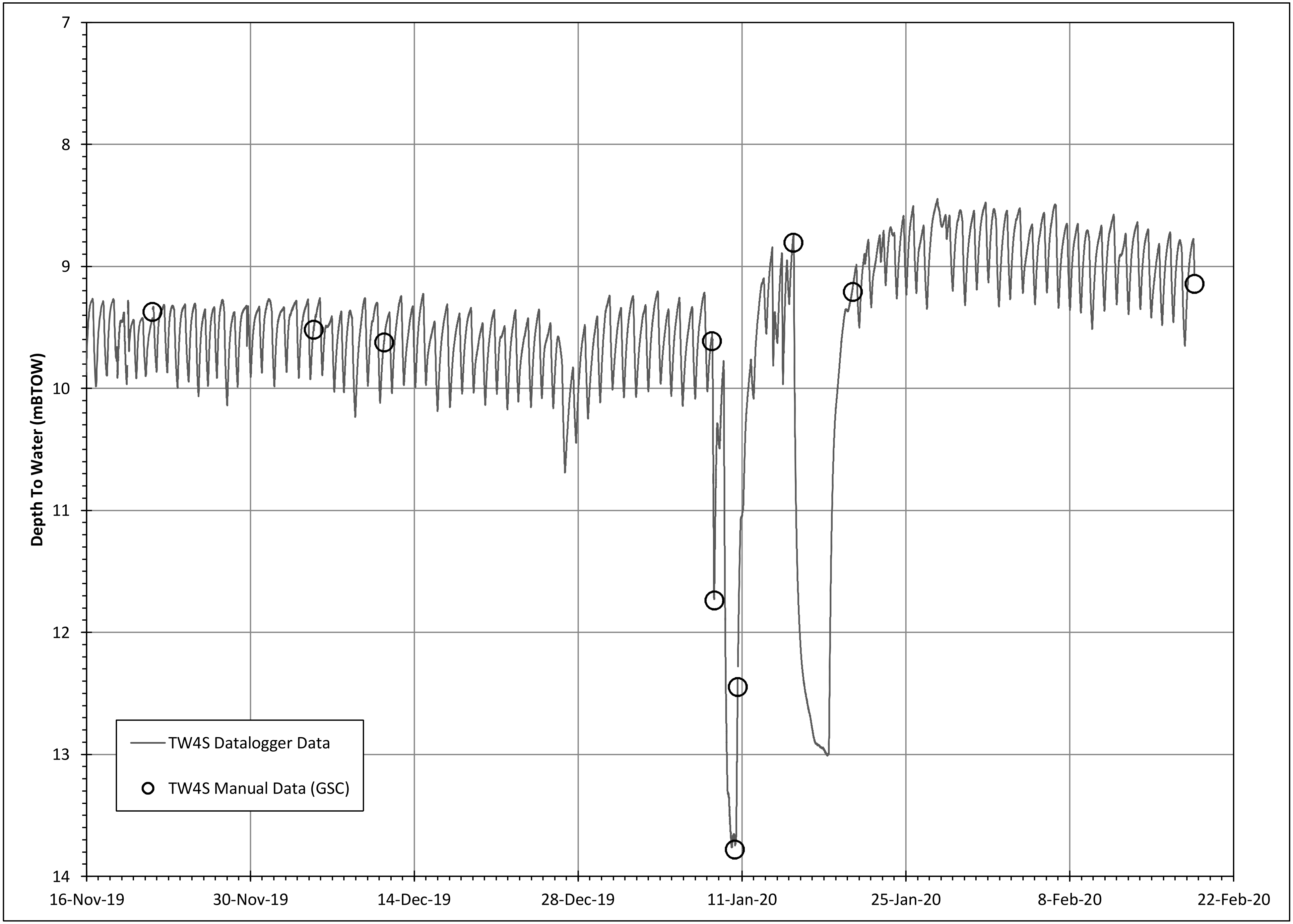
Town of Erin
Water Supply EA

H4 First (1 day) Pump Test Hydrograph

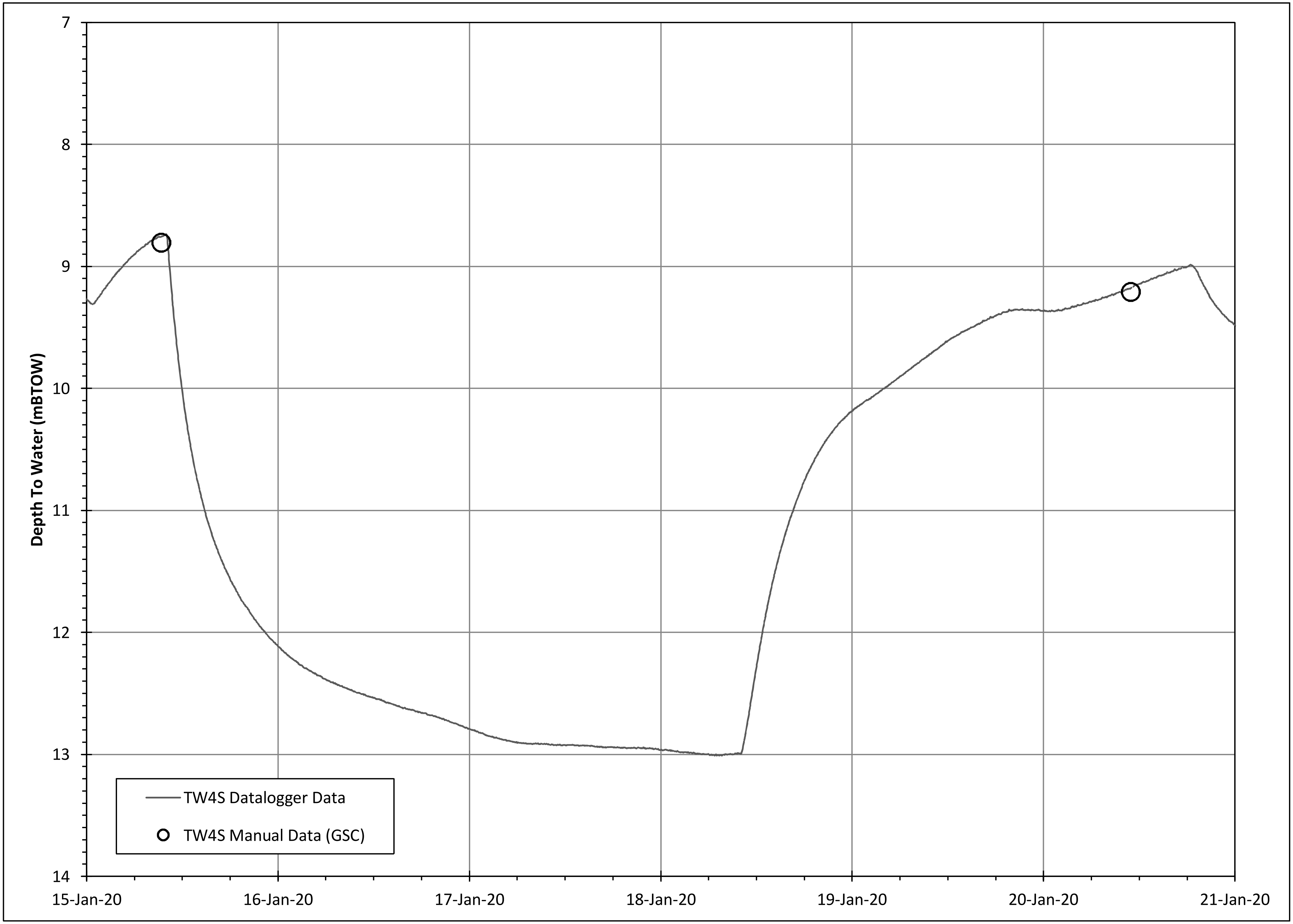
Groundwater Science Corp
Hydrogeological Assessment



H4 Second (3 day) Pump Test Hydrograph



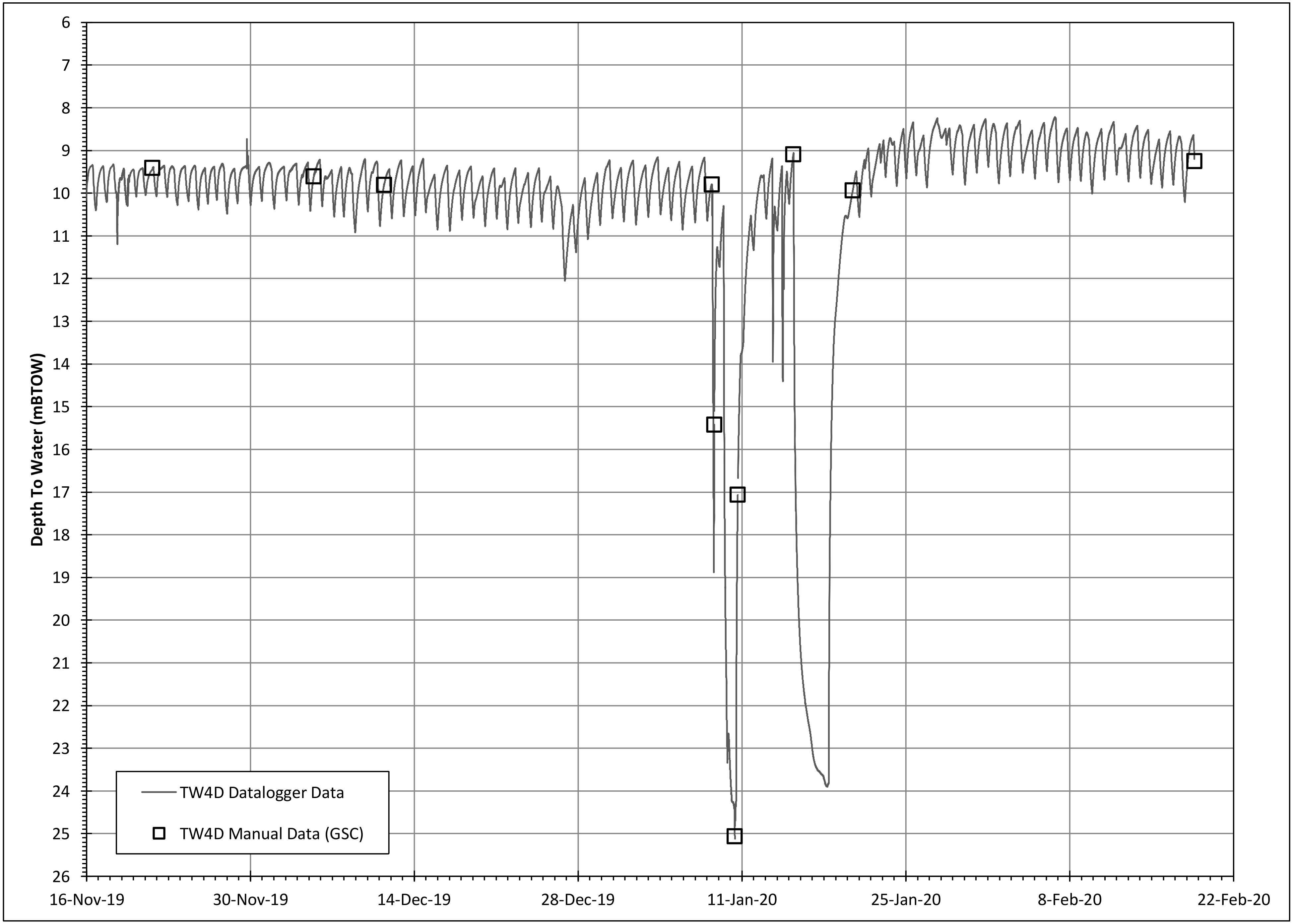
TW4-S Long Term Hydrograph



Town of Erin
Water Supply EA

H4 Second Pumping Test: TW4-S Hydrograph

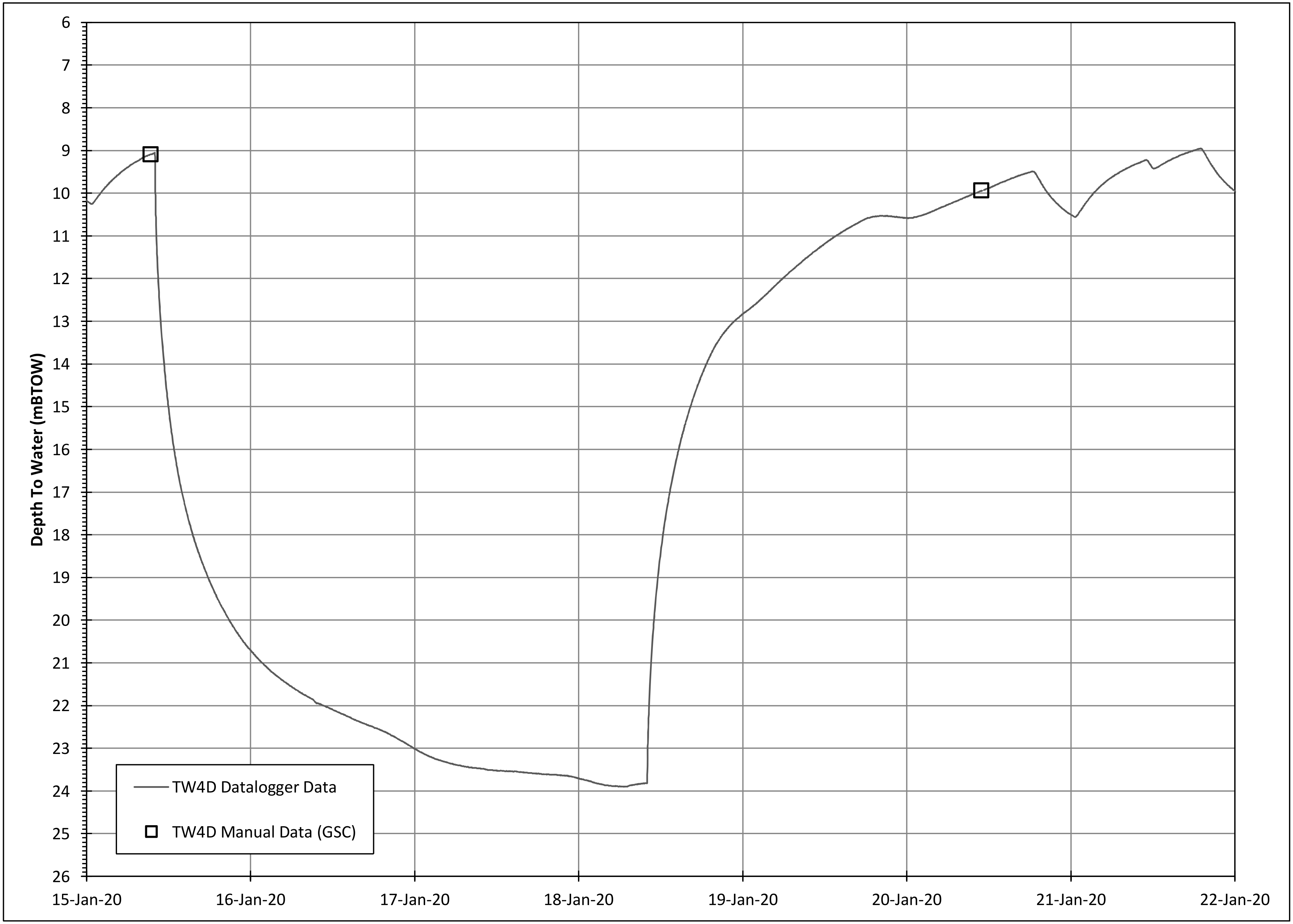
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

TW4-D Long Term Hydrograph

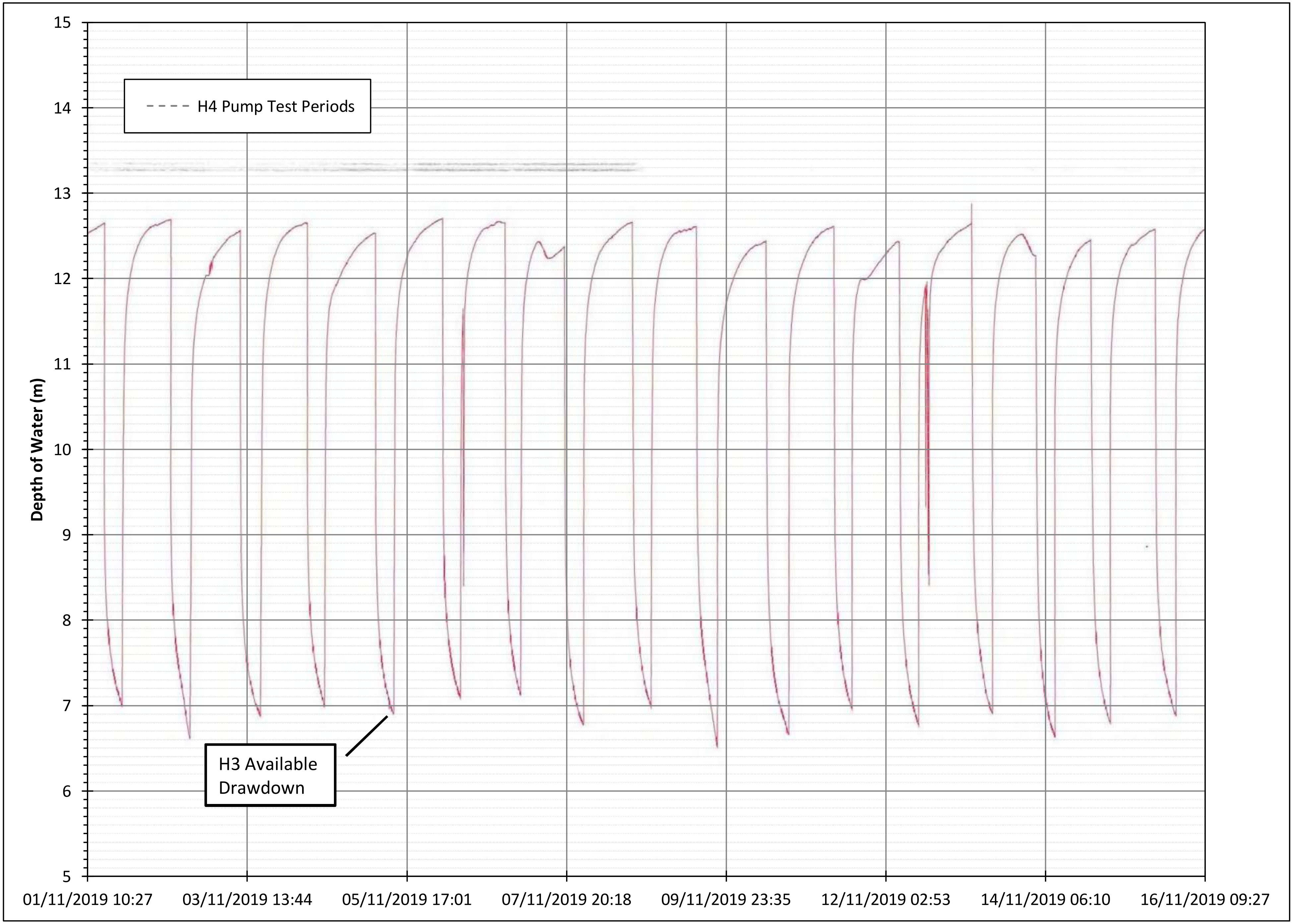
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

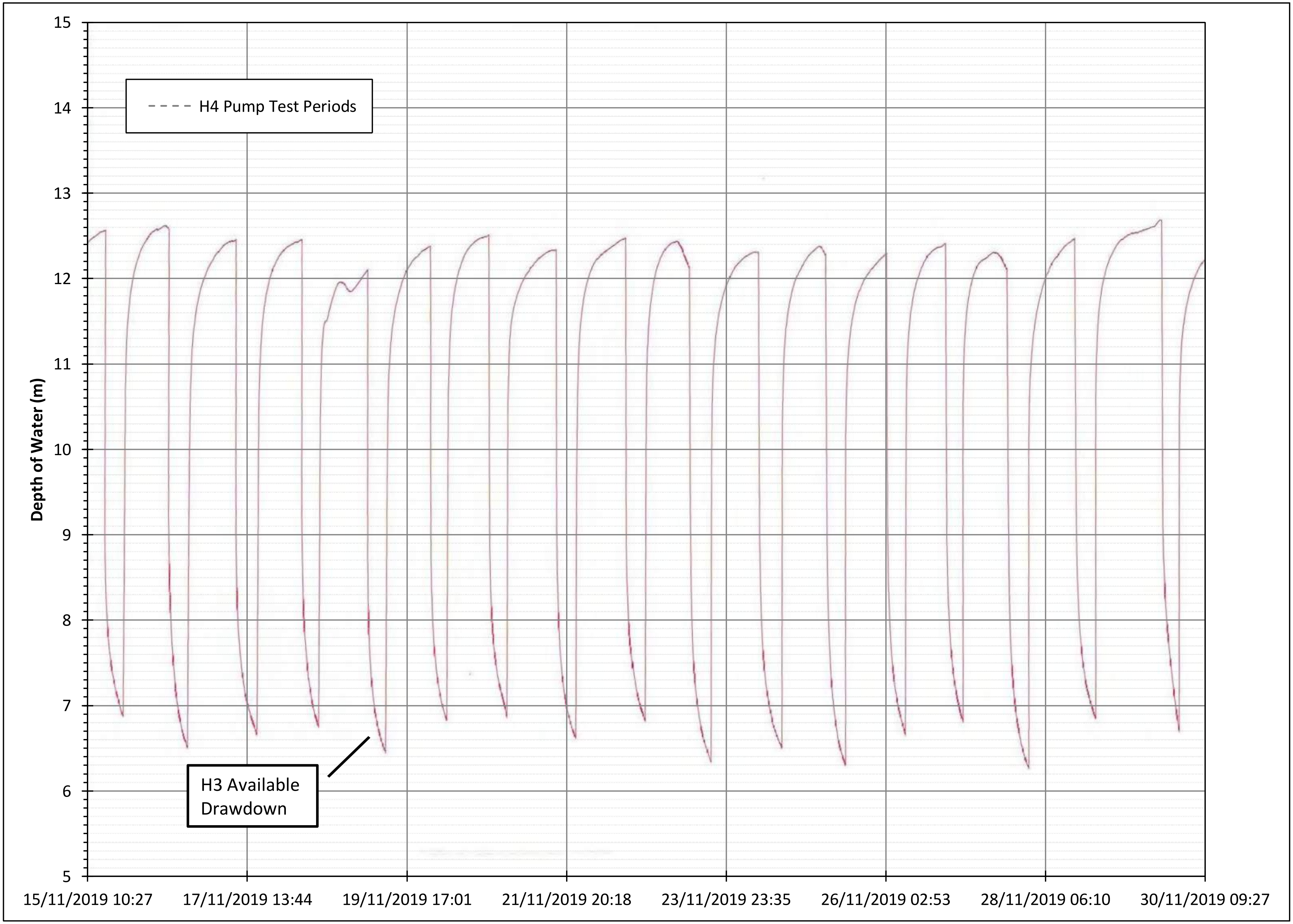
H4 Second Pumping Test: TW4-D Hydrograph

Groundwater Science Corp
Hydrogeological Assessment

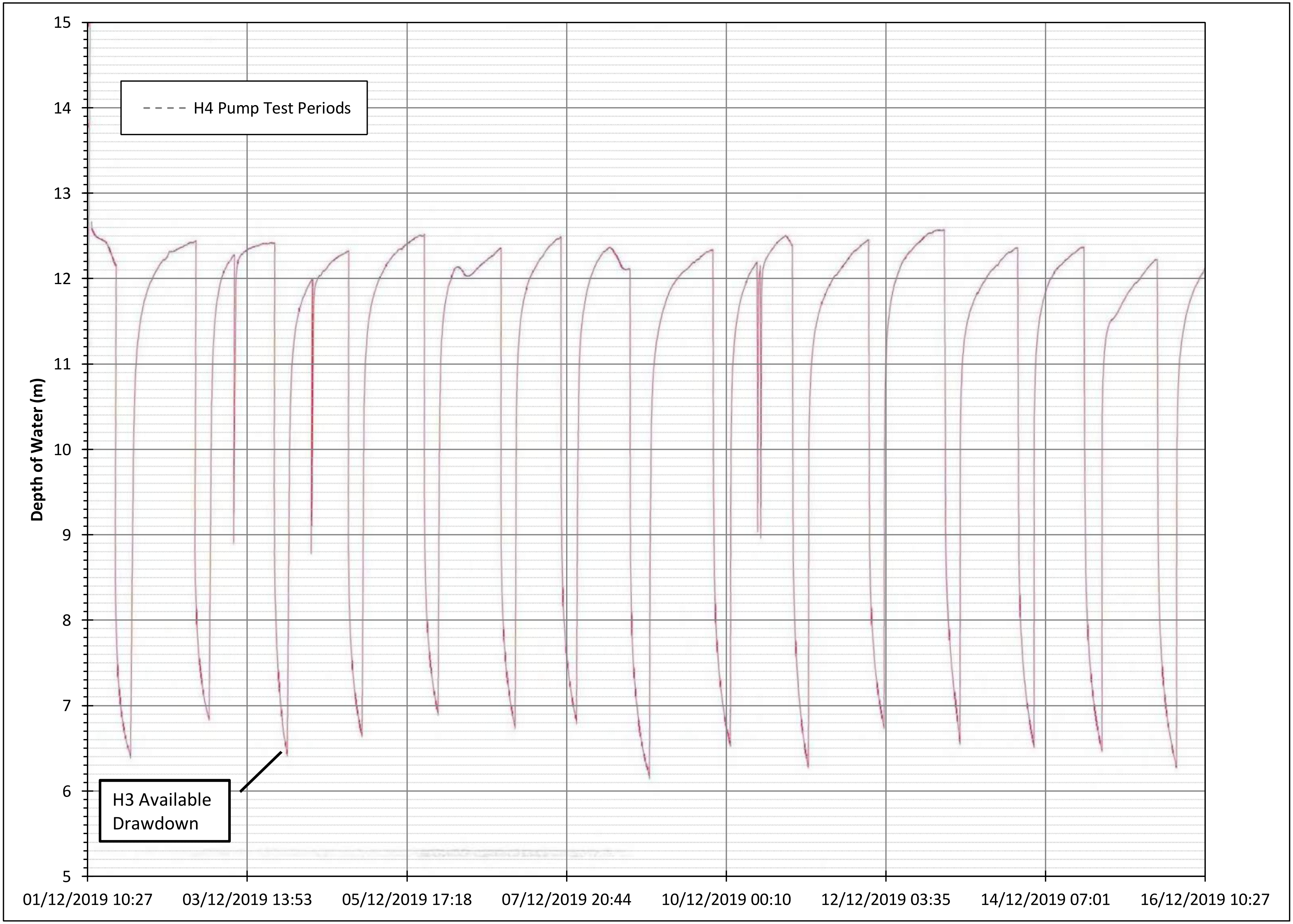


H3 (Glendevon well) SCADA Water Level Output

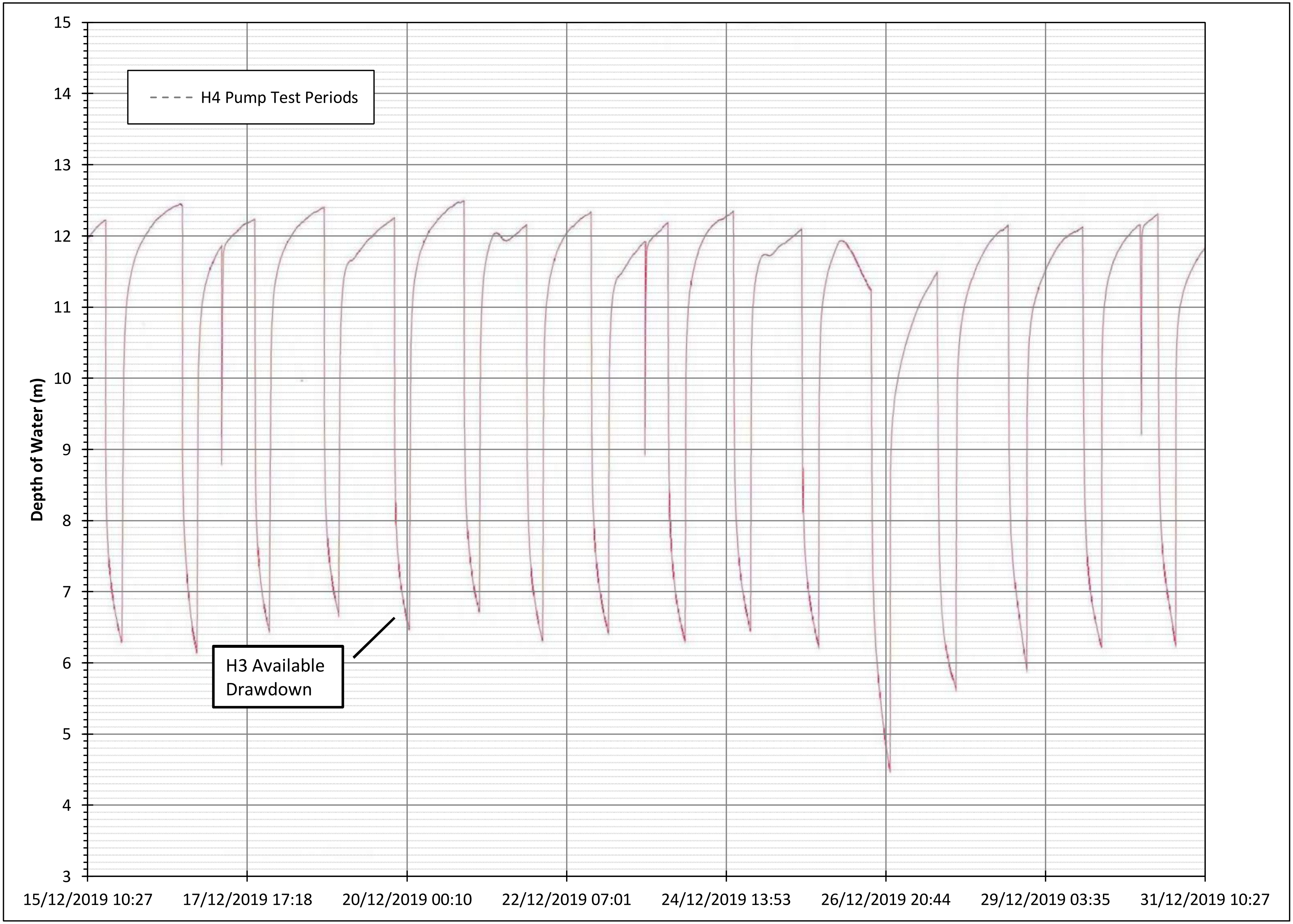
page 1 of 6



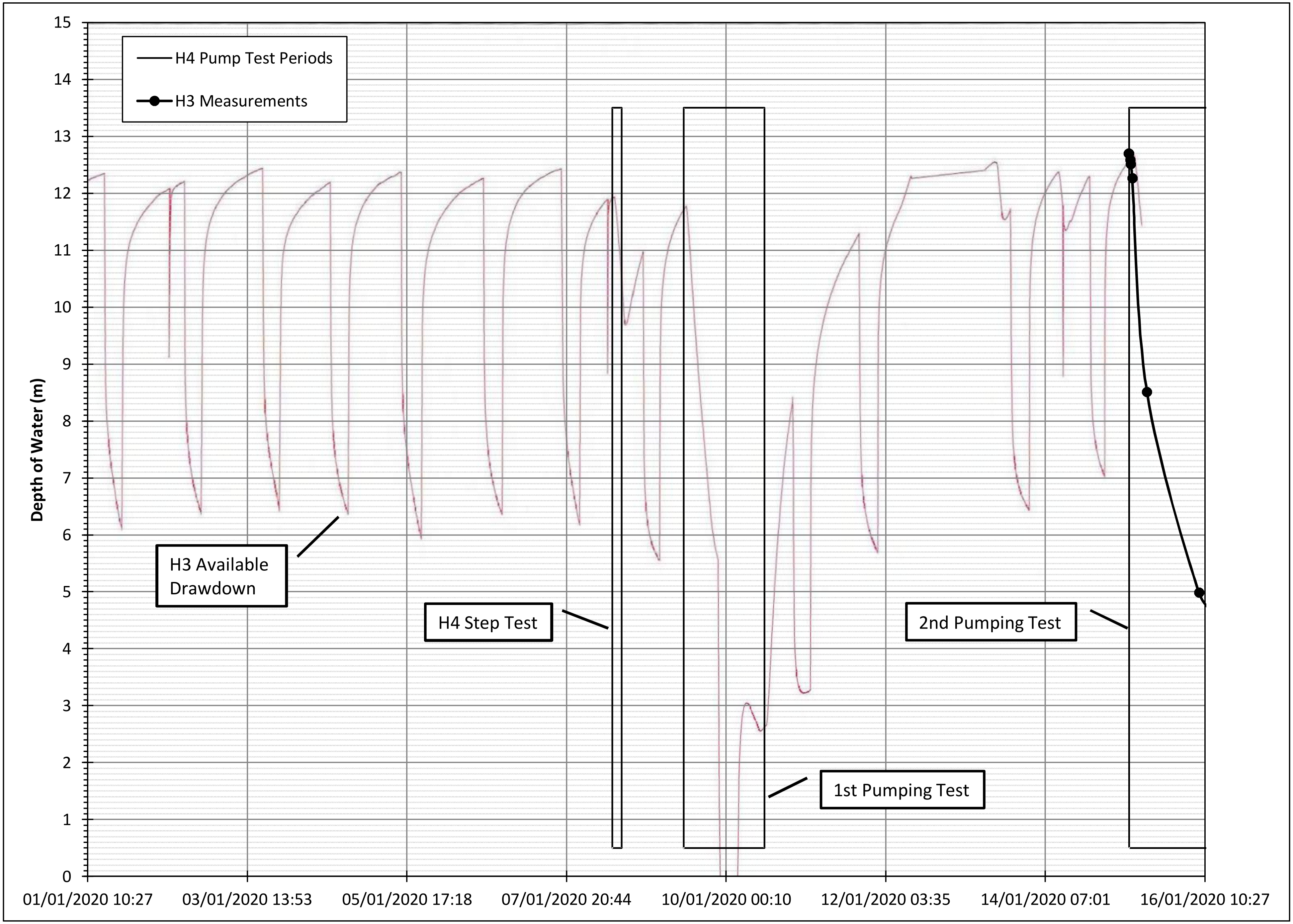
H3 (Glendevon well) SCADA Water Level Output



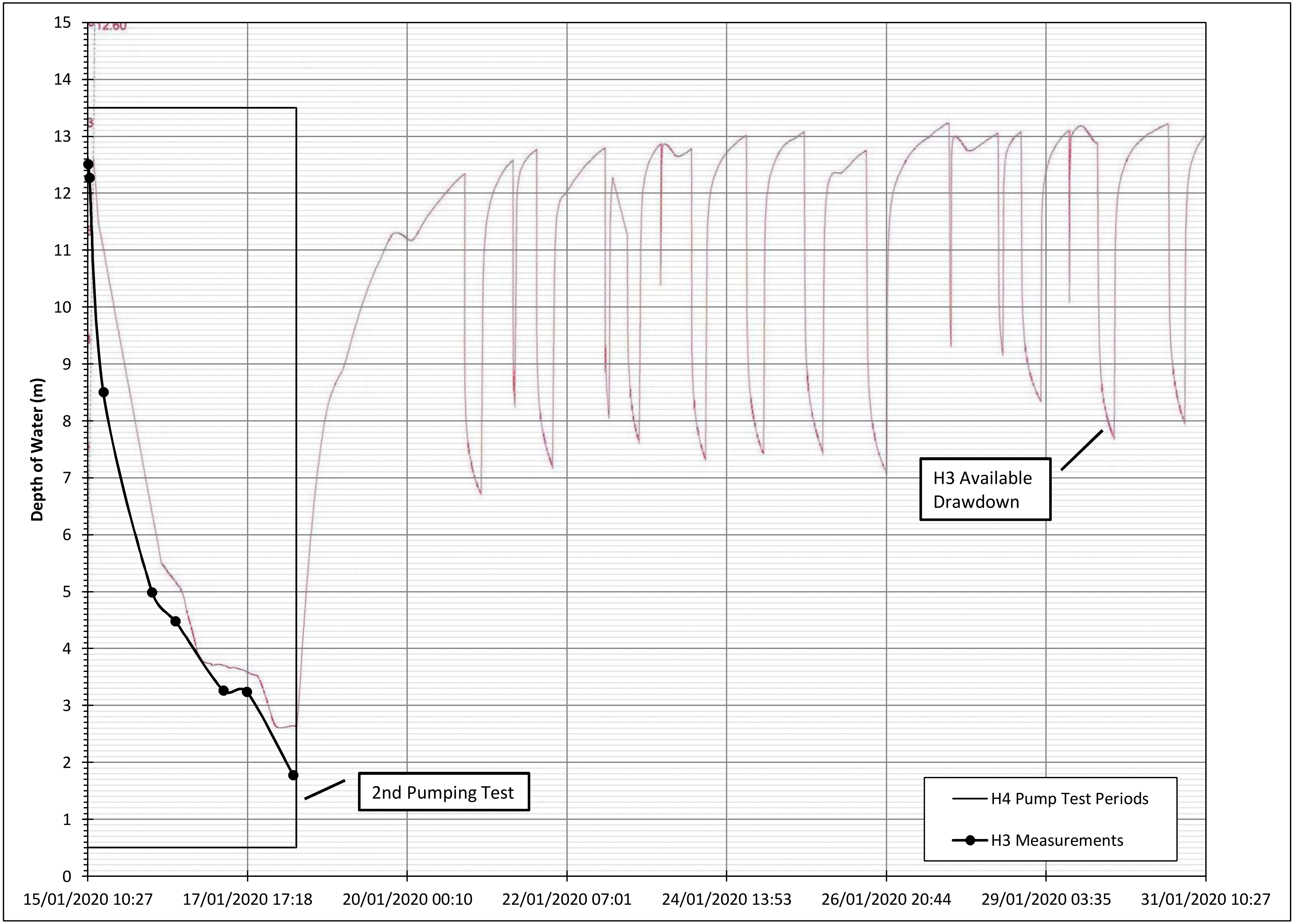
H3 (Glendevon well) SCADA Water Level Output



H3 (Glendevon well) SCADA Water Level Output



H3 (Glendevon well) SCADA Water Level Output



H3 (Glendevon well) SCADA Water Level Output

Appendix J
Water Quality Results

ALS					**Sample ID**	H4 START	H4 END	H4-24HR -20 4S
2/13/2020					**ALS ID**	L2403919-1	L2405008-1	L2406335-1
Multiple Work Orders					**Date Sampled**	1/9/2020 11:30:00 AM	1/13/2020 2:45:00 PM	1/16/2020 10:30:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water	Water
Colour, Apparent	CU	2	-	5	-	4.8	5.3	7
Colour, True	CU	2	-	-	-	-	2.6	-
Conductivity	umhos/cm	3	-	-	-	705	-	822
Hardness (as CaCO3)	mg/L	2.4	-	-	100	-	338 *	-
pH	pH units	0.1	-	6.5-8.5	-	7.94	8.2	7.79
Redox Potential	mV	-1000	-	-	-	214 *	-	307 *
Total Suspended Solids	mg/L	2	-	-	-	<2.0	<2.0	<2.0
Total Dissolved Solids	mg/L	20	-	500	-	475 *	423 *	579 *
Turbidity	NTU	0.1	-	5	-	1.03	-	1.48
Alkalinity, Bicarbonate (as CaCO3)	mg/L	2	-	-	-	181	-	182
Alkalinity, Carbonate (as CaCO3)	mg/L	2	-	-	-	<2.0	-	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	2	-	-	-	<2.0	-	<2.0
Alkalinity, Total (as CaCO3)	mg/L	2	-	-	500	181	179 *	182
Ammonia, Total (as N)	mg/L	0.01	-	-	-	0.074	0.072	0.091
Ammonia as N, Dissolved	mg/L	0.01	-	-	-	-	0.081	-
Bromate	ug/L	0.3	10	-	-	-	<0.30	-
Bromide (Br)	mg/L	0.1	-	-	-	<0.10	-	<0.10
Chlorate	mg/L	0.05	1	-	-	-	<0.050	-
Chloride (Cl)	mg/L	0.5	-	250	-	2.43	1.89	7.01
Chlorite	mg/L	0.05	1	-	-	-	<0.050	-
Computed Conductivity	uS/cm	n/a	-	-	-	732	-	868
Conductivity % Difference	%	n/a	-	-	-	4	-	5
Fluoride (F)	mg/L	0.02	1.5	-	-	0.527	0.533	0.489
Hardness (as CaCO3)	mg/L	n/a	-	-	-	371	-	414
Ion Balance	%	n/a	-	-	-	109	-	98
Langelier Index		n/a	-	-	-	1	-	1
Nitrate and Nitrite as N	mg/L	0.022	10	-	-	-	<0.022	-
Nitrate (as N)	mg/L	0.02	10	-	-	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	0.01	1	-	-	<0.010	<0.010	<0.010
Total Kjeldahl Nitrogen	mg/L	0.15	-	-	-	-	<0.15	-
Total Organic Nitrogen	mg/L	0.15	-	-	-	-	<0.15	-
Total Kjeldahl Nitrogen, Dissolved	mg/L	0.15	-	-	-	-	<0.15	-
Saturation pH	pH	n/a	-	-	-	7.22	-	7.18
Orthophosphate-Dissolved (as P)	mg/L	0.003	-	-	-	<0.0030	-	<0.0030
TDS (Calculated)	mg/L	n/a	-	-	-	451	-	551
Sulfate (SO4)	mg/L	0.3	-	500	-	199	199	276
Sulphide (as S)	mg/L	0.018	-	0.05	-	-	<0.018	-
Sulphide (as H2S)	mg/L	0.019	-	0.05	-	-	<0.019	-
Anion Sum	me/L	n/a	-	-	-	7.24	-	8.97
Cation Sum	me/L	n/a	-	-	-	7.88	-	8.83
Cation - Anion Balance	%	n/a	-	-	-	4	-	-1
Cyanide, Weak Acid Diss	mg/L	0.002	-	-	-	-	<0.0020	-
Dissolved Carbon Filtration Location		n/a	-	-	-	-	LAB	-
Dissolved Organic Carbon	mg/L	0.5	-	5	-	-	3.32	-
Chloramines	mg/L	0.05	3	-	-	-	<0.050	-
Chlorine, Free	mg/L	0.05	-	-	-	-	<0.050 *	-
Chlorine, Total	mg/L	0.05	-	-	-	-	<0.050 *	-
Silica Total	mg/L	0.21	-	-	-	11.8	-	11
Nonviable oocysts	oocysts	0	-	-	-	-	0	-
Cryptosporidium	oocysts/L	0.1	-	-	-	-	<0.1	-
E. Coli	CFU/100mL	0	0	-	-	0	0	0
Giardia	cysts/L	0.1	-	-	-	-	<0.1	-
Giardia Volume Filtered	L	0.1	-	-	-	-	8	-
Total Giardia	cysts/vol	1	-	-	-	-	<1	-
Nonviable Giardia	cysts	1	-	-	-	-	<1	-
Total Coliform Background	CFU/100mL	0	-	-	-	6	-	0
Total Coliforms	CFU/100mL	0	0	-	-	0	1	0
Viable Cysts	cysts	1	-	-	-	-	<1	-
Viable oocysts	oocysts	0	-	-	-	-	0	-

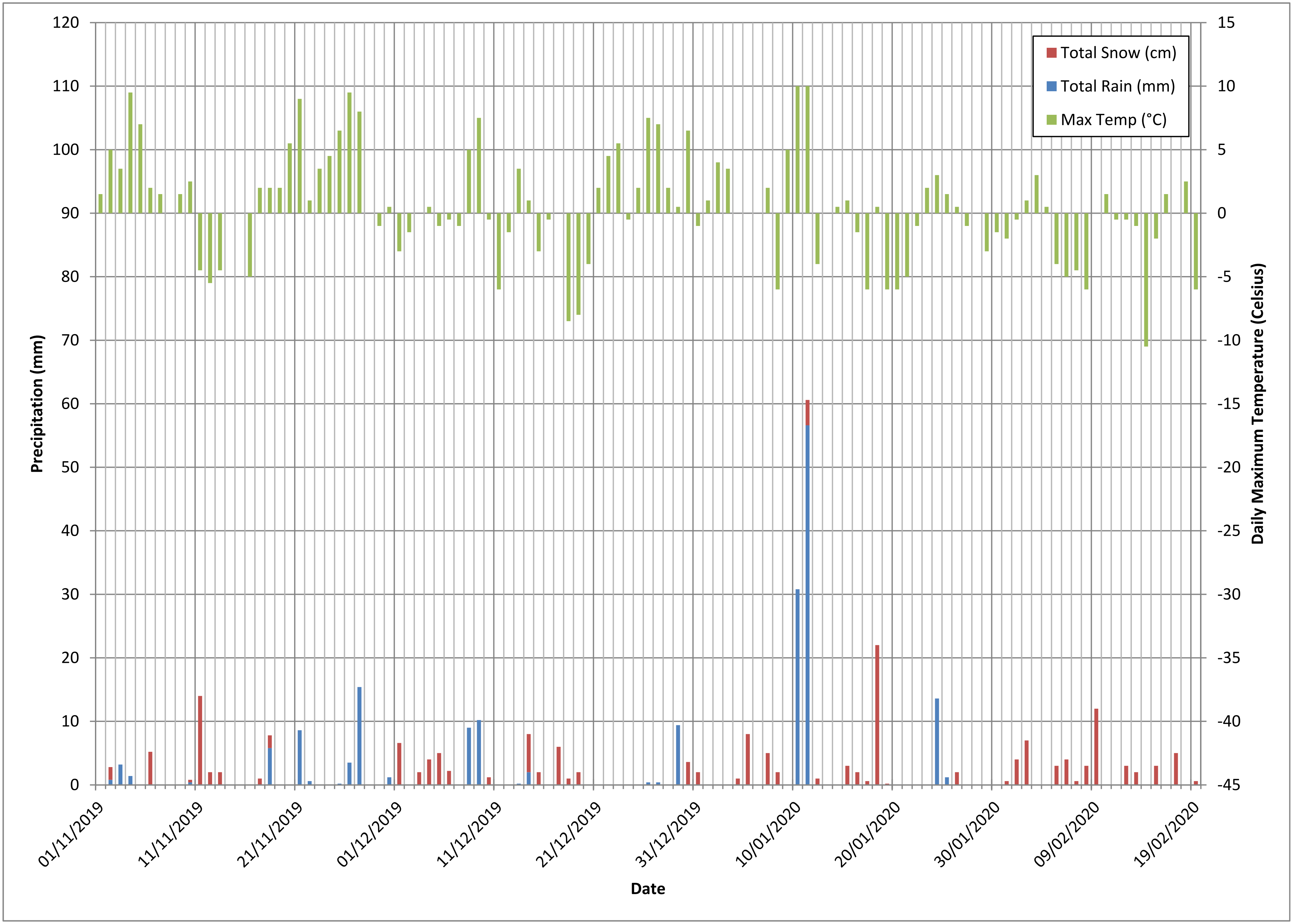
ALS					**Sample ID**	H4 START	H4 END	H4-24HR -20 4S
2/13/2020					**ALS ID**	L2403919-1	L2405008-1	L2406335-1
Multiple Work Orders					**Date Sampled**	1/9/2020 11:30:00 AM	1/13/2020 2:45:00 PM	1/16/2020 10:30:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water	Water
Sodium Adsorption Ratio	SAR	0.1	-	-	-	0.22	-	0.25
Aluminum (Al) Total	ug/L	10	-	-	100	-	<10	-
Aluminum (Al)-Total	mg/L	0.01	-	-	0.1	0.021	-	<0.010
Antimony (Sb) Total	ug/L	0.6	6	-	-	-	<0.60	-
Antimony (Sb)-Total	mg/L	0.0001	0.006	-	-	0.00014	-	0.00017
Arsenic (As) Total	ug/L	1	10	-	-	-	1.4	-
Arsenic (As)-Total	mg/L	0.0001	0.01	-	-	0.00122	-	0.0011
Barium (Ba) Total	ug/L	10	1000	-	-	-	18	-
Barium (Ba)-Total	mg/L	0.0002	1	-	-	0.0202	-	0.0179
Beryllium (Be)-Total	mg/L	0.0001	-	-	-	<0.00010	-	<0.00010
Bismuth (Bi)-Total	mg/L	0.00005	-	-	-	<0.000050	-	<0.000050
Boron (B) Total	ug/L	50	5000	-	-	-	<50	-
Boron (B)-Total	mg/L	0.01	5	-	-	0.03	-	0.031
Cadmium (Cd) Total	ug/L	0.1	5	-	-	-	0.11	-
Cadmium (Cd)-Total	mg/L	0.00001	0.005	-	-	0.00009	-	0.00017
Calcium (Ca) Total	mg/L	0.5	-	-	-	-	89.3	-
Calcium (Ca)-Total	mg/L	0.5	-	-	-	101	-	114
Cesium (Cs)-Total	mg/L	0.00001	-	-	-	0.00001	-	0.000012
Chromium (Cr) Total	ug/L	1	50	-	-	-	<1.0	-
Chromium (Cr)-Total	mg/L	0.0005	0.05	-	-	<0.00050	-	<0.00050
Cobalt (Co)-Total	mg/L	0.0001	-	-	-	0.00027	-	0.00033
Copper (Cu) Total	ug/L	1	-	1000	-	-	<1.0	-
Copper (Cu)-Total	mg/L	0.001	-	1	-	0.0019	-	<0.0010
Iron (Fe) Total	ug/L	50	-	300	-	-	139	-
Iron (Fe)-Total	mg/L	0.05	-	0.3	-	0.147	-	0.131
Lead (Pb) Total	ug/L	1	10	-	-	-	3.1	-
Lead (Pb)-Total	mg/L	0.0001	0.01	-	-	0.00296	-	0.00404
Magnesium (Mg) Total	mg/L	0.5	-	-	-	-	28	-
Magnesium (Mg)-Total	mg/L	0.05	-	-	-	29.2	-	31.6
Manganese (Mn) Total	ug/L	1	-	50	-	-	10.8	-
Manganese (Mn)-Total	mg/L	0.0005	-	0.05	-	0.0142	-	0.0227
Molybdenum (Mo)-Total	mg/L	0.00005	-	-	-	0.00741	-	0.00674
Nickel (Ni)-Total	mg/L	0.0005	-	-	-	0.00167	-	0.00181
Phosphorus (P)-Total	mg/L	0.05	-	-	-	<0.050	-	<0.050
Potassium (K)-Total	mg/L	0.05	-	-	-	1.03	-	1.01
Rubidium (Rb)-Total	mg/L	0.0002	-	-	-	0.001	-	0.0012
Selenium (Se) Total	ug/L	5	50	-	-	-	<5.0	-
Selenium (Se)-Total	mg/L	0.00005	0.05	-	-	<0.000050	-	<0.000050
Silicon (Si)-Total	mg/L	0.1	-	-	-	5.53	-	5.13
Silver (Ag)-Total	mg/L	0.00005	-	-	-	<0.000050	-	<0.000050
Sodium (Na) Total	mg/L	0.5	20	200	-	-	8.88	-
Sodium (Na)-Total	mg/L	0.5	20	200	-	9.8	-	11.8
Strontium (Sr)-Total	mg/L	0.001	-	-	-	1.36	-	1.7
Sulfur (S)-Total	mg/L	0.5	-	-	-	70.9	-	91
Tellurium (Te)-Total	mg/L	0.0002	-	-	-	<0.00020	-	<0.00020
Thallium (Tl)-Total	mg/L	0.00001	-	-	-	0.000015	-	<0.000020 *
Thorium (Th)-Total	mg/L	0.0001	-	-	-	<0.00010	-	<0.00010
Tin (Sn)-Total	mg/L	0.0001	-	-	-	0.00019	-	0.00015
Titanium (Ti)-Total	mg/L	0.0003	-	-	-	0.00092	-	<0.00030
Tungsten (W)-Total	mg/L	0.0001	-	-	-	<0.00010	-	<0.00010
Uranium (U) Total	ug/L	5	20	-	-	-	<5.0	-
Uranium (U)-Total	mg/L	0.00001	0.02	-	-	0.000752	-	0.000641
Vanadium (V)-Total	mg/L	0.0005	-	-	-	<0.00050	-	<0.00050
Zinc (Zn) Total	ug/L	3	-	5000	-	-	25	-
Zinc (Zn)-Total	mg/L	0.003	-	5	-	0.0233	-	0.0226
Zirconium (Zr)-Total	mg/L	0.0003	-	-	-	<0.00030	-	<0.00030
Mercury	ug/L	0.1	1	-	-	-	<0.10	-
Chromium, Hexavalent	mg/L	0.0005	-	-	-	-	<0.00050	-
Acetone	ug/L	20	-	-	-	-	<20	-

ALS					Sample ID	H4 START	H4 END	H4-24HR -20 4S
2/13/2020					ALS ID	L2403919-1	L2405008-1	L2406335-1
Multiple Work Orders					Date Sampled	1/9/2020 11:30:00 AM	1/13/2020 2:45:00 PM	1/16/2020 10:30:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water	Water
Benzene	ug/L	0.5	1	-	-	-	<0.50	-
Bromodichloromethane	ug/L	1	-	-	-	-	<1.0	-
Bromoform	ug/L	1	-	-	-	-	<1.0	-
Bromomethane	ug/L	0.5	-	-	-	-	<0.50	-
Carbon Disulfide	ug/L	1	-	-	-	-	<1.0	-
Carbon tetrachloride	ug/L	0.5	2	-	-	-	<0.50	-
Chlorobenzene	ug/L	0.5	80	30	-	-	<0.50	-
Dibromochloromethane	ug/L	1	-	-	-	-	<1.0	-
Chloroethane	ug/L	1	-	-	-	-	<1.0	-
Chloroform	ug/L	1	-	-	-	-	<1.0	-
Chloromethane	ug/L	1	-	-	-	-	<1.0	-
1,2-Dibromoethane	ug/L	0.2	-	-	-	-	<0.20	-
1,2-Dichlorobenzene	ug/L	0.5	200	3	-	-	<0.50	-
1,3-Dichlorobenzene	ug/L	0.5	-	-	-	-	<0.50	-
1,4-Dichlorobenzene	ug/L	0.5	5	1	-	-	<0.50	-
Dichlorodifluoromethane	ug/L	1	-	-	-	-	<1.0	-
1,1-Dichloroethane	ug/L	0.5	-	-	-	-	<0.50	-
1,2-Dichloroethane	ug/L	0.5	5	-	-	-	<0.50	-
1,1-Dichloroethylene	ug/L	0.5	14	-	-	-	<0.50	-
cis-1,2-Dichloroethylene	ug/L	0.5	-	-	-	-	<0.50	-
trans-1,2-Dichloroethylene	ug/L	0.5	-	-	-	-	<0.50	-
Dichloromethane	ug/L	2	50	-	-	-	<2.0	-
1,2-Dichloropropane	ug/L	0.5	-	-	-	-	<0.50	-
cis-1,3-Dichloropropene	ug/L	0.3	-	-	-	-	<0.30	-
trans-1,3-Dichloropropene	ug/L	0.3	-	-	-	-	<0.30	-
Ethylbenzene	ug/L	0.5	140	2.4	-	-	<0.50	-
n-Hexane	ug/L	0.5	-	-	-	-	<0.50	-
2-Hexanone	ug/L	20	-	-	-	-	<20	-
Methyl Ethyl Ketone	ug/L	20	-	-	-	-	<20	-
Methyl Isobutyl Ketone	ug/L	20	-	-	-	-	<20	-
MTBE	ug/L	0.5	15	-	-	-	<0.50	-
Styrene	ug/L	0.5	-	-	-	-	<0.50	-
1,1,1,2-Tetrachloroethane	ug/L	0.5	-	-	-	-	<0.50	-
1,1,2,2-Tetrachloroethane	ug/L	0.5	-	-	-	-	<0.50	-
Tetrachloroethylene	ug/L	0.5	10	-	-	-	<0.50	-
Toluene	ug/L	0.5	60	24	-	-	<0.50	-
1,1,1-Trichloroethane	ug/L	0.5	-	-	-	-	<0.50	-
1,1,2-Trichloroethane	ug/L	0.5	-	-	-	-	<0.50	-
Trichloroethylene	ug/L	0.5	5	-	-	-	<0.50	-
Trichlorofluoromethane	ug/L	1	-	-	-	-	<1.0	-
Vinyl chloride	ug/L	0.5	1	-	-	-	<0.50	-
o-Xylene	ug/L	0.3	-	-	-	-	<0.30	-
m+p-Xylenes	ug/L	0.4	-	-	-	-	<0.40	-
Xylenes (Total)	ug/L	0.5	90	300	-	-	<0.50	-
4-Bromofluorobenzene	%	Surrogate	-	-	-	-	98.7	-
1,4-Difluorobenzene	%	Surrogate	-	-	-	-	102.3 *	-
Benzo(a)pyrene	ug/L	0.005	0.01	-	-	-	<0.0050	-
d14-Terphenyl	%	Surrogate	-	-	-	-	96.2	-
Bromodichloromethane	ug/L	2	-	-	-	-	<2.0	-
Bromoform	ug/L	2	-	-	-	-	<2.0	-
Dibromochloromethane	ug/L	2	-	-	-	-	<2.0	-
Chloroform	ug/L	2	-	-	-	-	<2.0	-
Total THMs	ug/L	4	100	-	-	-	<4.0	-
Dibromoacetic Acid	ug/L	1	-	-	-	-	<1.0	-
Dichloroacetic Acid	ug/L	1	-	-	-	-	<1.0	-
Total Haloacetic Acids 5	ug/L	2.2	80	-	-	-	<2.2	-
Bromoacetic Acid	ug/L	1	-	-	-	-	<1.0	-
Chloroacetic acid	ug/L	1	-	-	-	-	<1.0	-
Trichloroacetic Acid	ug/L	1	-	-	-	-	<1.0	-

ALS					Sample ID	H4 START	H4 END	H4-24HR -20 4S
2/13/2020					ALS ID	L2403919-1	L2405008-1	L2406335-1
Multiple Work Orders					Date Sampled	1/9/2020 11:30:00 AM	1/13/2020 2:45:00 PM	1/16/2020 10:30:00 AM
Analyte	Units	LOR	Micro & Chemical Standards	AO	Upper Limit	Water	Water	Water
2-Bromobutanoic Acid	%	Surrogate	-	-	-	-	101	-
N-Nitrosodimethylamine	ng/L	0.5	9	-	-	-	<0.50 *	-
N-Nitrosodimethylamine (Surr.)	%	Surrogate	-	-	-	-	59	-
Aroclor 1242	ug/L	0.02	-	-	-	-	<0.020	-
Aroclor 1254	ug/L	0.02	-	-	-	-	<0.020	-
Aroclor 1260	ug/L	0.02	-	-	-	-	<0.020	-
Total PCBs	ug/L	0.035	3	-	-	-	<0.035	-
d14-Terphenyl	%	Surrogate	-	-	-	-	105.2	-
alpha-Chlordane	ug/L	0.1	-	-	-	-	<0.10	-
gamma-Chlordane	ug/L	0.1	-	-	-	-	<0.10	-
p,p-DDD	ug/L	0.1	-	-	-	-	<0.10	-
p,p-DDE	ug/L	0.1	-	-	-	-	<0.10	-
o,p-DDT	ug/L	0.1	-	-	-	-	<0.10	-
p,p-DDT	ug/L	0.1	-	-	-	-	<0.10	-
Oxychlordane	ug/L	0.1	-	-	-	-	<0.10	-
d14-Terphenyl	%	Surrogate	-	-	-	-	114.7	-
Bromoxynil	ug/L	0.2	5	-	-	-	<0.20	-
2,4-D	ug/L	0.2	100	-	-	-	<0.20	-
Dicamba	ug/L	0.2	120	-	-	-	<0.20	-
Glyphosate	ug/L	5	280	-	-	-	<5.0 *	-
MCPA	ug/L	0.2	100	-	-	-	<0.20	-
Picloram	ug/L	0.2	190	-	-	-	<0.20	-
2,4-Dichlorophenylacetic Acid	%	Surrogate	-	-	-	-	96	-
Aldicarb	ug/L	0.9	9	-	-	-	<0.90	-
Alachlor	ug/L	0.1	5	-	-	-	<0.10	-
Atrazine	ug/L	0.1	-	-	-	-	<0.10	-
Atrazine & Metabolites	ug/L	0.2	5	-	-	-	<0.20	-
Azinphos-methyl	ug/L	0.1	20	-	-	-	<0.10	-
Carbaryl	ug/L	0.2	90	-	-	-	<0.20	-
Carbofuran	ug/L	0.2	90	-	-	-	<0.20	-
Chlorpyrifos	ug/L	0.1	90	-	-	-	<0.10	-
Diazinon	ug/L	0.1	20	-	-	-	<0.10	-
2,4-Dichlorophenol	ug/L	0.3	900	0.3	-	-	<0.30	-
Dimethoate	ug/L	0.1	20	-	-	-	<0.10	-
Diquat	ug/L	1	70	-	-	-	<1.0 *	-
Diuron	ug/L	1	150	-	-	-	<1.0	-
Atrazine Desethyl	ug/L	0.1	-	-	-	-	<0.10	-
Malathion	ug/L	0.1	190	-	-	-	<0.10	-
Diclofop-methyl	ug/L	0.2	9	-	-	-	<0.20	-
Metolachlor	ug/L	0.1	50	-	-	-	<0.10	-
Metribuzin	ug/L	0.1	80	-	-	-	<0.10	-
Paraquat	ug/L	1	10	-	-	-	<1.0 *	-
Pentachlorophenol	ug/L	0.5	60	30	-	-	<0.50	-
Phorate	ug/L	0.1	2	-	-	-	<0.10	-
Prometryne	ug/L	0.1	1	-	-	-	<0.10	-
Simazine	ug/L	0.1	10	-	-	-	<0.10	-
Terbufos	ug/L	0.2	1	-	-	-	<0.20	-
2,3,4,6-Tetrachlorophenol	ug/L	0.5	100	1	-	-	<0.50	-
Triallate	ug/L	0.1	230	-	-	-	<0.10	-
2,4,6-Trichlorophenol	ug/L	0.5	5	2	-	-	<0.50	-
Trifluralin	ug/L	0.1	45	-	-	-	<0.10	-
2-Fluorobiphenyl	%	Surrogate	-	-	-	-	113.5	-
2,4,6-Tribromophenol	%	Surrogate	-	-	-	-	103.8	-
2,3,7,8-TCDD	pg/L	1.8	-	-	-	-	<1.8 *	-
1,2,3,7,8-PeCDD	pg/L	0.6	-	-	-	-	<0.60 *	-
1,2,3,4,7,8-HxCDD	pg/L	0.62	-	-	-	-	<0.62 *	-
1,2,3,6,7,8-HxCDD	pg/L	0.59	-	-	-	-	<0.59 *	-
1,2,3,7,8,9-HxCDD	pg/L	0.59	-	-	-	-	<0.59 *	-
1,2,3,4,6,7,8-HpCDD	pg/L	1.1	-	-	-	-	<1.1 *	-

ALS					**Sample ID**	H4 START	H4 END	H4-24HR -20 4S
2/13/2020					**ALS ID**	L2403919-1	L2405008-1	L2406335-1
Multiple Work Orders					**Date Sampled**	1/9/2020 11:30:00 AM	1/13/2020 2:45:00 PM	1/16/2020 10:30:00 AM
Analyte	**Units**	**LOR**	**Micro & Chemical Standards**	**AO**	**Upper Limit**	Water	Water	Water
OCDD	pg/L	1.7	-	-	-	-	<1.7 *	-
Total-TCDD	pg/L	1.8	-	-	-	-	<1.8 *	-
Total TCDD # Homologues		n/a	-	-	-	-	0	-
Total-PeCDD	pg/L	0.6	-	-	-	-	<0.60 *	-
Total PeCDD # Homologues		n/a	-	-	-	-	0	-
Total-HxCDD	pg/L	0.62	-	-	-	-	<0.62 *	-
Total HxCDD # Homologues		n/a	-	-	-	-	0	-
Total-HpCDD	pg/L	1.1	-	-	-	-	<1.1 *	-
Total HpCDD # Homologues		n/a	-	-	-	-	0	-
2,3,7,8-TCDF	pg/L	1.1	-	-	-	-	<1.1 *	-
1,2,3,7,8-PeCDF	pg/L	0.57	-	-	-	-	<0.57 *	-
2,3,4,7,8-PeCDF	pg/L	0.52	-	-	-	-	<0.52 *	-
1,2,3,4,7,8-HxCDF	pg/L	0.44	-	-	-	-	<0.44 *	-
1,2,3,6,7,8-HxCDF	pg/L	0.42	-	-	-	-	<0.42 *	-
1,2,3,7,8,9-HxCDF	pg/L	0.7	-	-	-	-	<0.70 *	-
2,3,4,6,7,8-HxCDF	pg/L	0.45	-	-	-	-	<0.45 *	-
1,2,3,4,6,7,8-HpCDF	pg/L	0.63	-	-	-	-	<0.63 *	-
1,2,3,4,7,8,9-HpCDF	pg/L	0.86	-	-	-	-	<0.86 *	-
OCDF	pg/L	1.9	-	-	-	-	<1.9 *	-
Total-TCDF	pg/L	1.1	-	-	-	-	<1.1 *	-
Total TCDF # Homologues		n/a	-	-	-	-	0	-
Total-PeCDF	pg/L	0.57	-	-	-	-	<0.57 *	-
Total PeCDF # Homologues		n/a	-	-	-	-	0	-
Total-HxCDF	pg/L	0.7	-	-	-	-	<0.70 *	-
Total HxCDF # Homologues		n/a	-	-	-	-	0	-
Total-HpCDF	pg/L	0.86	-	-	-	-	<0.86 *	-
Total HpCDF # Homologues		n/a	-	-	-	-	0	-
13C12-2,3,7,8-TCDD	%	Surrogate	-	-	-	-	69	-
13C12-1,2,3,7,8-PeCDD	%	Surrogate	-	-	-	-	73	-
13C12-1,2,3,4,7,8-HxCDD	%	Surrogate	-	-	-	-	68	-
13C12-1,2,3,6,7,8-HxCDD	%	Surrogate	-	-	-	-	82	-
13C12-1,2,3,4,6,7,8-HpCDD	%	Surrogate	-	-	-	-	71	-
13C12-OCDD	%	Surrogate	-	-	-	-	40	-
13C12-2,3,7,8-TCDF	%	Surrogate	-	-	-	-	68	-
13C12-1,2,3,7,8-PeCDF	%	Surrogate	-	-	-	-	75	-
13C12-2,3,4,7,8-PeCDF	%	Surrogate	-	-	-	-	69	-
13C12-1,2,3,4,7,8-HxCDF	%	Surrogate	-	-	-	-	72	-
13C12-1,2,3,6,7,8-HxCDF	%	Surrogate	-	-	-	-	79	-
13C12-2,3,4,6,7,8-HxCDF	%	Surrogate	-	-	-	-	74	-
13C12-1,2,3,7,8,9-HxCDF	%	Surrogate	-	-	-	-	64	-
13C12-1,2,3,4,6,7,8-HpCDF	%	Surrogate	-	-	-	-	67	-
13C12-1,2,3,4,7,8,9-HpCDF	%	Surrogate	-	-	-	-	69	-
37Cl4-2,3,7,8-TCDD (Cleanup)	%	Surrogate	-	-	-	-	71	-
Microcystin	ug/L	0.2	1.5	-	-	-	<0.20	-
Nitrilotriacetic Acid (NTA)	mg/L	0.2	0.4	-	-	-	<0.20	-
Lower Bound PCDD/F TEQ (WHO 2005)	pg/L	n/a	-	-	-	-	0	-
Mid Point PCDD/F TEQ (WHO 2005)	pg/L	n/a	-	-	-	-	1.55	-
Upper Bound PCDD/F TEQ (WHO 2005)	pg/L	n/a	-	-	-	-	3.09	-
* = Result Qualified	🟩 Within Guideline		🟥 Exceeds Guideline					
Applied Guideline:	**Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON Drinking Water Standards, Objectives and Guidelines**							

Appendix K
Climate Data



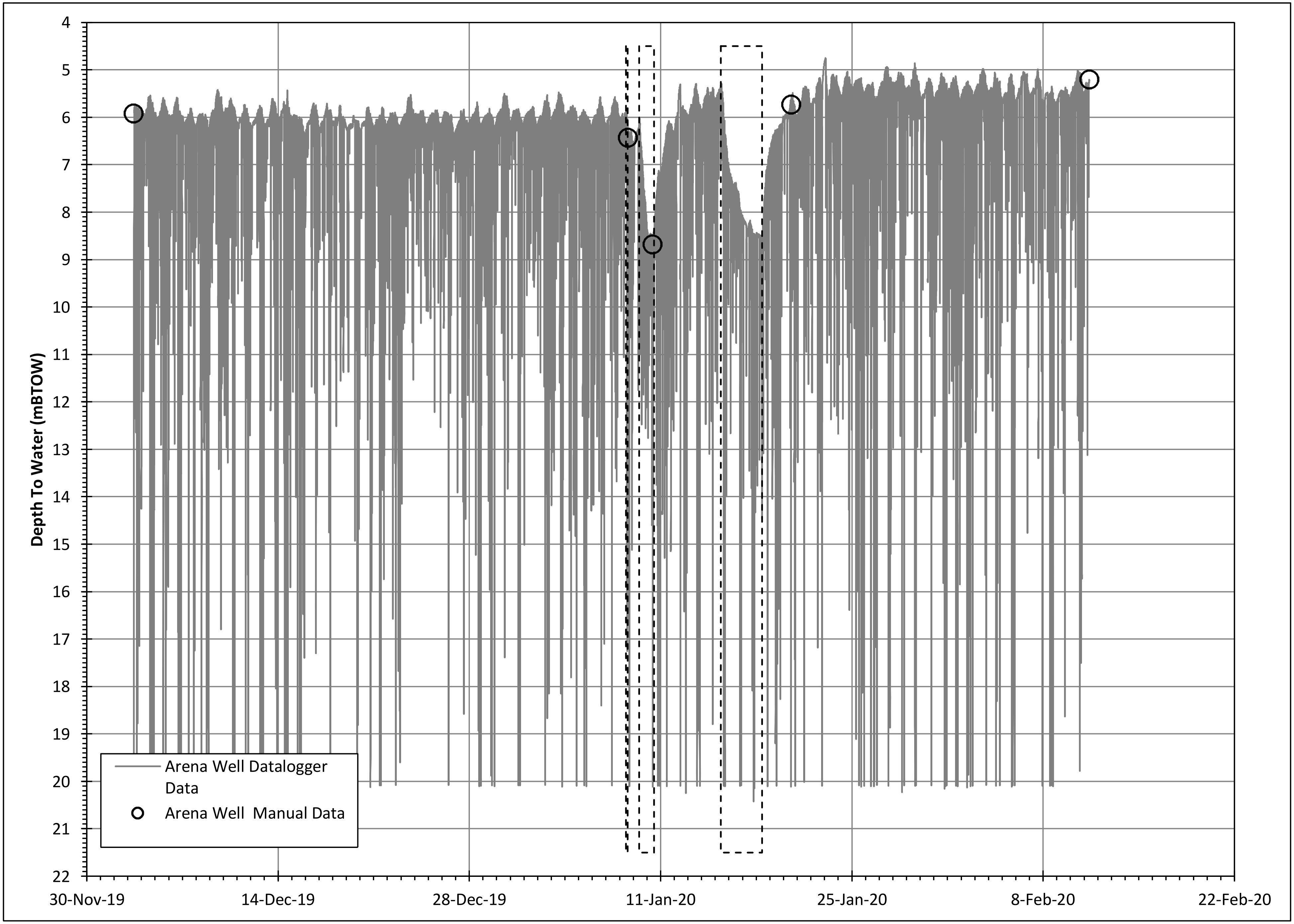
Town of Erin
Water Supply EA

Climate Summary - Environment Canada Fergus Shand Dam Station

Groundwater Science Corp
Hydrogeological Assessment

Appendix L

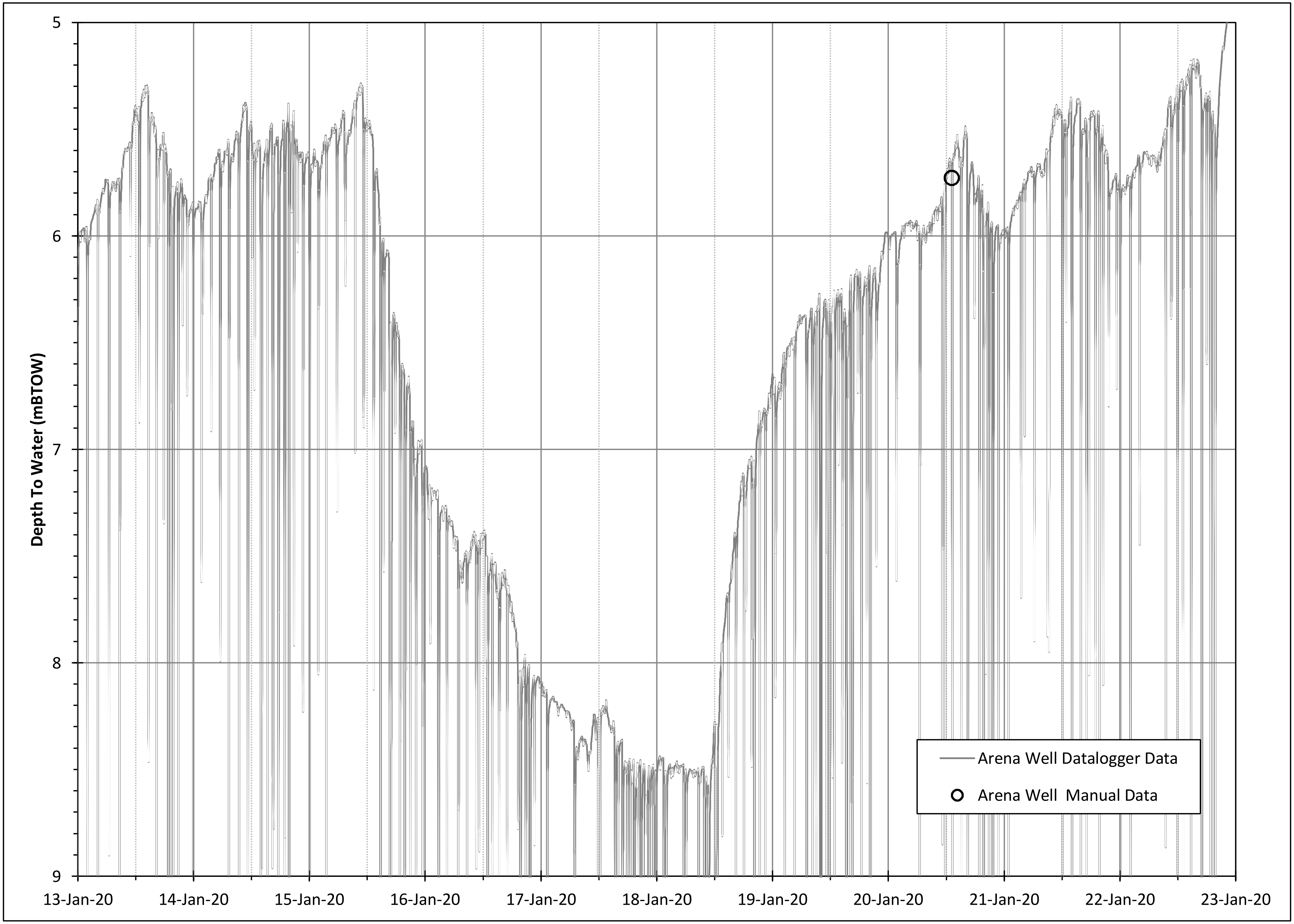
Pump Test Results: Observation Wells



Town of Erin
Water Supply EA

Arena Well Long Term Hydrograph

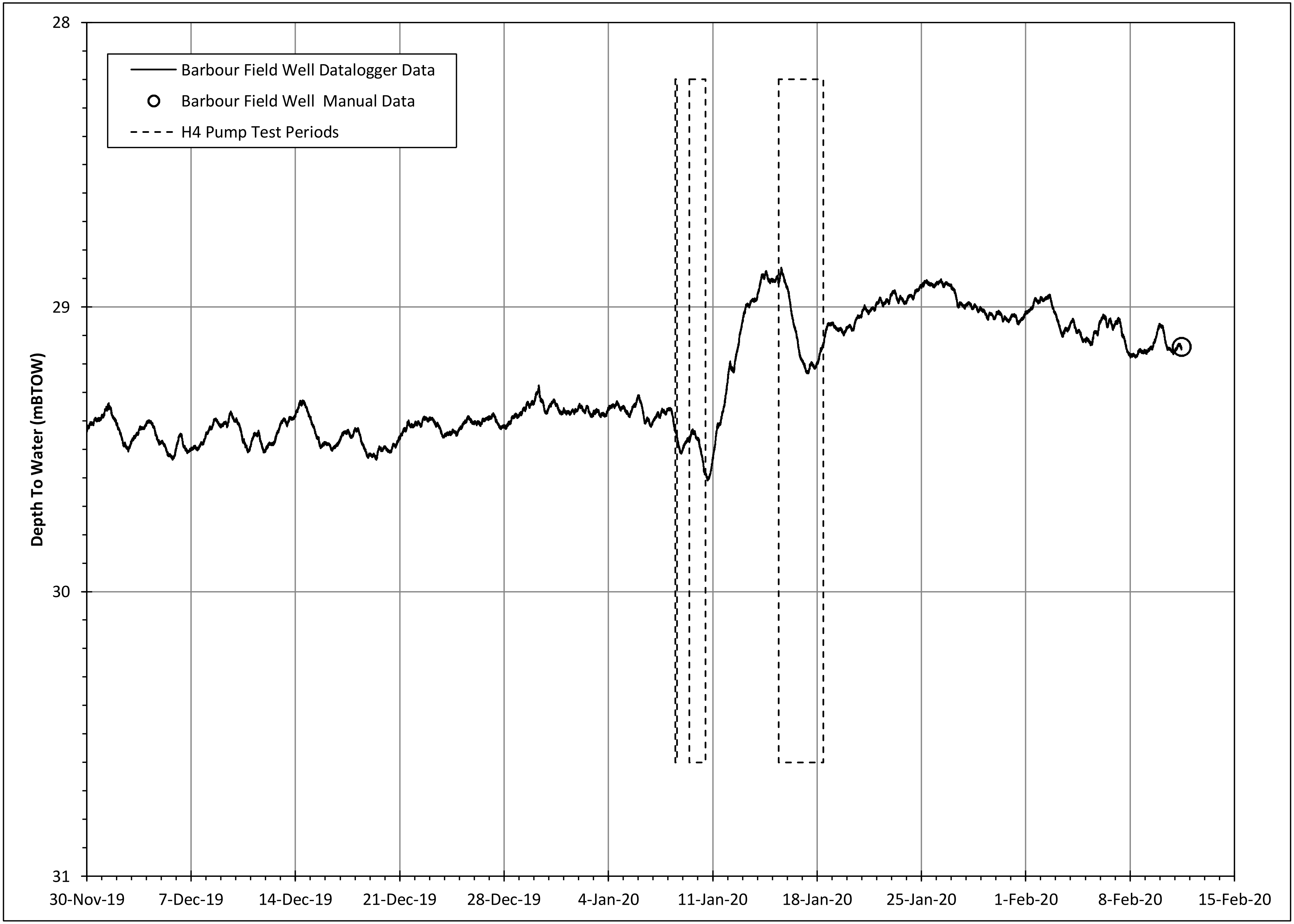
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

H4 Second Pumping Test: Arena Well Hydrograph

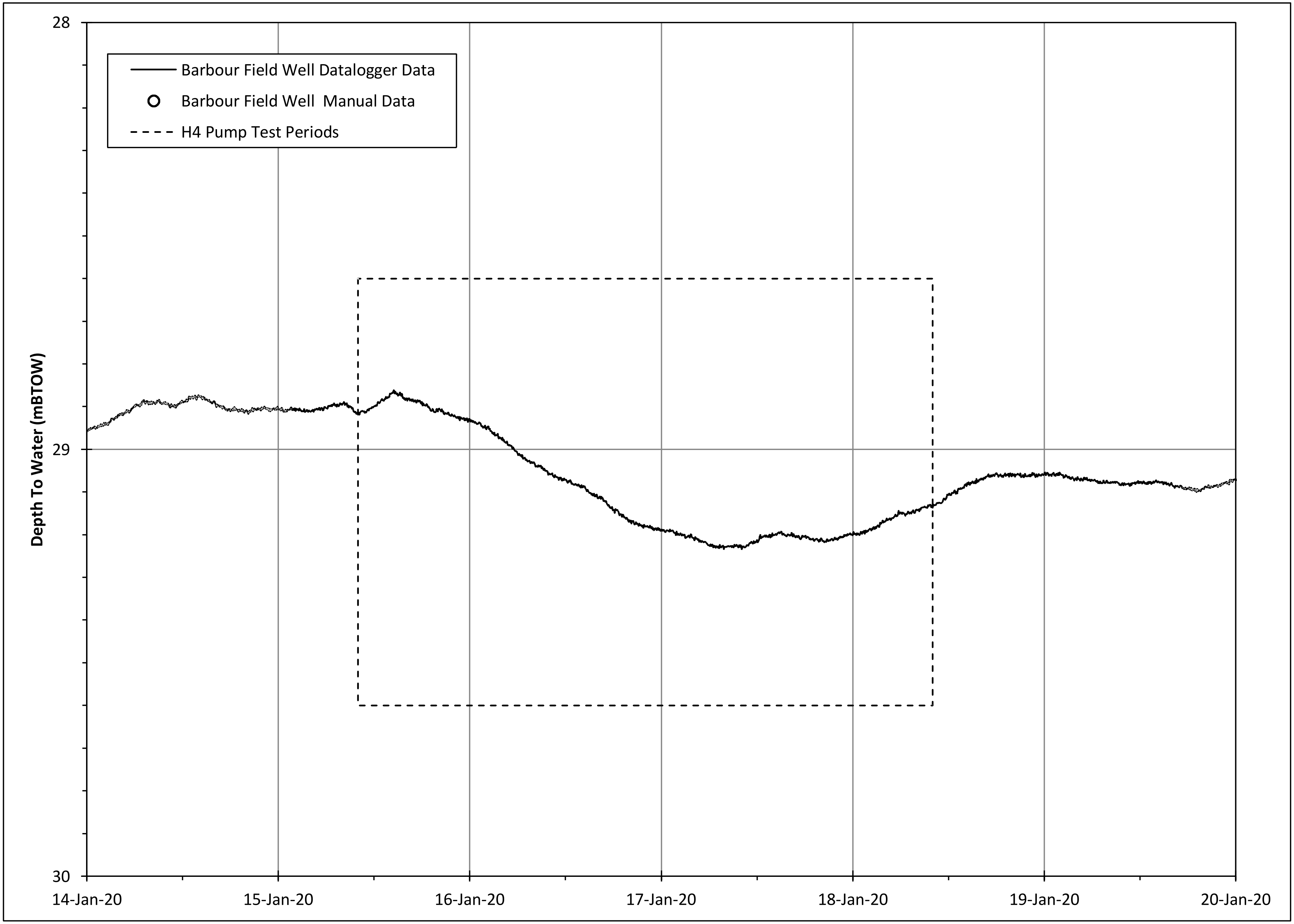
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

Barbour Field Well Long Term Hydrograph

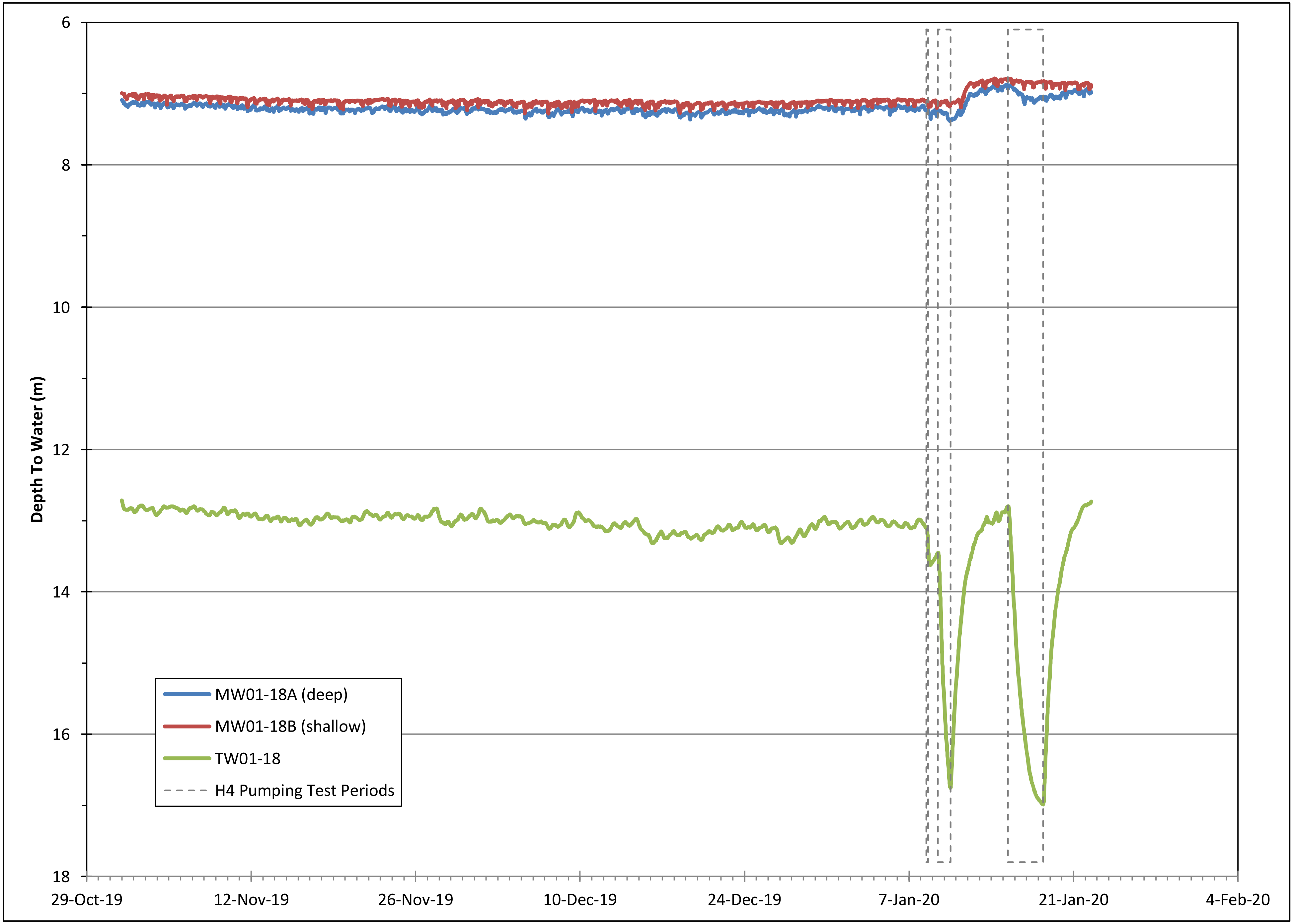
Groundwater Science Corp
Hydrogeological Assessment



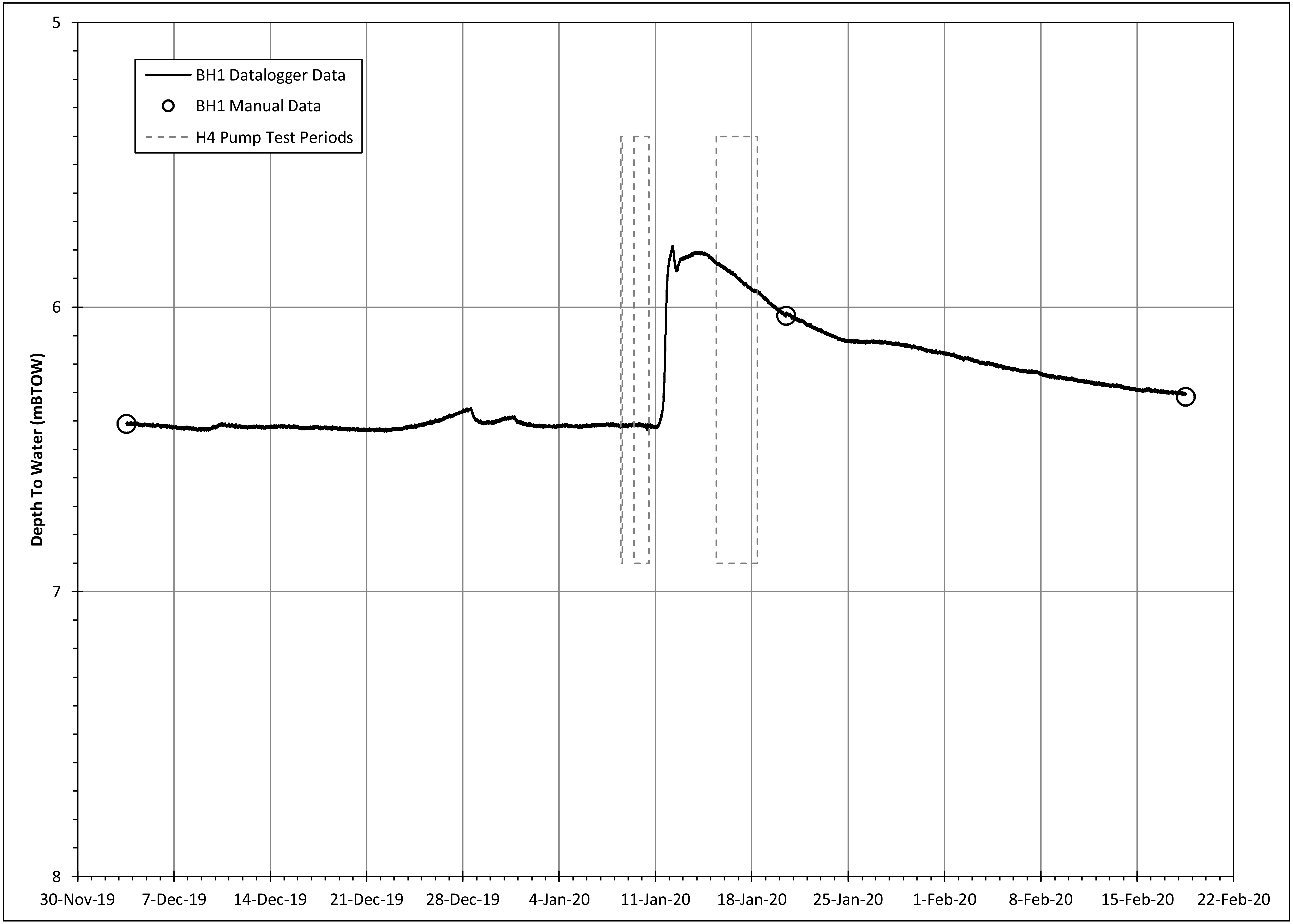
Town of Erin
Water Supply EA

H4 Second Pumping Test: Barbour Field Hydrograph

Groundwater Science Corp
Hydrogeological Assessment



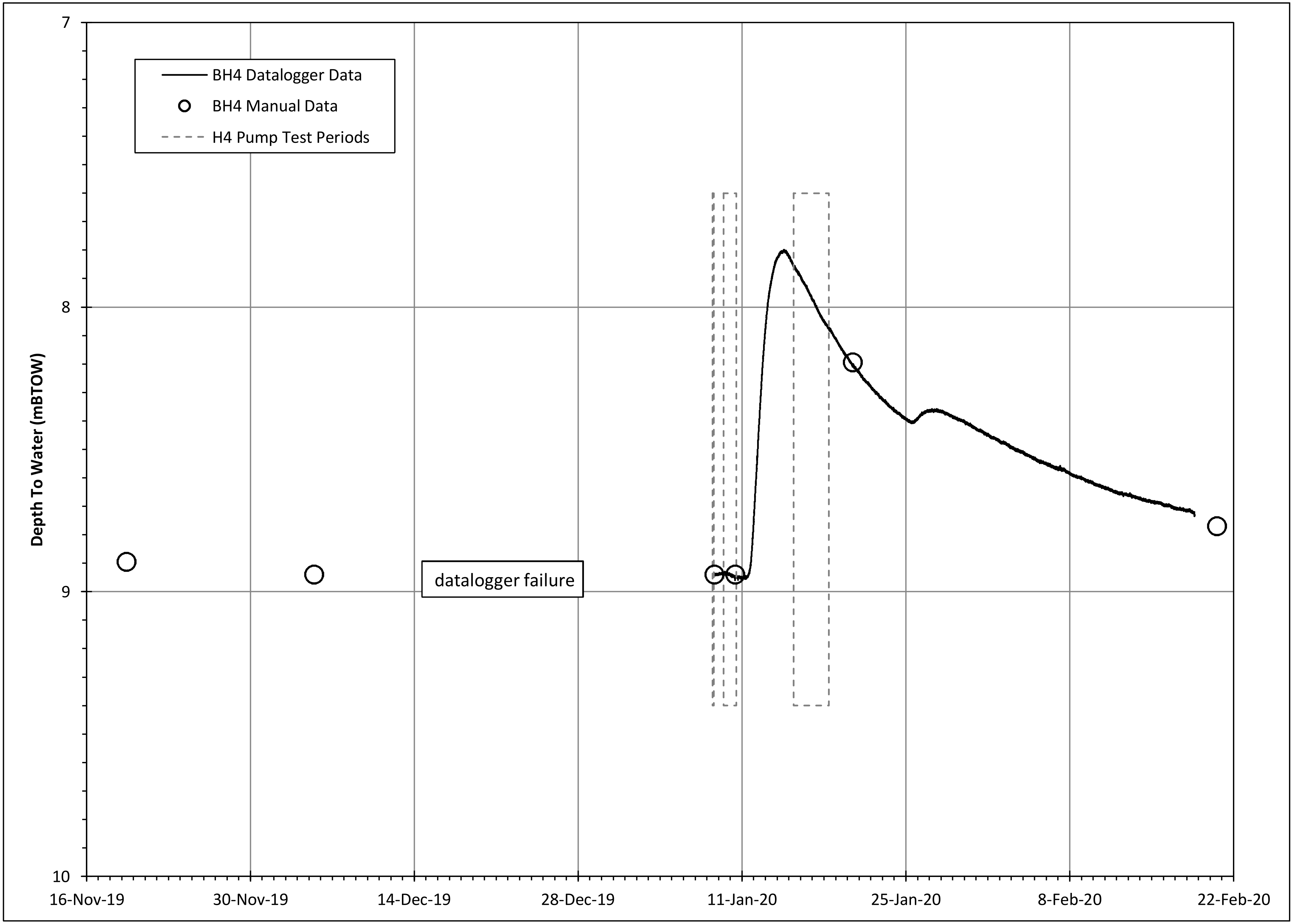
TW01-19 and MW01-19 A/B Long Term Hydrographs
(data provided by Golder Associates)



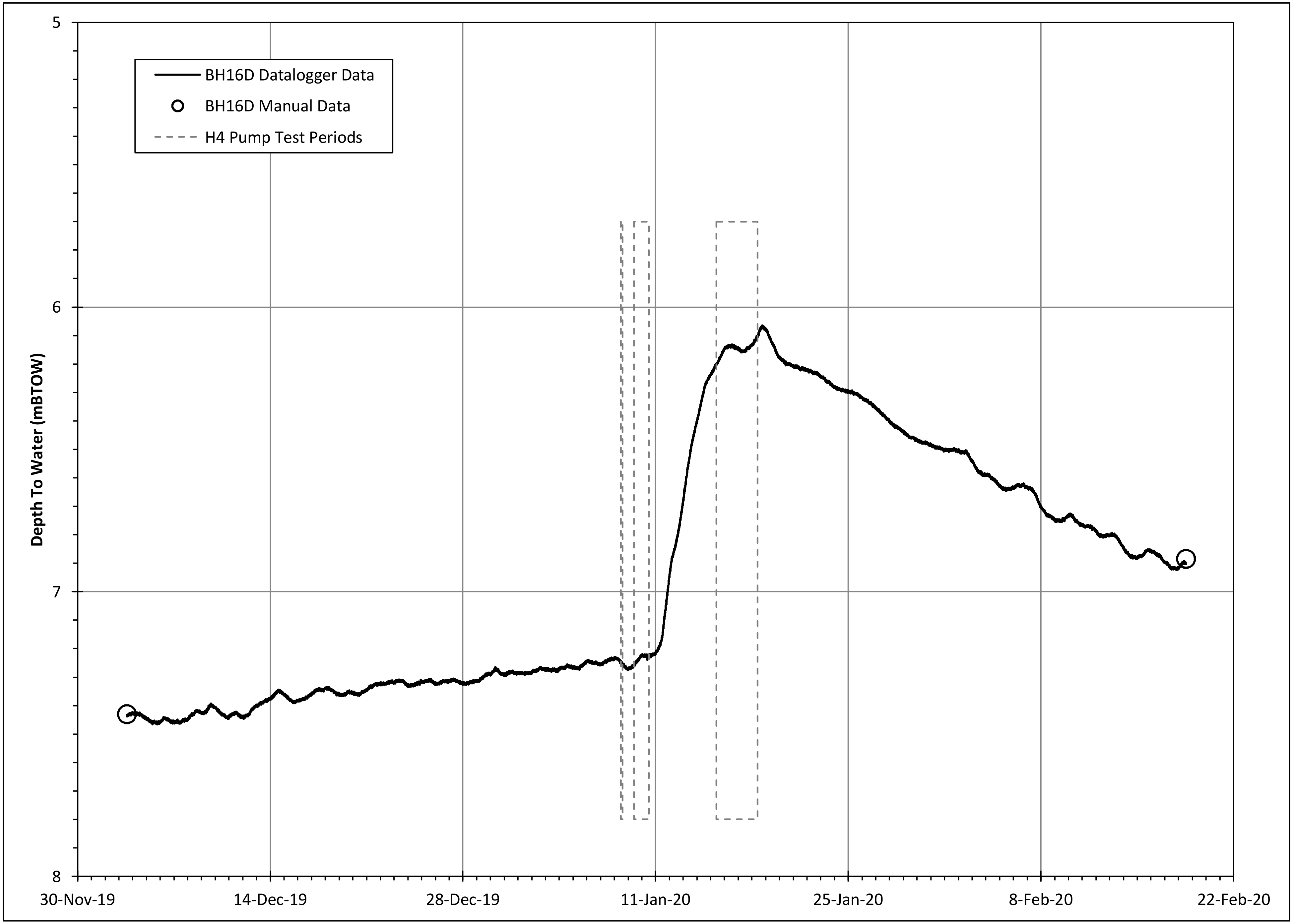
Town of Erin
Water Supply EA

BH1 Long Term Hydrograph

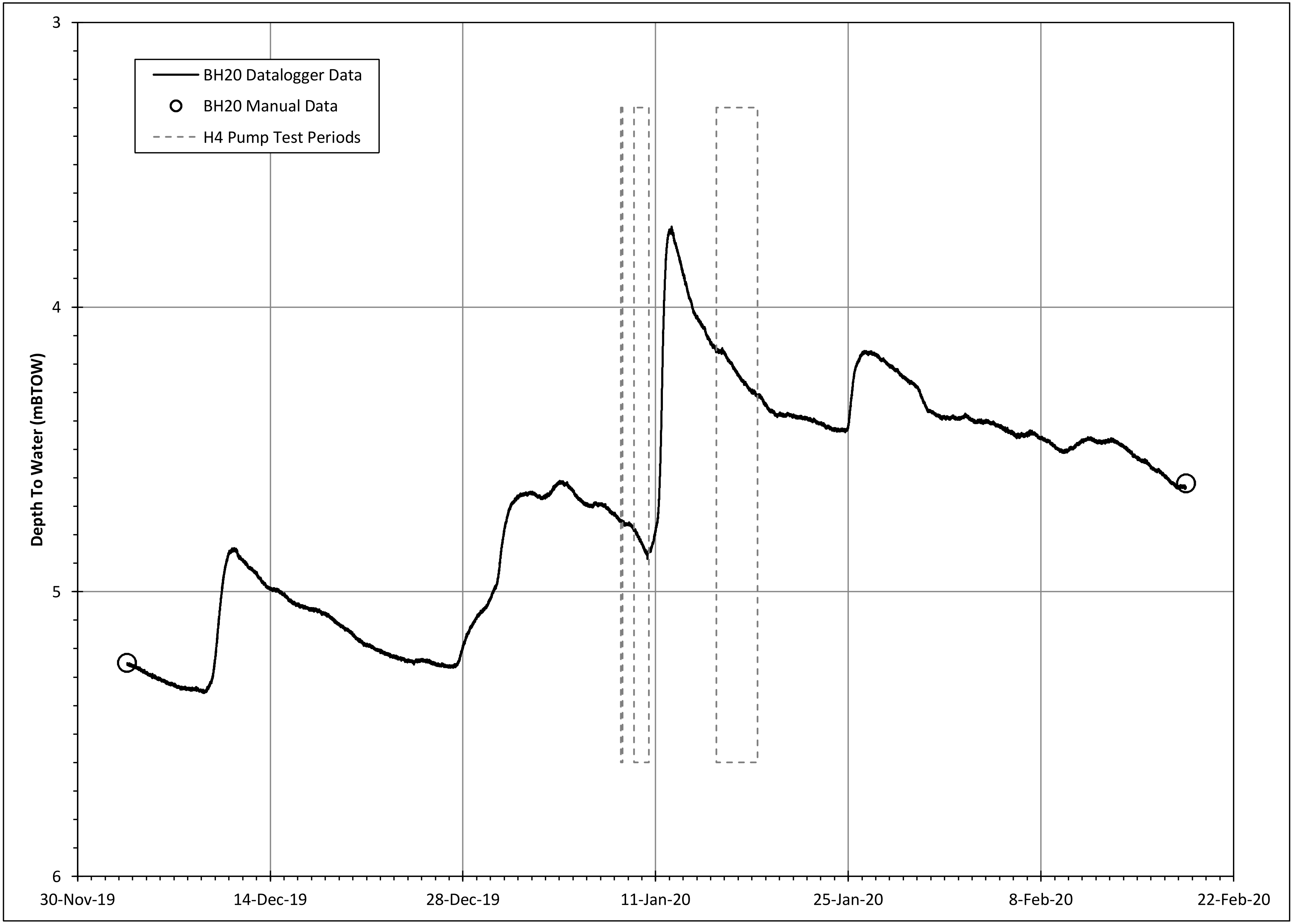
Groundwater Science Corp
Hydrogeological Assessment



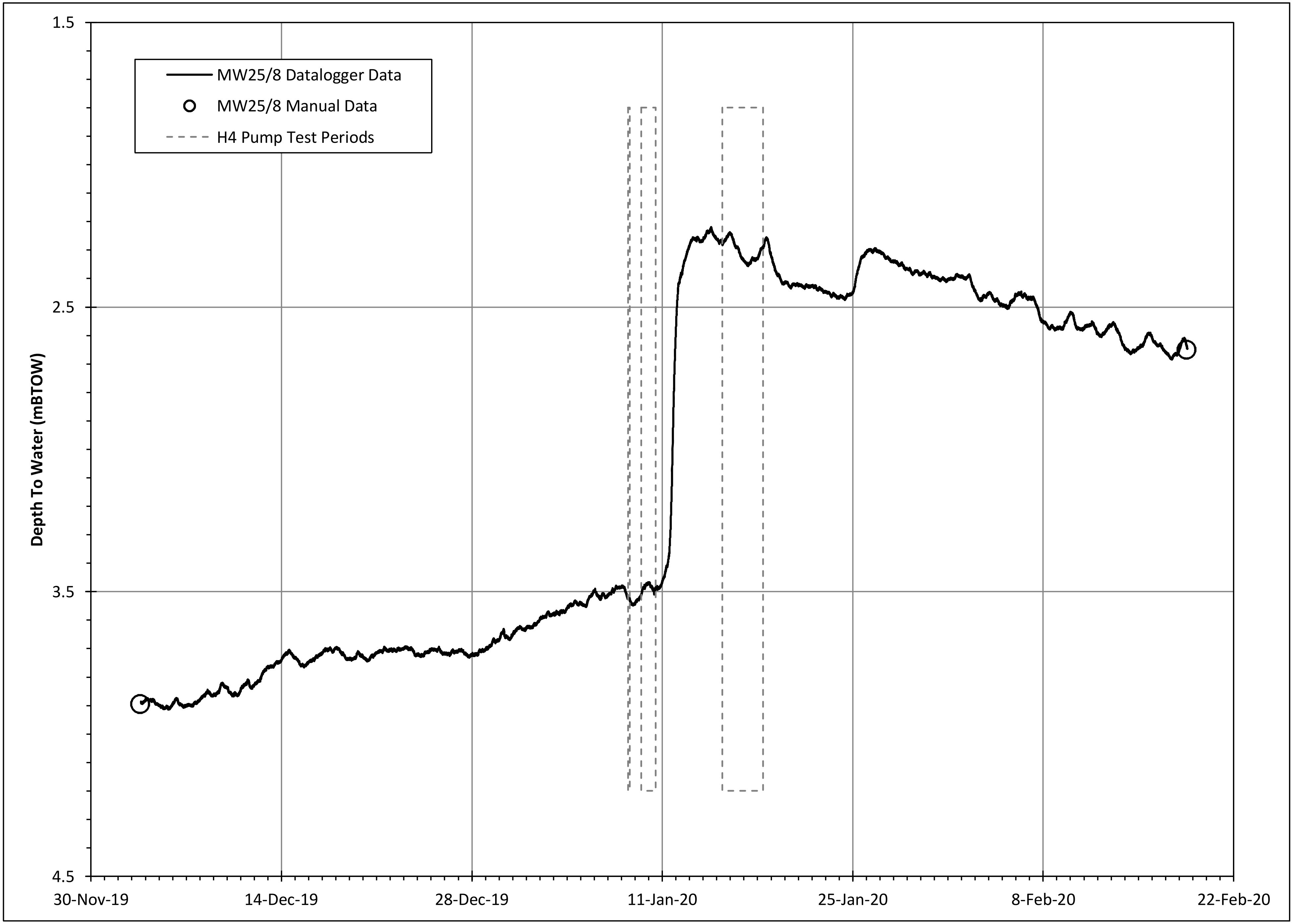
BH4 Long Term Hydrograph



BH16-D Long Term Hydrograph



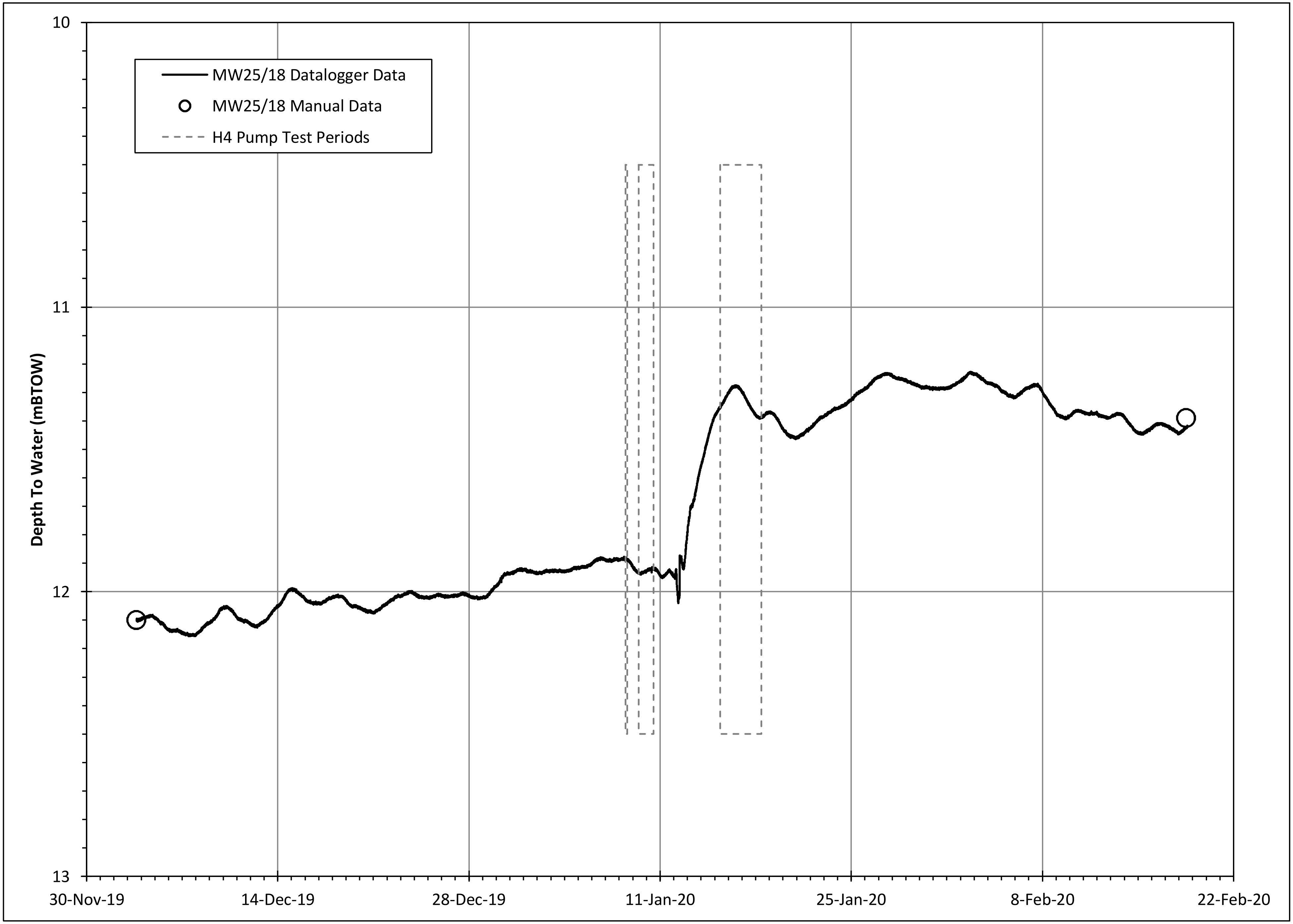
BH20 Long Term Hydrograph



Town of Erin
Water Supply EA

MW25/8 Long Term Hydrograph

Groundwater Science Corp
Hydrogeological Assessment

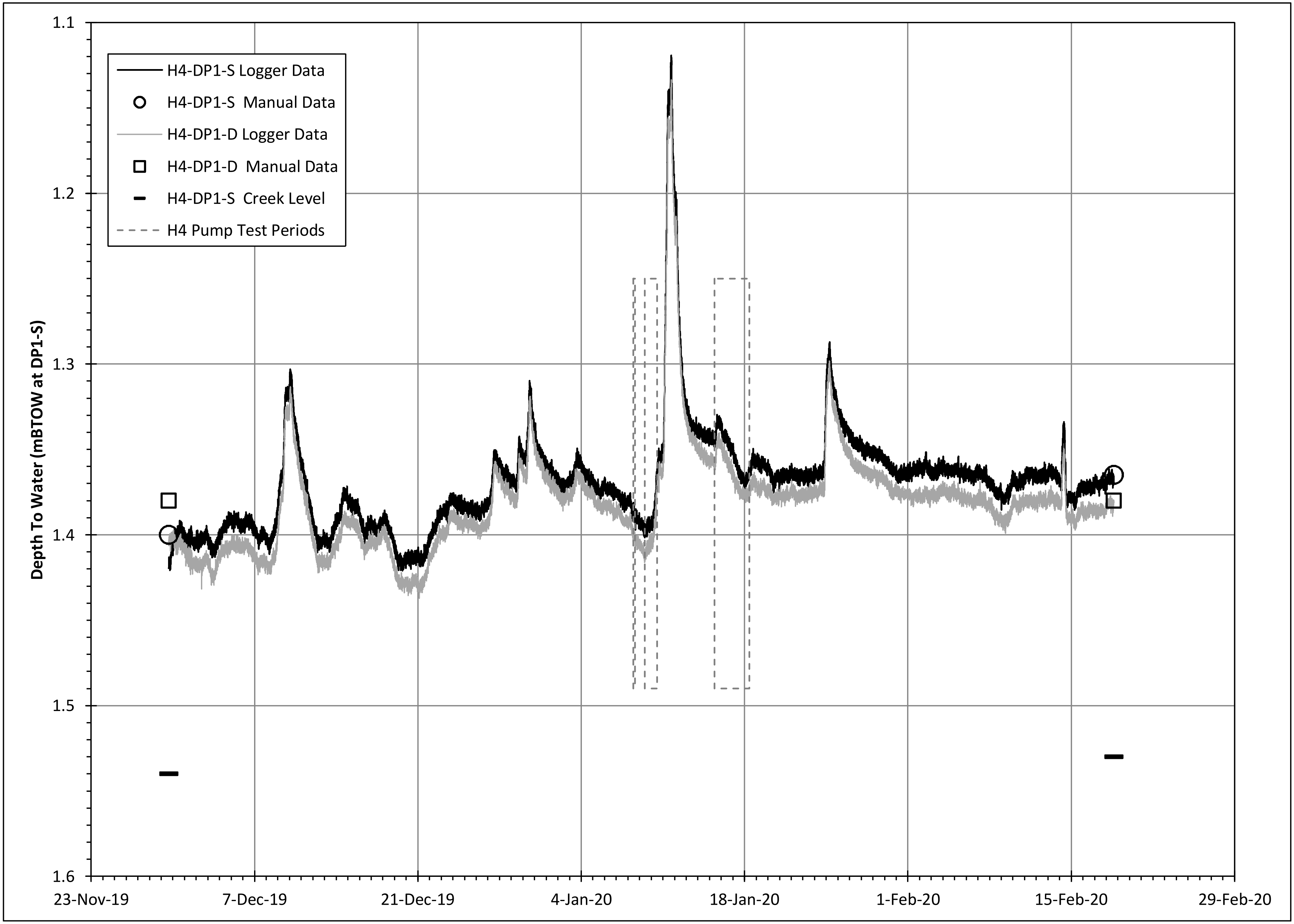


Town of Erin
Water Supply EA

MW25/18 Long Term Hydrograph

Groundwater Science Corp
Hydrogeological Assessment

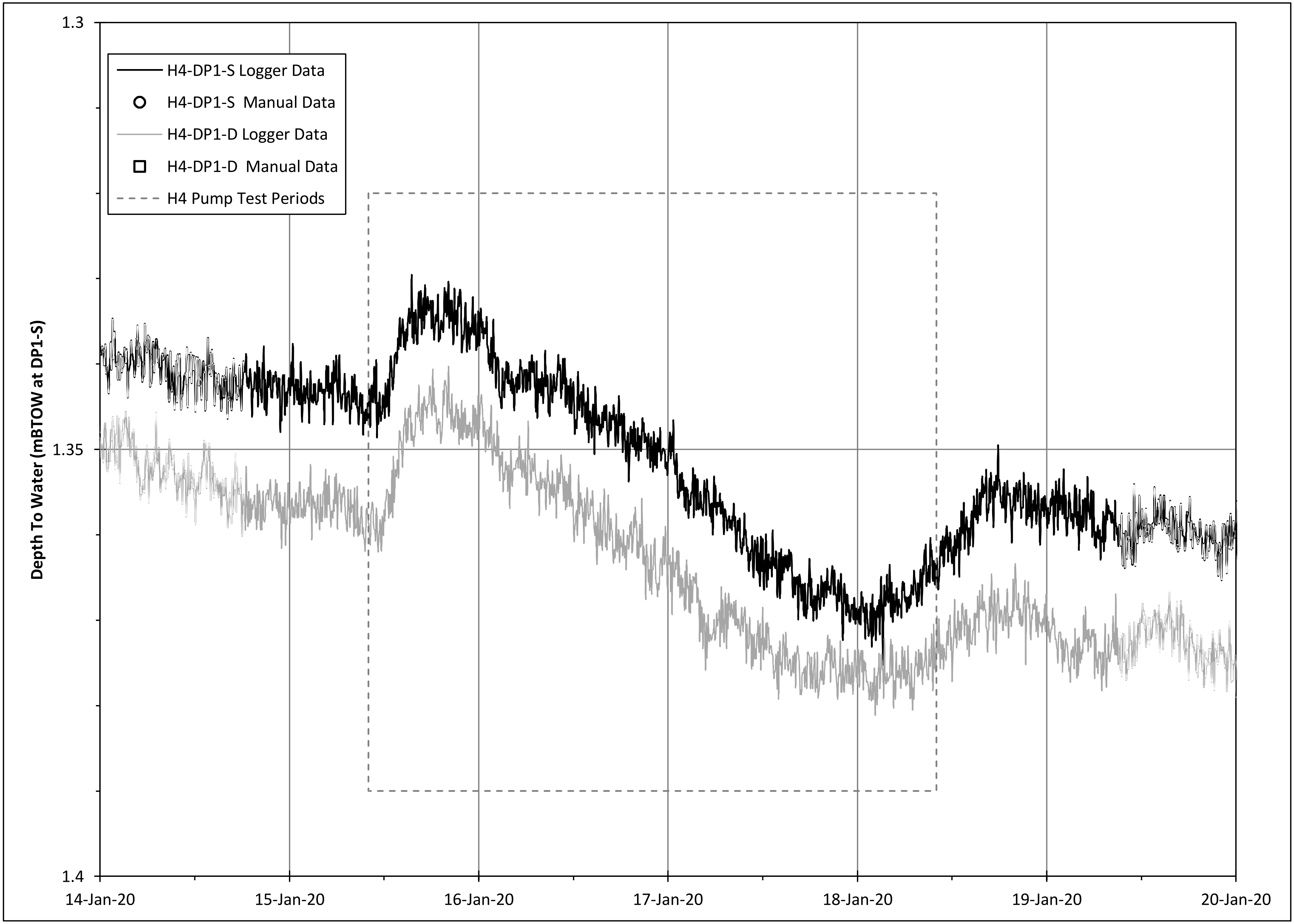
Appendix M
Pump Test Results: Drive Point Piezometers and H4-MW1-19



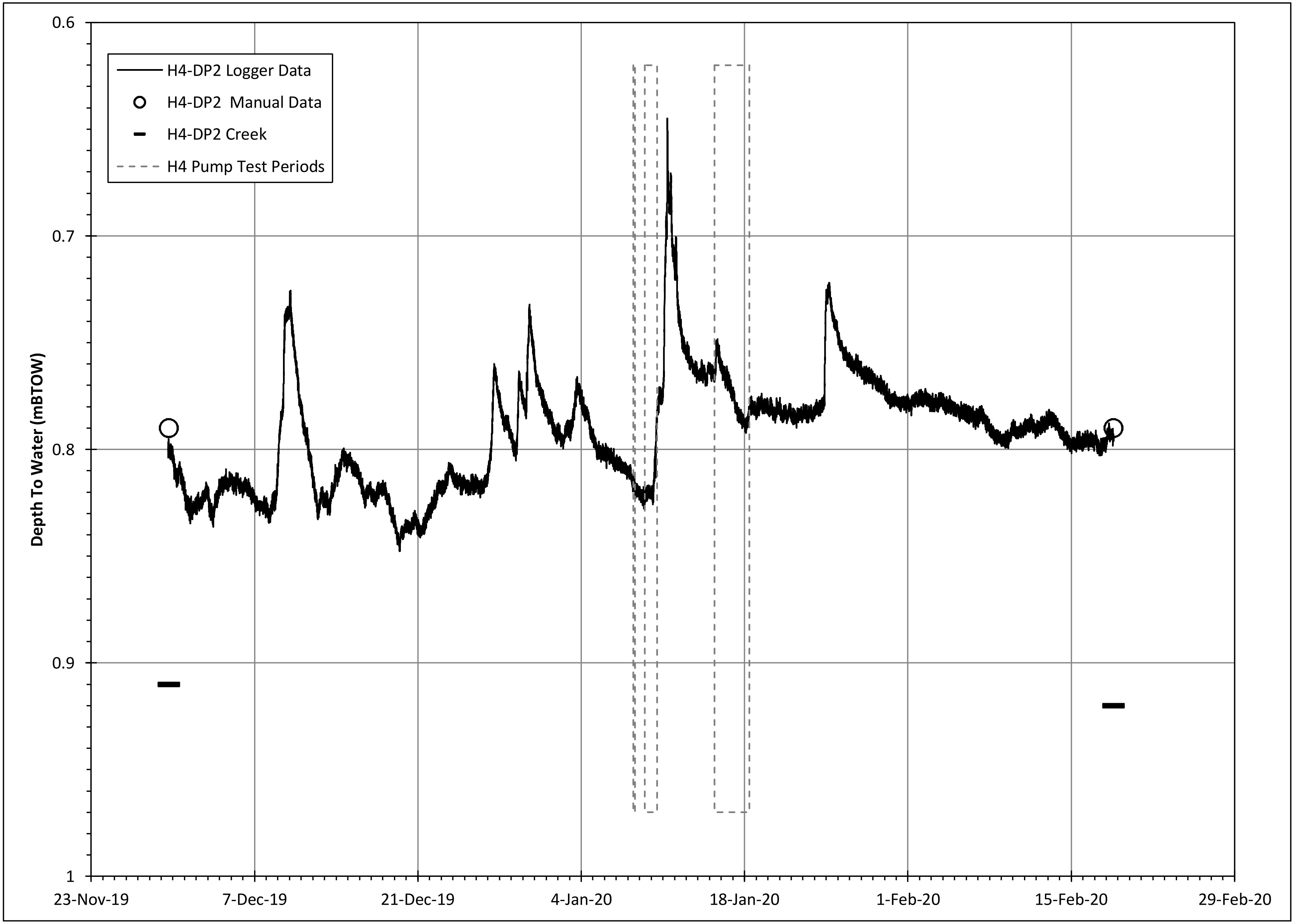
Town of Erin
Water Supply EA

DP1 Long Term Hydrograph

Groundwater Science Corp
Hydrogeologic Assessment



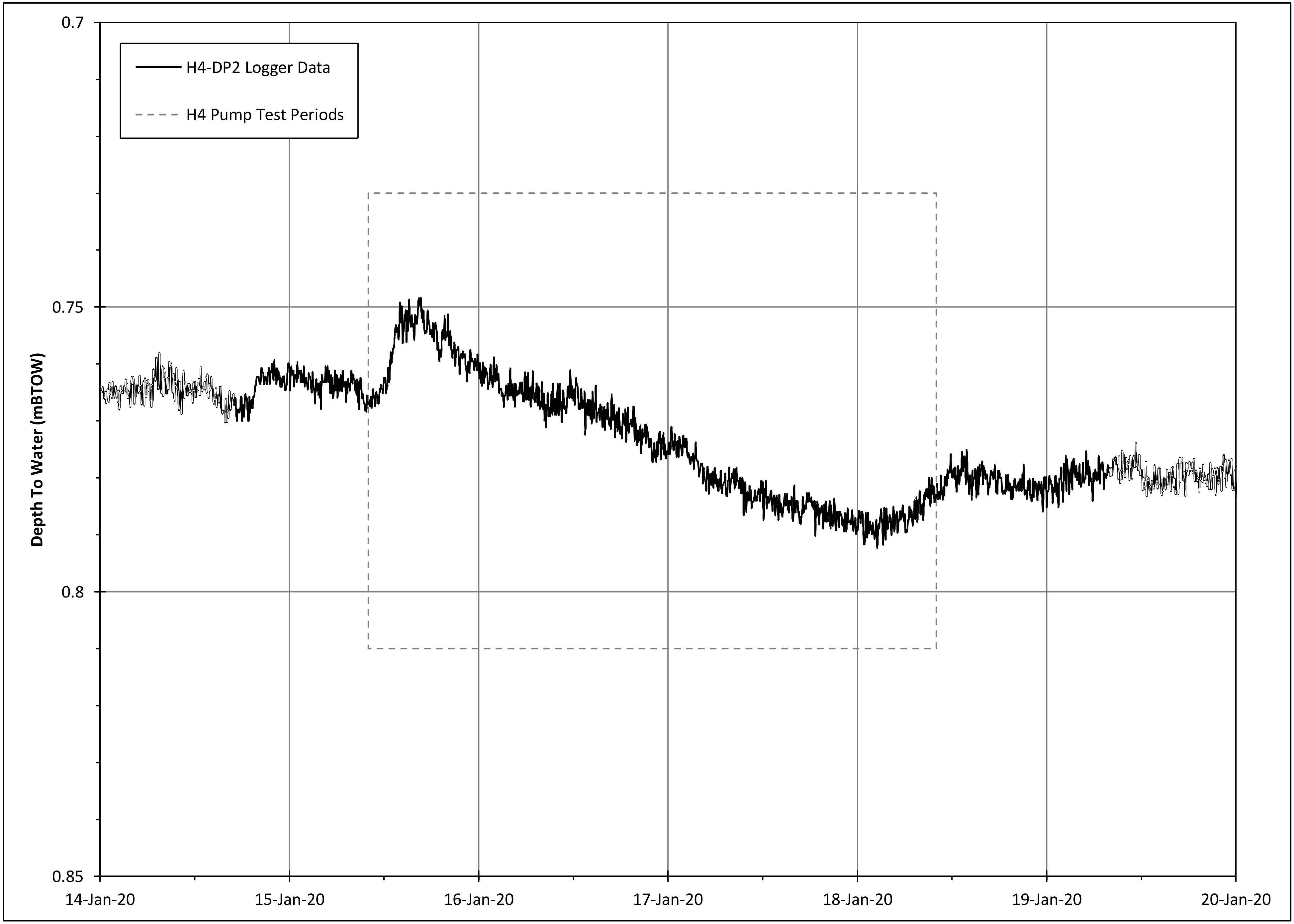
H4 Pumping Test Hydrograph: DP1



Town of Erin
Water Supply EA

DP2 Long Term Hydrograph

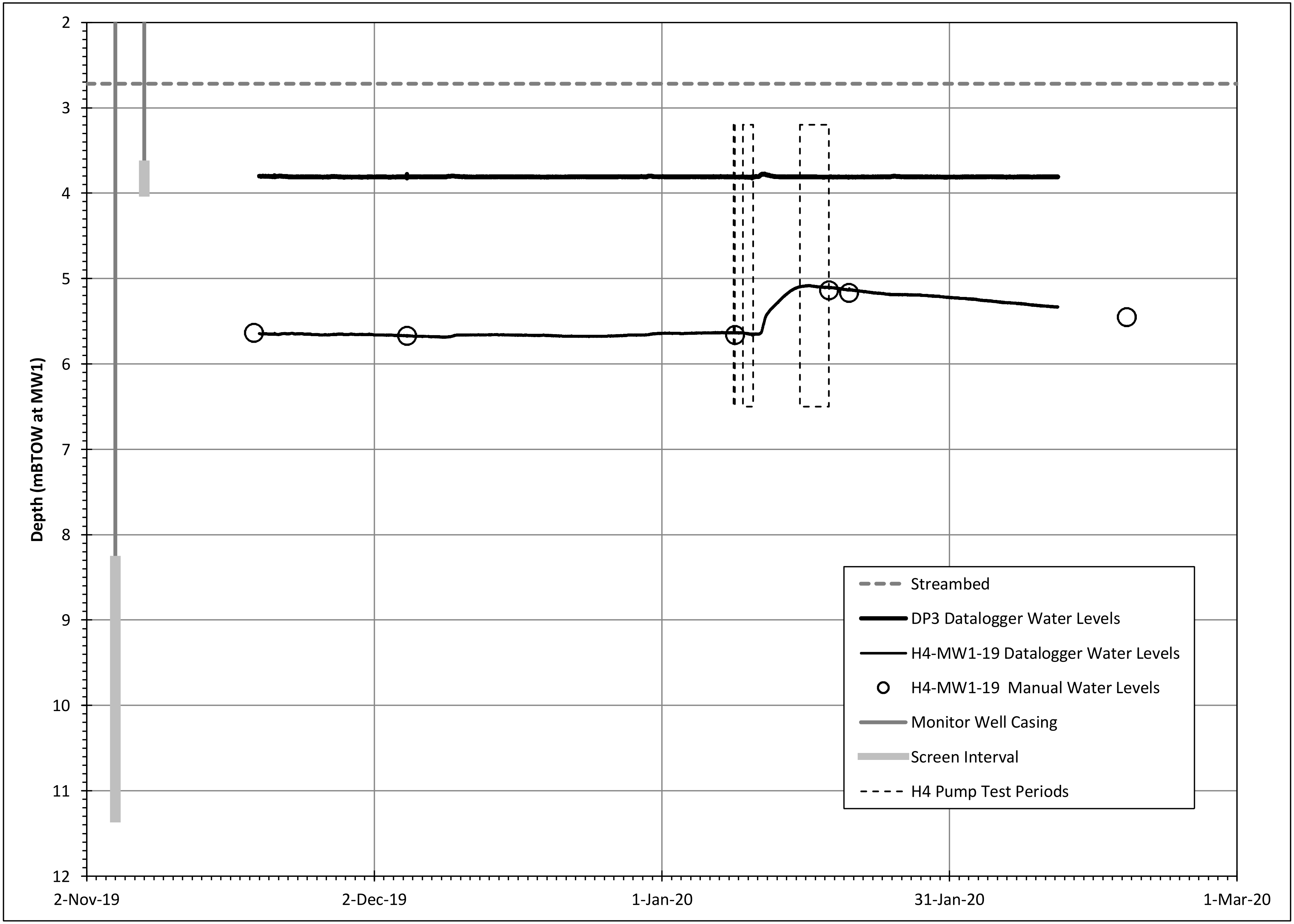
Groundwater Science Corp
Hydrogeologic Assessment



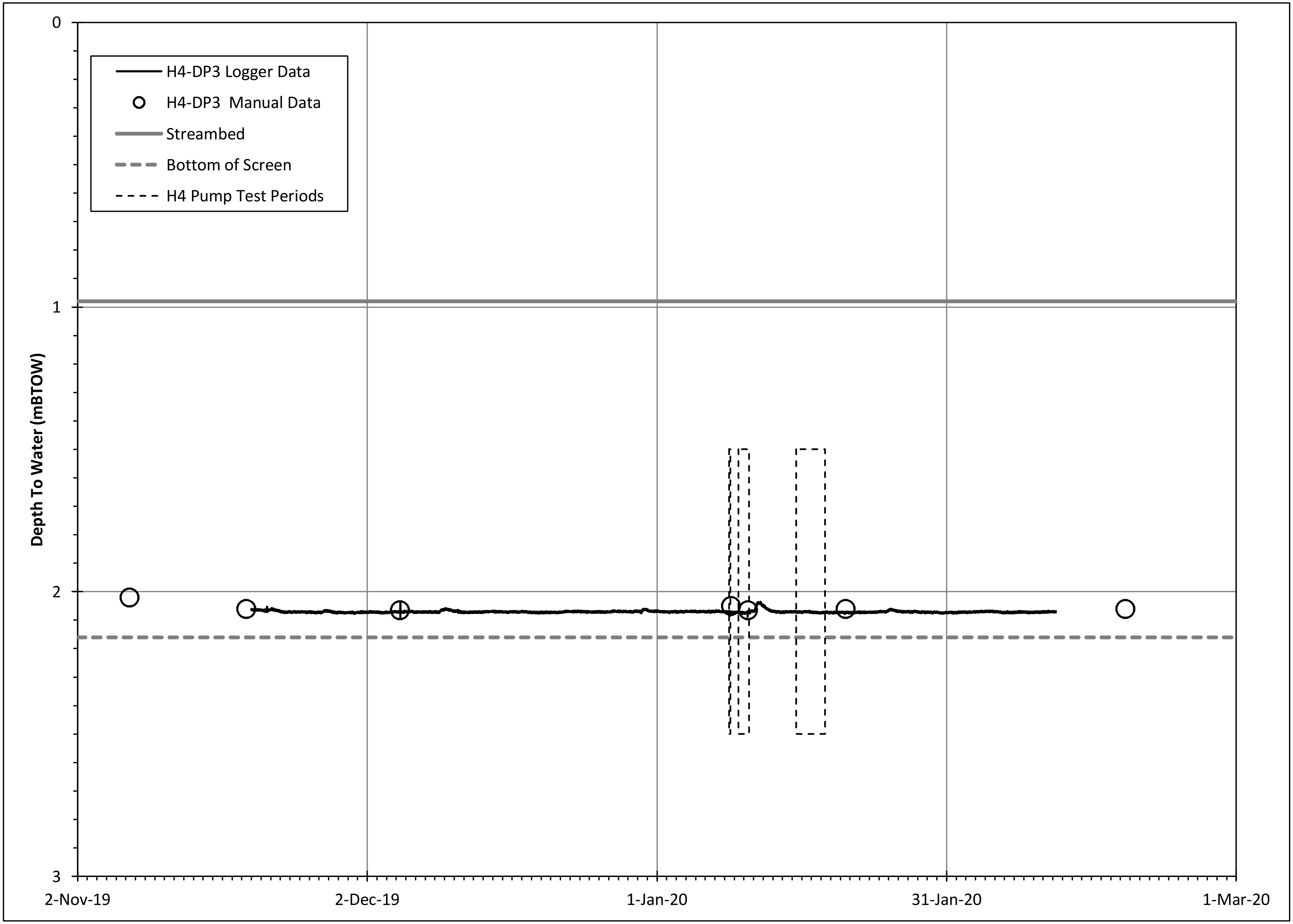
Town of Erin
Water Supply EA

H4 Pumping Test Hydrograph: DP2

Groundwater Science Corp
Hydrogeologic Assessment



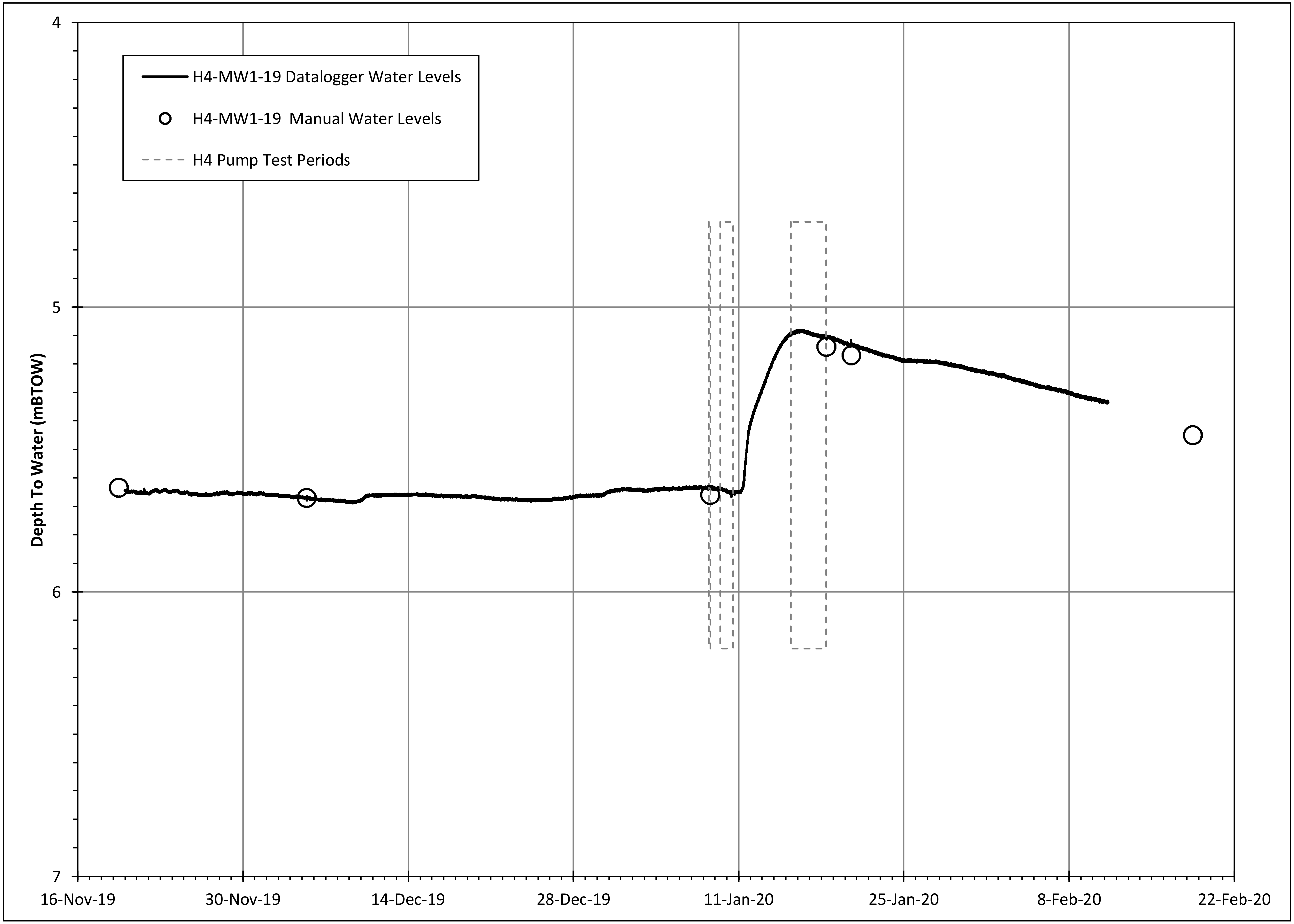
DP3 to H4-MW1-19 Nest Hydrograph



Town of Erin
Water Supply EA

DP3 Long Term Hydrograph

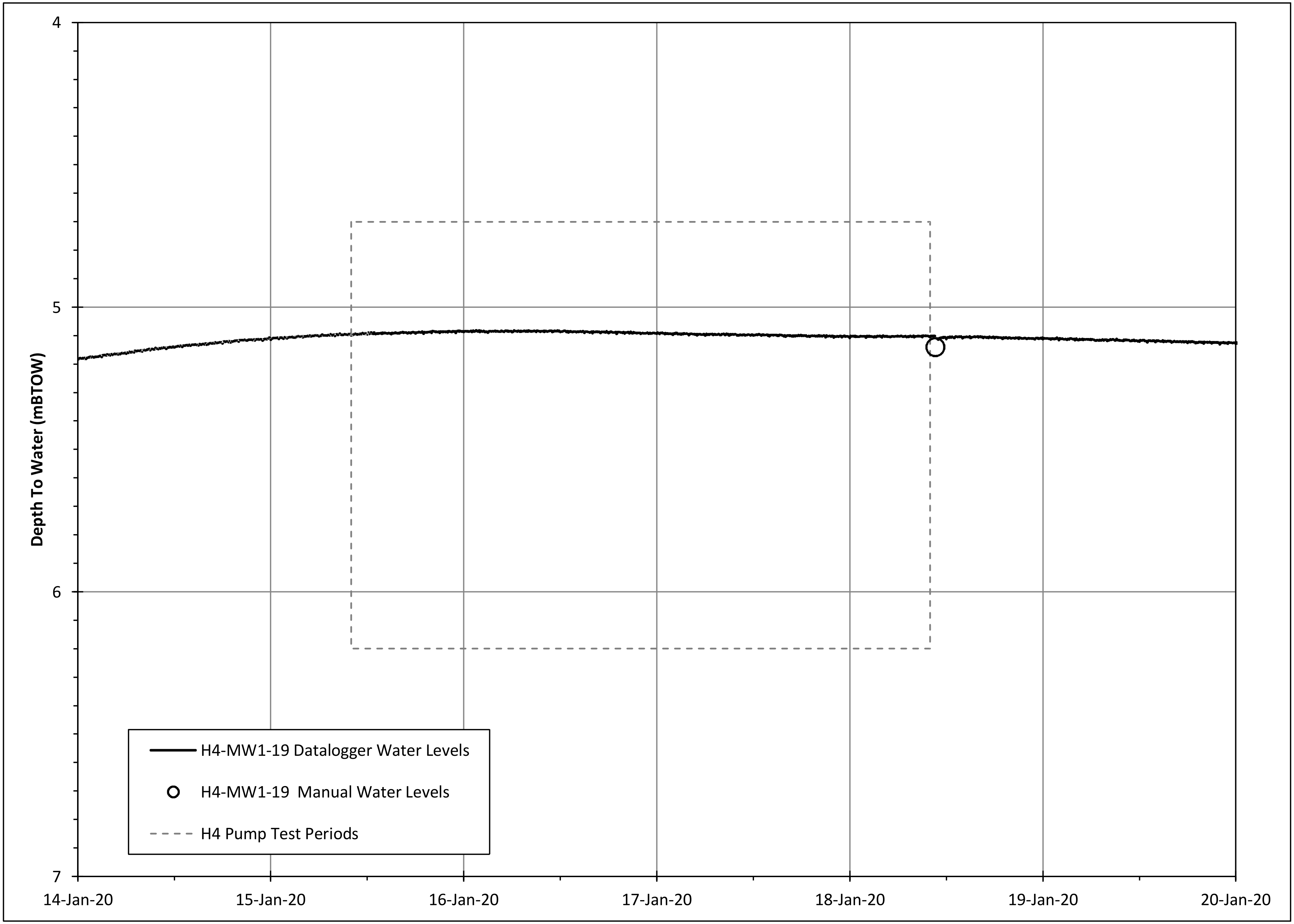
Groundwater Science Corp
Hydrogeological Assessment



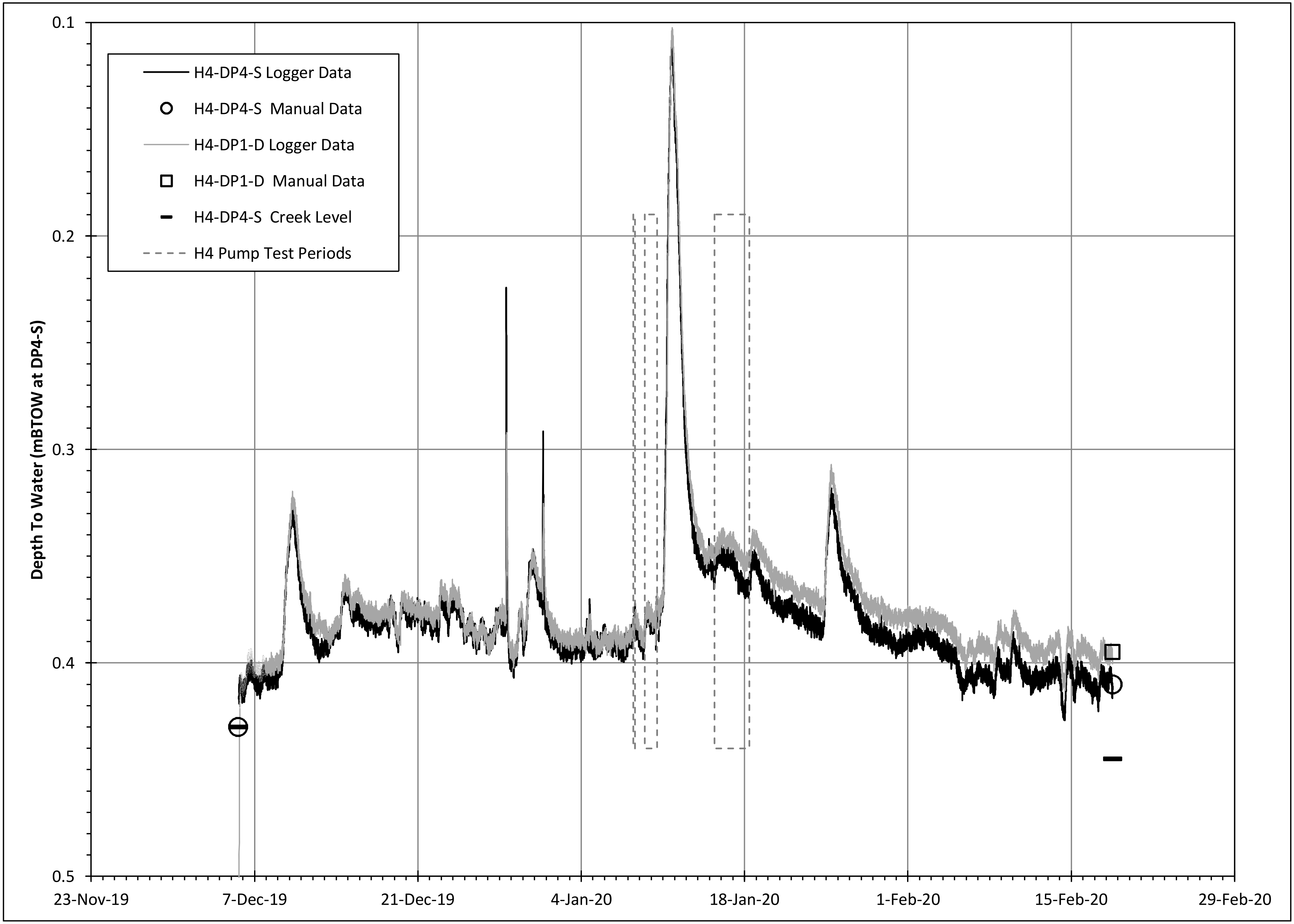
Town of Erin
Water Supply EA

H4-MW1-19 Long Term Hydrograph

Groundwater Science Corp
Hydrogeological Assessment



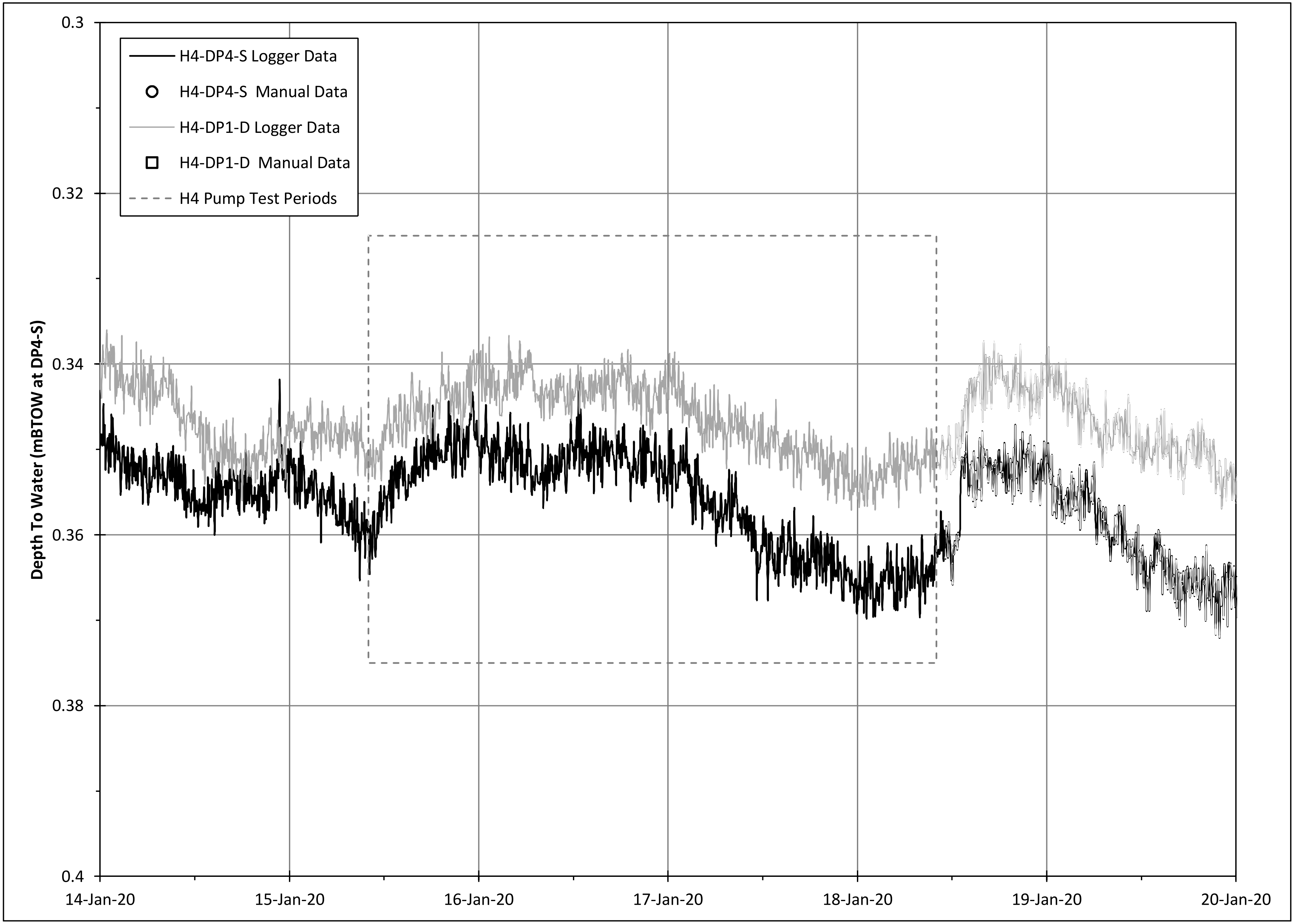
H4 Pumping Test Hydrograph: H4-MW1-19



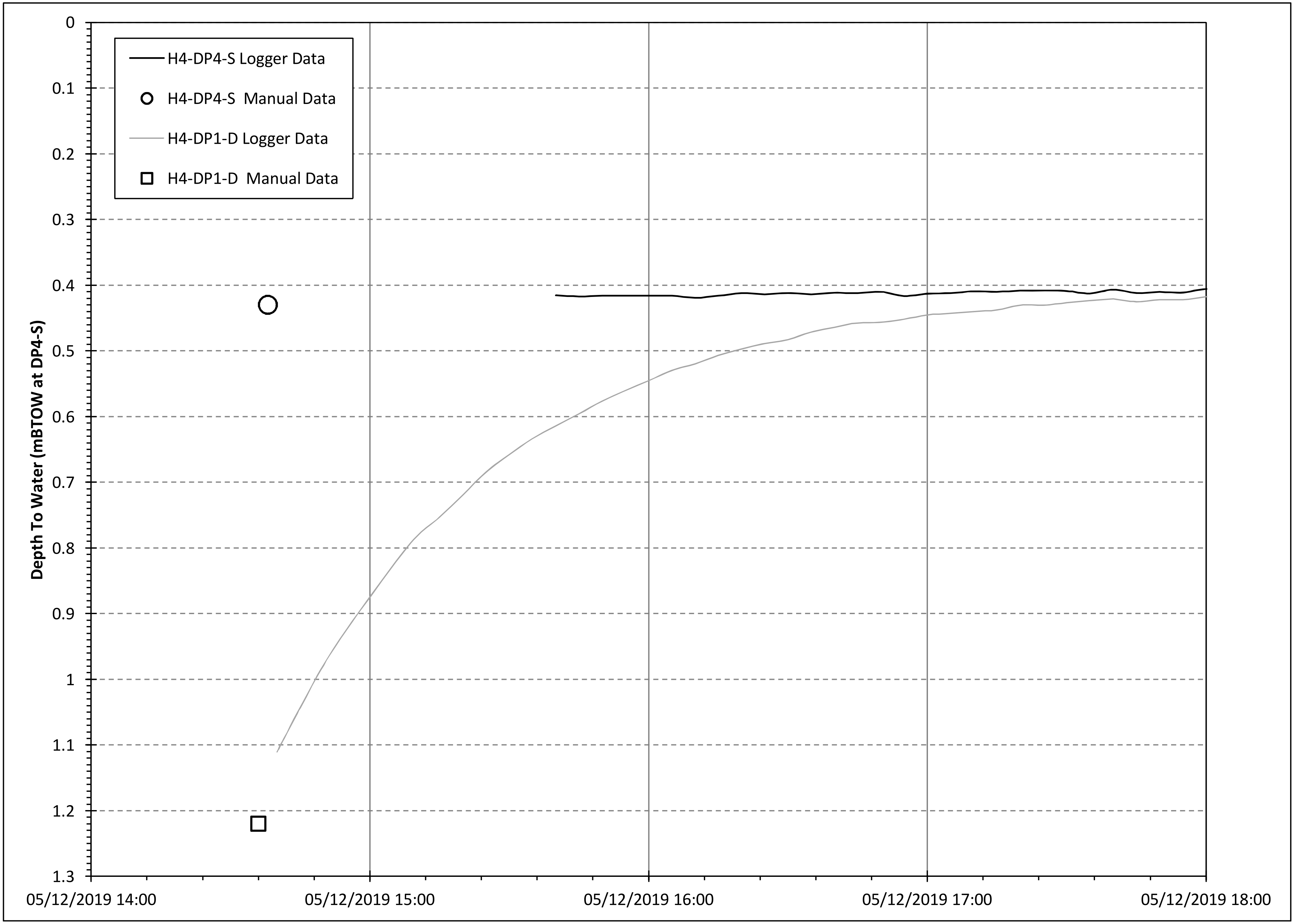
Town of Erin
Water Supply EA

DP4 Long Term Hydrograph

Groundwater Science Corp
Hydrogeologic Assessment



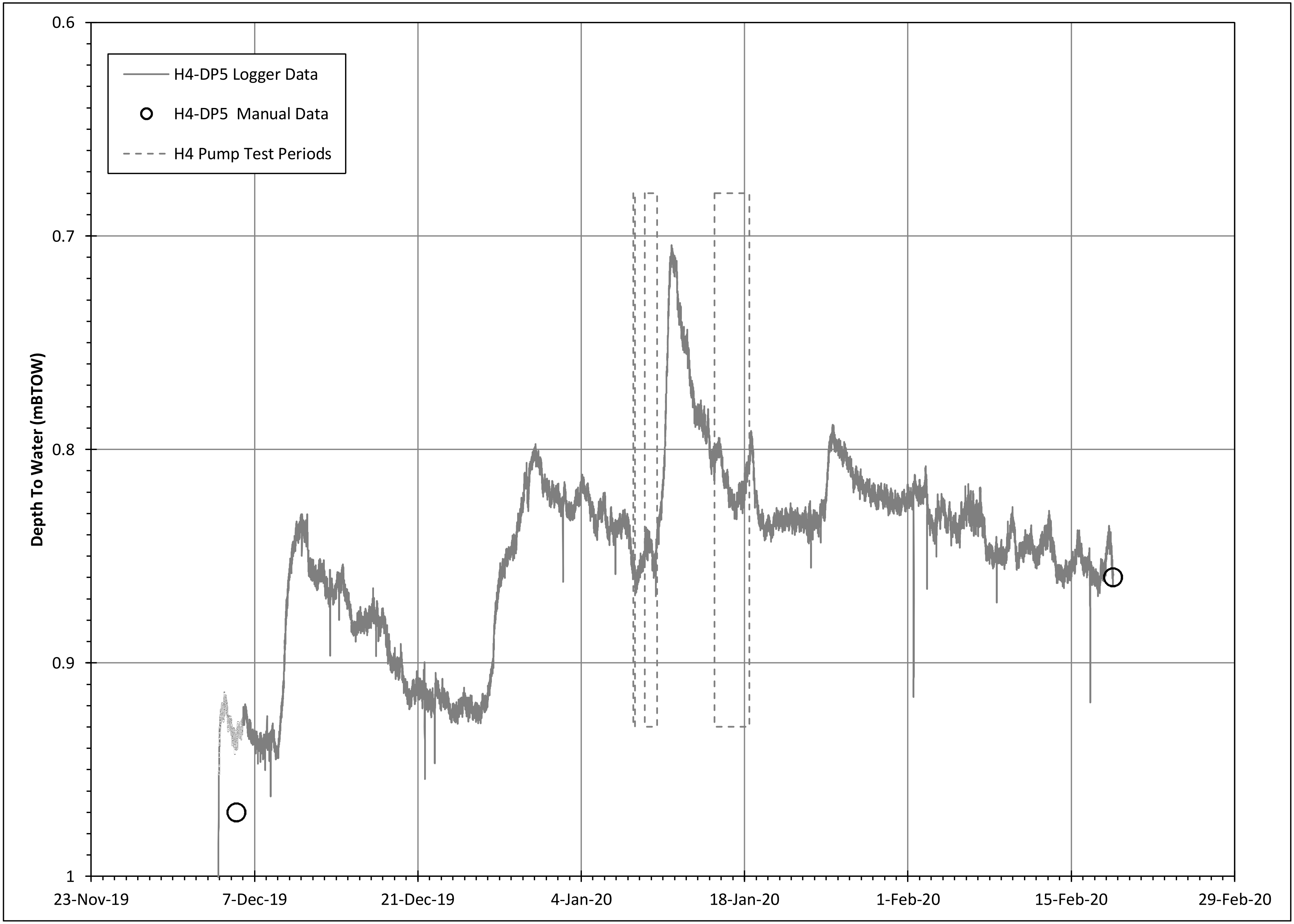
H4 Pumping Test Hydrograph: DP4



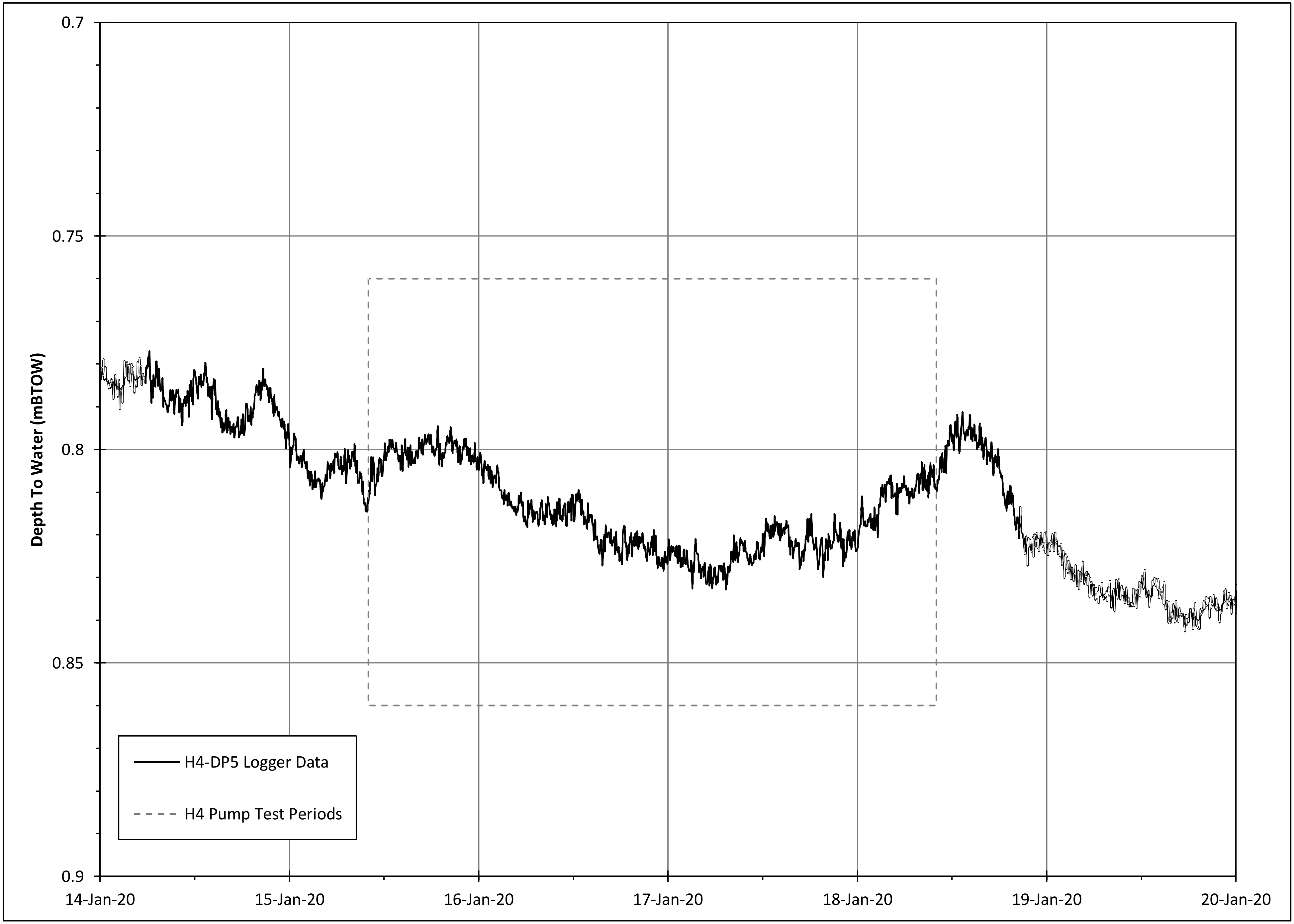
Town of Erin
Water Supply EA

DP4-D Water Level Recovery After Installation

Groundwater Science Corp
Hydrogeologic Assessment



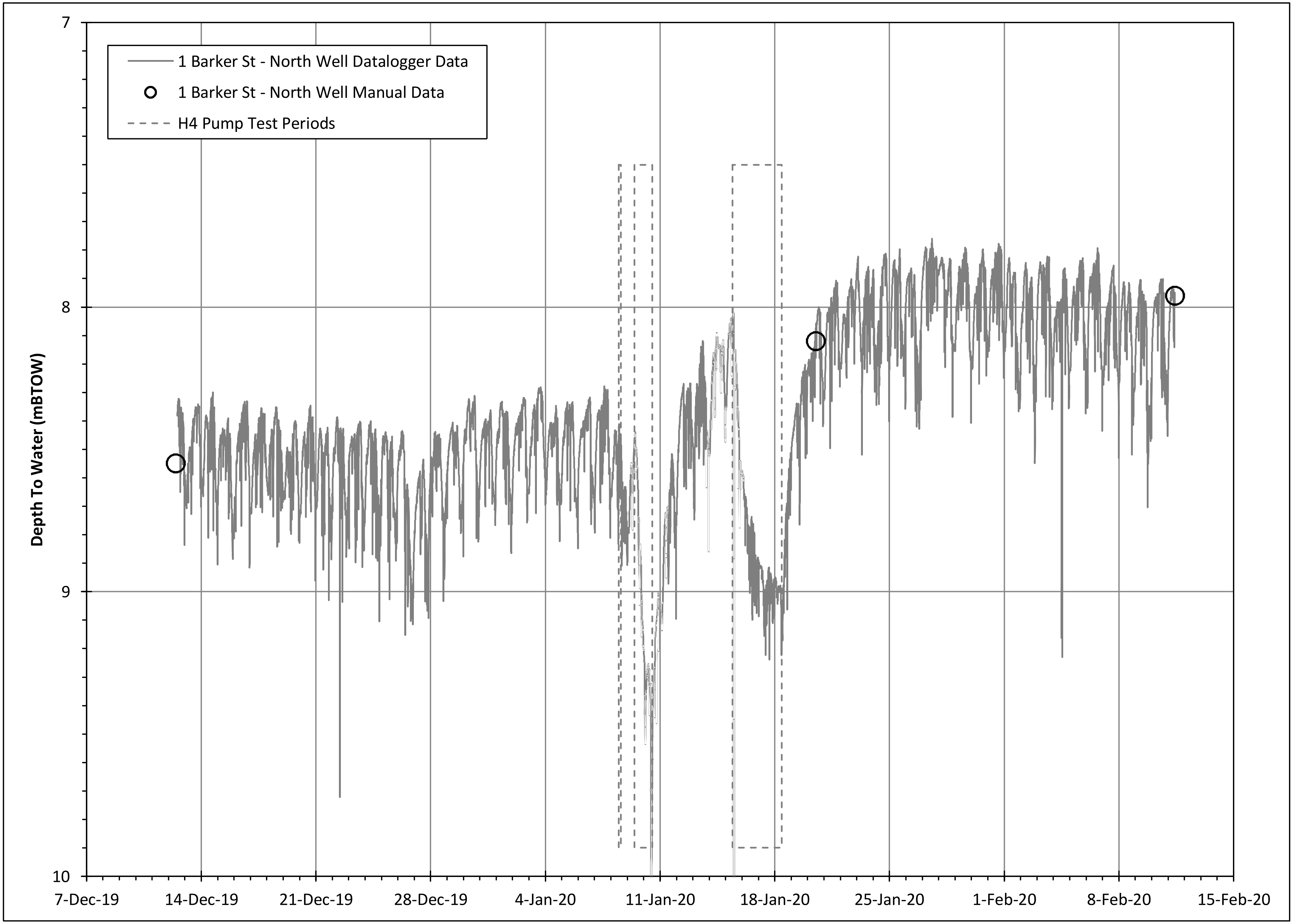
DP5 Long Term Hydrograph



H4 Pumping Test Hydrograph: DP5

Appendix N

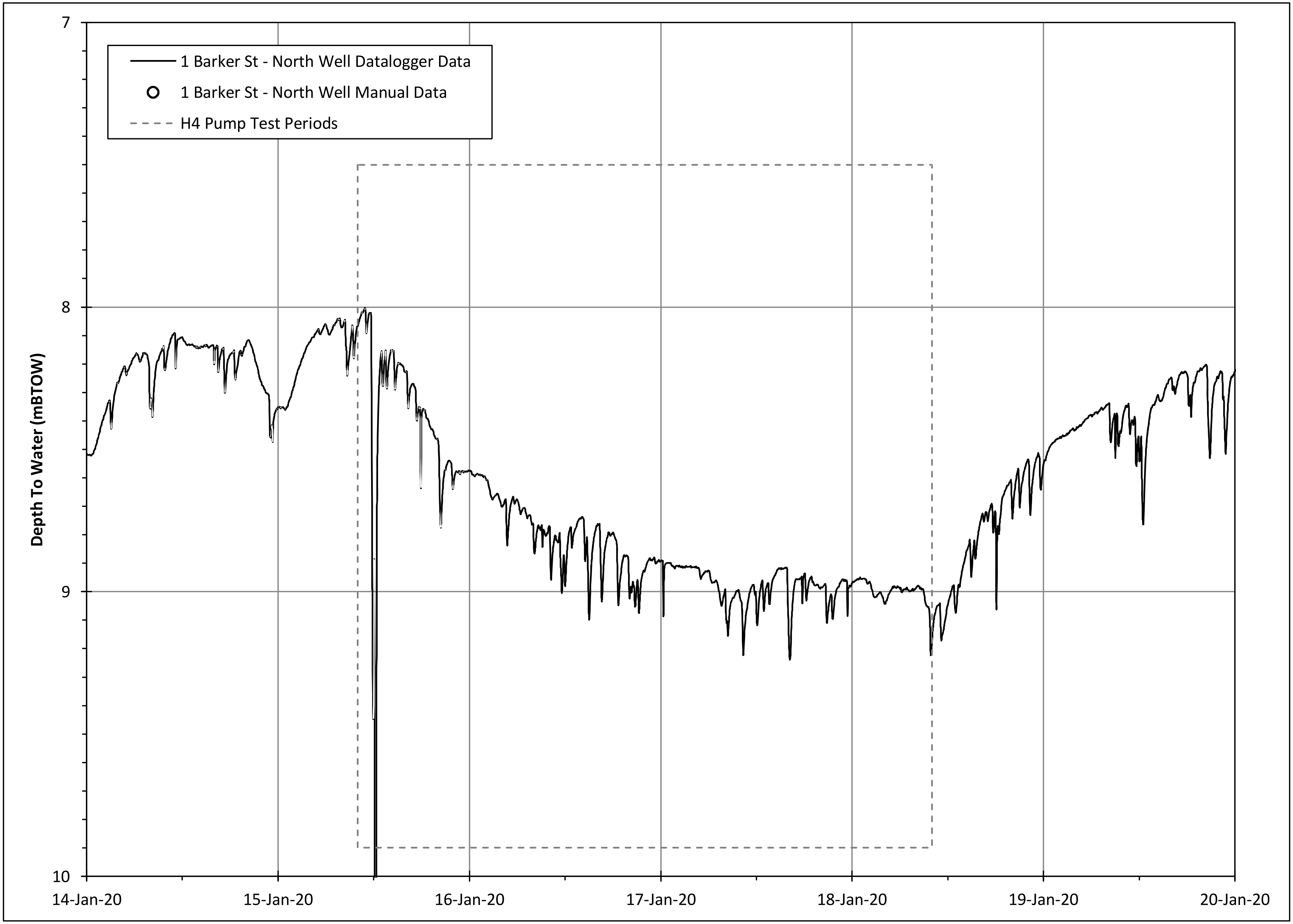
Pump Test Results: Private Wells



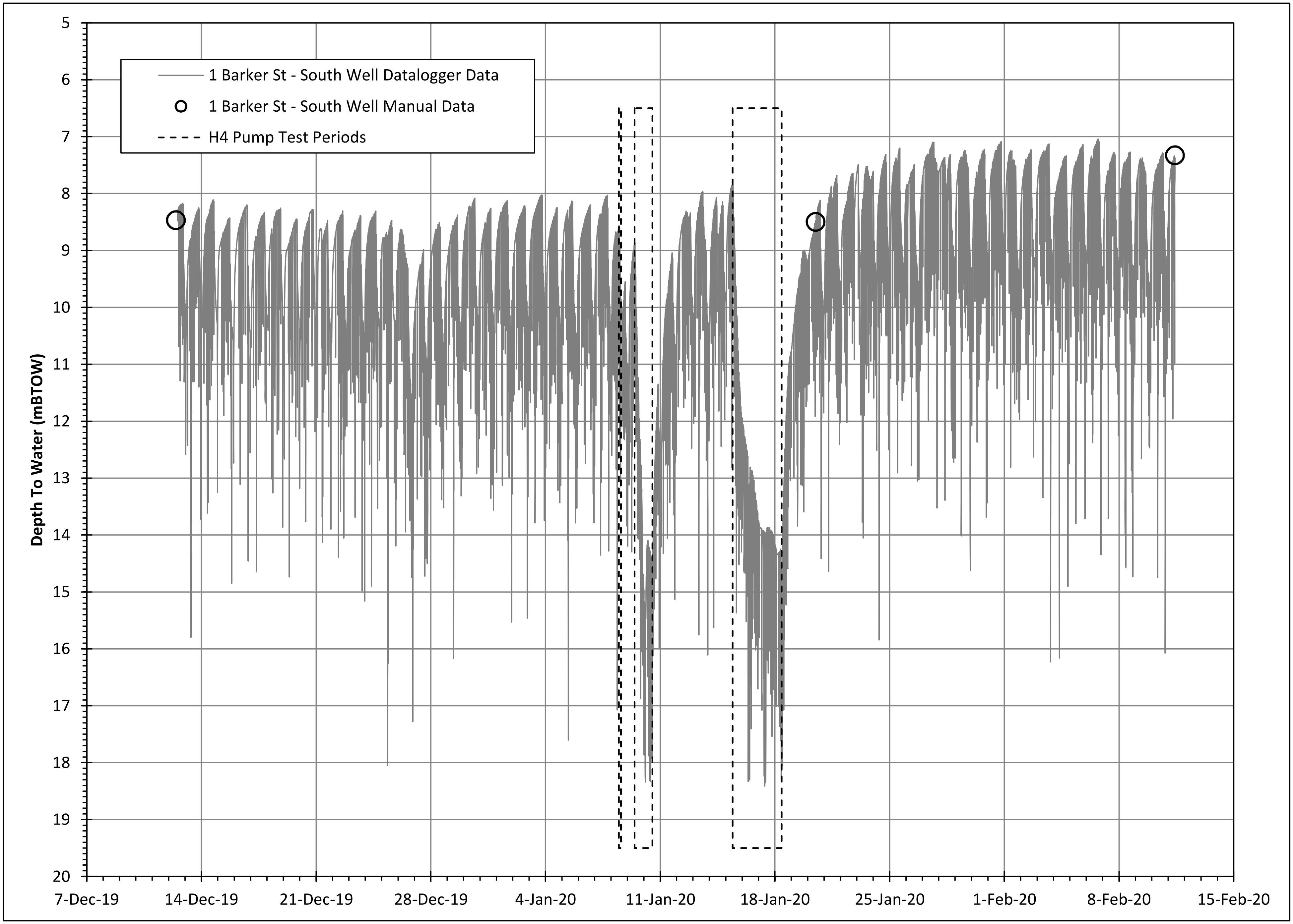
Town of Erin
Water Supply EA

1 Barker Street - North Well Long Term Hydrograph

Groundwater Science Corp
Hydrogeological Assessment



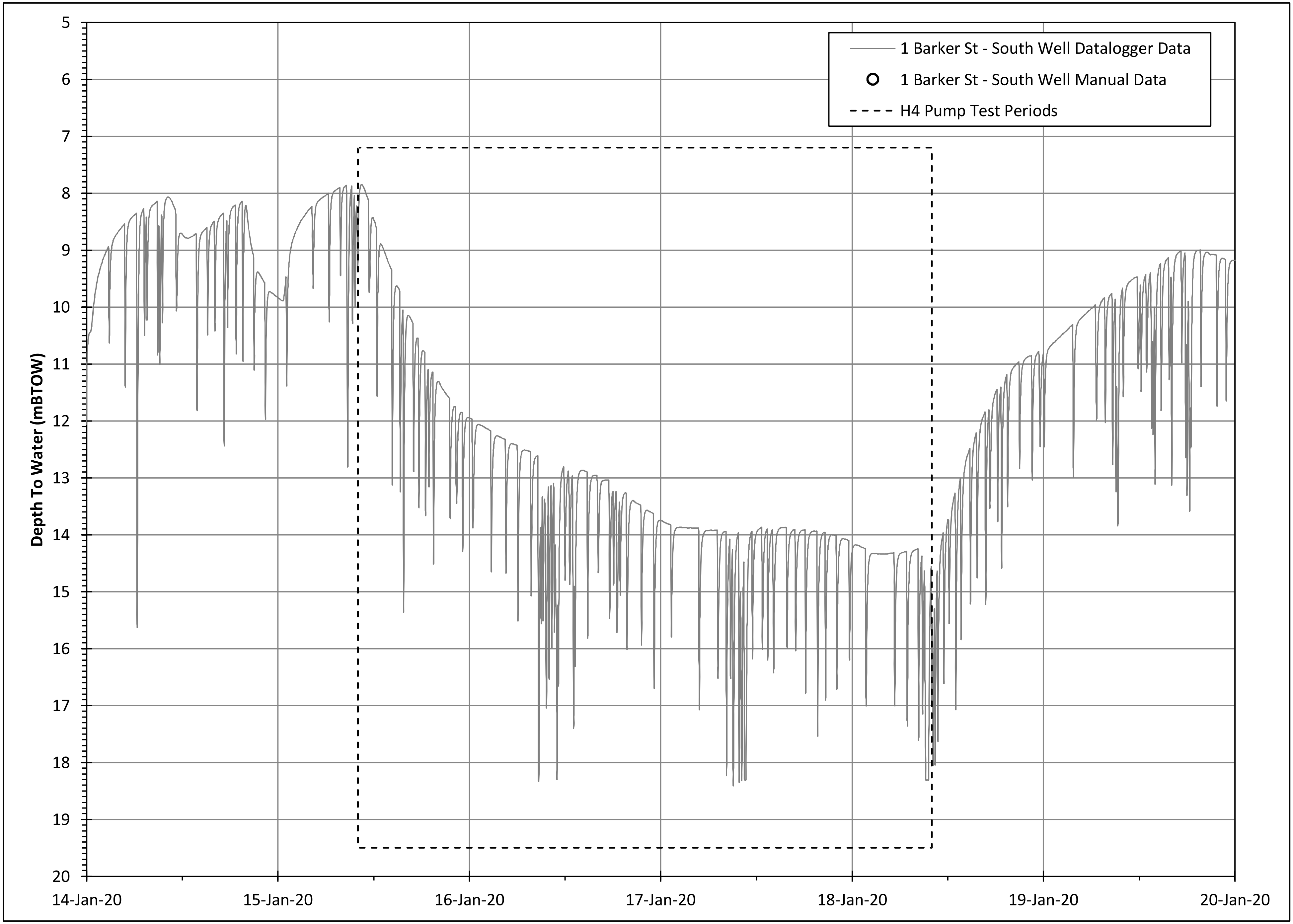
H4 Pumping Test Hydrograph: 1 Barker Street - North Well



Town of Erin
Water Supply EA

1 Barker Street - South Well Long Term Hydrograph

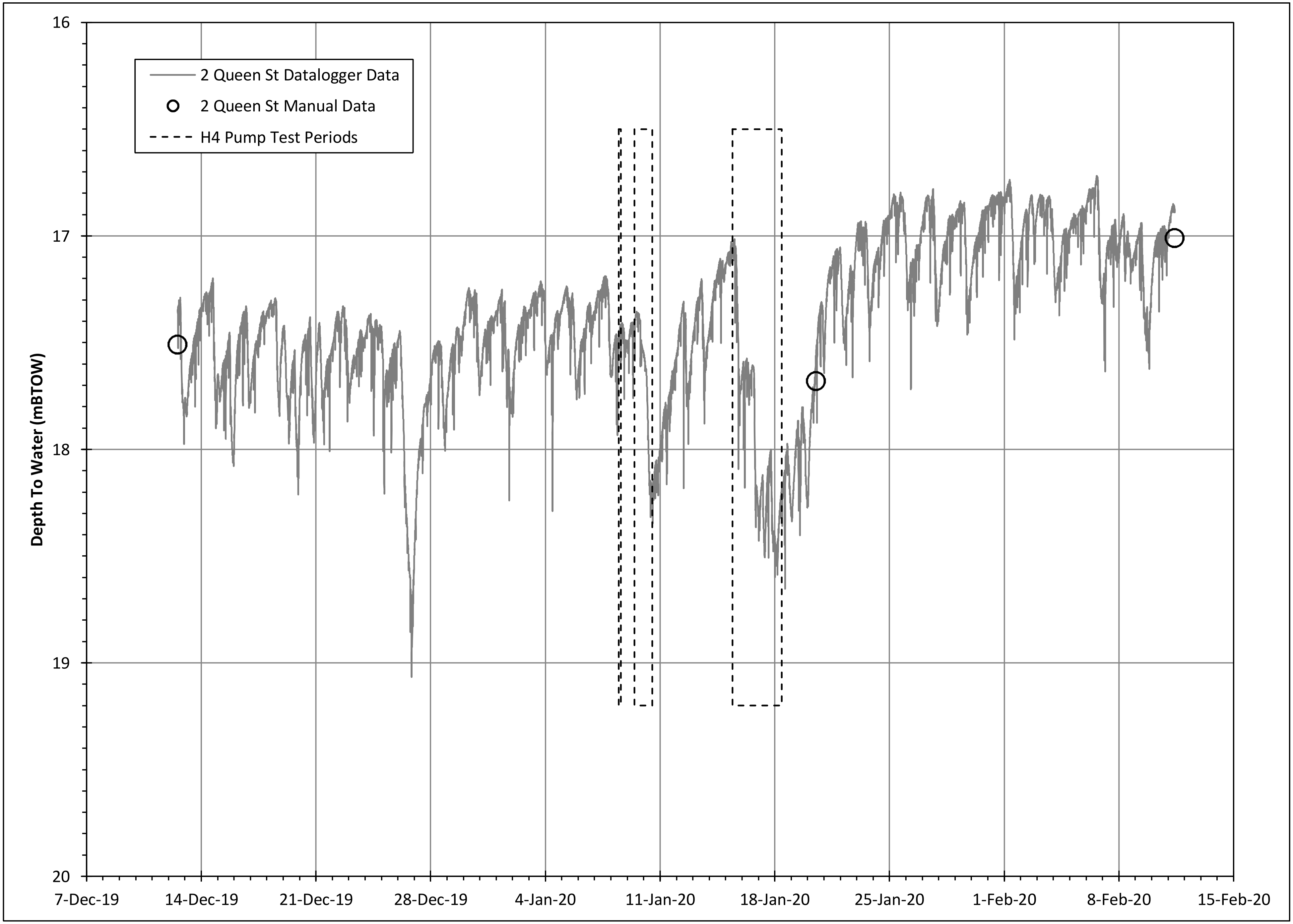
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

H4 Pumping Test Hydrograph: 1 Barker Street - South Well

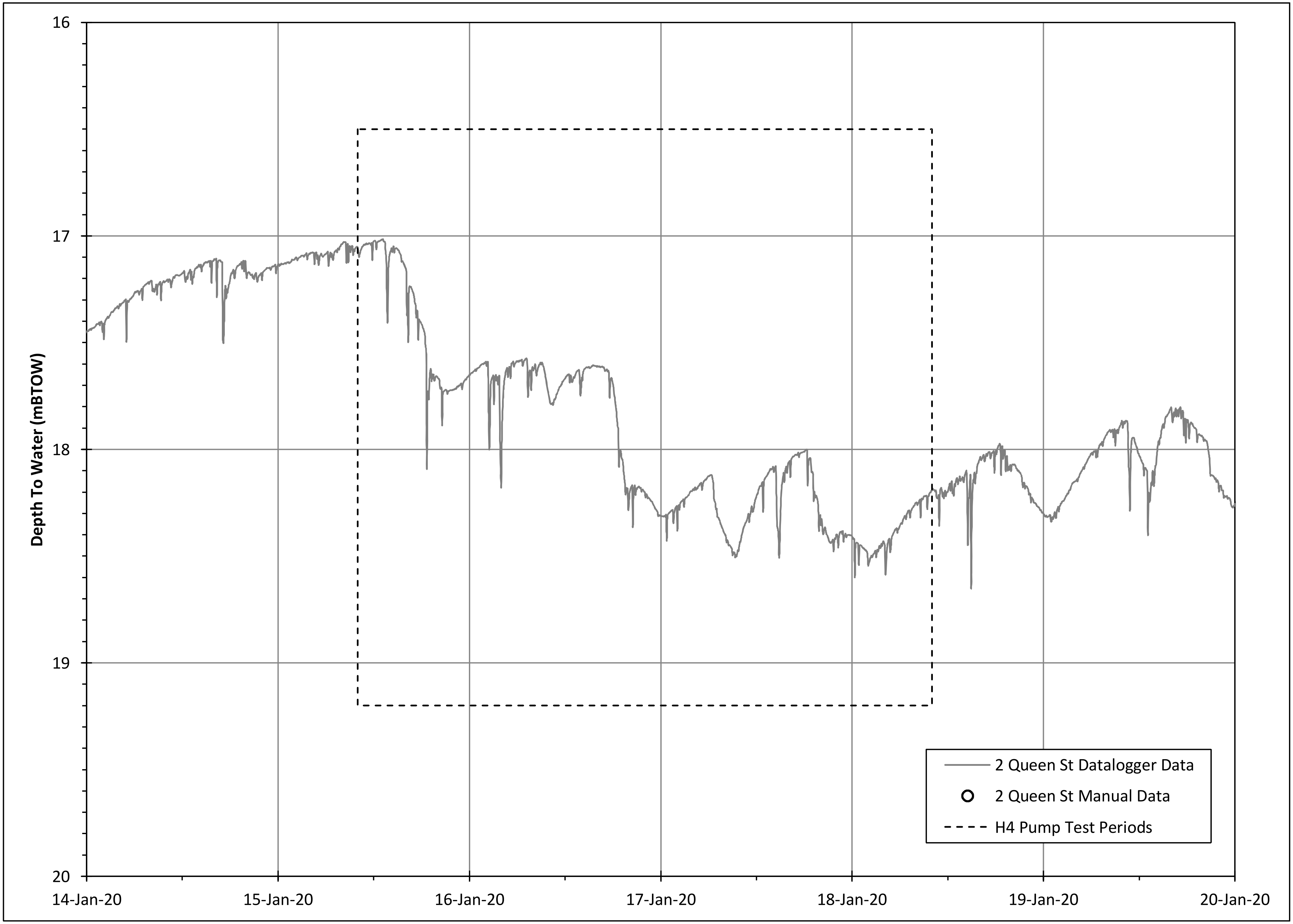
Groundwater Science Corp
Hydrogeological Assessment



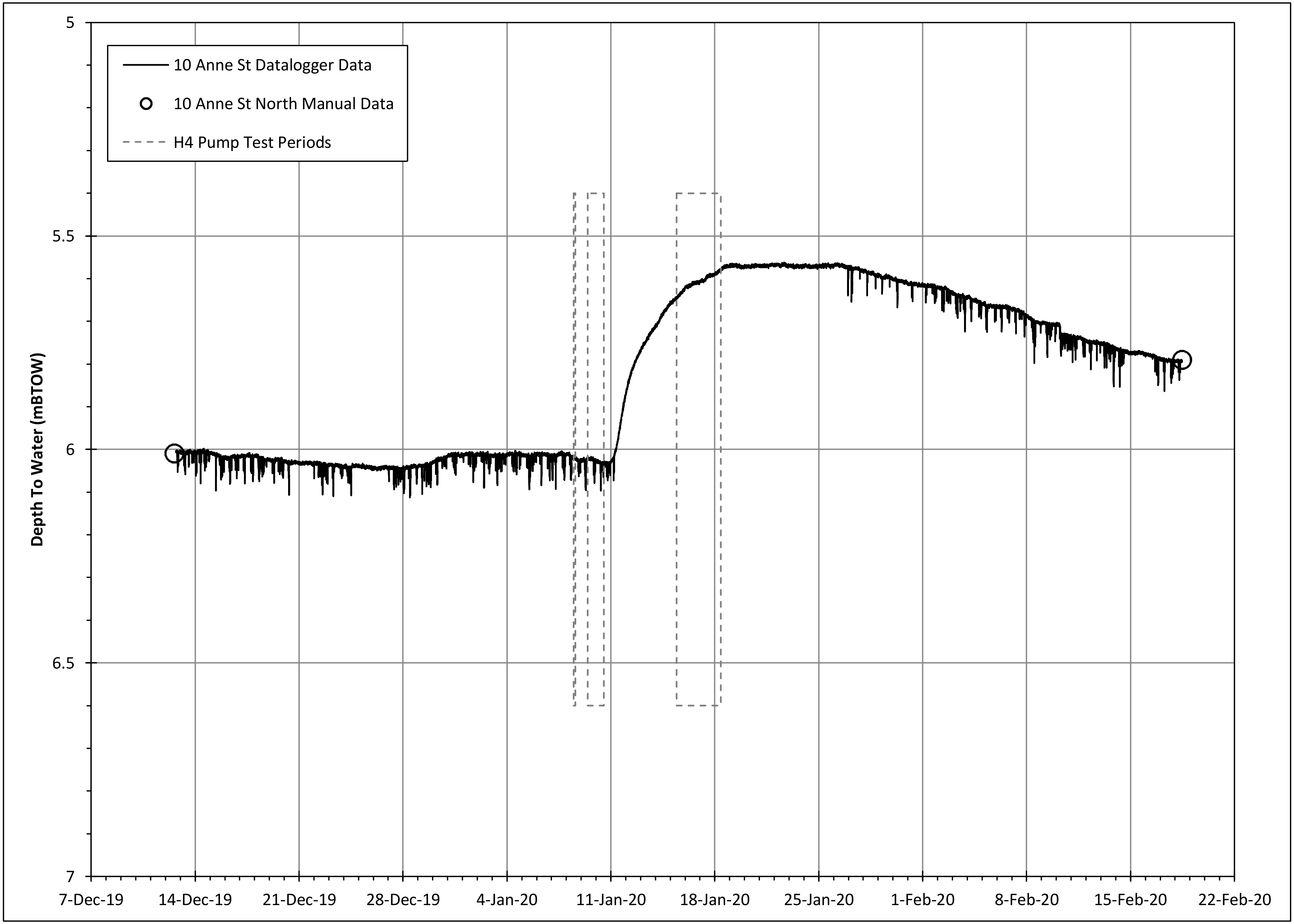
Town of Erin
Water Supply EA

2 Queen Street Long Term Hydrograph

Groundwater Science Corp
Hydrogeological Assessment



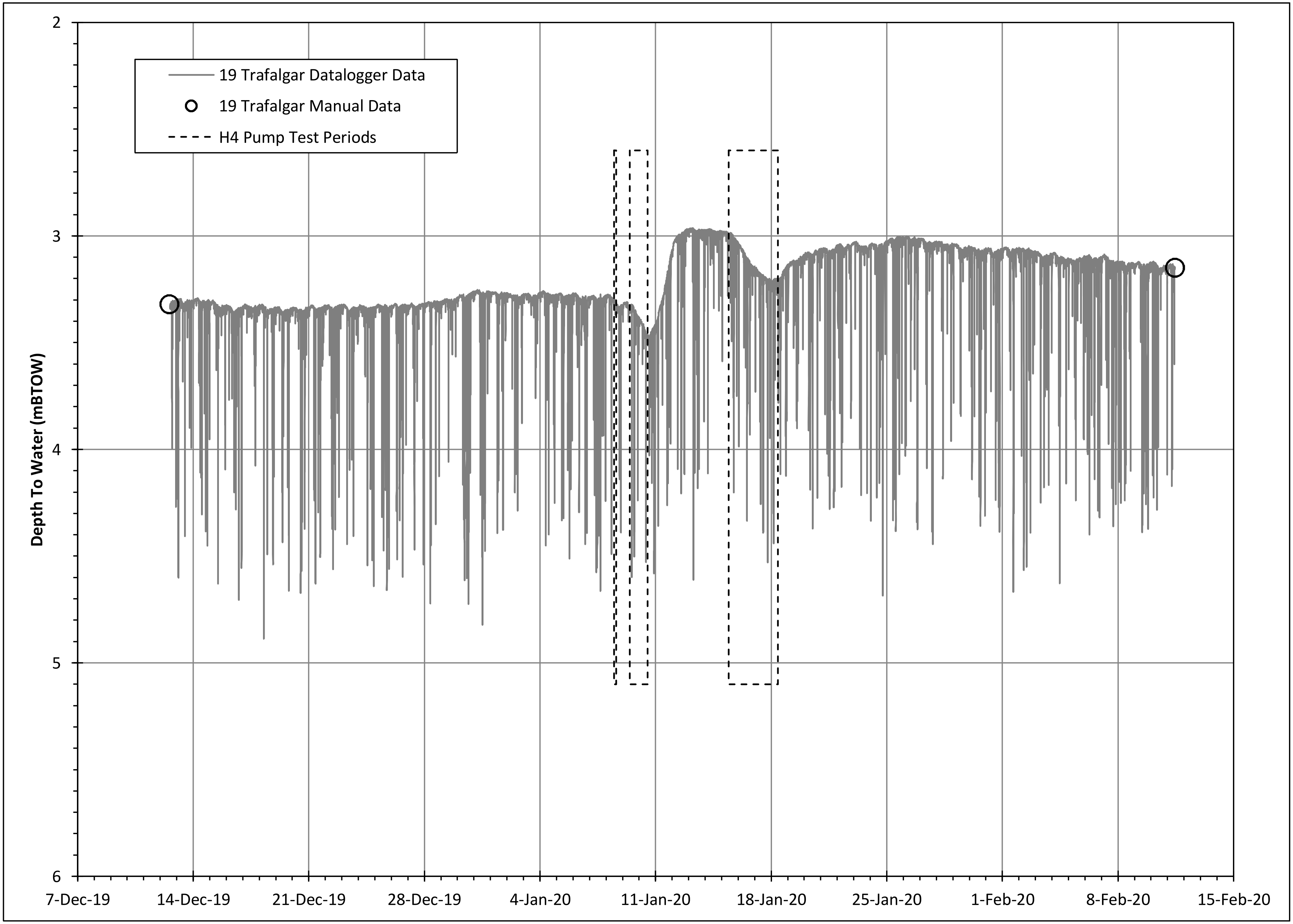
H4 Pumping Test Hydrograph: 2 Queen Street



Town of Erin
Water Supply EA

10 Anne Street North Dug Well Long Term Hydrograph

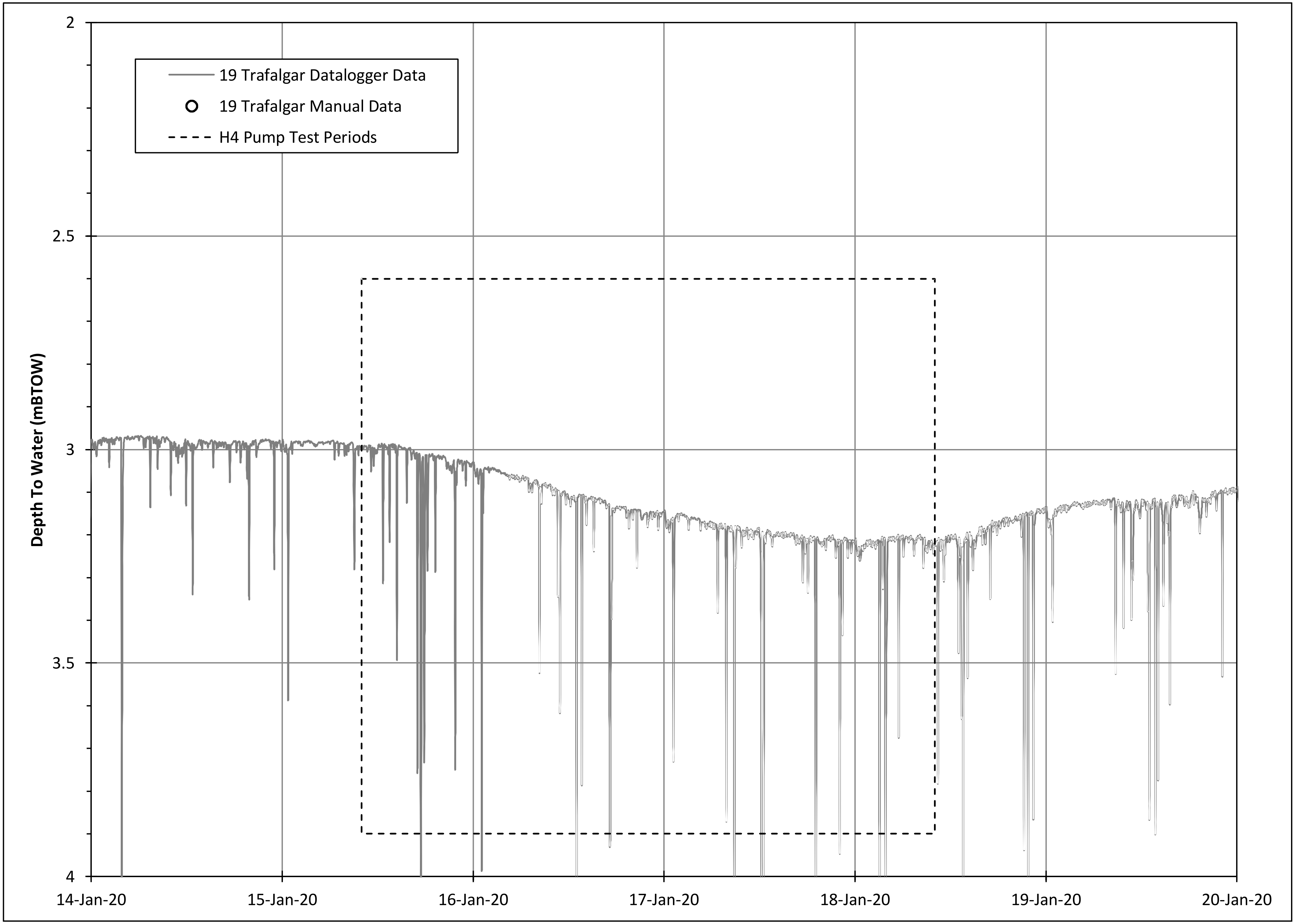
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

19 Trafalgar Road Long Term Hydrograph

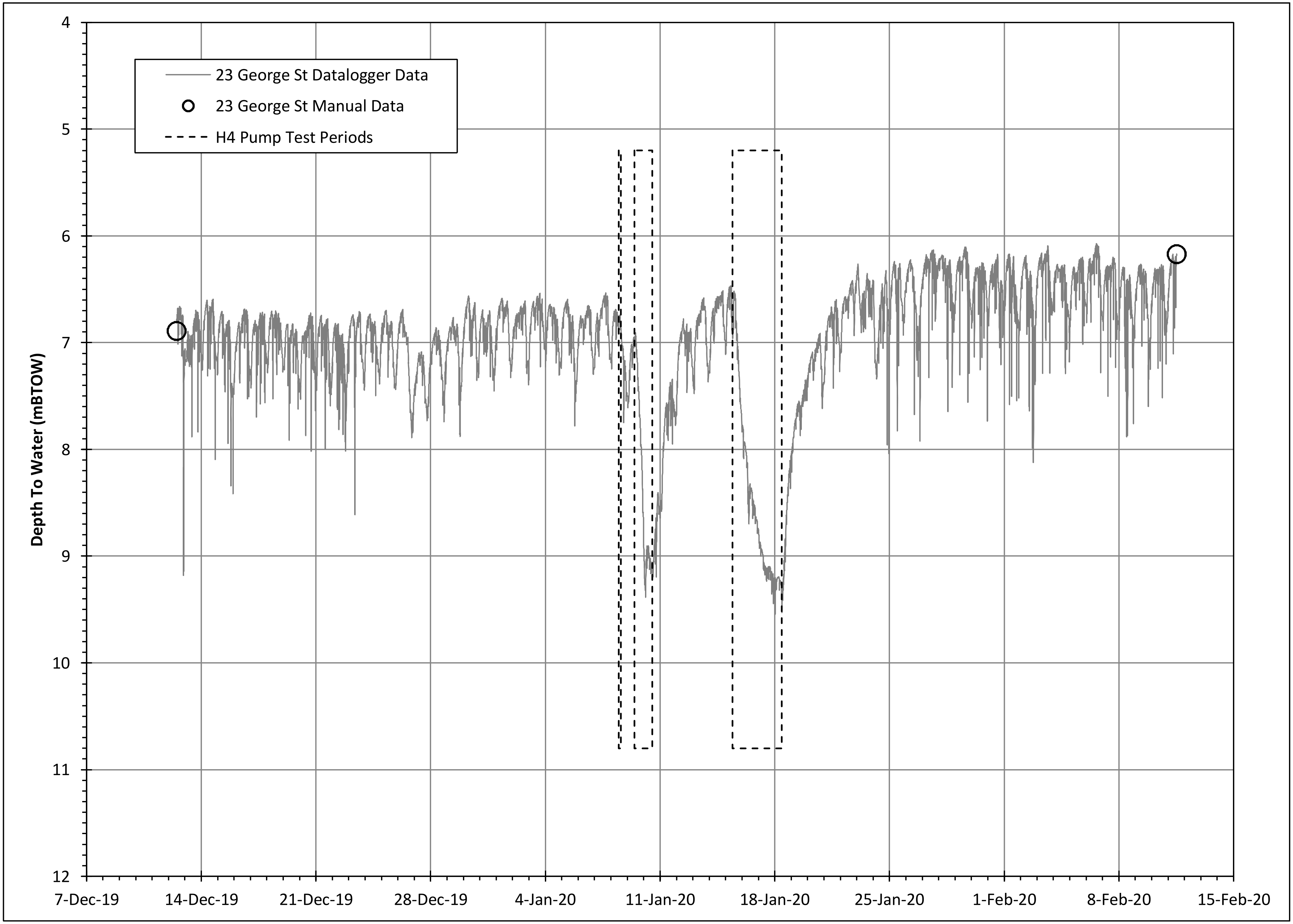
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

H4 Pumping Test Hydrograph: 19 Trafalgar Road

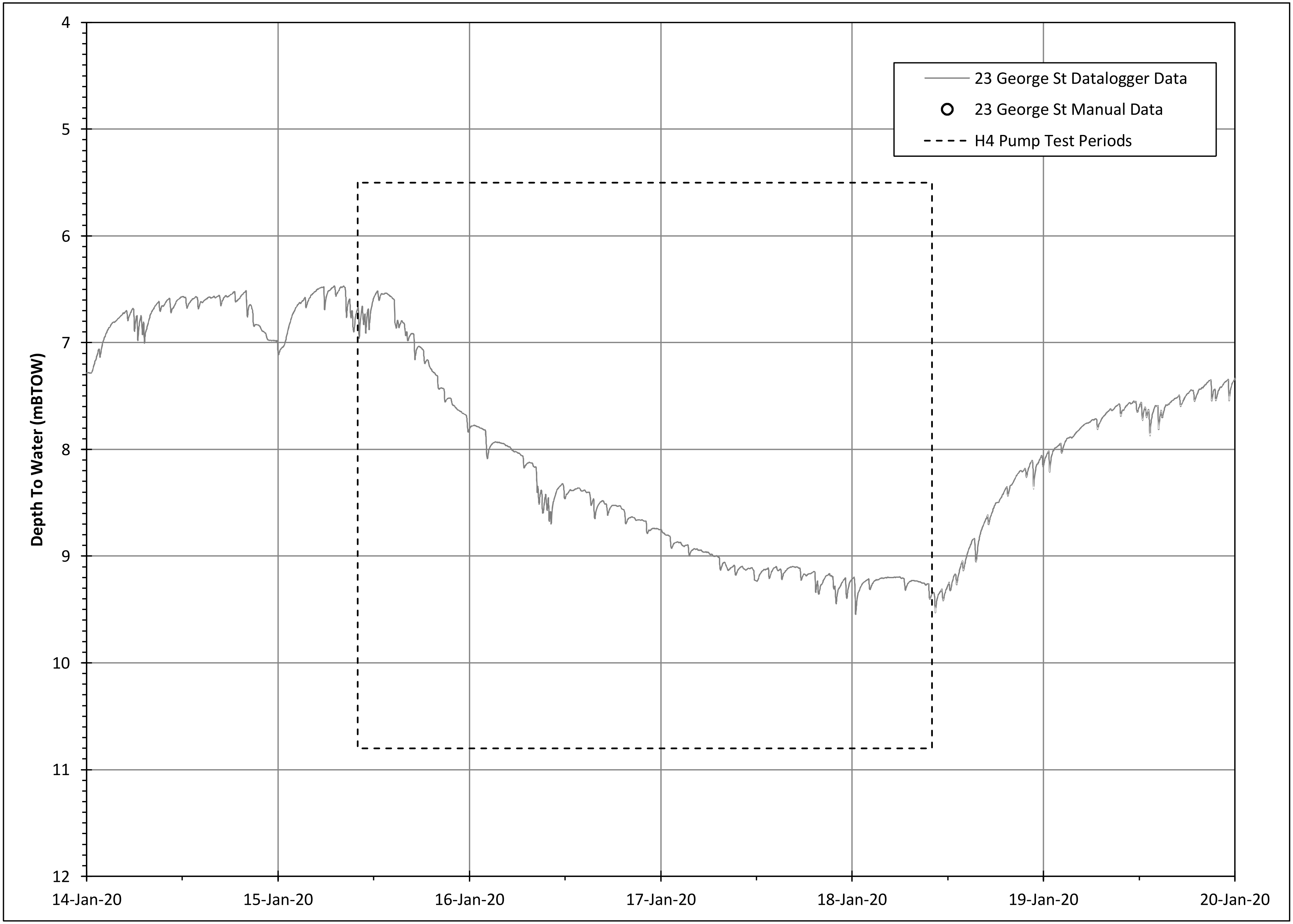
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

23 George Street Long Term Hydrograph

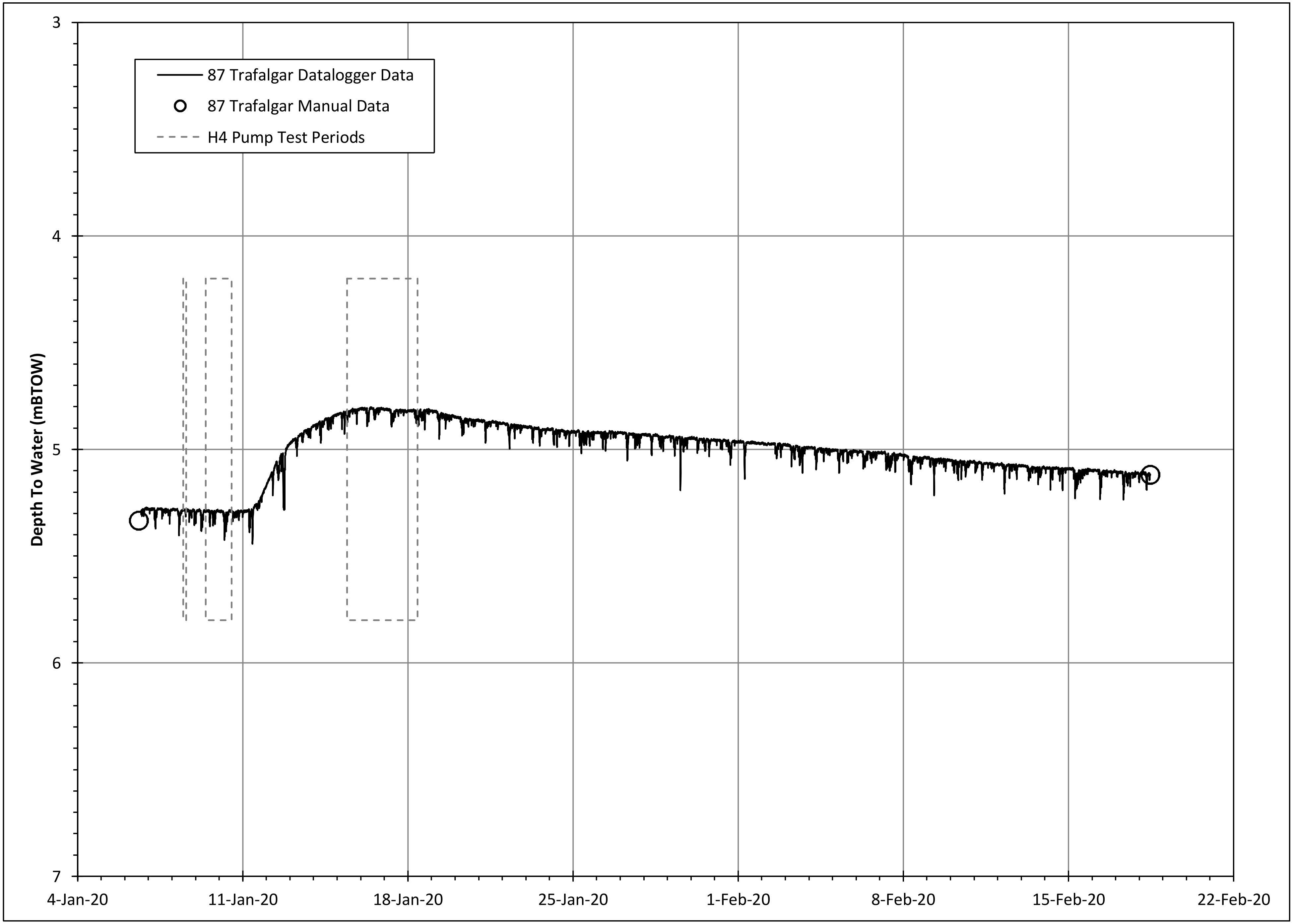
Groundwater Science Corp
Hydrogeological Assessment



Town of Erin
Water Supply EA

H4 Pumping Test Hydrograph: 23 George Street

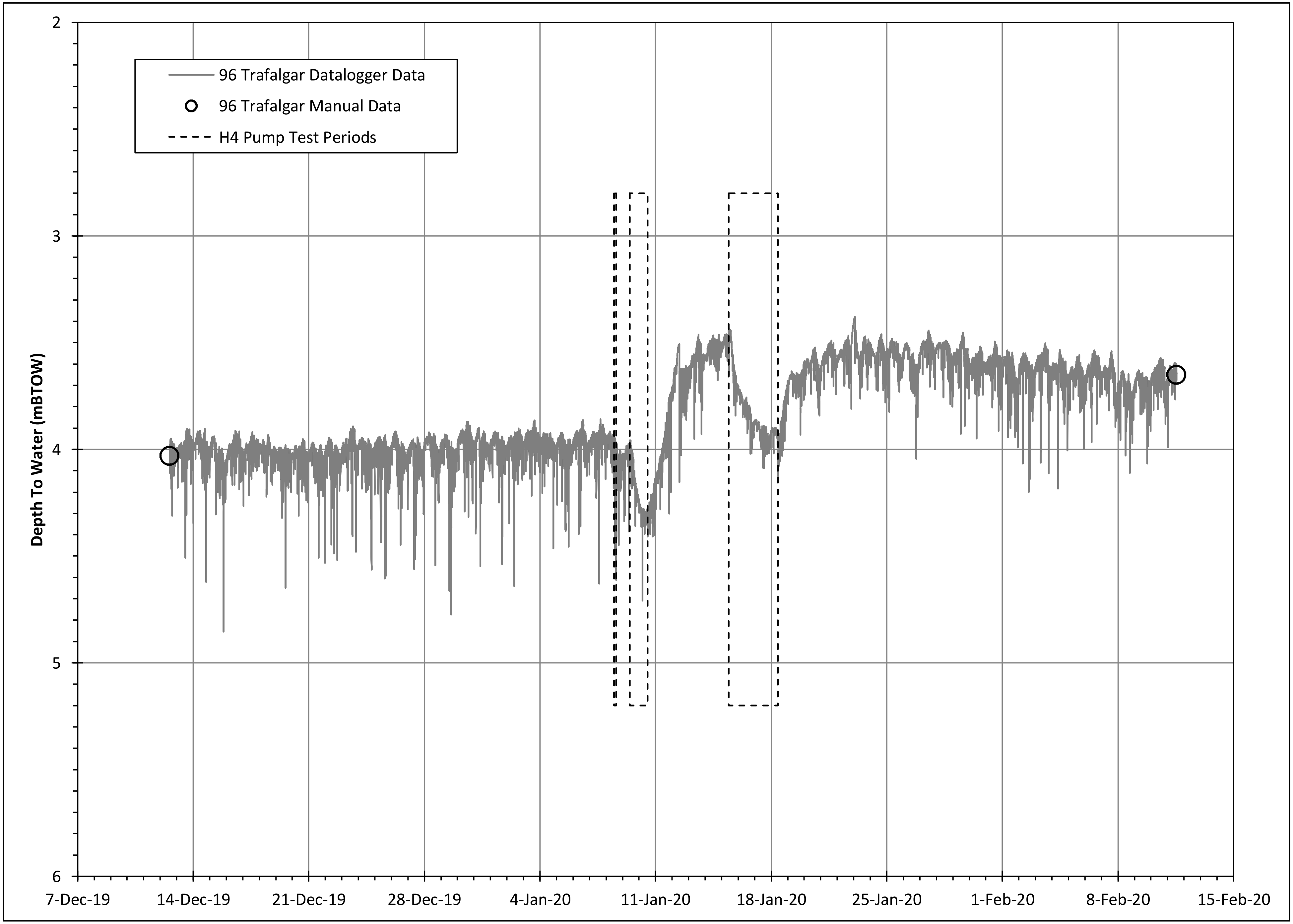
Groundwater Science Corp
Hydrogeological Assessment



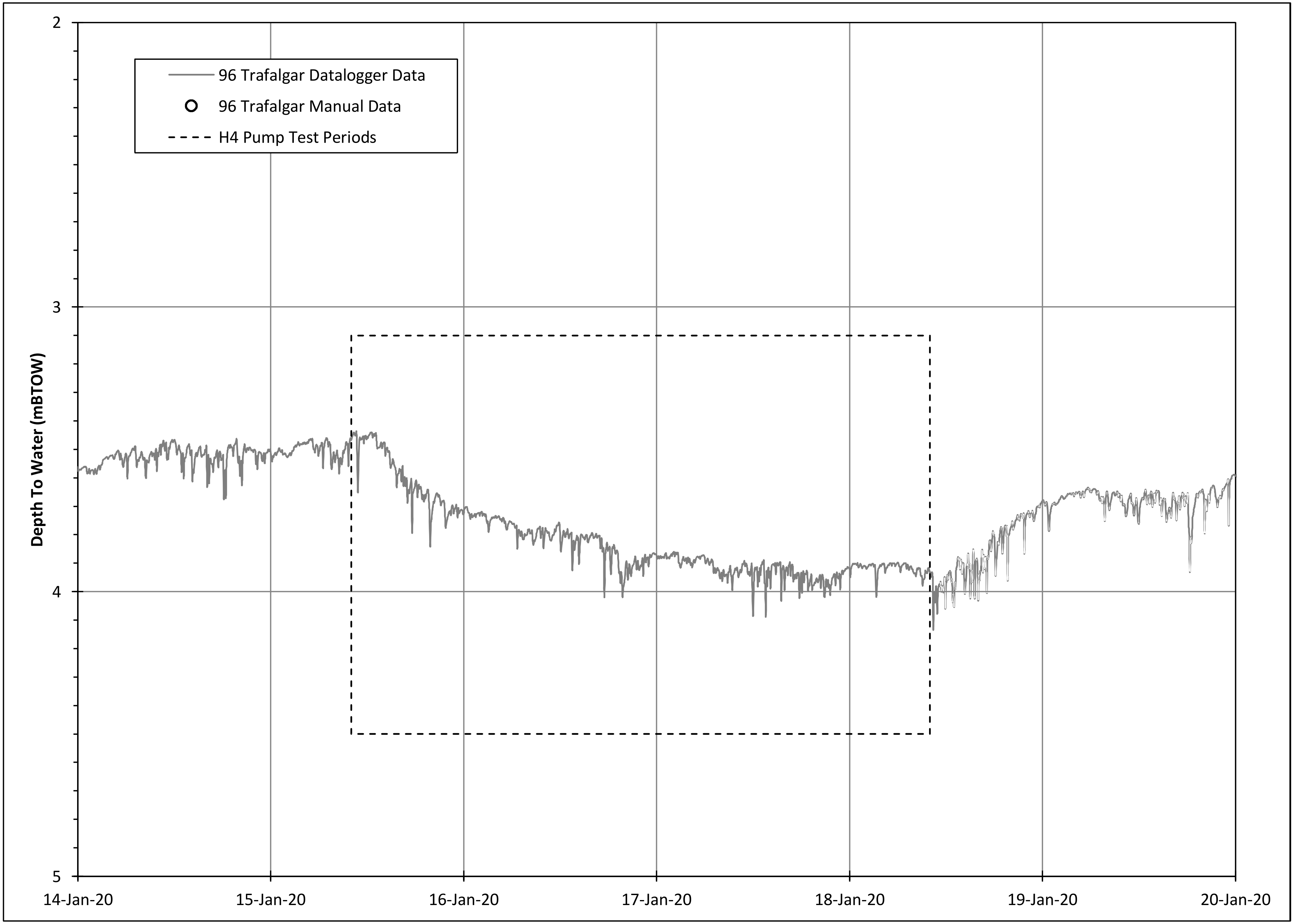
Town of Erin
Water Supply EA

87 Trafalgar Road Dug Well Long Term Hydrograph

Groundwater Science Corp
Hydrogeological Assessment



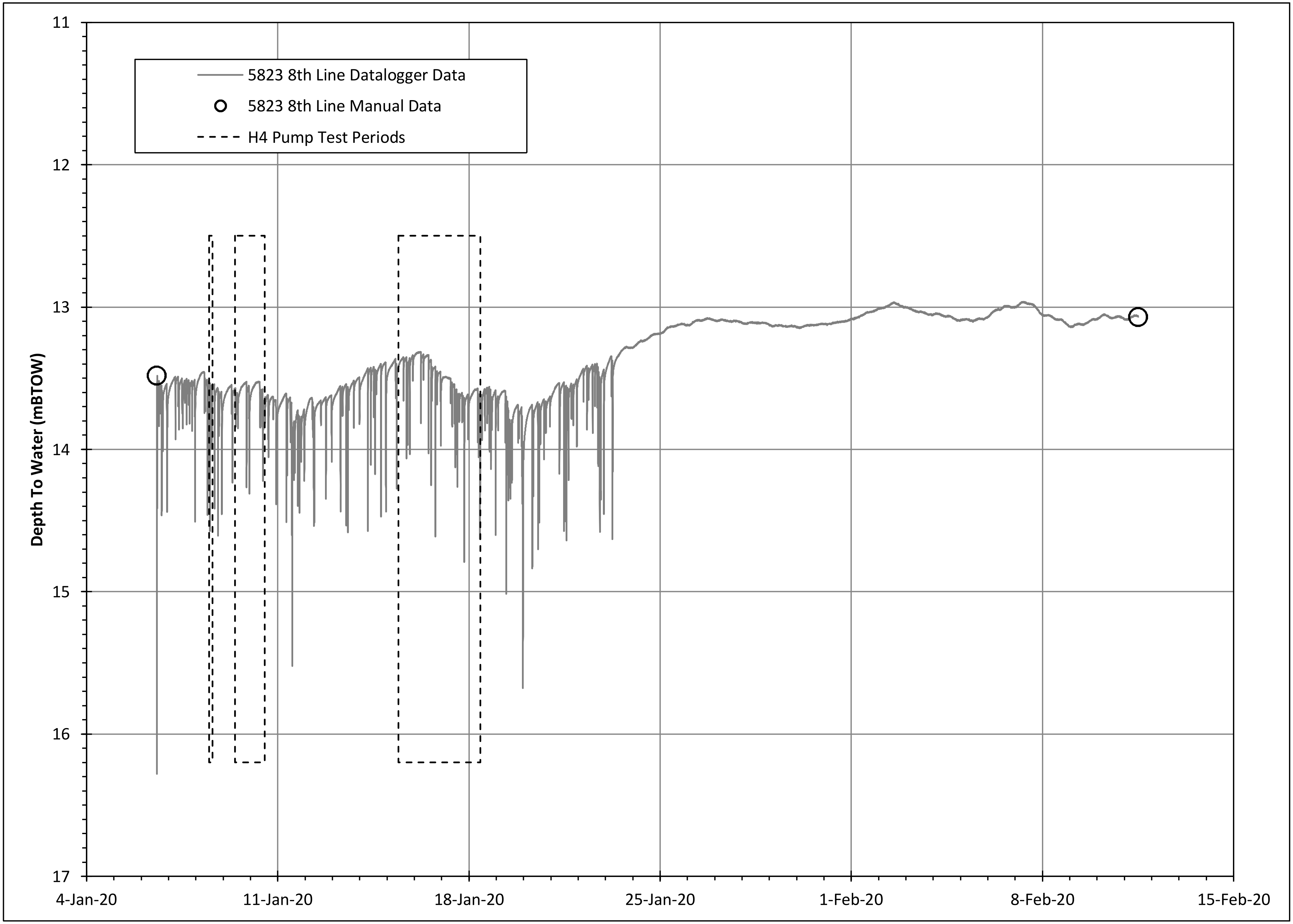
96 Trafalgar Road Long Term Hydrograph



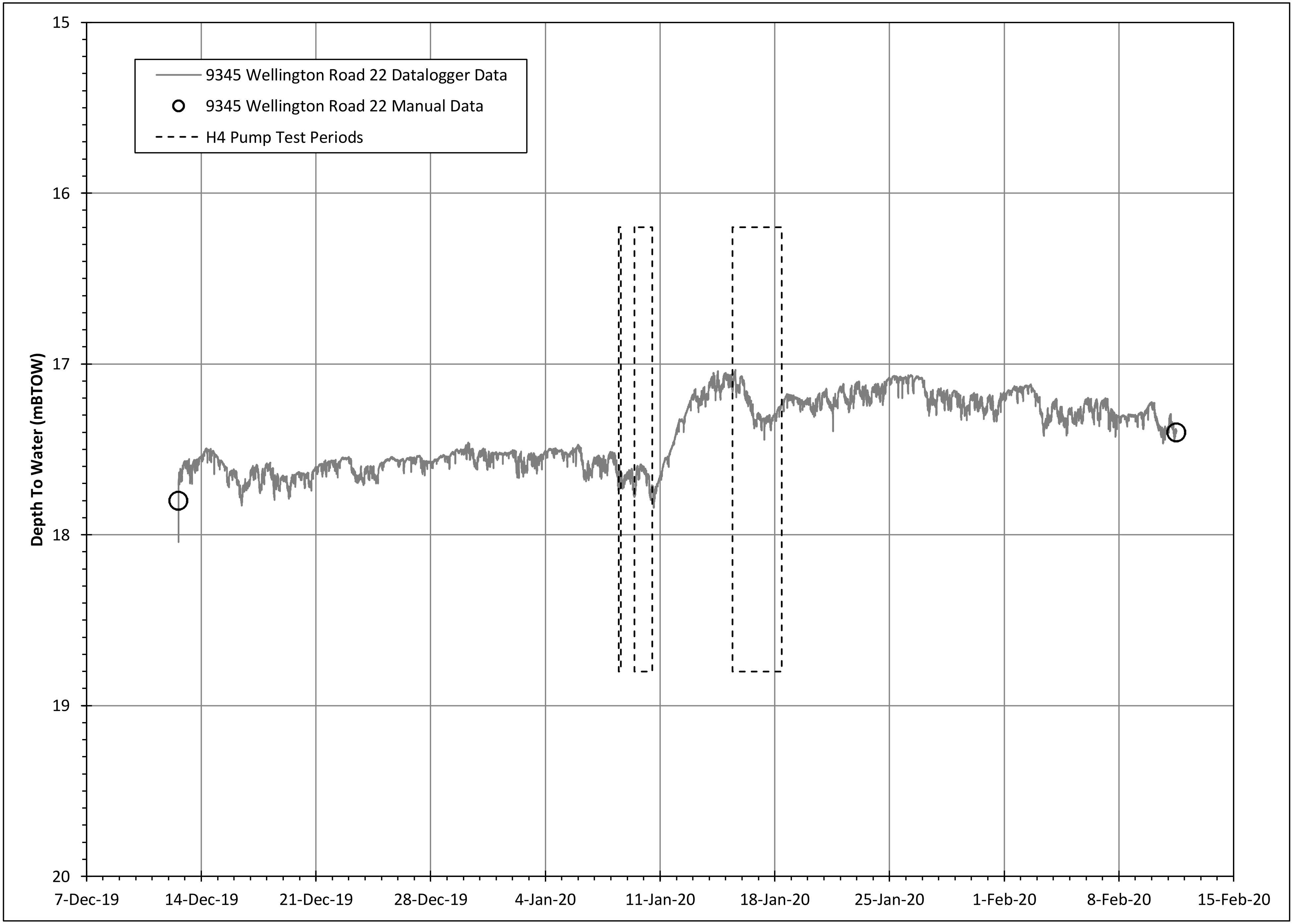
Town of Erin
Water Supply EA

H4 Pumping Test Hydrograph: 96 Trafalgar Road

Groundwater Science Corp
Hydrogeological Assessment



5823 8th Line Long Term Hydrograph

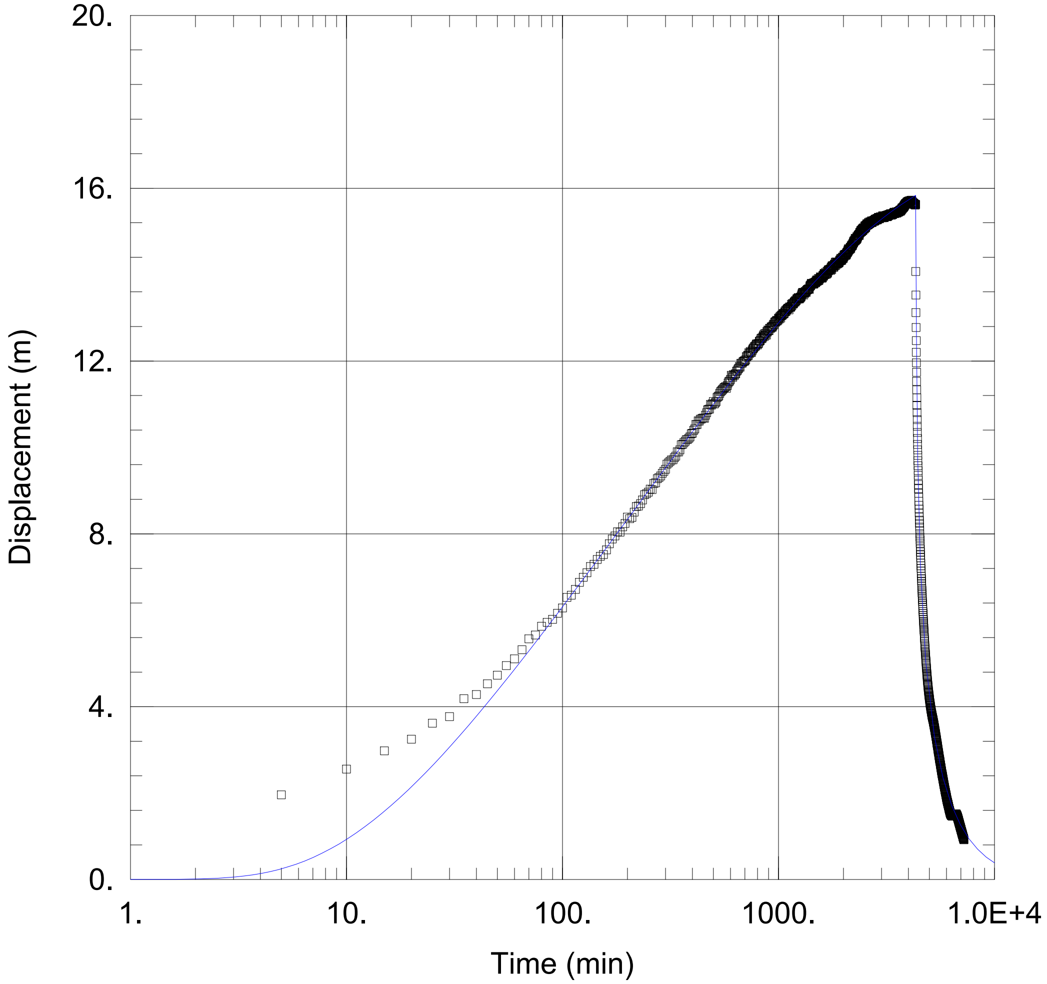


Town of Erin
Water Supply EA

9345 Wellington Road 22 Long Term Hydrograph

Groundwater Science Corp
Hydrogeological Assessment

Appendix O
Pump Test Analysis



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Hillsburgh 2 Site
Test Well: H4
Test Date: January 2020

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
H4	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ H4	0	0

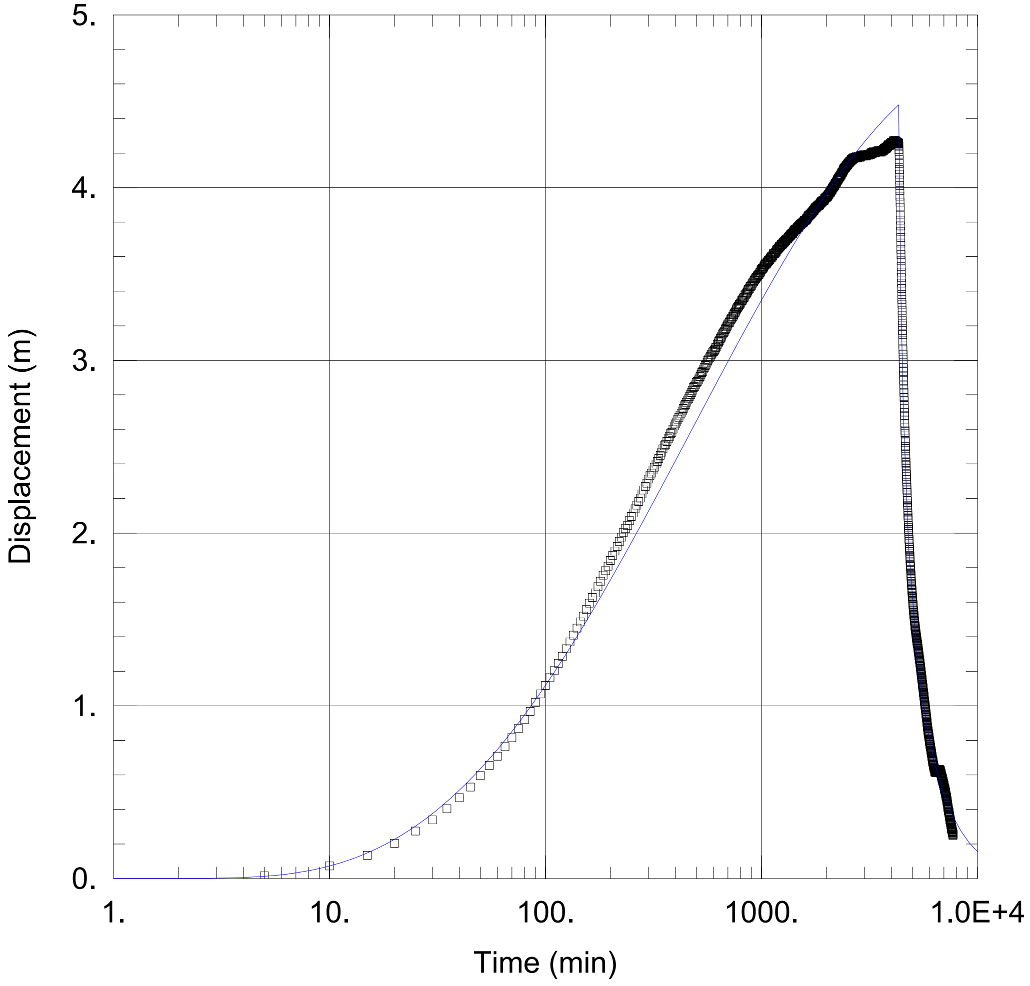
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.0005793 m^2/sec
r/B = 0.08266
b = 76. m

S = 72.46
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Hillsburgh 2 Site
Test Well: H4
Test Date: January 2020

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
H4	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ TW4-S	10	0

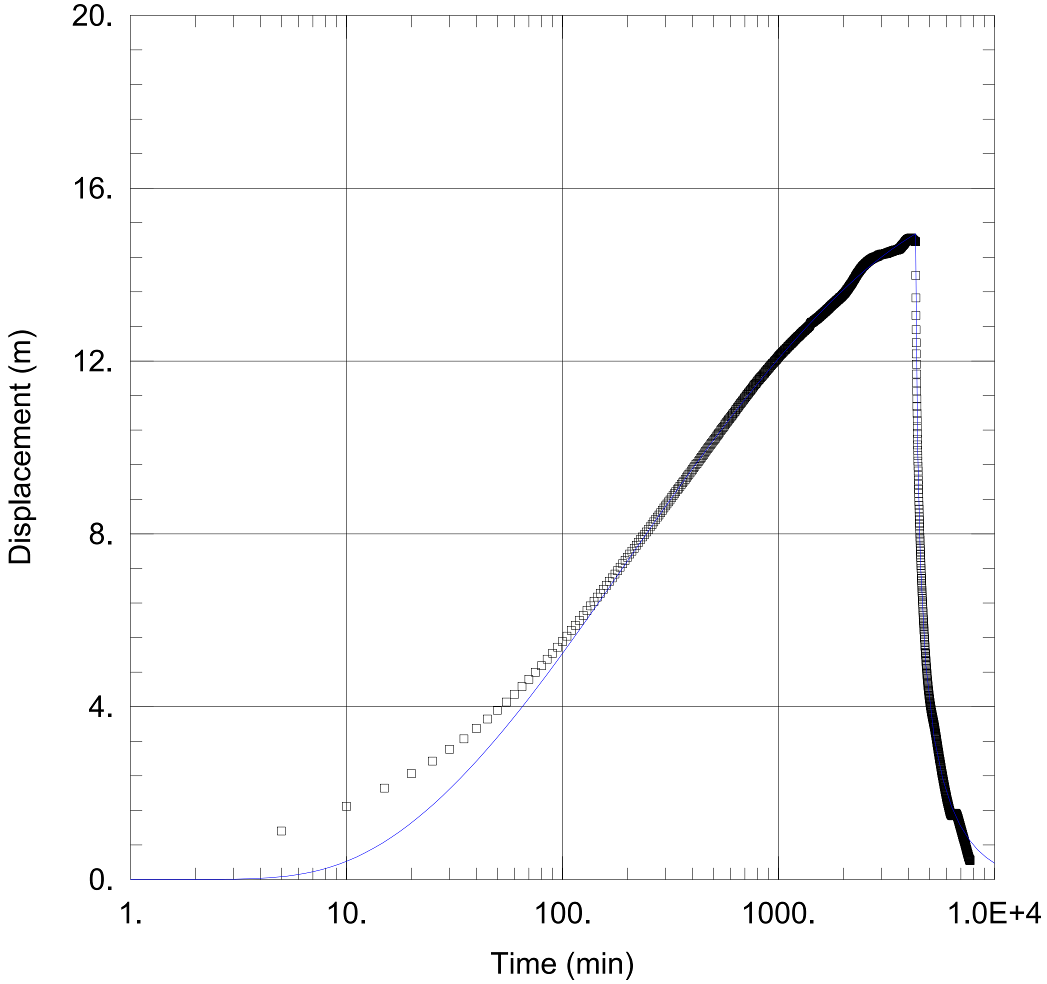
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.001224 m^2/sec
r/B = 0.08693
b = 76. m

S = 0.02821
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Hillsburgh 2 Site
Test Well: H4
Test Date: January 2020

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
H4	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ TW4-D	10	0

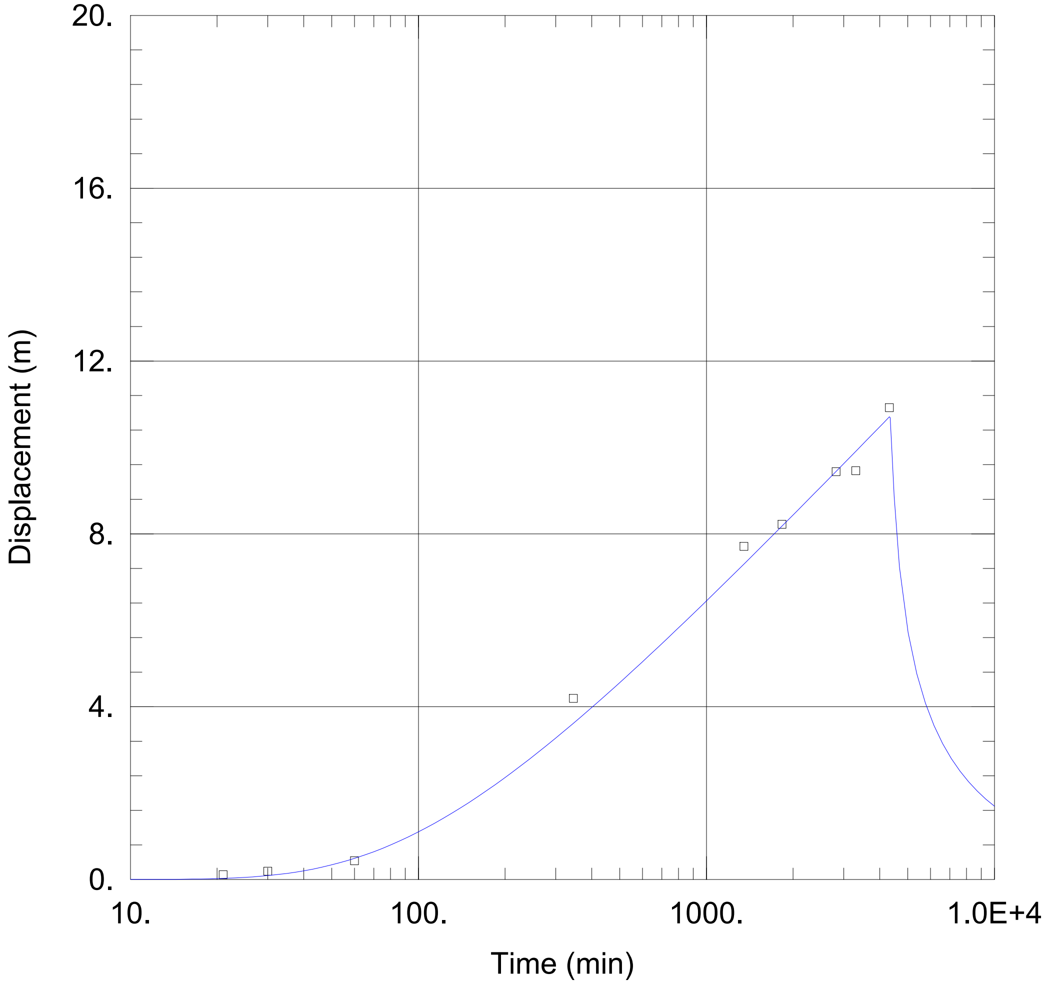
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.0004699 m^2/sec
r/B = 0.108
b = 76. m

S = 0.01596
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Hillsburgh 2 Site
Test Well: H4
Test Date: January 2020

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
H4	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ H3 (Glendevon Well)	370	0

SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.0004843 m^2/sec
r/B = 1.0E-5
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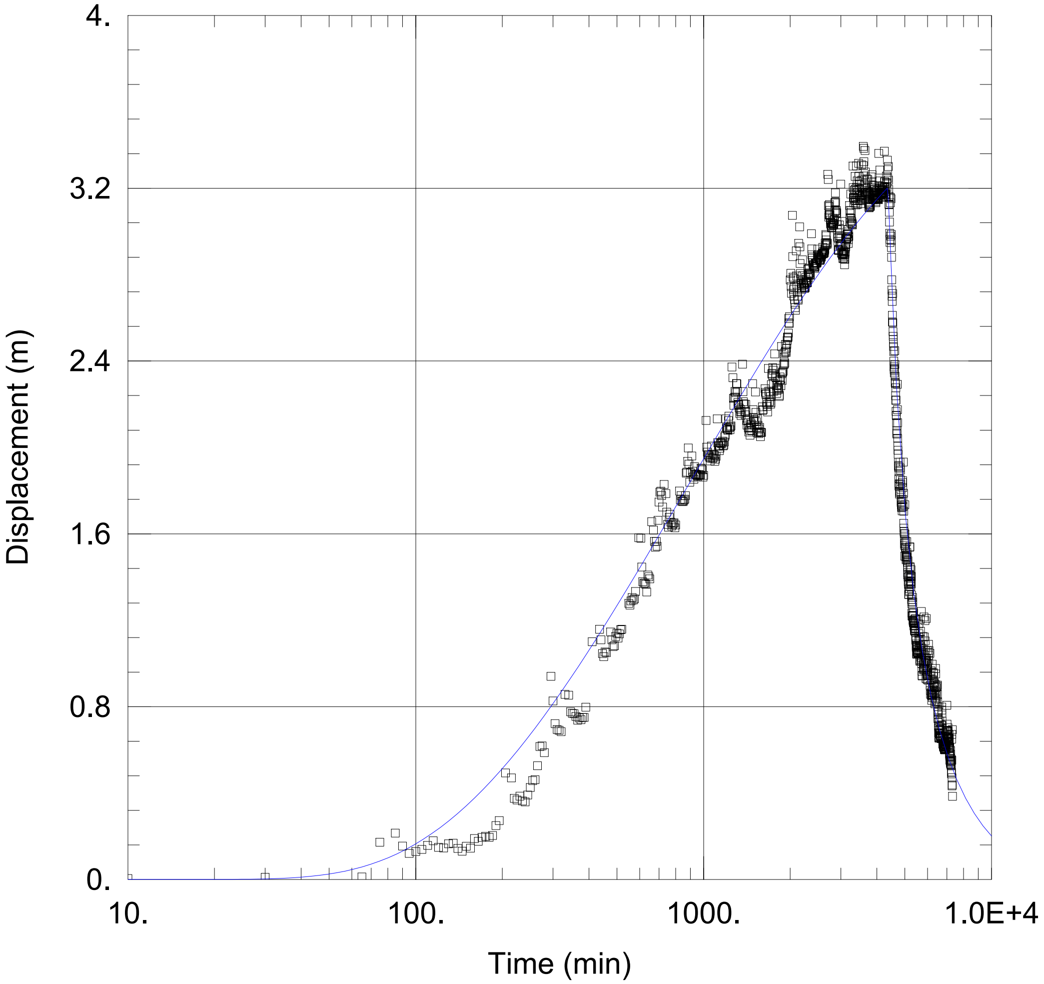
S = 6.062E-5
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Hillsburgh 2 Site
Test Well: H4
Test Date: January 2020

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
H4	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ Arena Well	475	0

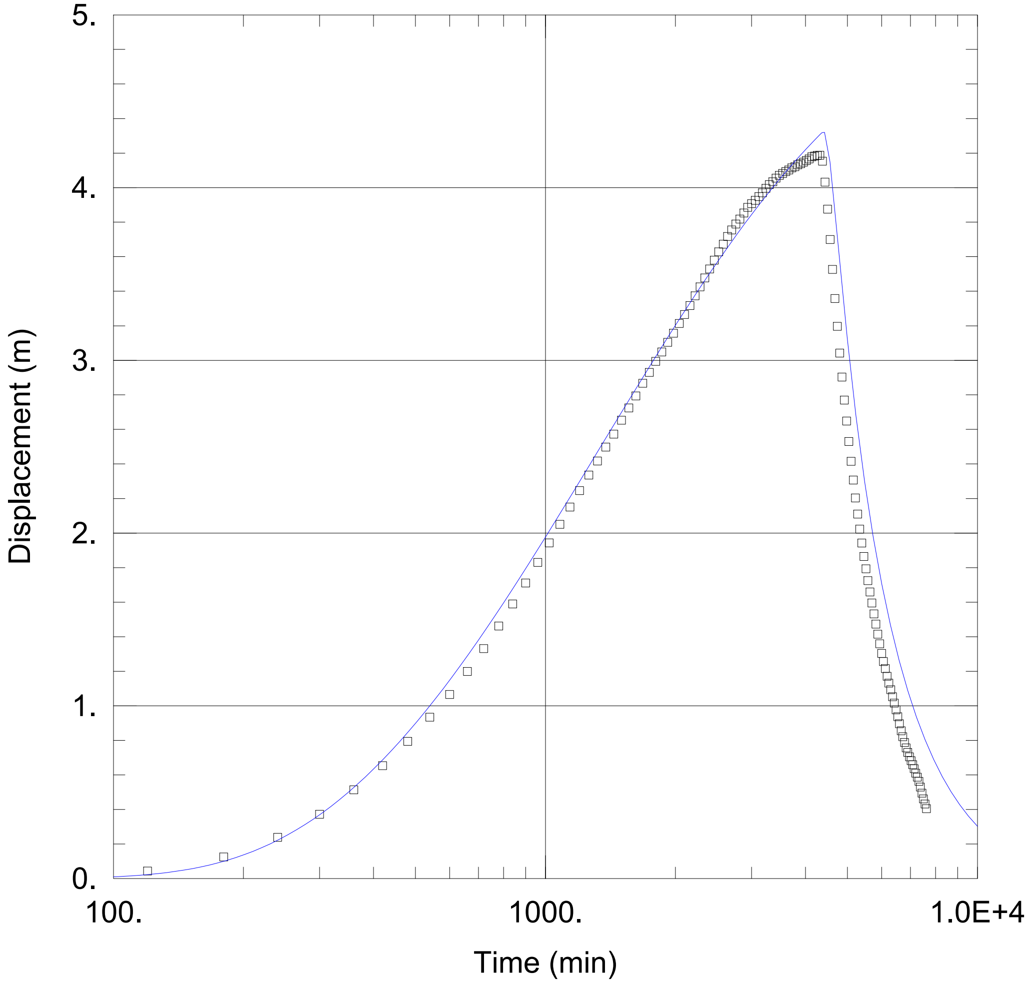
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.001081 m^2/sec
r/B = 0.3095
b = 76. m

S = 0.0001567
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Hillsburgh 2 Site
Test Well: H4
Test Date: January 2020

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
H4	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ TW01-18	980	0

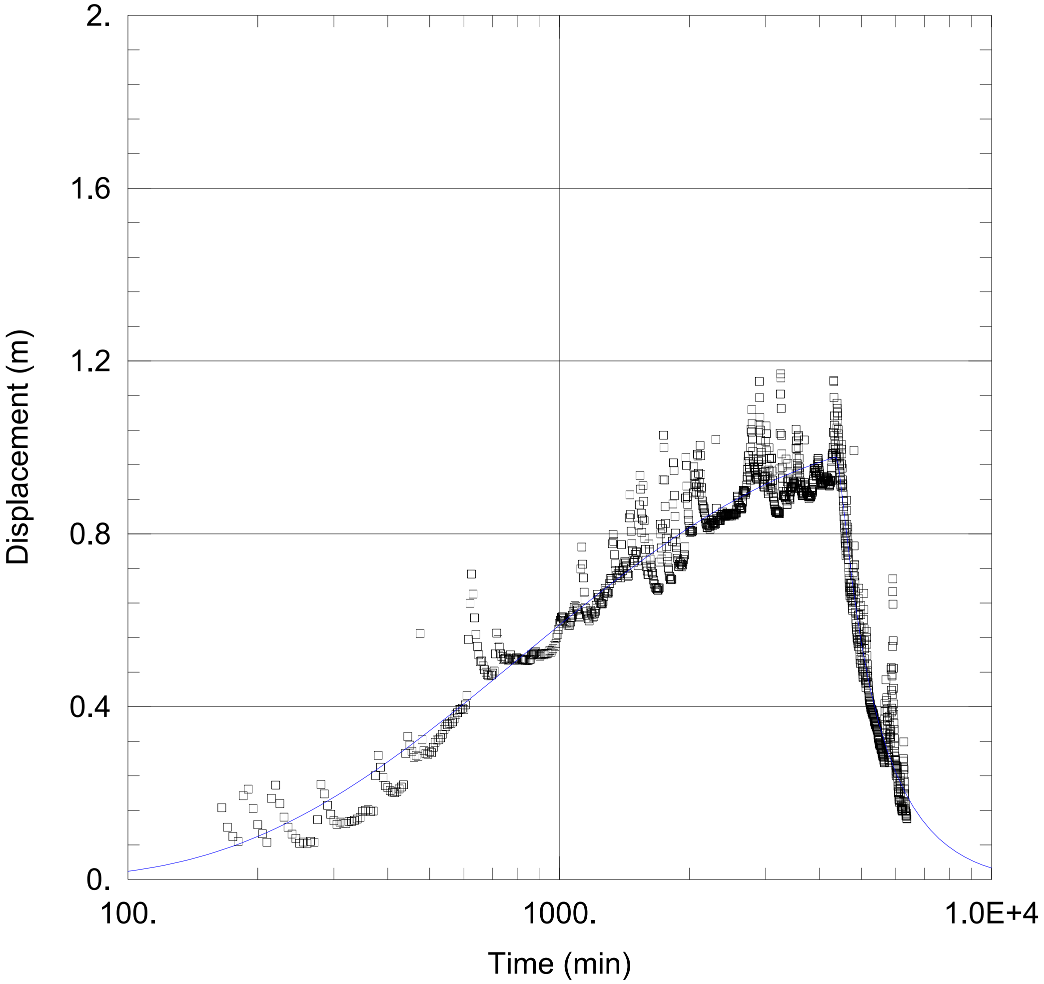
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.0004315 m^2/sec
r/B = 0.6369
b = 76. m

S = 4.562E-5
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Hillsburgh 2 Site
Test Well: H4
Test Date: January 2020

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
H4	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ 1 Barker - North Well	550	0

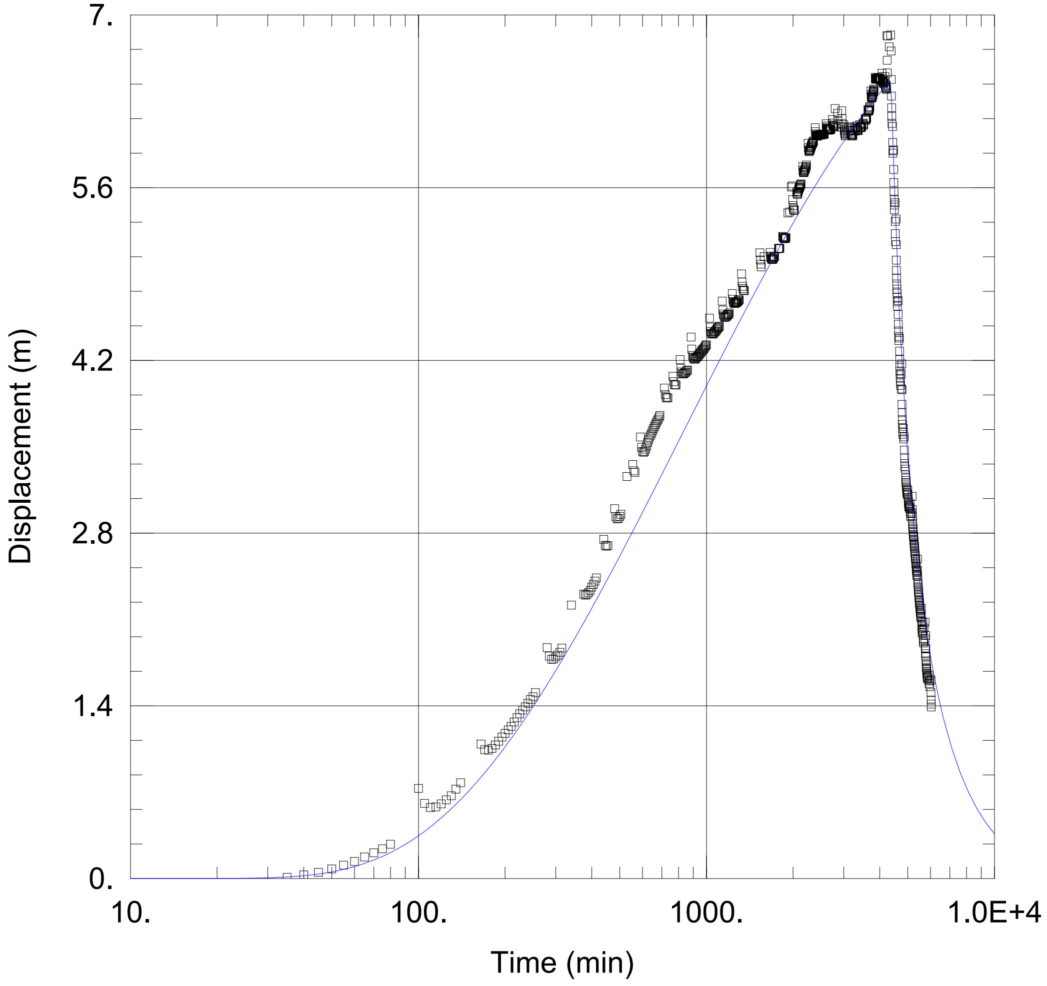
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.002296 m^2/sec
r/B = 0.5732
b = 76. m

S = 0.0004292
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Hillsburgh 2 Site
Test Well: H4
Test Date: January 2020

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
H4	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ 1 Barker - South Well	530	0

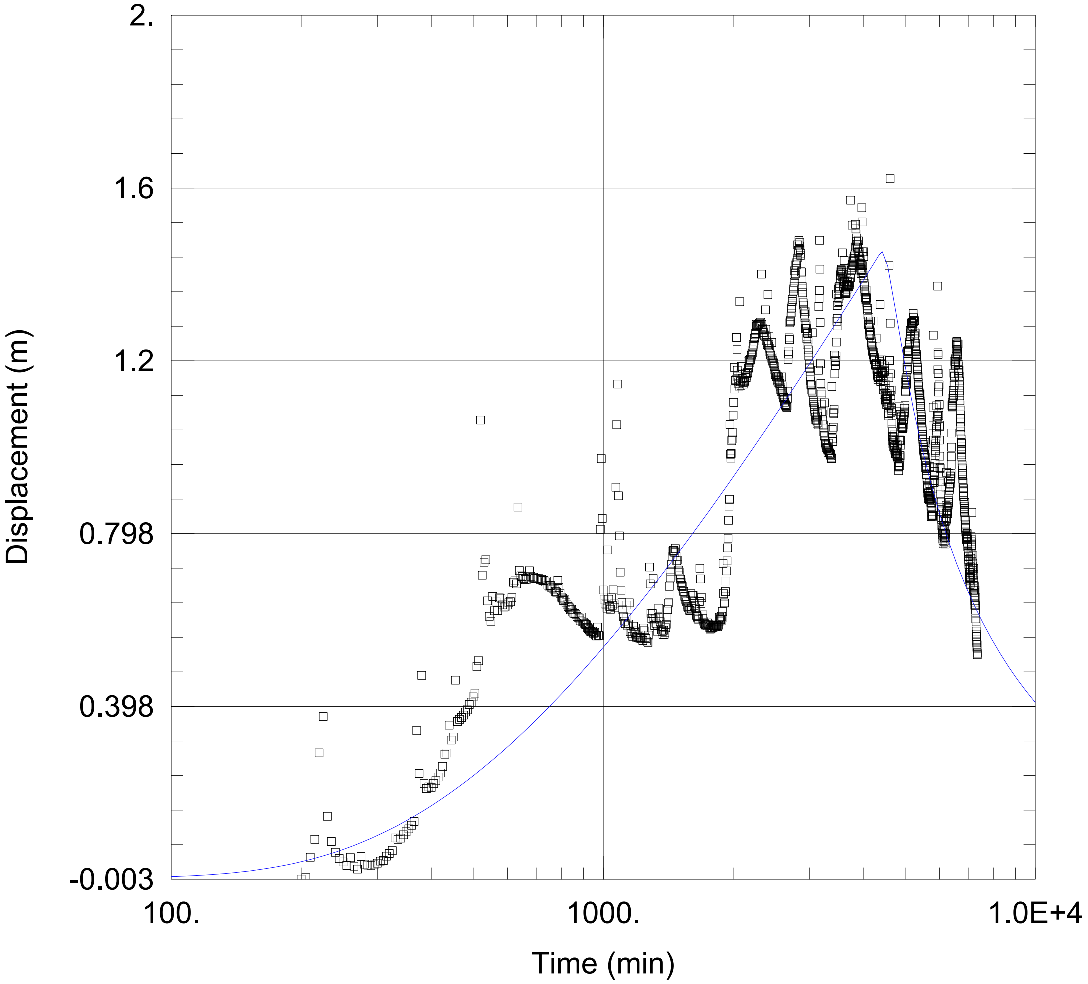
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.0005269 m^2/sec
r/B = 0.3232
b = 76. m

S = 6.062E-5
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Hillsburgh 2 Site
Test Well: H4
Test Date: January 2020

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
H4	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ 2 Queen Street	740	0

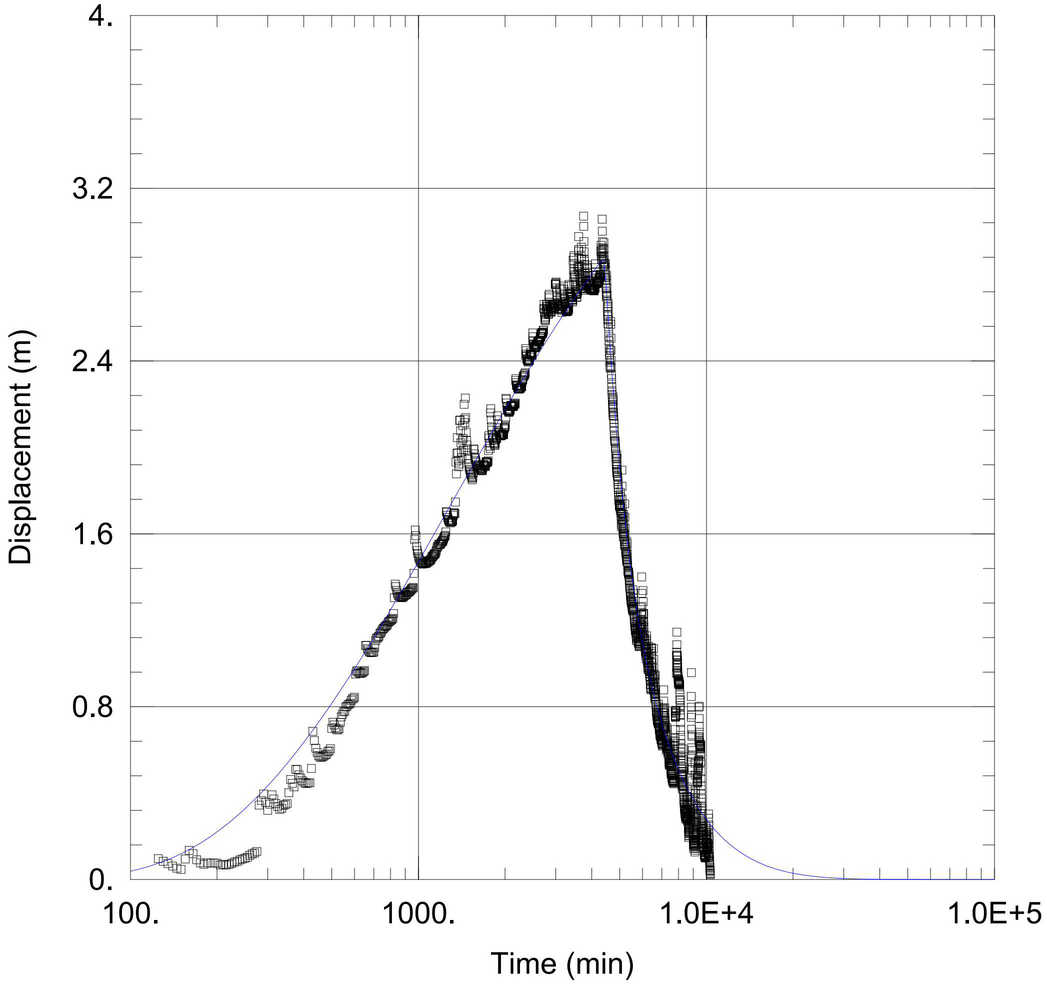
SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 0.001928 m^2/sec
r/B = 1.0E-5
b = 76. m

S = 0.0003374
Kz/Kr = 1.



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: Groundwater Science Corp.
Client: Town of Erin
Project: Water Supply EA
Location: Hillsburgh 2 Site
Test Well: H4
Test Date: January 2020

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
H4	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ 23 George Street	810	0

SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

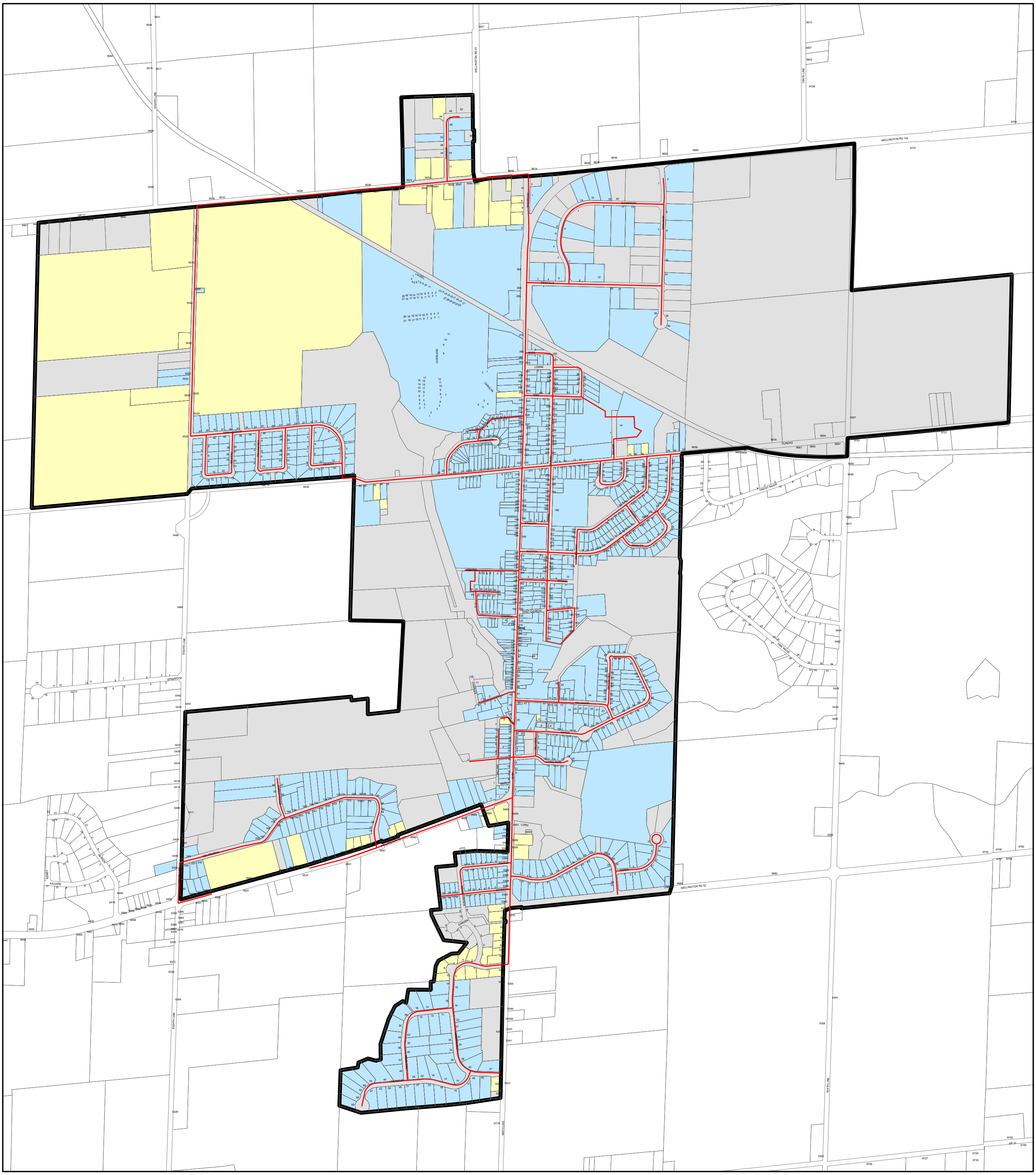
T = 0.0009778 m^2/sec
r/B = 0.3771
b = 76. m

S = 8.831E-5
Kz/Kr = 1.

Appendix F

Existing Erin Municipal Water System Distribution Map

Village of Erin



0 250 500 1,000 1,500 2,000
Meters

Legend

— Erin_Water_Main

🟨 56 Buildings within Urban Boundary not serviced by municipal water

🟦 On Municipal Water

⬜ Urban Boundary

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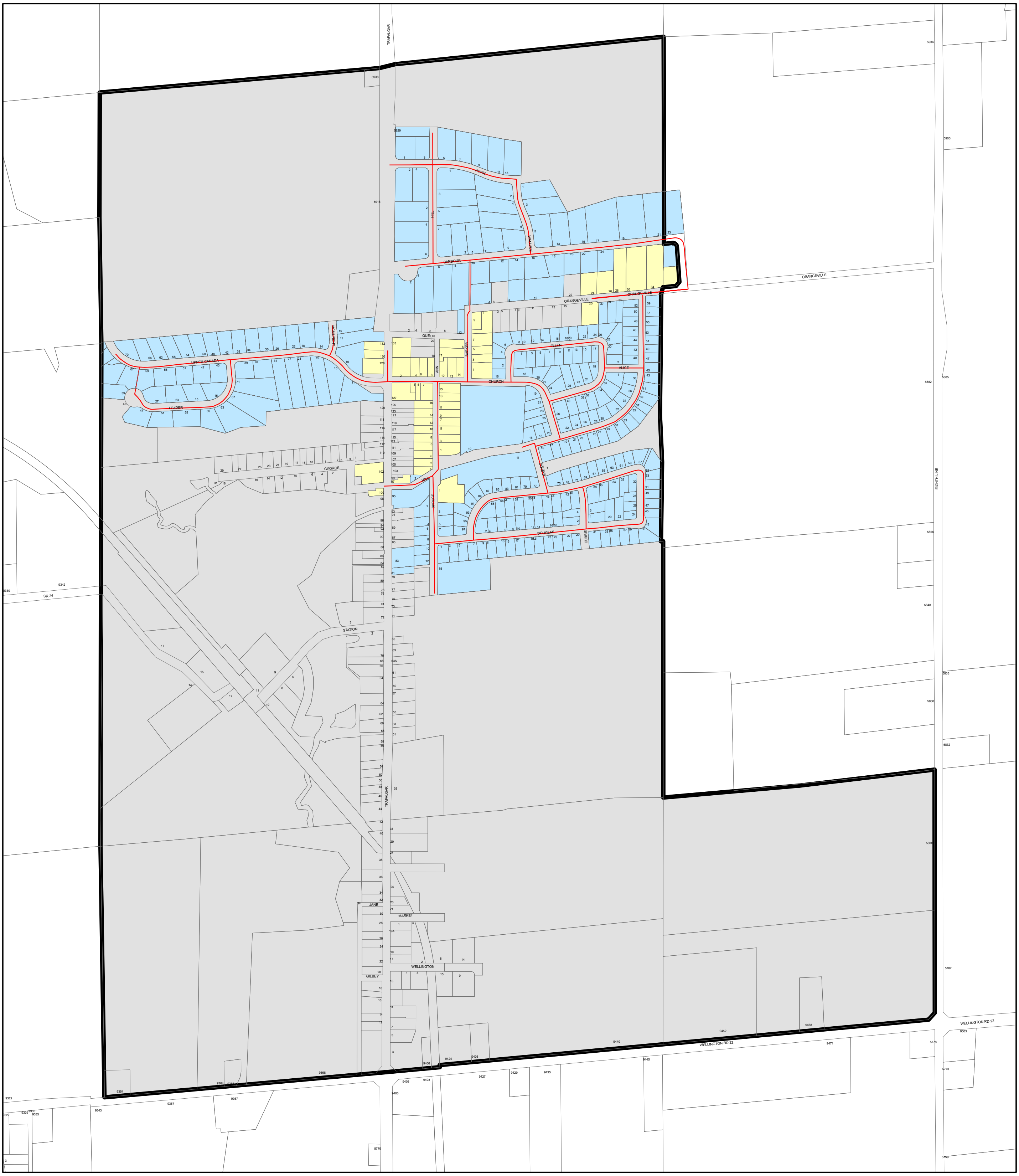
Sources:
County of Wellington Planning and Development Department 2011.

Appendix G

Existing Hillsburgh Municipal Water System Distribution Map

Village of Hillsburgh



Legend

- Hillsburgh water main
- 🟦 On Muncipal Water
- 🟨 51 Buildings within Urban Boundary not serviced by municipal water
- ▨ Urban Boundary