



BURNSIDE

**2025 Biennial Groundwater Monitoring  
Report - Pinebush East Well Field  
(P10, P10A, P10B, P11, P17 and P19)**

**The Region of Waterloo**



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**The Region of Waterloo**

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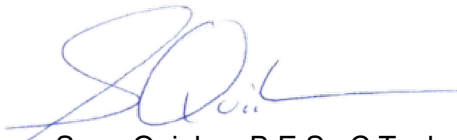
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## 1.0 Introduction

The Regional Municipality of Waterloo (the Region) is unique in Ontario in that it is the largest urban municipality to rely almost exclusively on groundwater supplies for its drinking-water (Region of Waterloo, 2015). Figure 1 shows the location of municipal well fields within the Region.

The Permit to Take Water (PTTW 7858-BXUUUH) for the Pinebush East Well Field requires submission of a well field specific biennial report to the Ministry of Environment, Conservation and Parks (MECP) which documents well pumping volumes and water levels in specific monitoring wells during 2024 and 2025. This report has been prepared to meet the reporting condition of the PTTW for 2024 and 2025. A copy of the PTTW is included in Appendix A.

The location of the Pinebush East Well Field is shown in Figure 1 and the production wells in Cambridge are shown in Figure 2 with the monitoring network for P10, P10A, P10B, P11, P17 and P19 shown in Figure 3. Well records for the production and monitoring wells are found in Appendix B.

### 1.1 Scope of Work

The Region records water levels on a regular basis within a network of monitoring wells to satisfy requirements of their PTTW and to confirm that water taking is sustainable in the long term. The monitoring wells are concentrated near the production wells. The data from these wells and regular measurements of pumping volume obtained from the production wells are used to evaluate the impact of Region pumping on aquifers and potential impacts to private wells, other water takers and the natural environment.

The Region has developed a monitoring program for Pinebush East Well Field (P10, P10A, P10B, P11, P17 and P19) in accordance with PTTW (PTTW 7858-BXUUUH) which consists of the following activities:

- Measuring the daily volume pumped from the P10, P10A, P10B, P11, P17 and P19 production wells (Condition 4.1 of the PTTW);
- Measuring water levels in monitoring wells C-PB-OW5-94-ABCDEFG, C-PB-OW2-06-ABCDEF\*, C-PB-OW1-09-ABCDE, C-PB-OW1-11-AB C-PB-OW1-92-ABC, C-PB-OW1-22-ABCDEFGH, C-PB-OW2-22-ABC and C-PB-OW3-22-ABC (Condition 4.2 of the PTTW);
- Measure water levels in piezometers C-PB-DP1-21-AB, C-PB-DP3-21-AB and C-PB-DP5-22-AB (Condition 4.2 of the PTTW);
- Measure surface water levels at C-PB-SW3-21-Z and C-PB-SW5-22-Z (Condition 4.2 of the PTTW);
- Measure surface water flow at C-PB-SW3-21-Z(Condition 4.2 of the PTTW);
- Review of precipitation data from the nearest GRCA/Environment Canada weather station (Condition 4.3 of the PTTW); and
- Completion of a biennial report (every 2 years) that presents data in compliance with condition 4.3 of the PTTW.

*Note\*: Monitoring well nest C-PB-OW2-06 was previously identified as C-CM-PBOW2-06 in the Permit to Take Water.*

The Monitoring data (pumped volumes and hydrographs) are found in Appendix C with precipitation data in Appendix D. The monitoring program procedures and methodology are included in Appendix E.

## 2.0 Site Setting

### 2.1 Well Field Description

The Pinebush East Well field consists of six wells (P10 / P10A / P10B / P11 / P17 / P19) on three properties. P11 and P17 are located on a property south of Pinebush Road on Thompson Drive, wells P10 / P10A and P10B are located south of Pinebush Road and Well P19 is located north of Pinebush Road. The other wells in the Pinebush Well Field (G5 / G5A and P9 / P15 / P15A) are located west along Pinebush Road closer to Highway 401. The Clemens Mill Well Field is located about 1 km to the south of the P11 / P17 property (Figure 2). The P11 and P17 wells are in an urban area that is municipally serviced. The P10, P10A and P10B wells are located adjacent to a small wetland / pond. The closest surface water feature to the P19 site is a small wetland / pond located approximately 170 m to the east. P11 and P17 are located adjacent to the provincially significant wetland called the Portuguese Swamp (Figure 3). P10 was decommissioned in 2022.

#### 2.1.1 Pumping Wells

Well records for the production wells are found in Appendix B.

Production well P10A was brought online during March 2024 and P19 was brought online during February 2024. Production wells P10, P10B, P11, P17 and P19 were pumped in 2024 while P10B and P17 were the primary wells pumped in 2025.

A summary of the production well construction details is provided in Table 1 below.

**Table 1: Production Well Construction Details**

| Well Name | Year Built | Casing Diameter (mm) | Open Hole Diameter (mm) | Open Hole interval (mbgs) | Aquifer                          |
|-----------|------------|----------------------|-------------------------|---------------------------|----------------------------------|
| P10       | 1959       | 203                  | 203                     | 30.6-32.3                 | Contact to Upper Guelph Fm.      |
| P10A      | 2010       | 305                  | 200 & 305               | 58.0-121.0                | Goat Island to Lower Gasport Fm. |

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| Well Name | Year Built | Casing Diameter (mm) | Open Hole Diameter (mm) | Open Hole interval (mbgs) | Aquifer                           |
|-----------|------------|----------------------|-------------------------|---------------------------|-----------------------------------|
| P10B      | 2011       | 305                  | 286                     | 26.5-33.5                 | ATB1 to Upper Guelph Fm.          |
| P11       | 1958       | 254                  | 254                     | 44.8-83.8                 | Reformatory to Upper Gasport Fm.  |
| P17       | 1994       | 254                  | 300                     | 48.2-110.3                | Goat Island to Middle Gasport Fm. |
| P19       | 2010       | 203                  | 203                     | 50.3-106.5                | Middle Guelph to Lower Gasport    |

The water taking volumes for the Pinebush East Well Field are regulated by Condition 3.2 of the PTTW and are summarized in Table 2 below.

**Table 2: Annual Water Taking 2024 / 2025**

| Well     | PTTW Details | 2024                                      |                                     |                                       | 2025                                      |                                     |                                       |
|----------|--------------|---|-------------------------------------|---------------------------------------|---|-------------------------------------|---------------------------------------|
|          |              | Avg. Daily Water Taking (m <sup>3</sup> ) | Max Taken per Day (m <sup>3</sup> ) | Total Volume Pumped (m <sup>3</sup> ) | Avg. Daily Water Taking (m <sup>3</sup> ) | Max Taken per Day (m <sup>3</sup> ) | Total Volume Pumped (m <sup>3</sup> ) |
| P10      | 13,910*      | Decommissioned                            |                                     |                                       | Decommissioned                            |                                     |                                       |
| P10A     | 13,910*      | 20.3                                      | 1,027                               | 7,440                                 | 0   | 2                                   | 153                                   |
| P10B     | 13,910*      | 1,840                                     | 2,809                               | 673,322                               | 1,378                                     | 2,247                               | 504,515                               |
| P11      | 13,910*      | 260                                       | 875                                 | 95,078                                | 0   | 0                                   | 0                                     |
| P17      | 13,910*      | 291                                       | 1,157                               | 103,665                               | 537                                       | 1,085                               | 196,640                               |
| P19      | 13,910*      | 102                                       | 1,296                               | 37,464                                | 0   | 2                                   | 2                                     |
| Combined | 13,910       | 2,514                                     | 4,011 <sup>1</sup>                  | 919,969                               | 1,921                                     | 3,150 <sup>2</sup>                  | 701,310                               |

Note:\* the Max Taken per Day of 13,910.4 m<sup>3</sup>/day is based on a combined Max taken per minute of 9.66 (m<sup>3</sup>)

<sup>1</sup> Combined maximum water taking in 2024 occurred on March 27<sup>th</sup>.

<sup>2</sup> Combined maximum water taking in 2025 occurred on February 18<sup>th</sup>.

The total combined water taking shall not exceed an annual daily average of 11,104 m<sup>3</sup>/day, as specified in Condition 3.3 of the PTTW. As shown in Table 2, this requirement was met in both 2024 and 2025.

The pumping volumes are based on the total daily volumes as recorded by the Region's SCADA system and are presented in Appendix C as total monthly volumes. The highest total monthly volumes in 2024 occurred in April (95,649 m<sup>3</sup>) and the highest total monthly volume in 2025 occurred in January (81,791 m<sup>3</sup>). In total, 919,969 m<sup>3</sup> was produced at this well field in 2024 and 701,310 m<sup>3</sup> was produced in 2025. The total well field volume in 2024 is higher than the 2021, 2022 and 2023 volumes and below the permitted volume of 4,053,007 m<sup>3</sup> per year (Table C-1). In contrast, the 2025 volume was lower than the 2021 and 2022 totals but higher than the volume reported in 2023.

### **2.1.2 Monitoring Wells**

Construction and monitoring details are provided in Appendix B - Table B1. Well records for the monitoring wells are provided in Appendix B.

## **2.2 Regional Geology and Hydrostratigraphy**

The following sections provide a brief overview of the regional geology and hydrogeology of the Pinebush East Well Field. The surficial geology based on regional OGS mapping is provided in Figure 4. Representative cross-sections showing the stratigraphy in the vicinity of the Pinebush East Well Field (P10, P10A, P10B, P11, P17 and P19) are included as Figures 5-7 to visualize the stratigraphy described in this section. The cross-section locations are provided in Figure 3. The cross-sections are provided as a visual aid and do not necessarily contain all wells in the monitoring program for the Pinebush East Well Field. The recently completed Tier Three Assessment Update Project (Aqua Insight et al, 2023) has revised the stratigraphic interpretation of the bedrock lithology at the Pinebush Wellfield with the most significant changes in the area of production wells P10A and P15A. Based on an updated interpretation of geophysical logs in the vicinity of Well P10A and C-PB-OW1-09, the Guelph Formation is interpreted to be thicker and the tops of the Reformatory Quarry, Goat Island and Gasport Formations are interpreted to occur at a deeper depth. In the vicinity of Well P15A, the tops of the Reformatory Quarry, Goat Island and Gasport are all interpreted to be shallower, with the Reformatory Quarry slightly thicker than previously interpreted (Aqua Insight et al, 2023).

The lithological layers were updated in accordance with documentation provided in the Numerical Model Surface Transfer memorandum (Aqua Insight Inc, 2026).

### **2.2.1 Surficial Geology and Conceptual Hydrostratigraphy**

The surficial geology of the Study Area has been mapped and described by Karrow (1987). Along the eastern side of the Grand River and the south side of the Speed River, the surficial geology (Figure 4) largely consists of sand and gravel outwash deposits (Units 7a and 7b in Figure 4). Ice-contact kame stratified sands and gravels (Unit 6 in Figure 4) are present east of the outwash deposits and extend towards Puslinch Lake.

The thickness of overburden deposits generally ranges from approximately 5 to 10 m in areas of outwash deposits; however it can be up to approximately 30 to 40 m thick in areas of the Paris and Galt moraines to the east of Cambridge. In the vicinity of the Shades Mill, Clemens Mill and Pinebush Well Fields, the overburden thickness is generally 20 to 40 m. In the Hespeler Well Field area in northern Cambridge adjacent to the Speed River, overburden thickness is generally less than 20 m, and the overburden is thin or absent in the Speed River valley.

The Quaternary Geology of the Cambridge area includes the following units (Lotowater 1997, Karrow 1987 and Bajc and Shirota, 2007) as described below.

#### **Aquitard ATA2 - Wentworth Till**

The Wentworth Till was deposited by the last glacier to advance in the area. It is described as a stony, sandy silt to sand textured till, and is often inter-bedded with sand and gravel. In the Cambridge area, the Wentworth Till is generally less than 10 m thick. Due to the loose, coarse-grained nature of the till, the unit behaves as a leaky aquitard or poor aquifer that is readily recharged from precipitation.

#### **Aquifer AFA2 - Outwash Deposits**

The outwash sand and gravel sediments of AFA2 are present within the Grand River Valley and vicinity, however extensive deposits have also been identified underlying the Wentworth Till in the Paris and Galt moraines. These outwash deposits are interpreted as the main production aquifer for the Shade's Mills municipal wells.

#### **Aquitard ATB1 - Port Stanley Till**

The Port Stanley Till is a sandy silt to silty sand till, with occasional stony texture. The Port Stanley Till was deposited by ice advancing from the Erie-Ontario ice lobe. In other parts of the Region, Bajc and Shirota (2007) have also used unit ATB1 to represent Tavistock, Mornington and Upper Maryhill Tills. In the Grand River and Speed River valleys this unit has been largely removed by erosion. This unit is generally finer grained than the Wentworth Till and behaves as an aquitard.

#### **Aquifer AFB1 - Upper Waterloo Moraine Stratified Sediments and Equivalents**

Significant thicknesses of aquifer AFB1 are interpreted to occur southeast of the Speed River and west of Puslinch Lake and generally corresponds with mapped surficial ice-contact sands

and gravels. AFB1 is generally fine sand with some gravel and is often slightly finer grained than unit AFA2, which typically contains greater amounts of gravel. Since AFB1 and AFA2 both behave as aquifers, differentiation of these units is not critical from a hydraulic perspective, although it is necessary to represent AFB1 separately from AFA2 to allow sequential layers for aquifer units both above and below the Port Stanley Till (ATB1), where this situation occurs. Where AFB1 is not present, Port Stanley Till may directly overlie Maryhill Till and Catfish Creek Till (described below), forming a single combined aquitard unit composed of these tills.

### **Aquitard ATB3 - Lower Maryhill Till**

Fine grained till and glaciolacustrine deposits of the Lower Maryhill Till ATB3 generally separate AFB1 from the underlying Catfish Creek Till. The Lower Maryhill Till is described as a dense, dark brown, clayey silt to silty clay till and is interpreted to be present in the Fountain Street (Well P16) well field area above the Catfish Creek and below the Port Stanley Till. Aquitard ATB3 can be difficult to distinguish from ATB1 throughout most of the study area due to the similar lithologies of these units. Lotowater (1997) grouped the Port Stanley and Maryhill Tills as a single aquitard hydrostratigraphic unit, which is a reasonable approach where no significant thickness of sand and gravel separate these units.

### **Aquitard ATC1 – Upper / Main Catfish Creek Till**

The Catfish Creek Till was deposited by a major glacial advance from the north to northeast that covered all of southern Ontario. The Catfish Creek Till is a dense, stony, sandy silt to silty sand till with little clay content. Although originally deposited over the entire Cambridge area, erosion, glaciations and meltwater events have removed areas of the Catfish Creek Till and it is now discontinuous. In the Cambridge Area, the thickness of this unit ranges from approximately 5 m in areas east of the Grand River, to approximately 20 m west of the Grand River, and is usually found immediately overlying bedrock and beneath clayey sediments. The hydrogeologic properties of the Catfish Creek Till are variable, ranging from a good aquitard to a poor aquifer, depending on local lithology, degree of compaction, and the presence of overlying aquitard units.

### **Aquifer AFD1 - Sand and Gravel**

The Pre-Catfish sand and gravel aquifer is present below the Catfish Creek Till. AFD1 corresponds to sand and gravel re-worked from Catfish Creek and Pre-Catfish Creek Tills.

## 2.2.2 Bedrock Geology and Conceptual Hydrostratigraphy

The stratigraphy discussed below is consistent with the revised stratigraphic framework described by the OGS (Brunton, 2009) and is also used in the Tier 3 Study of the area (Golder, 2011). A brief description (from Stantec, 2013 and Stantec 2022) of each bedrock formation and conceptual hydrostratigraphic units typically present in Cambridge is provided below (from youngest to oldest). The formations present in the vicinity of the Pinebush well field are shown on the cross sections in Figures 5 to 7.

### Guelph Formation

The Guelph Formation is a cream-coloured fossiliferous dolostone that represents an important aquifer in the Cambridge and Guelph area, where it is most often the uppermost bedrock unit.

### Eramosa Formation

The Upper Eramosa Formation is described by Brunton (2009) as light brown to cream coloured, pseudonodular, thickly bedded and coarsely crystalline dolostone. The formation consists of the Reformatory Quarry Member, and the Vinemount Member.

The Reformatory Quarry Member is susceptible to karstification due to its uniform fine dolomite crystallinity (Brunton, 2009), and also often contains mud-rich and microbial mat-bearing lithofacies. As a result, this unit generally represents a poor aquifer or poor aquitard. This unit was described as either the Guelph Formation or Eramosa Member in previous studies within the Region.

The Vinemount Member is comprised of thinly bedded, fine crystalline dolostone with shaley beds that give off a distinctive petroliferous odour when broken (Brunton, 2009). This unit represents an aquitard when present within the Cambridge and Guelph areas.

### Goat Island Formation

The Goat Island Formation consists of the upper Ancaster Member and lower Niagara Falls Member. The Ancaster Member is a chert rich, finely crystalline dolostone that is medium to ash grey in colour. The Niagara Falls Member is a finely crystalline and cross laminated crinoidal grainstone with small reef mounds. The finely crystalline nature of these Members results in a lower hydraulic conductivity and transmissivity compared to the underlying Gasport Formation (Brunton, 2009). Conceptually, the two members of the Goat Island Formation are treated as a single hydrostratigraphic unit.

### Gasport (Amabel) Formation

The Gasport Formation is a cross-bedded crinoidal grainstone-packstone with sequences of reef mound and coquina (shell bed) lithofacies. This unit has commonly been referred to as the Amabel Formation in previous studies in the Region. Upper, middle and lower hydrostratigraphic units of the Gasport have been defined to allow for general representation of

the vertical distribution of the more transmissive reef mound and coquina bed lithofacies. Highly transmissive reef mounds, crinoidal grainstones and coquina beds are generally present in the upper and middle portions of the formation, and are largely absent from the lower 10 m to 20 m.

The lower portion of the Gasport Formation has been grouped with the Rochester, Irondequoit, Rockway, and Merriton Formations due to the difficulty in distinguishing the various units from available borehole data and geophysical logs. All four formations, as well as the base of the Gasport Formation, are relatively less permeable than the upper sections of the Gasport Formation.

## 2.3 Local Geology

Figure 3 displays the Pinebush East Well Field well plan and cross-section locations. Representative cross-sections are included as Figures 5 to 7 to visualize the stratigraphy described in this section.

The borehole log for P10B indicates that AFB1 is present from surface to 9.1 mbgs, AFB3 is present between 9.1 to 16.8 mbgs, ATC1 is present between 16.8 to 22.9 mbgs and AFB1 was identified between 22.9 to 29.6 mbgs. The well log for P10A does not have the lithology classified using the OGS nomenclature.

### 2.3.1 Bedrock Geology

Based on the results of drilling investigations (Stantec, 2013) the bedrock surface is encountered at approximately 29 mbgs (Appendix B). Based on the borehole log for C-PB-OW2-06 (the closest well with the OGS nomenclature provided for the bedrock), the Guelph Formation was identified between 29.6 and 61.1 mbgs, the Eramosa Formation was identified between 61.1 and 72.2 mbgs and Goat Island and Gasport (previously referred to as Amabel formation) between 72.2 and 115.8 mbgs. Shale of the Cabot Head Formation (not shown on cross sections) was encountered at 134 mbgs at C-PB-OW1-09 and 143 mbgs at PB-TW1-10. Drilling completed by Stantec in 2022 at monitoring wells C-PB-OW1-22, C-PB-OW2-22, and C-PB-OW3-22 confirms this stratigraphic sequence with while refining the depth intervals with some changes from the original Tier 3. New boreholes (C-PB-OW1-22 and C-PB-OW2-22) are located well to the east of the production wells where there was previously a lack of hydrostratigraphic information (Figure 3). In general, the data from these wells shows some small changes relative to the original Tier 3 conceptualization, including the top of Reformatory Quarry located approximately 5 m shallower at C-PB-OW2-22, a thicker Vinemount Formation (3 to 6 m) at both wells and the top of Gasport Formation encountered at a shallower depth (3 to 5 m) at both of the new wells (Aqua Insight et al, 2023).

### 2.3.2 Drainage and Surface Water

Surface water drainage in the well field is dominated by interconnected lake and creek systems to the east. Little Lake, approximately 7 hectares in size, drains to Puslinch Lake. Puslinch Lake is a glacially formed kettle lake and a major regional surface water body with an

approximate surface area of 156 hectares. Puslinch Lake discharges to Irish Creek, a small watercourse, which subsequently flows to the Speed River. These features are shown in Figure 3.

### 3.0 2024 / 2025 Results

In accordance with condition 4.2 of the PTTW, water levels were measured and recorded in monitoring wells C-PB-OW5-94-ABCDEFGF, C-PB-OW2-06-ABCDEF, C-PB-OW1-09-ABCDE, C-PB-OW1-11-AB C-PB-OW1-92-ABC, C-PB-OW1-22-ABCDEFGH, C-PB-OW2-22-ABC, C-PB-OW3-22-ABC and in piezometers C-PB-DP1-21-AB, C-PB-DP3-21-AB and C-PB-DP5-22-AB. Surface water levels were measured at C-PB-SW3-21-Z and C-PB-SW5-22-Z.

The following sections summarize groundwater levels in the monitoring wells in relation to precipitation, water taking from the aquifer (in accordance with condition 4.3 of the PTTW)

#### 3.1 Precipitation

Longer term precipitation trends can have an impact on water levels in the supply aquifer. To assess the potential influence, monthly precipitation is plotted for comparison to water levels and pumping and presented in Appendix C.

Since variations in precipitation totals can occur throughout the Region due to localized events, monthly precipitation data from the GRCA and Environment Canada station located closest to the production wells are used. The closest GRCA weather station relative to the Pinebush East well field is the Shades Mills Dam station located 3.6 km south. The closest Environment Canada station is the Waterloo International Airport (WIA) located 8.5 km to the northwest. The locations of the meteorological stations are shown in Figure 1.

Annual precipitation data from the past 10 years for all stations are compared with long term averages in Table D.1, Appendix D. At the Shades Mills Dam, the long-term average was calculated from when measurements started until the end of 2025. The WIA has “Climate Normals” calculated by Environment Canada for 1971 to 2000.

Annual 2024 / 2025 precipitation data for all the meteorological stations closest to the Pinebush East well field are presented in Table 3 below. WIA was missing 6 days of data in 2024 and 6 days in 2025. As a result, the precipitation totals at this station may be under reported.

**Table 3: Summary of Precipitation Data**

| Station               | 2024<br>Precipitation<br>(mm) | 2024<br>Deviation<br>(mm) | Long-<br>Term<br>Average<br>(mm) | 2025<br>Precipitation<br>(mm) | 2025<br>Deviation<br>(mm) |
|-----------------------|-------------------------------|---------------------------|----------------------------------|-------------------------------|---------------------------|
| Region of<br>Waterloo | 874                           | +23                       | 851 <sup>A</sup>                 | 723                           | -128                      |

| Station   | 2024<br>Precipitation<br>(mm) | 2024<br>Deviation<br>(mm) | Long-<br>Term<br>Average<br>(mm) | 2025<br>Precipitation<br>(mm) | 2025<br>Deviation<br>(mm) |
|---|-------------------------------|---------------------------|----------------------------------|-------------------------------|---------------------------|
| International<br>Airport <sup>(1)</sup>   |                               |                           |                                  |                               |                           |
| Shades<br>Mills Dam <sup>(2)</sup>  | 976                           | +67                       | 909 <sup>B</sup>                 | 895                           | -14                       |
| <b>Sources:</b> Environment Canada (1), GRCA (2)<br><sup>A</sup> 1991 to 2020 Normal<br><sup>B</sup> Average annual precipitation since monitoring began to the end of 2025 |                               |                           |                                  |                               |                           |

Water levels typically follow a seasonal trend with highest levels occurring in the spring with the depth and water content of the snowpack having a significant influence on water levels. Lowest levels occurring in July / August. Widespread synoptic rainfall events can also result in Region-wide water level responses. Summer thunderstorms tend to be short lived and occur over a smaller area resulting in short term, localized water level rises not typically seen in the monitoring wells.

The 2024 total precipitation at Shades Mills station was 976 mm, which is 67 mm above the long-term average, indicating 2024 was wetter-than-average at the well field A similar above long-term average trend is noted at the WIA station. The March 1 GRCA snow survey indicated a snowpack across the Region that was low compared to normal. In 2025, the total precipitation was 895 mm, which is 14 mm below the long-term average. The 2025 total precipitation at the WIA station was 128 mm below the long-term average, indicating 2025 was a drier-than-average year. However, WIA was missing 12 days of data in 2024 / 2025 and as a result, precipitation totals may be under reported. The snow survey conducted by the GRCA on March 15, 2025, showed that the stations in the Region had a high to very high measured snow water equivalent.

### 3.2 Monitoring Results

Hydrographs showing the results of water level monitoring over the past 10 years (or since monitoring began if there is less than 10 years of data) are provided in Appendix C. The method used to collect the water levels (manual or electronic) is indicated on the graphs in Appendix C.

#### C-PB-OW5-94-ABCDEFGF

The C-PB-OW5-94 well nest is located approximately 1.3 km east of the production wells and monitoring has been ongoing since 1994. Monthly manual water level monitoring is conducted at C-PB-OW5-94-ACDEG and water level monitoring was completed using an electronic data logger at C-PB-OW5-94-BF. The shallow G screen has been dry for the majority of time and therefore has limited data which does not allow for any trends to be discerned. The water levels at the other six screens follow a seasonal trend with annual variations of approximately 1 m.

Water levels observed in 2024 / 2025 are consistent with historical values and do not show any declining trends because of pumping.

The influence of pumping is minor but discernable in all screens except G. For example, water levels in the A to F screens show varying degrees of recovery during the well field shut down from October to December 2021 and from November 2022 to April 2023.

### **C-PB-OW2-06-ABCDEF**

The C-PB-OW2-06 well nest is located approximately 1.5 km east of the production wells and monitoring has been ongoing since 2006. Monthly manual water level monitoring is conducted at C-PB-OW2-06-BCDE and water level monitoring was completed using an electronic data logger at C-PB-OW2-06-AF. Water levels in 2024 / 2025 are within historical ranges and do not show any declining trends because of pumping.

Water levels in all screens display similar patterns with a response to pumping and well field shutdown. Water levels rose approximately 0.4 in the A screen and 0.2 in the F screen during the well field shutdowns in March 2015, May 2020 and April 2023. The response from the other screens is not as obvious because they are not equipped with electronic data loggers. Water levels at C-PB-OW2-06-ABCDEF also appear to be influenced by seasonal effects with highest water levels in the spring, declines in the summer and a rise in the fall.

### **C-PB-OW1-09-ABCDE**

The C-PB-OW1-09 well nest is located adjacent to the P10A / P10B production well site and monitoring has been ongoing since November 2013. Monthly manual water level monitoring is conducted at C-PB-OW1-09-BDE and water level monitoring is completed using electronic data loggers at C-PB-OW1-09-AC. Water levels observed in 2024 / 2025 are consistent with historical values and do not show any declining trends because of pumping.

Water levels in screens A, B, C and D display similar patterns with a clear response to pumping. The greatest response is seen in screens A, B and C which are installed within the Gasport and Guelph Formations respectively. The D screen (ATB1) and E screen (ATB1) also respond to pumping but the response is muted. A similar response is seen at most screens during the shutdown of P10 / P11 / P17 from November 2022 to April 2023 and December 2025 with levels rising by up to 4.8 m. Water levels at C-PB-OW1-09-E (ATB1) appear to be influenced by seasonal effects. The C screen (Middle to Upper Guelph Formation) shows the greatest response to the start up of P10B (ATB1 / Guelph Formation) after May 2023 and shows a similar water level response as decommissioned well P10.

### **C-PB-OW1-11-AB**

The C-PB-OW1-11 well nest is located adjacent the P11 / P17 production well site and monitoring has been ongoing since April 2012. Monthly manual water level monitoring is conducted at C-PB-OW1-11-AB with screens installed in ATB3 / AFB3 / ATC1 and ATB1

respectively. 2024 / 2025 water levels are within historical ranges and do not show any declining trends because of pumping.

The water levels show small but measurable responses to pumping and well field shutdown at P11 / P17 with the greatest response seen in the A screen. The A screen also has a greater response to P10B and water levels gradually rise about 0.8 m between June and December 2025 as pumping at P17 and P10B is reduced.

### **C-PB-OW1-92-ABC**

The C-PB-OW1-92 well nest is located approximately 0.2 km southwest from P11 / P17 with monitoring ongoing since August 1992. Water level monitoring was completed using an electronic data logger at C-PB-OW1-92-ABC. Water levels in 2024 / 2025 are within historical ranges and do not show any declining trends because of pumping.

Screen A which extends from the Guelph Formation to the Gasport Formation shows a clear response to pumping and shutdown of P11 / P17 with the water levels rising by up to 10 m. Water levels rise about 10m in December 2025 when P10B and P17 are shutdown. Water levels in screen B (AFB1 to ATB3) and screen C (ATB1) fluctuate slightly with well field pumping and shutdown.

### **C-PB-OW1-22-ABCDEFGH**

The C-PB-OW1-22 well nest is located approximately 4.2 km east of P19, with monitoring ongoing since March 2022. Water level monitoring using electronic data loggers began at C-PB-OW1-22-AH in March 2022, and monthly manual water level monitoring commenced in November 2022 at C-PB-OW1-22-BCDEFG. The water levels in all seven screens display a seasonal trend with annual variations of approximately 2 m. There is no response to pumping of the Pinebush East wells.

The water levels in the A, B, C, and D screens, which are installed within the Gasport Formation, are approximately 3 to 4 meters below those in screens E (Vinemount), F (Guelph), G (Guelph), and H (AFB1). An abrupt water level decline of 2-3 m was observed in the Gasport Formation during the summer of 2025, compared to the typical gradual seasonal decline of about 1 m observed from 2022 to 2024. This larger-than-normal drawdown suggests that nearby groundwater extraction is likely occurring (also noted at C-PB-OW2-22 and to a lesser degree at C-PB-OW3-22). The increased drawdown occurred during City of Guelph's Operational Testing Program (OTP), conducted under PTTW No. 4002-DDRJ8X. OTP Stages 5 and 6 included sustained high-rate pumping of Test Well GSTW01-20 (maximum permitted rate 4,750,000 L/day), located approximately 6.5 km northeast of C-PB-OW1-22. Pumping at GSTW01-20 occurred from June 23-27, 2025 (Stage 5) and continuously from July 8 to August 8, 2025 (Stage 6). The timing and magnitude of the observed drawdown at the Gasport screens indicate regional groundwater extraction associated with the City of Guelph's OTP (City of Guelph, 2025).

### **C-PB-OW2-22-ABC**

The C-PB-OW2-22 well nest is located approximately 5.8 km east of P11 / P17 with monitoring ongoing since March 2022. Water levels were monitored at C-PB-OW2-22-ABC using an electronic data logger. The measurements show a seasonal trend with annual variations of about 1.5 m. There is no response to pumping of the Pinebush East wells.

The water levels in the three screens exhibit a similar pattern, with the levels in the A screen (Gasport) being approximately 2.0 m higher than those in the B (Reformatory Quarry) and C (AFA2) screens. An abrupt water level decline of about 2 m was observed in the Gasport Formation during the summer of 2025, compared to the typical gradual seasonal decline of about 1 m observed from 2022 to 2024. This larger than normal drawdown is associated with the previously described City of Guelph water taking at GSTW1-20 located 7.7 km to the north.

### **C-PB-OW3-22-ABC**

The C-PB-OW3-22 well nest is located approximately 2.3 km northeast of P19 with monitoring ongoing since March 2022. Water levels were monitored at C-PB-OW3-22-ABC using an electronic data logger. There is no response to pumping of the Pinebush East wells.

The measurements show a seasonal trend with annual variations of about 0.7 m. The water levels in the three screens exhibit a similar pattern, with the levels in the A screen (Goat Island) and B (Reformatory Quarry) being approximately 0.9 m lower than those in the C (AFA2) screen. The water levels during the summer declined by approximately 1 m in the A (Goat Island) and B (Reformatory Quarry) screen and approximately 0.5 in the C screen (AFA2) during testing of GSTW1-20. The water level decline noted in C-PB-OW1-22 and C-PB-OW2-22 is noted to a lesser degree in all three screens at C-PB-OW3-22. GSTW1-20 is located 7.4 km northeast of C-PB-OW3-22.

C-PB-DP1-21-AB Piezometer C-PB-DP1-21-AB is located on the edge of Puslinch lake located approximately 1,800 m from P10A with monitoring ongoing since May 2022. Water levels were monitored using an electronic data logger. There is no response to pumping of the Pinebush East wells and water levels observed in 2024 / 2025 were consistent with 2022 / 2023 values.

The measurements indicate a seasonal trend, with annual variations of approximately 0.3 m in 2024 and 0.6 m in 2024. Water levels in C-PB-DP1-21-A are about 0.2 m lower than in C-PB-DP1-21-B, however water levels in both screens follow the same seasonal trend with highest levels typically seen in the spring and declines during the summer. The water levels in both A and B screens are influenced by precipitation events and show a similar response. Water levels in the shallow screen remain consistently higher than in the deeper screen throughout the monitoring period, indicating a persistent downward vertical gradient.

### **C-PB-DP3-21-AB and C-PB-SW3-21-Z**

PB-DP3-21-A and C-PB-DP3-21-B are shallow overburden piezometers located in the middle of Irish Creek approximately 2,810 m from P19 with monitoring ongoing since May 2022.

C-PB-DP3-21-Z is a surface water monitoring station located adjacent to the piezometers in Irish Creek. Water level monitoring was conducted using electronic data loggers at C-PB-DP3-21-AB and C-PB-SW3-21-Z. The water levels in the piezometers are approximately 0.3 m above the surface water elevation. There is no response to pumping of the Pinebush East wells and water levels observed in 2024 / 2025 were consistent with 2022 / 2023 values.

Water levels in C-PB-DP3-21-A rose slightly through early 2024 and then remained relatively stable before beginning a gradual decline to late 2024. Levels increased again during spring 2025, followed by a steady decrease toward the end of the year. In contrast, water levels in C-PB-DP3-21-B generally declined throughout 2024, with several short duration precipitation related fluctuations. In 2025, this piezometer showed a more pronounced drop from spring through late summer, after which water levels stabilized toward year-end. Surface water levels at C-PB-SW3-21-Z remained stable during both 2024 and 2025, fluctuating by less than approximately 0.1 m except for brief precipitation-related peaks in each year.

The water levels in both surface water and the A and B screens are influenced by precipitation events. The piezometer pair begins with a consistent downward gradient, but during the spring of 2024 and 2025 the pattern shifts, with the A screen rising above the B-screen and establishing an upward vertical gradient

Manual stream flow monitoring took place on 14 occasions in 2024 and 2025, with flows ranging from 1 L/s to 325 L/s. The results from flow monitoring and the stream flow curve are presented in Appendix C.

### **C-PB-DP5-22-AB and C-PB-SW5-22-Z**

Water level monitoring was conducted using electronic data loggers at C-PB-DP5-22-AB and C-PB-SW5-22-Z with monitoring ongoing since November 2022. C-PB-DP5-22-A and C-PB-DP5-22-B are shallow overburden piezometers driven into the middle of Irish Creek, while C-PB-DP5-22-Z is a surface water monitoring station. This location is approximately 2,610 m from the closest production well (P19) and is 760 m downstream from C-PB-DP3-21-AB. The water levels in the piezometers and surface water flow similar pattern with the B screen approximately 0.1 m above C-PB-DP5-22-A and the surface water elevation. Water levels in 2024 and 2025 peaked in the spring and declined throughout the year. The dataloggers are removed during the winter months to avoid freezing. There is no response to pumping of the Pinebush East wells and water levels observed in 2024 / 2025 were consistent with 2022 / 2023 values.

Water levels at the surface water station and in the deep piezometer (C-PB-DP5-22-A) show pronounced, rapid responses to precipitation events, as indicated by the sharp, short-duration fluctuations visible throughout the monitoring period. In contrast, the shallow piezometer (C-PB-DP5-22-B) demonstrates a much more damped and gradual response, with limited short-term variability. This behaviour is atypical, as shallow piezometers usually respond more quickly to rainfall than deeper intervals, but in this case the deep screen displays the more immediate event-driven changes while the shallow screen reflects slower, more buffered

groundwater conditions. Water levels in the shallow screen remain consistently higher than in the deeper screen throughout the monitoring period, indicating a persistent downward vertical gradient. A site visit was conducted in March 2026 to verify that the piezometers at this location were correctly identified. Total depths were measured in the field, confirming that each monitoring interval was accurately labeled and that the correct piezometers have been used throughout the monitoring program. A follow-up site visit in June 2026 including downhole video inspection, purging, and installation of a new adjacent piezometer (C-PB-DP5-26-A) installed to a similar depth as C-PB-DP5-22-A and equipped with a data logger, were completed to further assess hydraulic conditions. Data downloads will be reviewed to compare responses between installations and determine whether C-PB-DP5-22-A is functioning properly and if it should remain in the monitoring network.

## **4.0 Impact Assessment**

### **4.1 Well Interference**

PTTW Condition 5.1 states, "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."

PTTW Condition 5.2 states: For Groundwater Takings - If the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements or shall compensate such persons for their reasonable costs of doing so. If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected.

When a well interference complaint is received, the Region has a Well Interference Policy in place. A copy of the policy is presented in Appendix F of the 2019 Biennial Groundwater Monitoring Report – Multiple Well Fields (Burnside, 2020). There were no well interference complaints related to pumping of P10, P10B, P11 and P17 received in 2024 and 2025.

There are no other Groundwater takings registered in the MECP PTTW database within 2 km of the P10, P10A, P10B, P11, P17 and P19 wells other than Regional production wells. As shown in Figure 3, several permits are located more than 2 km away, associated with Puslinch Beach and Marine, the Puslinch Golf Course to the east as well as PTTW No. 4002-DDRJ8X issued to the City of Guelph for pumping of Test Well GSTW01-20. The City of Guelph pumping test

resulted in drawdown at monitoring locations C-PB-OW1-22, C-PB-OW2-22, and C-PB-OW3-22 during the summer of 2025, consistent with the City of Guelph's analysis. GSTW01-20 is located approximately 10 km northeast from P10.

## 4.2 Aquifer Impacts to Pumping and Precipitation

PTTW Condition 4.3 states: " The Permit Holder shall prepare and submit a report every two years by June 30, that presents the results of the well field water level monitoring for the two preceding calendar years, assesses changes in water levels in the supply aquifer(s) in relation to precipitation and water taking from the aquifer(s)".

Water levels in the bedrock aquifers of P10A / P10B / P11 / P17 / P19 do not show any declining trends due to pumping.

Based on monitoring results, the water levels in the Cabot Head Formation indicate a clear response to pumping at P10 / P10B / P11 / P17 with water levels increasing about 1 m during the recent shutdowns of P11 / P10 / P17. The groundwater levels in Cabot Head Formation did not display a correlation with precipitation events.

The water levels in the Gasport Formation indicate a clear response to pumping at P10 / P10B / P11 / P17 with water levels increasing 1 m during the recent shutdowns of P11 / P10 / P17. The greatest response was observed in C-PB-OW2-06-A. The groundwater levels in Gasport Formation did not display a correlation with precipitation events.

Based on monitoring results, the water levels in both wells in the Goat Island Formation indicate a clear response to pumping at P10 / P10B / P11 / P17 with water levels increasing 1 m during the recent shutdowns of P11 / P10 / P17. The groundwater levels in Gasport Formation did not display a correlation with precipitation events.

The water levels in the Guelph Formation indicate a clear response to pumping at P10 / P10B / P11 / P17 with water levels increasing during the recent shutdowns of P11 / P10 / P17. The greatest response was observed in C-PB-OW1-09-C with water levels rising by 5 m. This well also shows the greatest response when P10B begins pumping after May 2023 and the late November / December 2025 when pumping was reduced. The groundwater levels in Guelph Formation did not display a correlation with precipitation events.

The largest water level response of up to 8 m during pumping of P11 and P10 was measured in C-PB-OW1-92-A which straddles the Guelph, Eramosa, Goat Island and Gasport formations. The water level response measured in C-PB-OW1-92-A decreased to approximately 5 m in 2023 when new production well P10B replaced P10. Levels rose approximately 8 m in late November 2025 when pumping was reduced.

The water levels in the lower overburden showed a minor response to pumping at P10 / P10B / P11 / P17 with water levels rising during the shutdowns of P11 / P10 / P17 after October 2022. The greatest response was observed at C-PB-OW1-09-D (AFD1) with water

levels rising 2 m. The groundwater levels in the lower overburden follow seasonal trends but do not display a correlation with precipitation events.

The water levels in the upper overburden showed a minor response to pumping at P10 / P10B / P11 / P17 with water levels rising after the recent shutdowns of P11 / P10 / P17. The groundwater levels in some of the upper overburden did display a correlation with precipitation events.

The drive-point piezometers and surface-water monitoring locations do not appear to respond to pumping; however, they do show clear responses to precipitation events. These sites have only been monitored since late 2022, so the dataset remains limited.

## 5.0 Conclusions

Impacts from pumping the municipal wells at the Pinebush East Well Field (P10, P10A, P10B, P11, P17 and P19) were evaluated through implementation of the Groundwater Monitoring Program. Based on the information contained in the report, Burnside offers the following conclusions:

- The information presented in this report satisfies condition 4.3 of PTTW 7858-BXUUUH.
- P10B, P11 and P17 were the main sources in 2024.
- In 2024, wells P19 and P10A were operated only on a short-term, testing basis under the Pinebush WTP – Well Connection Upgrades project to confirm the system was functioning as intended. Under the Cambridge East EA, P10A and P19 were otherwise intended to remain offline until the commencement of Phase 2 of the Operational Testing Program.
- P10B and P17 were the main sources in 2025.
- 2024 and 2025 pumping volumes were within the permitted range.
- There were no reported well interference complaints arising from water taking at the Pinebush East well field.
- Water levels in wells screened in the Guelph Formation, Eramosa Formation, Goat Island Formation, Gasport Formation and Cabot Head Formation show a measurable response to pumping that is most apparent during P10 / P11 / P17 recent shutdowns.
- Water levels in the lower and upper overburden show a measured response to pumping.
- Water levels have remained within the established historical range. No long-term declining or increasing trends are evident.
- Drawdown observed at C-PB-OW1-22, C-PB-OW2-22, and C-PB-OW3-22 during summer 2025 reflects regional groundwater impacts associated with the City of Guelph's OTP, consistent with the City of Guelph's interpretation of their pumping test.
- Further monitoring of the new piezometers and stream monitoring locations is necessary to evaluate the groundwater and surface water interactions.

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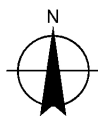
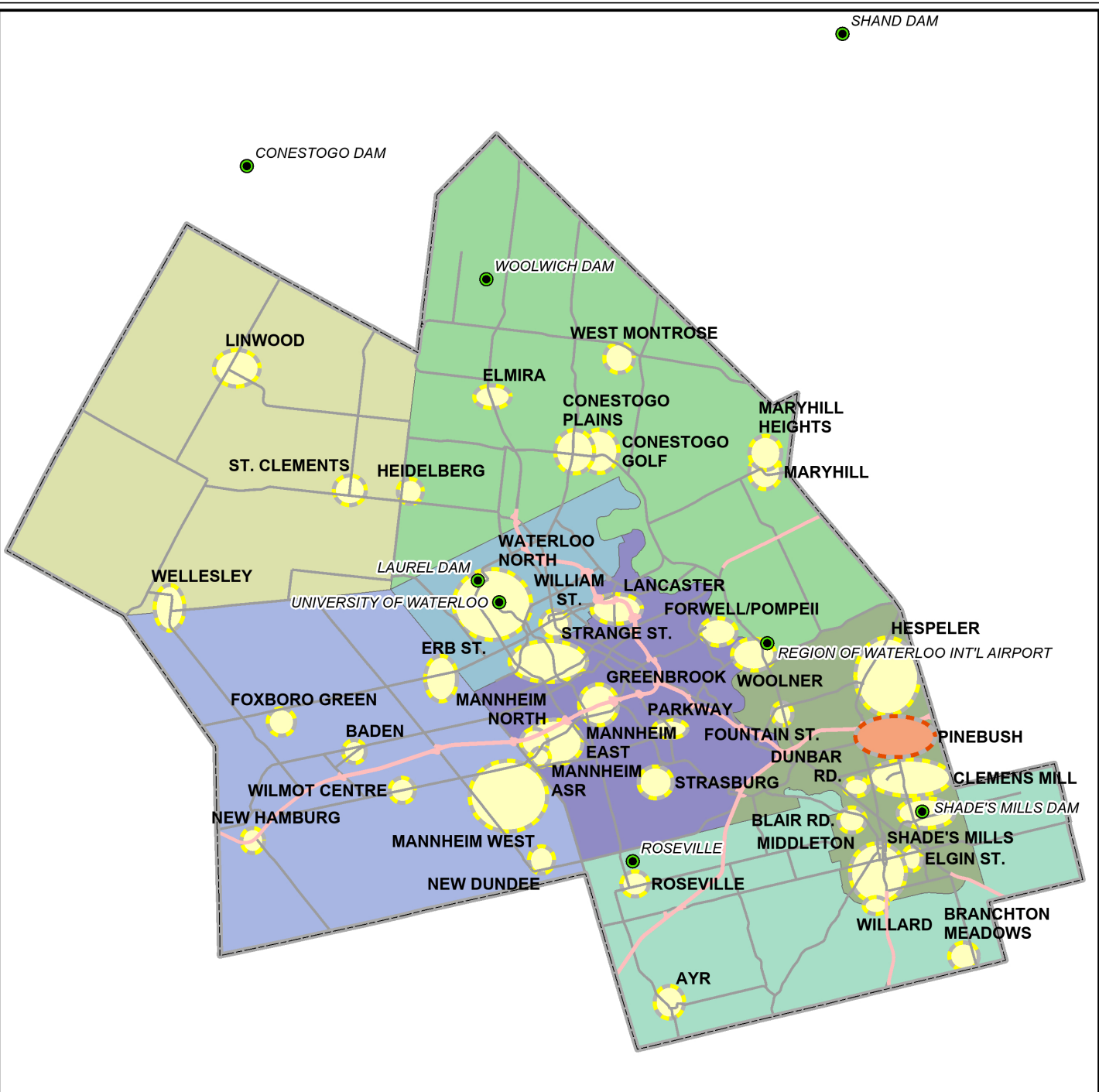


# BURNSIDE

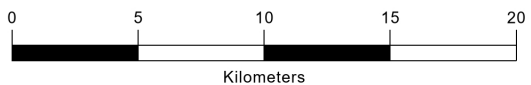
[ THE DIFFERENCE IS OUR PEOPLE ]



**Figures**



Data Source:  
Region of Waterloo; Includes material © 2012 of the Queen's  
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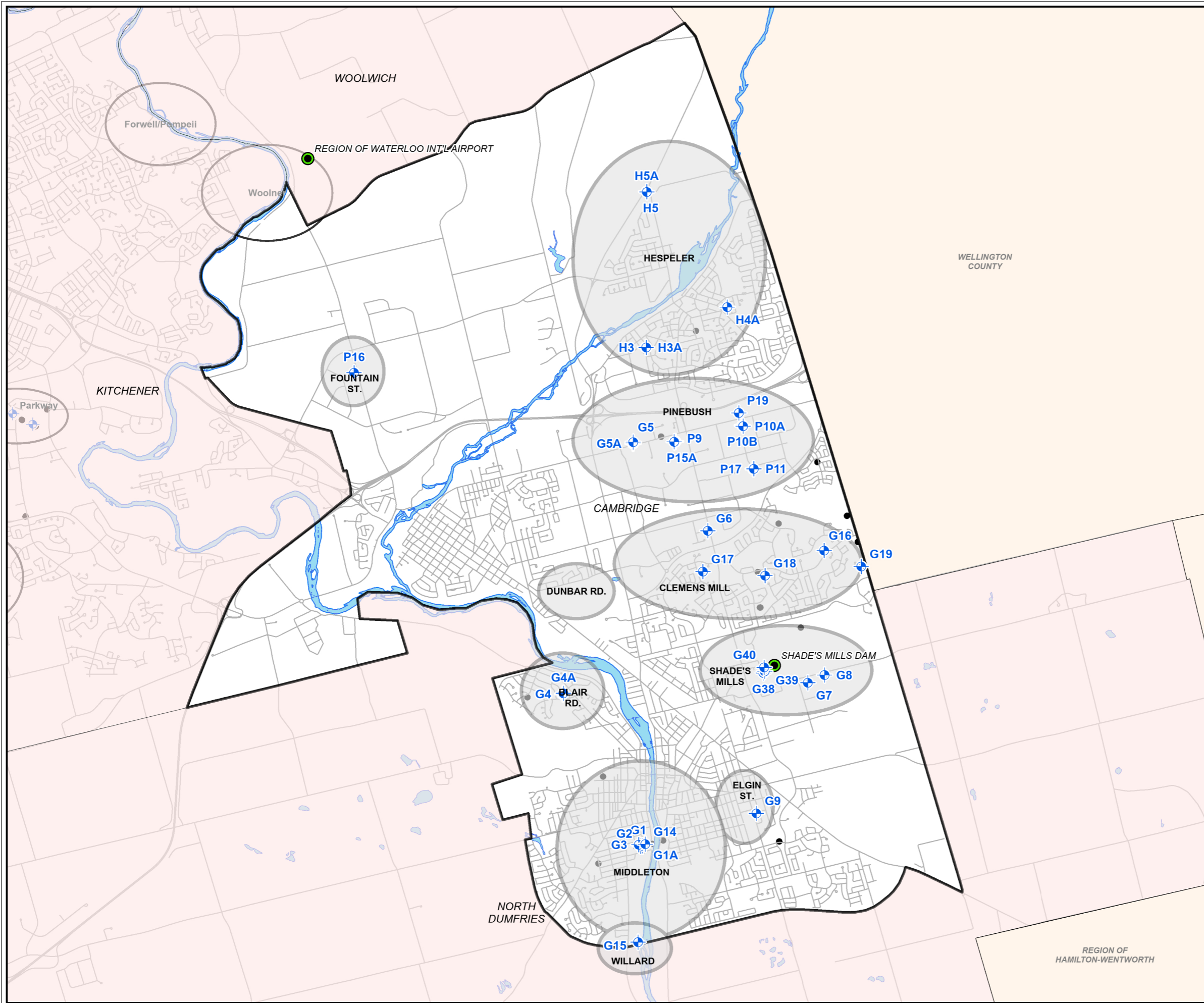
- Well Field Location
- Well Fields
- Regional Municipal Boundaries
- City of Cambridge
- City of Kitchener
- City of Waterloo
- Township of North Dumfries
- Township of Wellesley
- Township of Wilmot
- Township of Woolwich
- Meteorological Monitoring Locations



Map Title  
**2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD**  
**WELL FIELD LOCATION MAP**

Client  
**REGION OF WATERLOO**

|           |             |               |                        |
|-----------|-------------|---------------|------------------------|
| Drawn     | Checked     | Date          | Figure No.<br><b>1</b> |
| HN        | SQ          | February 2026 |                        |
| Scale     | Project No. |               |                        |
| 1:300,000 |             | HA0464020     |                        |




**LEGEND**

- Production Well Location
- Monitoring Well Location
- Well Fields
- Cambridge Municipal Boundary
- Meteorological Monitoring Locations

Sources:

1. Ministry of Natural Resources, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.

Datum: North American 1983 CSRS  
 Coord. System: NAD 1983 CSRS UTM Zone 17N



Client

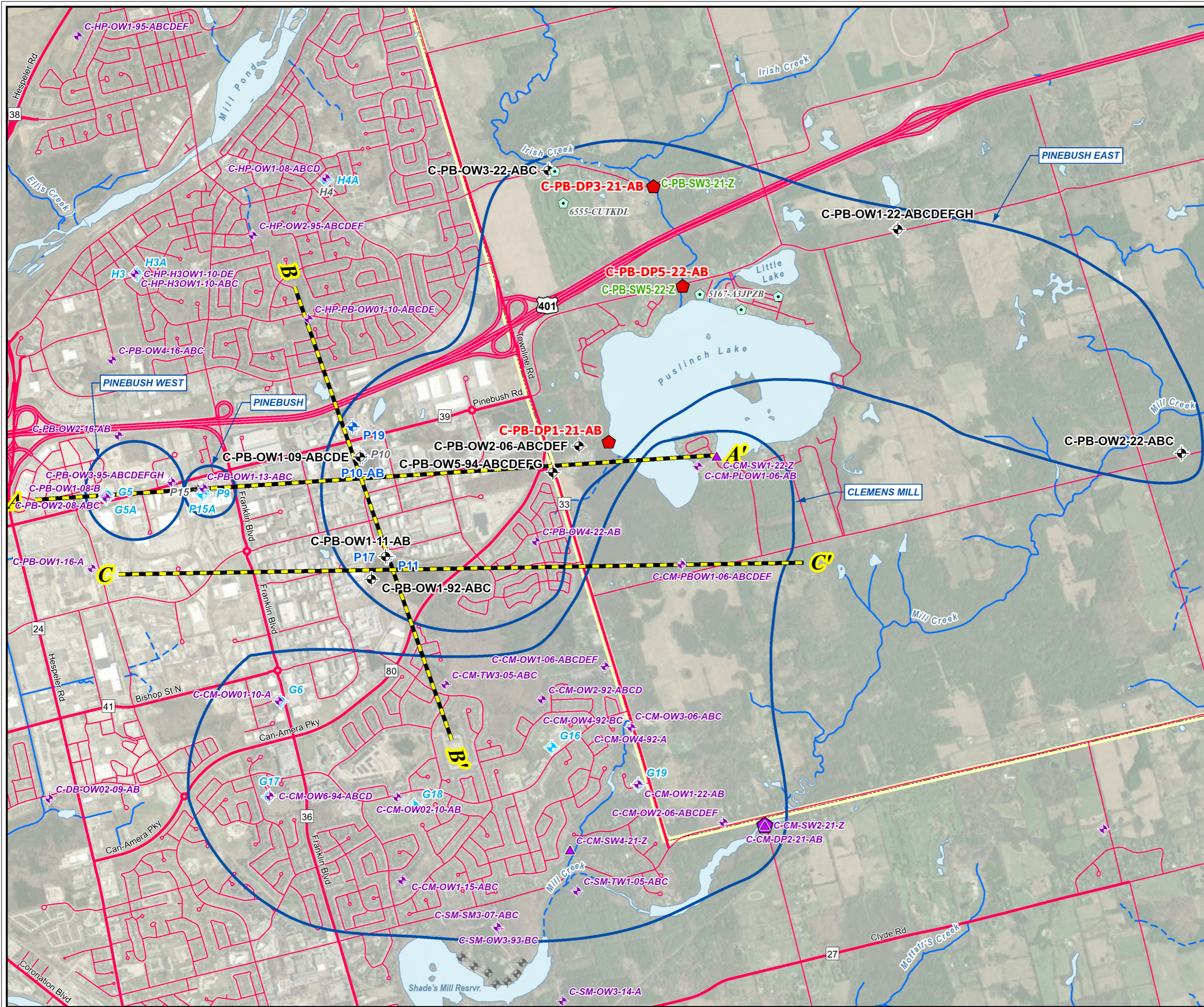
**REGION OF WATERLOO**

Figure Title

**2025 GROUNDWATER MONITORING REPORT - PINEBUSH EAST WELL FIELD**

**CAMBRIDGE WELL FIELDS AND MONITORING NETWORK**

|          |             |               |            |
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| HN       | SQ          | February 2026 | <b>2</b>   |
| Scale    | Project No. |               |            |
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**Legend**

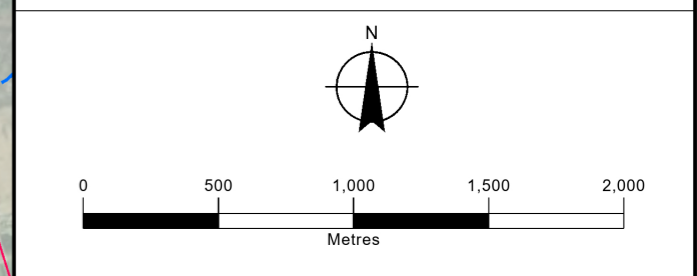
- PTTW Monitoring Well Location
- Production Well Location
- PTTW Surface Water Location
- PTTW Piezometer Location
- Nearby Monitoring Well Location
- Nearby Production Well Location
- Nearby Piezometer Location
- Nearby Surface Water Location
- Decommissioned Production Well Location

**Additional MECP PTTW Locations**

- Groundwater
- Cross Section Orientation
- Well Fields
- Provincial Highway
- Municipal Roads
- Local Roads
- Stream: Permanent (OHN)
- Stream: Intermittent (OHN)
- Waterbody: Permanent (OHN)
- Region of Waterloo Municipal Boundary

**Sources:**  
 Region of Waterloo GIS Data; Background 2020 Air Photo: ArcGIS Image Service Region of Waterloo; Ministry of Natural Resources, © Queen's Printer for Ontario, Natural Resources Canada © Her Majesty the Queen in Right of Canada.

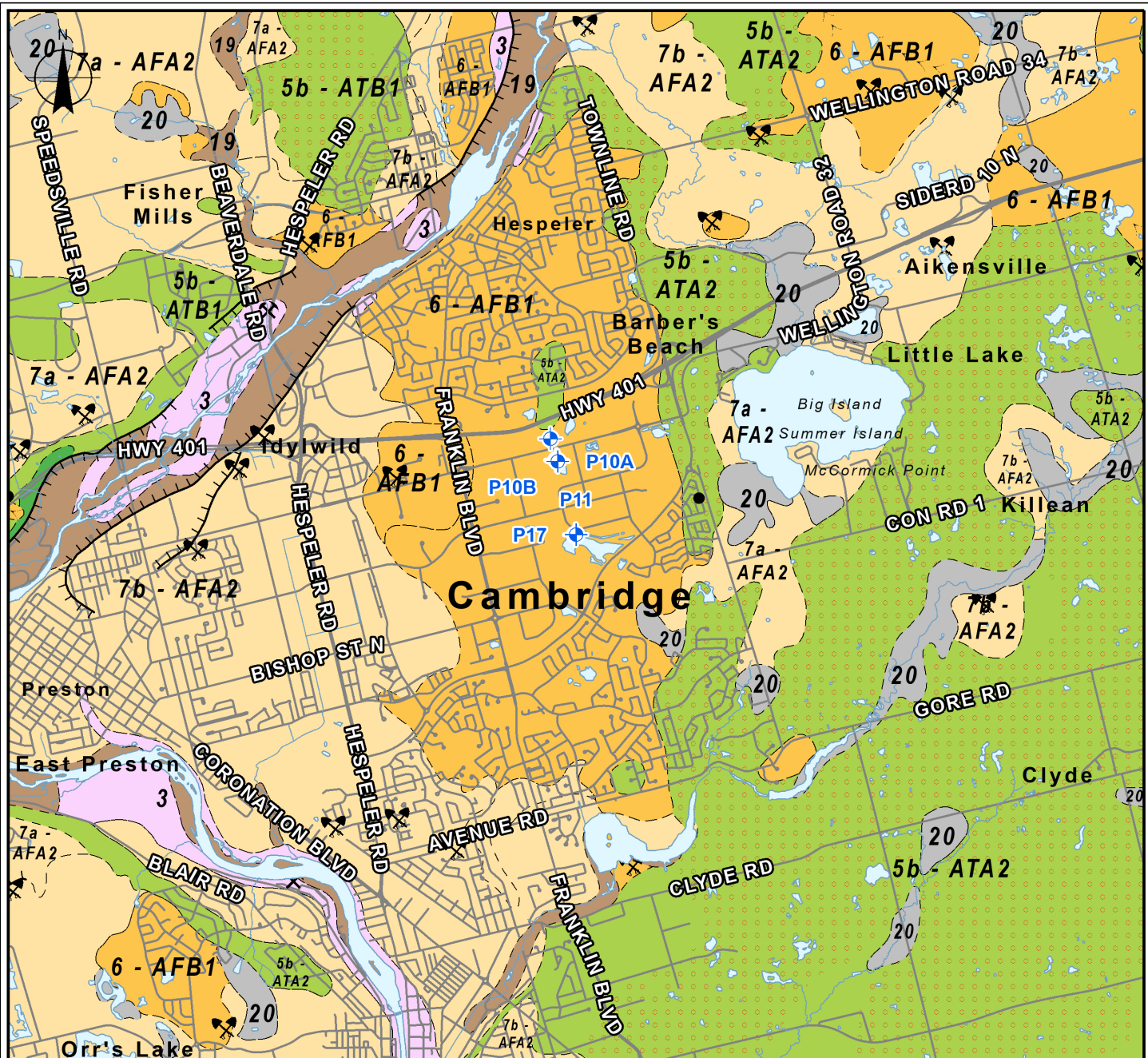
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Client  
**REGION OF WATERLOO**

Figure Title  
**2025 GROUNDWATER MONITORING REPORT**  
**PINEBUSH EAST WELL PLAN AND CROSS SECTION LOCATIONS**

|          |             |               |            |
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| HN       | SQ          | February 2026 | 3          |
| Scale    | Project No. |               |            |
| 1:28,000 | HA0464020   |               |            |



Data Source:  
 1. Ontario Geological Survey 2003. Surficial Geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128.  
 2. Region of Waterloo GIS



- RMOV Supply Well
- Watercourse
- Waterbody
- Surficial Geology**
- 3: Paleozoic bedrock
- 5b: Stone-poor, carbonate-derived silty to sandy till (ATA2/ATB1 - Aquitard)
- 5d: Glaciolacustrine-derived silty to clayey till (ATB1 - Aquitard)
- 6: Ice-contact stratified deposits (AFB1 - Aquifer)
- 7a: Glaciofluvial deposits: Sandy deposits (AFA2 - Aquifer)
- 7b: Glaciofluvial deposits: Gravelly deposits (AFA2 - Aquifer)
- 19: Modern alluvial deposits
- 20: Organic deposits
- Quarry (Point)
- Sand and Gravel Pit
- Esker: Direction of Flow Known
- Terrace
- Sample Location
- Hummocky Topography
- Unit Contact
- Boundary



Map Title  
**2025 GROUNDWATER MONITORING REPORT - PINEBUSH EAST WELL FIELD**

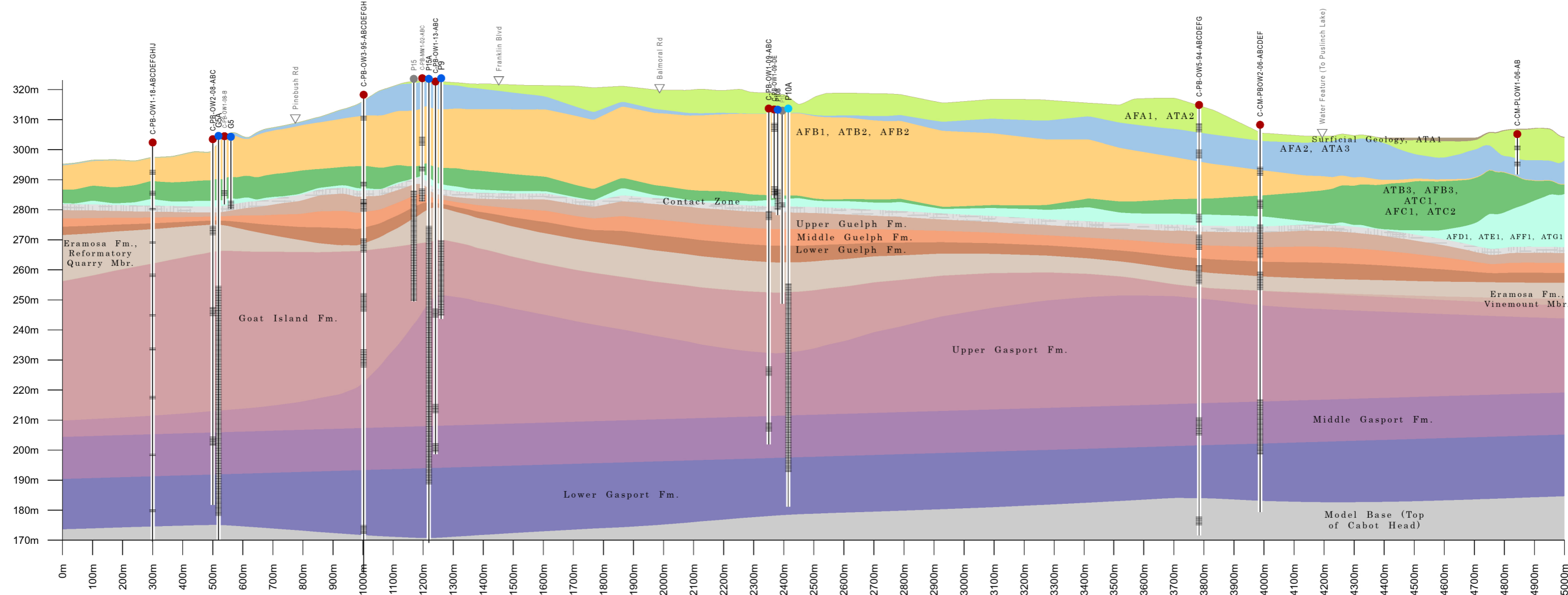
**SURFICIAL GEOLOGY**

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**REGION OF WATERLOO**

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| HN       | SQ          | February 2026 |            |
| Scale    | Project No. |               | <b>4</b>   |
| 1:60,000 | HA0464020   |               |            |

A

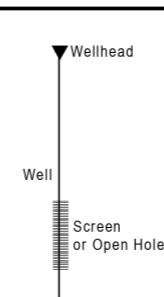
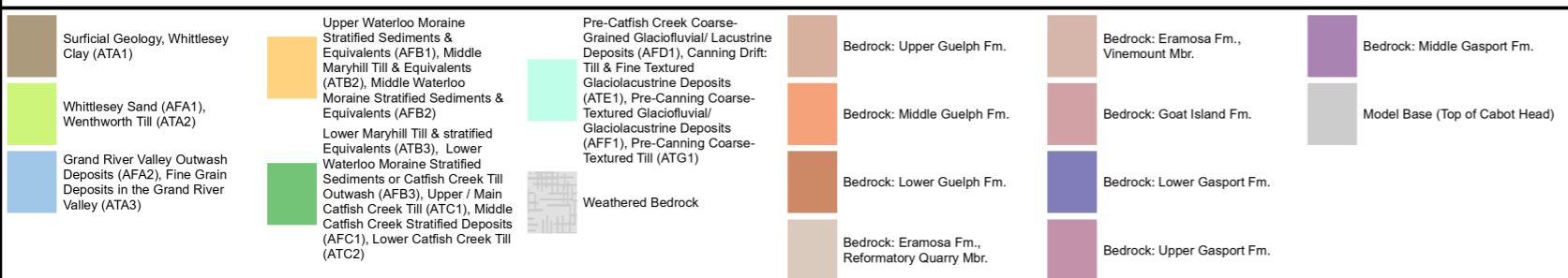
A'



Wells

- Production Well (Active)
- Production Well (Inactive)
- Production Well (Decommissioned)
- Monitoring Well

Cambridge Model 2026



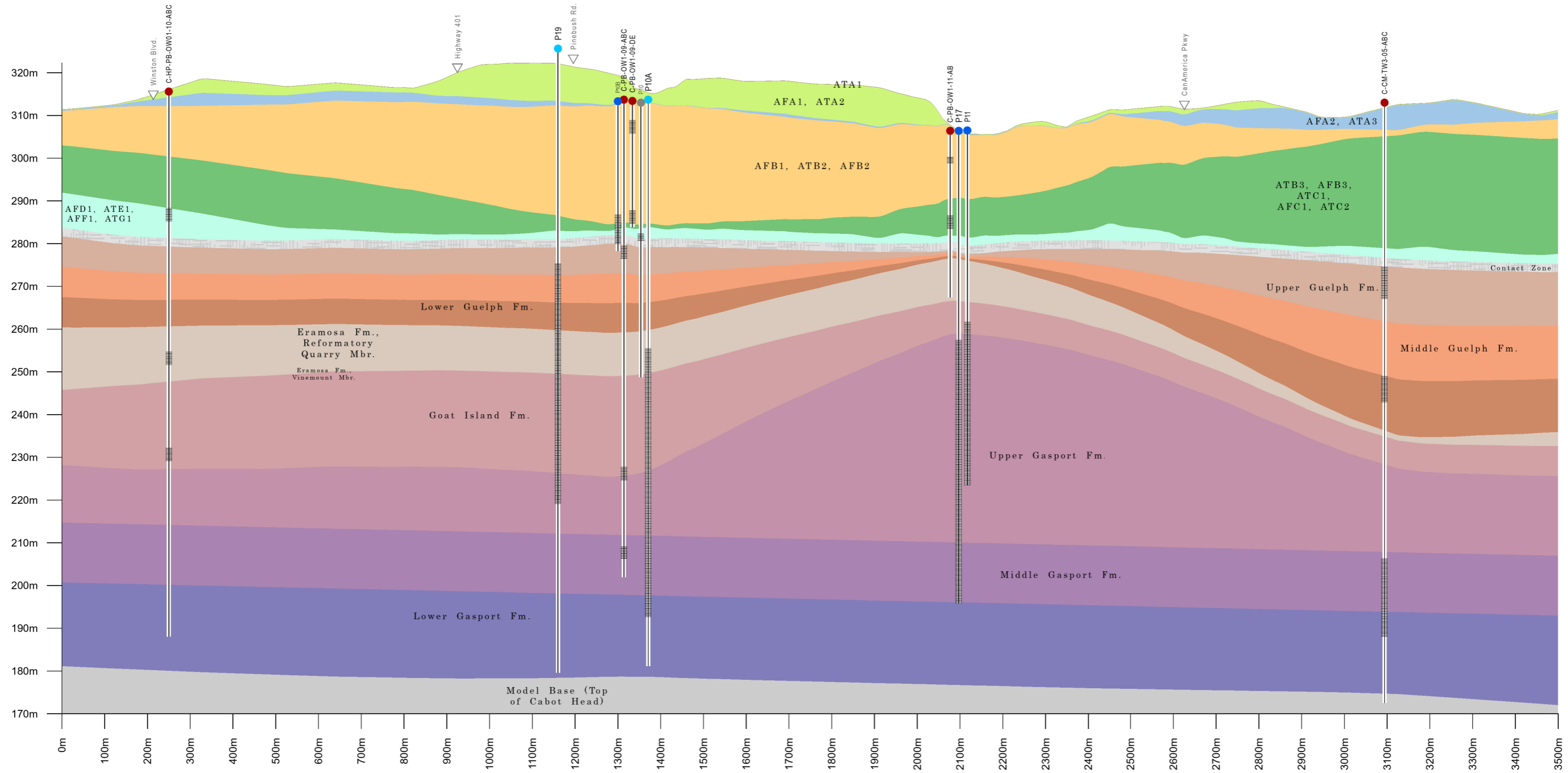
**BURNSIDE**

Client  
**REGION OF WATERLOO**

|  |         |             |            |
|--|---------|-------------|------------|
| <p>Figure Title<br/><b>GEOLOGIC CROSS SECTION<br/>REGION OF WATERLOO</b><br/>Pinebush<br/>Cross Section A - A'</p> |         |             |            |
| Drawn  | Checked | Date        | Figure No. |
| PS   | DH      | 2026/06/25  | 5          |
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| Vertical Ex.:10x   |         | HA046402    |            |

B

B'

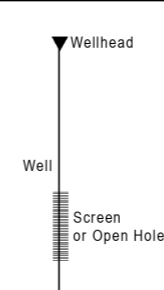


Wells

- Production Well (Active)
- Production Well (Inactive)
- Production Well (Decommissioned)
- Monitoring Well

Cambridge Model 2026

|  |   |  |   |                                      |                                |
|--|---|--|---|--------------------------------------|--------------------------------|
| Surficial Geology, Whittlesey Clay (ATA1)  | Upper Waterloo Moraine Stratified Sediments & Equivalents (AFB1), Middle Maryhill Till & Equivalents (ATB2), Middle Waterloo Moraine Stratified Sediments & Equivalents (AFB2)  | Pre-Catfish Creek Coarse-Grained Glaciofluvial/ Lacustrine Deposits (AFD1), Canning Drift: Till & Fine Textured Glaciolacustrine Deposits (ATE1), Pre-Canning Coarse-Textured Glaciofluvial/ Glaciolacustrine Deposits (AFF1), Pre-Canning Coarse-Textured Till (ATG1) | Bedrock: Upper Guelph Fm.                     | Bedrock: Eramosa Fm., Vinemount Mbr. | Bedrock: Middle Gasport Fm.    |
| Whittlesey Sand (AFA1), Wenthworth Till (ATA2)   | Lower Maryhill Till & stratified Equivalents (ATB3), Lower Waterloo Moraine Stratified Sediments or Catfish Creek Till Outwash (AFB3), Upper / Main Catfish Creek Till (ATC1), Middle Catfish Creek Stratified Deposits (AFC1), Lower Catfish Creek Till (ATC2) | Weathered Bedrock  | Bedrock: Middle Guelph Fm.                    | Bedrock: Goat Island Fm.             | Model Base (Top of Cabot Head) |
| Grand River Valley Outwash Deposits (AFA2), Fine Grain Deposits in the Grand River Valley (ATA3) |   |  | Bedrock: Lower Guelph Fm.                     | Bedrock: Lower Gasport Fm.           |                                |
|  |   |  | Bedrock: Eramosa Fm., Reformatory Quarry Mbr. | Bedrock: Upper Gasport Fm.           |                                |



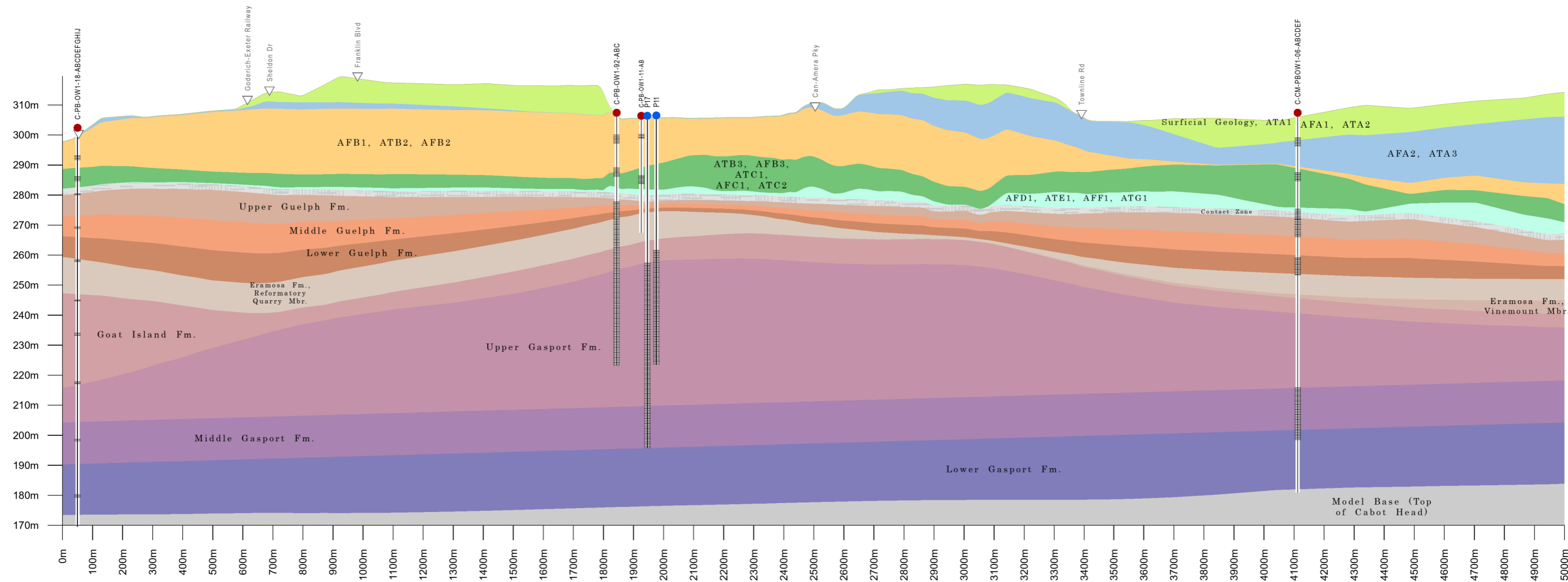
**BURNSIDE**

Client  
**REGION OF WATERLOO**

|  |               |                         |                 |
|--|---------------|-------------------------|-----------------|
| Figure Title<br><b>GEOLOGIC CROSS SECTION<br/>REGION OF WATERLOO<br/>Pinebush<br/>Cross Section B - B'</b> |               |                         |                 |
| Drawn<br>PS  | Checked<br>DH | Date<br>2026/06/25      | Figure No.<br>6 |
| Horizontal Scale 1:10,000  |               | Project No.<br>HA046402 |                 |
| Vertical Ex.:10x   |               |                         |                 |

C

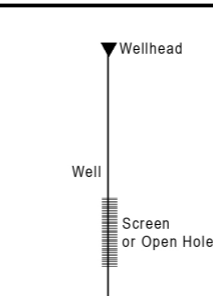
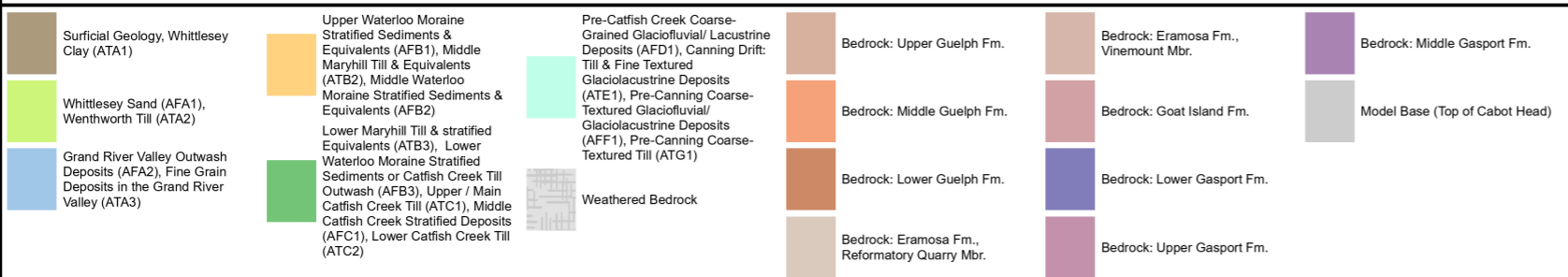
C'



Wells

- Production Well (Active)
- Monitoring Well

Cambridge Model 2026



Client  
**REGION OF WATERLOO**

|  |               |                         |                 |
|--|---------------|-------------------------|-----------------|
| Figure Title<br><b>GEOLOGIC CROSS SECTION<br/>REGION OF WATERLOO</b><br>Pinebush<br>Cross Section C - C' |               |                         |                 |
| Drawn<br>PS  | Checked<br>DH | Date<br>2026/06/25      | Figure No.<br>7 |
| Horizontal Scale 1:14,000  |               | Project No.<br>HA046402 |                 |
| Vertical Ex.:10x   |               |                         |                 |



BURNSIDE

[ THE DIFFERENCE IS OUR PEOPLE ]

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**Appendix A**

**Permit To Take Water**

Appendix A



This document is a Clone of Permit # 4073-BURPRF

**AMENDED PERMIT TO TAKE WATER**  
Ground Water

NUMBER 7858-BXUUUH

Reference Number 1507-BVBQSN

*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 Regional Municipality of Waterloo  
Floor 7 - 150 Frederick St  
Kitchener, Ontario, N2G 4J3  
Canada

**For the water taking from:** Pinebush Well Field; (P10, P11, P17, P10A, B10B, and P19)

**Located at:** Lot 4, Concession 3 Beasleys Lower Block, Geographic Township of Waterloo  
Cambridge, Regional Municipality of Waterloo

340 Pinebush Rd Lot 5 Concession 3 Beasley Lower Block  
Cambridge, Regional Municipality of Waterloo

381 Pinebush Rd Lot 5 Concession 3 Beasley Lower Block  
Cambridge, Regional Municipality of Waterloo

*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. 7858-BXUUUH including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.

(f) "Permit Holder" means The Regional Municipality of Waterloo.

(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 July 27, 2020 and signed by Karl Belan, and all Schedules included in this Permit.

1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.

1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.

1.4 This Permit is not transferable to another person.

1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.

1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.

1.7 The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change. A change in ownership in the property shall cause this Permit to be cancelled.

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

## 2.1 Inspections

The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the *Environmental Protection Act*, R.S.O. 1990, the *Pesticides Act*, R.S.O. 1990, or the *Safe Drinking Water Act*, S. O. 2002.

## 2.2 Other Approvals

The issuance of, and compliance with this Permit, does not:

- (a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the *Ontario Water Resources Act*, and the *Environmental Protection Act*, and any regulations made thereunder; or
- (b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

## 2.3 Information

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

- (a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or
- (b) acceptance by the Ministry of the information's completeness or accuracy.

## 2.4 Rights of Action

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

## 2.5 Severability

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

## 2.6 Conflicts

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

# 3. Water Takings Authorized by This Permit

## 3.1 Expiry

This Permit expires on **May 31, 2030**. No water shall be taken under authority of this Permit after the expiry

date.

3.2 Amounts of Taking Permitted

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

**Table A**

|   | Source Name / Description:     | Source: Type: | Taking Specific Purpose: | Taking Major Category: | Max. Taken per Minute (litres): | Max. Num. of Hrs Taken per Day: | Max. Taken per Day (litres): | Max. Num. of Days Taken per Year: | Zone/ Easting/ Northing: |
|---|--------------------------------|---------------|--------------------------|------------------------|---------------------------------|---------------------------------|------------------------------|-----------------------------------|--------------------------|
| 1 | P10, P11, P17, P10A, P10B, P19 | Well Drilled  | Municipal                | Water Supply           | 9,660                           | 24                              | 13,910,400                   | 365                               | 17<br>556957<br>4806840  |
|   |                                |               |                          |                        |                                 | <b>Total Taking:</b>            | 13,910,400                   |                                   |                          |

3.3 Notwithstanding the Maximum Taken per Day specified in Table A of Condition 3.2, the combined taking from wells P10, P10A, P10B, P11, P17 and P19 shall not exceed an annual daily average of 11,104,128 L/day.

**4. Monitoring**

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

4.2 The Permit Holder shall complete the monitoring plan as described in the letter by Golder Associates titled “Monitoring Plan – Cambridge East Well Fields (Pinebush and Clemens Mill) PTTW Applications” dated April 22, 2020. The Permit Holder shall measure and record water levels hourly in the following monitoring wells:

- C-CM-PBOW2-06 ABCDEF
- C-PB-OW1-09 ABCDE
- C-PB-OW1-11 AB
- C-PB-OW1-92 ABC

4.3 The Permit Holder shall prepare and submit an electronic copy of a report prepared by a Qualified Person (P. Geo or equivalent) every two years by June 30 commencing in 2022. The report shall present the results of the well field water level monitoring for the two preceding calendar years, assess changes in water levels in the supply aquifer in relation to the . precipitation and the water taking from the aquifer, and provide a summary for all interference complaints received by the Permit Holder related to this Permit and reported to the District Office in accordance with Condition 5.1 and the manner in which the Permit Holder has dealt with the complaint. Any application for an amendment or renewal shall be accompanied by the most recent biennial report.

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

### **5.1 Notification**

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

### **5.2 For Groundwater Takings**

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

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

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

The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal

under the *Ontario Water Resources Act*, Section 100 (4).

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

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

*In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me 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*  
[ERTTribunalsecretary@ontario.ca](mailto:ERTTribunalsecretary@ontario.ca)

AND

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

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

*from the Tribunal:*

by Telephone at  
(416) 212-6349  
Toll Free 1(866) 448-2248

by Fax at  
(416) 326-5370  
Toll Free 1(844) 213-3474

by e-mail at  
[www.ert.gov.on.ca](http://www.ert.gov.on.ca)

This Permit cancels and replaces Permit Number 0271-BURPRE, issued on 2020/11/02.

Dated at Toronto this 3<sup>rd</sup> day of February, 2021.



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

**Schedule A**

This Schedule "A" forms part of Permit To Take Water 7858-BXUUUH, dated February 3, 2021.

1. "Monitoring Plan – Cambridge East Well Fields (Pinebush and Clemens Mill) PTTW Applications" dated April 22, 2020.
2. "Regional Municipality of Waterloo Cambridge East Water Supply Class Environmental Assessment, Project File Report Appendix A, Hydrogeology and Natural Environmental Report" dated December 2017.
3. Pinebush Road Well Field Construction and Testing of Test Wells P10A, P10B, TW1-10, And Production Wells P11 and P17" dated Sept 6, 2013.
4. Municipal Well P10 Optimization Project, Test Well PB-TW1-10 Construction and Diagnostics, Cambridge, Ontario" dated November 1, 2010.

April 22, 2020

Project No. 19119485

**Karl Belan, M.A.Sc., P.Geo., Hydrogeologist**

Regional Municipality of Waterloo

Water Services

150 Fredrick Street, 7th Floor

Kitchener, ON N2G 4J3

**MONITORING PLAN – CAMBRIDGE EAST WELL FIELDS (PINEBUSH AND CLEMENS MILL)  
PTTW APPLICATIONS**

Dear Mr. Belan,

In support of the Region of Waterloo's Permit to Take Water (PTTW) applications to the Ministry of the Environment, Conservation and Parks (MECP) for the Pinebush and Clemens Mill well fields, the following letter presents the monitoring plan to be completed by the Region in support of the updated PTTWs. This letter follows the completion of the Cambridge East Water Supply Class Environmental Assessment (EA) (Golder, 2018), which recommended the addition of water supply from wells P10A, P10B and P19 in the Pinebush well field and from G19 in the Clemens Mill well field. This letter provides additional details on the recommended monitoring program provided in the EA documentation (Golder, 2018).

**Background – Pinebush Well Field**

The Region currently has a Permit for wells P11 and P17 (PTTW No. 7343-9FFJBX) for 120 L/s in the Pinebush well field. This permit was issued in January 2014 and expires on May 31, 2024. Wells P10, P11 and P17 supply the Pinebush Water Treatment Plant (WTP). Well P10 was constructed prior to the Ontario Water Resources Act and therefore is not listed on the PTTW. In 2010 and 2011 new test wells P10A, P10B, P19 (previously referred to as PBTW1-10) were constructed, a steel well casing liner was installed in P17 and P11 was re-drilled and re-constructed. Following testing of the new and existing wells in 2010/2011 (Stantec, 2013), groundwater modelling (Golder, 2017) and the completion of the Class EA (Golder, 2018), the Region is applying for a PTTW renewal for the Pinebush well field which will include P10, P10A, P10B, P11/P17 and P19. P10B is intended as a replacement for P10 which will be decommissioned once these new wells are brought online. Wells P10A and P19 were constructed to restore municipal well capacity that has declined at P11 and P17.

**Background – Clemens Well Field**

The Regional currently has a Clemens Mill well field permit for wells G6, G16, G17 and G18 (PTTW No. 8842-9FDJUC) for 150.8 L/s. This permit was issued in January 2014 and expires on May 31, 2024. These wells supply the Turnbull WTP. Following the completion of the Class EA (Golder, 2018), the Region is applying for a PTTW renewal for the Clemens well field, which will include wells G6, G16, G17, G18 and G19 (previously referred to as CMPW2-06 or Cedarbrook Well). As part of the Hydrogeological and Natural Environment Report,

an assessment of the sustainability of the new takings was completed and a monitoring program was recommended (Golder, 2017); a copy of this report is included with the application (electronic).

## Monitoring Program

As required in the current PTTWs, monthly annual monitoring is completed at five wells in Pinebush and 13 wells in Clemens Mills, as shown in Table 1 and on Figure 1.

**Table 1: Monitoring Included in Current PTTW**

| Pinebush Well Field | Clemens Mill Well Field |
|---------------------|-------------------------|
| C-PB-OW1A-11        | C-CM-OW6ABCD-94         |
| C-PB-OW1B-11        | C-CM-OW02A-10           |
| C-PB-OW1A-92        | C-CM-OW02B-10           |
| C-PB-OW1BC-92       | C-CM-OW01A-10           |
|                     | C-CM-OW4A-92            |
|                     | C-CM-OW4BC-92           |
|                     | C-CM-OW3ABC-06          |

## Recommended Additional Monitoring – Existing Locations

As part of the Hydrogeological and Natural Environment Report (Golder, 2017), a monitoring program was recommended for the Pinebush and Clemens Mills well fields. The following additional recommended monitoring is consistent with the recommendations included in the Cambridge East Class EA.

- 1) Groundwater monitoring should be completed at the locations listed in Table 2 (appended) and shown on Figure 1. Groundwater monitoring should be completed using dataloggers set to record at 1-hour intervals. As per the protocol in the Region’s Groundwater Monitoring Program (GMP), manual measurements will be completed to backup the dataloggers.
  - It is noted that the following proposed monitoring locations have already been incorporated by the Region into their GMP: CMOW1-06, CMOW2-10, PBOW1-06, PBOW2-06, and PLOW1-06.
- 2) Monitoring should continue at the following wells: TW9-78, TW10-78 and MW09-T3-01. These wells are currently being monitored by the Township of Puslinch.
- 3) Water levels in Puslinch Lake (LWL) should be monitored at a higher frequency (datalogger for continuous measurement during ice-free conditions).

## Recommended Monitoring - New Locations

- 1) The locations of proposed new monitoring locations are shown on Figure 1. The Region has initiated discussions with the property owners at these locations. The final locations of these proposed monitoring stations will be dependent on receipt of signed access agreements with the property owners.

- 2) As ongoing water level monitoring is limited primarily in the area west of Puslinch Lake, the following additional monitoring wells were recommended as part of the Class EA to better define groundwater gradients and groundwater level changes around the lake:
  - A multi-level deep monitoring well nest installed near Irish Creek north of Puslinch Lake (Well A);
  - A multi-level deep monitoring well nest installed to the northeast/east of Puslinch Lake (Well B);
  - A multi-level deep monitoring well nest installed further east of PBOW1-06 along Concession 1, in the vicinity of Mill Creek to better define the eastern limits of the zone of influence of pumping (Well C); and
  - Additional shallow drivepoint piezometers installed in accessible locations in the vicinity of the Puslinch Lake shoreline.
- 3) A shallow streambank piezometer is recommended east of CMOW2-06 along Shellard Road, south of Gore Road and adjacent to Mill Creek.
- 4) A stream gauging station is recommended on Irish Creek for continuous flow gauging, during ice-free conditions; additional spot baseflow measurements are also recommended for Irish Creek.
- 5) A shallow streambank piezometer should be installed adjacent to Irish Creek to assess shallow groundwater gradients.
- 6) A shallow piezometer along Cedarbrook Creek (H7-06) should be reinstalled at an historic monitoring location and included in the monitoring program.

## **Operational Testing and Adaptive Management**

Details about the Operational Testing and Adaptive Management Plan are provided in the Hydrogeological and Natural Environment Report (Golder, 2017) and in the Class Environmental Assessment Project File Report (Golder, 2018)

To ensure that the optimized pumping rates are sustainable, an operational testing program should be carried out, which is recommended to include the following steps:

- Continue pumping of only the existing wells and P10B with expanded monitoring to collect baseline data;
- Increase pumping from new wells in the Pinebush well field (P10A and P19); and
- Increase pumping from new wells in the Pinebush well field (P10A and P19) and the Clemens Mill well field (G19).

After each step, a report will be completed with an updated adaptive management plan. Quarterly data reports at key monitoring locations will also be completed. The pumping duration of each operational step will be up to five years and the monitoring results will be available to the public and provided to the Township of Puslinch. The total supply increase of 38 L/s is not required until the year 2031 and the Region would have the flexibility to gradually increase takings in the period leading up to this time.

Reporting on progress of operational testing will be provided every two years in the form of Biennial Monitoring Reports incorporated into the Region's existing Groundwater Monitoring Program.

## Well Interference Policy

The Region's well interference policy can be found on their website at [www.regionofwaterloo.ca/protectwater](http://www.regionofwaterloo.ca/protectwater).

A revised well interference Policy Area was developed as part of the Class Environmental Assessment, considering the new wells in the Pinebush and Clemens Mill well fields. The revised well interference Policy Area is presented on Figure 11 of the Class Environmental Assessment Project File Report (Golder, 2018). This Revised Policy Area will be added to the policy prior to new wells coming online. Although impacts to private wells are not expected from the increased taking, an enhanced level of response will be given to any well complaints within these policy areas.

## Closure

We trust that this information is suitable to support the PTTW application. Please do not hesitate to contact us if you have any questions or concerns.

Sincerely,

**Golder Associates Ltd.**



Jennifer Hancox, M.Sc., P.Geo.  
*Hydrogeologist*



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

JLH/JAP/II

Attachments: Figure 1 – Monitoring Locations in Pinebush and Clemens Mill Well Fields  
Table 2 – Proposed Cambridge East Monitoring Locations

[https://golderassociates.sharepoint.com/sites/105935/project files/6 deliverables/cambridge east ptw support/04\\_final letter\\_2020apr22/19119485\\_cambridge east ptw monitoring support\\_2020apr22.docx](https://golderassociates.sharepoint.com/sites/105935/project%20files/6%20deliverables/cambridge%20east%20ptw%20support/04_final%20letter_2020apr22/19119485_cambridge%20east%20ptw%20monitoring%20support_2020apr22.docx)

## References

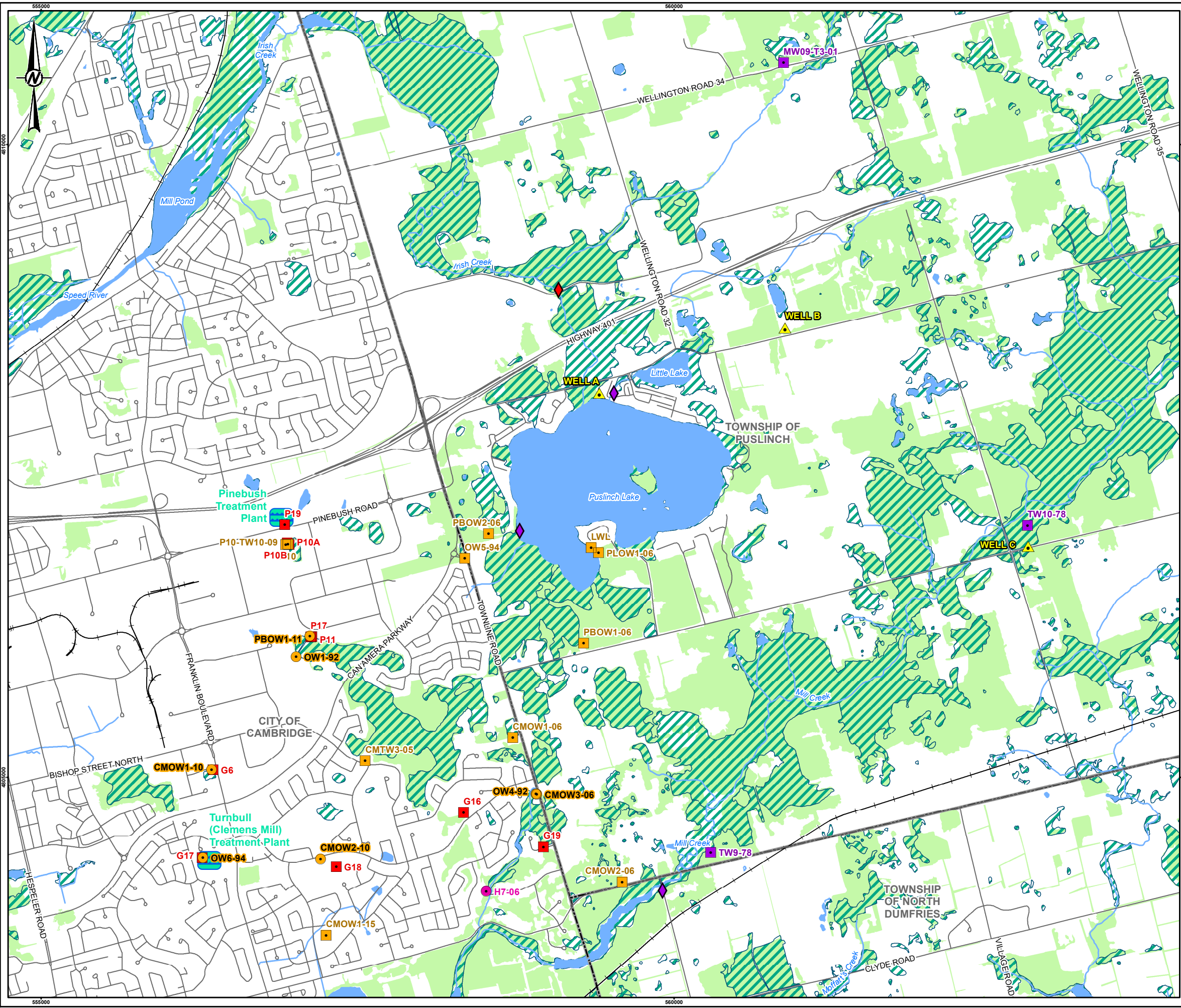
Golder Associates Ltd. (Golder), 2018. Regional Municipality of Waterloo Cambridge East Water Supply Class Environmental Assessment – Project File Report. Submitted to The Regional Municipality of Waterloo. Dated April 2018.

Golder Associates Ltd. (Golder), 2017. Regional Municipality of Waterloo Cambridge East Water Supply Class Environmental Assessment – Hydrogeological and Natural Environment Report. Submitted to The Regional Municipality of Waterloo. Dated December 2017.

Stantec Consulting Ltd. (Stantec), 2015. Pinebush Road Well Field Construction and Testing of Test Wells P10A, P10B, TW1-10 and Production Wells P11 and P17. Prepared for Regional Municipality of Waterloo. Dated September 6, 2013.

**FIGURE**

Figure 1 – Monitoring Locations in  
Pinebush and Clemens Mill Well  
Fields



**LEGEND**

**PROPOSED NEW MONITORING LOCATIONS**

- ▲ PROPOSED MULTILEVEL WELLS
- ◆ PROPOSED STAFF GAUGE AND MINI-PIEZOMETER
- ◇ PROPOSED MINI-PIEZOMETER

**EXISTING MONITORING LOCATIONS**

- ONGOING TOWNSHIP OF PUSLINCH MONITORING LOCATIONS
- MUNICIPAL SUPPLY WELL
- NEW LONG-TERM MONITORING LOCATION
- CURRENT PTTW MONITORING WELL
- MINI-PIEZOMETER

— ROAD

— RAILWAY

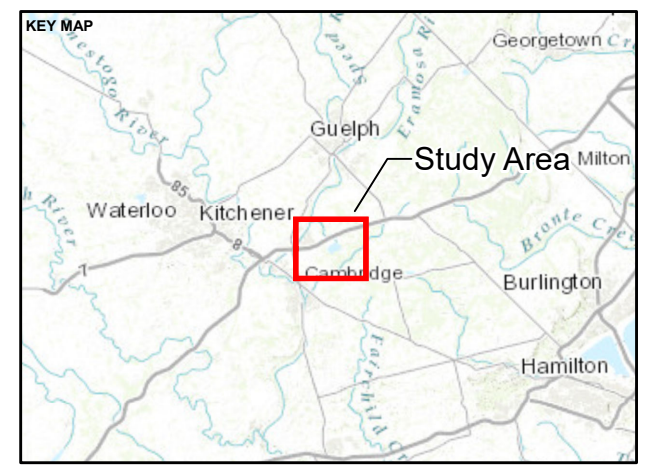
— WATERCOURSE

— WATER BODY

▨ GRCA WETLAND

▨ WOODED AREA

▭ MUNICIPAL BOUNDARY



**REFERENCE(S)**

1. BASE DATA: LIO MNRf OBTAINED 2019
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N
3. BASE MAP: SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT  
REGIONAL MUNICIPALITY OF WATERLOO

PROJECT  
REGIONAL MUNICIPALITY OF WATERLOO,  
CAMBRIDGE EAST PERMITS TO TAKE THE WATER

TITLE  
**MONITORING LOCATIONS IN PINEBUSH AND CLEMENS MILL  
WELL FIELDS**

|            |            |            |
|------------|------------|------------|
| CONSULTANT | YYYY-MM-DD | 2020-01-07 |
| DESIGNED   | PR/LMM     |            |
| PREPARED   | LMM/ST     |            |
| REVIEWED   | JLH        |            |
| APPROVED   | JAP        |            |

PATH: S:\Clients\Region of Waterloo\Cambridge\_East109\_PROD\19119485\_19119485\_0001\_CS\_0002.mxd PRINTED ON: 2020-01-07 AT: 14:47 PM  
 IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

**TABLE**

**Table 2 – Proposed Cambridge  
East Monitoring Locations**

| Well Name | Sys_Loc Code | Region Name    | Easting  | Northing  | Screened Interval (mbgs) | Formation Screened      | Well Field   | Notes                        |
|-----------|--------------|----------------|----------|-----------|--------------------------|-------------------------|--------------|------------------------------|
| CMOW3A-06 | 9202639A     | C-CM-OW3-06-A  | 558916.3 | 4804866.4 | 77.7 - 108.2             | Gasport                 | Clemens Mill | Existing PTTW - Clemens Mill |
| CMOW3B-06 | 9202639B     | C-CM-OW3-06-B  |          |           | 50.3 - 56.1              | Guelph                  |              | Existing PTTW - Clemens Mill |
| CMOW3C-06 | 9202639C     | C-CM-OW3-06-C  |          |           | 36.6 - 39.6              | Guelph                  |              | Existing PTTW - Clemens Mill |
| CMOW1-10  | 9205505A     | C-CM-OW01-10-A | 556344.5 | 4805060.2 | 9.8 - 12.8               | Shallow Overburden      | Clemens Mill | Existing PTTW - Clemens Mill |
| CMOW2A-10 | 9205506A     | C-CM-OW02-10-A | 557206.2 | 4804356.0 | 33.8 - 35.4              | Deep Overburden         | Clemens Mill | Existing PTTW - Clemens Mill |
| CMOW2B-10 | 9205507B     | C-CM-OW02-10-B | 557208.1 | 4804356.7 | 9.7 - 12.7               | Shallow Overburden      |              | Existing PTTW - Clemens Mill |
| OW4A-92   | 1000389A     | C-CM-OW4-92-A  | 558908.1 | 4804869.3 | 36.9 - 37.8              | Guelph                  | Clemens Mill | Existing PTTW - Clemens Mill |
| OW4B-92   | 1000390B     | C-CM-OW4-92-B  | 558910.8 | 4804870.2 | 28.4 - 29.9              | Deep Overburden         |              | Existing PTTW - Clemens Mill |
| OW4C-92   | 1000390C     | C-CM-OW4-92-C  |          |           | 8.8 - 10.4               | Shallow Overburden      |              | Existing PTTW - Clemens Mill |
| OW6A-94   | 6507562A     | C-CM-OW6-94-A  | 556277.2 | 4804365.8 | 155.5 - 158.5            | Cabot Head              | Clemens Mill | Existing PTTW - Clemens Mill |
| OW6B-94   | 6507562B     | C-CM-OW6-94-B  |          |           | 130.0 - 133.0            | Gasport                 |              | Existing PTTW - Clemens Mill |
| OW6C-94   | 6507562C     | C-CM-OW6-94-C  |          |           | 111.0 - 114.0            | Gasport                 |              | Existing PTTW - Clemens Mill |
| OW6D-94   | 6507562D     | C-CM-OW6-94-D  |          |           | 68.6 - 71.6              | Guelph                  |              | Existing PTTW - Clemens Mill |
| OW1A-92   | 1000383A     | C-PB-OW1-92-A  | 557014.6 | 4805951.6 | 29.5 - 84.1              | Guelph - Gasport        | Pinebush     | Existing PTTW - Pinebush     |
| OW1B-92   | 1000382B     | C-PB-OW1-92-B  |          |           | 18.3 - 21.3              | Deep Overburden         |              | Existing PTTW - Pinebush     |
| OW1C-92   | 1000382C     | C-PB-OW1-92-C  |          |           | 7.3 - 10.4               | Shallow Overburden      |              | Existing PTTW - Pinebush     |
| PBOW1-11A | 9205806A     | C-PB-OW1-11-A  | 557123.0 | 4806116.0 | 19.8 - 22.9              | Deep Overburden         | Pinebush     | Existing PTTW - Pinebush     |
| PBOW1-11B | 9205807A     | C-PB-OW1-11-B  |          |           | 6.1 - 7.62               | Shallow Overburden      |              | Existing PTTW - Pinebush     |
| CMOW1A-06 | 9202637A     | C-CM-OW1-06-A  | 558725.7 | 4805314.2 | 102.1 - 120.4            | Gasport                 | Clemens Mill | GMP                          |
| CMOW1B-06 | 9202637B     | C-CM-OW1-06-B  |          |           | 48.8 - 57.9              | Guelph                  |              | GMP                          |
| CMOW1C-06 | 9202637C     | C-CM-OW1-06-C  |          |           | 36.6 - 39.6              | Guelph                  |              | GMP                          |
| CMOW1D-06 | 9202664D     | C-CM-OW1-06-D  | 558724.0 | 4805313.1 | 30.2 - 33.1              | Deep Overburden         |              | GMP                          |
| CMOW1E-06 | 9202665E     | C-CM-OW1-06-E  | 558723.0 | 4805312.4 | 14.0 - 17.1              | Intermediate Overburden |              | GMP                          |
| CMOW1F-06 | 9202666F     | C-CM-OW1-06-F  | 558724.8 | 4805313.7 | 4.6 - 7.6                | Shallow Overburden      |              | GMP                          |
| CMOW2A-06 | 9202638A     | C-CM-OW2-06-A  | 559589.2 | 4804173.7 | 91.4 - 111.6             | Gasport                 |              | Clemens Mill                 |
| CMOW2B-06 | 9202638B     | C-CM-OW2-06-B  |          |           | 45.0 - 58.2              | Guelph                  | GMP          |                              |
| CMOW2C-06 | 9202638C     | C-CM-OW2-06-C  |          |           | 30.5 - 35.4              | Guelph                  | GMP          |                              |
| CMOW2D-06 | 9202667D     | C-CM-OW2-06-D  | 559589.8 | 4804173.5 | 27.4 - 29.0              | Deep Overburden         | GMP          |                              |
| CMOW2E-06 | 9202668E     | C-CM-OW2-06-E  | 559588.2 | 4804174.2 | 13.7 - 16.8              | Intermediate Overburden | GMP          |                              |
| CMOW2F-06 | 9202669F     | C-CM-OW2-06-F  | 559590.5 | 4804173.0 | 4.6 - 7.6                | Shallow Overburden      | GMP          |                              |
| CMTW3A-05 | 9202049A     | C-CM-TW3-05-A  | 557560.0 | 4805132.0 | 106.7 - 125.0            | Gasport                 | Clemens Mill | GMP                          |
| CMTW3B-05 | 9202049B     | C-CM-TW3-05-B  |          |           | 64.0 - 70.1              | Guelph                  |              | GMP                          |
| CMTW3C-05 | 9202049C     | C-CM-TW3-05-C  |          |           | 38.4 - 46.0              | Guelph                  |              | GMP                          |

| Well Name | Sys_Loc Code | Region Name     | Easting  | Northing  | Screened Interval (mbgs) | Formation Screened               | Well Field   | Notes |
|-----------|--------------|-----------------|----------|-----------|--------------------------|----------------------------------|--------------|-------|
| CMOW1A-15 | 9207189A     | C-CM-OW1-15-A   | 557250.5 | 4803752.0 | 93.0 - 96.0              | Gasport                          | Clemens Mill | GMP   |
| CMOW1B-15 | 9207190B     | C-CM-OW1-15-B   | 557244.0 | 4803751.0 | 77.1 - 80.2              | Goat Island                      |              | GMP   |
| CMOW1C-15 | 9207190C     | C-CM-OW1-15-C   |          |           | 30.5 - 33.5              | Guelph                           |              | GMP   |
| PBOW1A-06 | 9202643A     | C-PB-OW1-06-A   | 559285.9 | 4806058.2 | 91.4 - 109.1             | Gasport                          | Pinebush     | GMP   |
| PBOW1B-06 | 9202643B     | C-PB-OW1-06-B   |          |           | 48.2 - 54.3              | Guelph                           |              | GMP   |
| PBOW1C-06 | 9202643C     | C-PB-OW1-06-C   |          |           | 35.4 - 41.5              | Guelph                           |              | GMP   |
| PBOW1D-06 | 9202670D     | C-PB-OW1-06-D   | 559284.4 | 4806058.2 | 32.0 - 35.5              | Deep Overburden                  |              | GMP   |
| PBOW1E-06 | 9202671E     | C-PB-OW1-06-E   | 559283.1 | 4806058.4 | 19.0 - 22.9              | Intermediate Overburden          |              | GMP   |
| PBOW1F-06 | 9202672F     | C-PB-OW1-06-F   | 559281.8 | 4806058.7 | 8.2 - 11.3               | Shallow Overburden               |              | GMP   |
| PBOW2A-06 | 9202673A     | C-PB-OW2-06-A   | 558534.8 | 4806923.5 | 91.4 - 109.8             | Gasport                          | Pinebush     | GMP   |
| PBOW2B-06 | 9202673B     | C-PB-OW2-06-B   |          |           | 48.9 - 55.0              | Reformatory Quarry               |              | GMP   |
| PBOW2C-06 | 9202673C     | C-PB-OW2-06-C   |          |           | 33.5 - 44.4              | Guelph                           |              | GMP   |
| PBOW2D-06 | 9202674D     | C-PB-OW2-06-D   | 558535.9 | 4806925.7 | 33.2 - 36.3              | Deep Overburden                  |              | GMP   |
| PBOW2E-06 | 9202675E     | C-PB-OW2-06-E   | 558536.3 | 4806926.8 | 25.0 - 28.0              | Intermediate Overburden          |              | GMP   |
| PBOW2F-06 | 9202676F     | C-PB-OW2-06-F   | 558534.4 | 4806922.1 | 14.0 - 17.1              | Shallow Overburden               |              | GMP   |
| PLOW1A-06 | 9202647A     | C-PB-PLOW1-06-A | 559402.9 | 4806775.2 | 9.1 - 10.7               | Shallow Overburden               | Pinebush     | GMP   |
| PLOW1B-06 | 9202647B     | C-PB-PLOW1-06-B | 559403.1 | 4806774.7 | 3.8 - 5.3                | Shallow Overburden               |              | GMP   |
| OW5A-94   | 9200572A     | C-PB-OW5-94-A   | 558345.8 | 4806730.4 | 137.0 - 140.0            | Cabot Head                       | Pinebush     | GMP   |
| OW5B-94   | 9200572B     | C-PB-OW5-94-B   |          |           | 104.0 - 110.0            | Gasport                          |              | GMP   |
| OW5C-94   | 9200572C     | C-PB-OW5-94-C   |          |           | 53.3 - 59.7              | Reformatory Quarry - Goat Island |              | GMP   |
| OW5D-94   | 9200572D     | C-PB-OW5-94-D   |          |           | 43.3 - 48.3              | Guelph                           |              | GMP   |
| OW5E-94   | 9200572E     | C-PB-OW5-94-E   |          |           | 36.3 - 39.3              | Deep Overburden                  |              | GMP   |
| OW5F-94   | 9200572F     | C-PB-OW5-94-F   |          |           | 6.1 - 9.1                | Shallow Overburden               |              | GMP   |
| OW5G-94   | 9200572G     | C-PB-OW5-94-G   |          |           | 14.8 - 17.8              | Shallow Overburden               |              | GMP   |
| LWL       | 9202660      | P-LWL-06        | 559343.8 | 4806815.2 | surface water            | Puslinch Lake                    | Pinebush     | GMP   |



# BURNSIDE

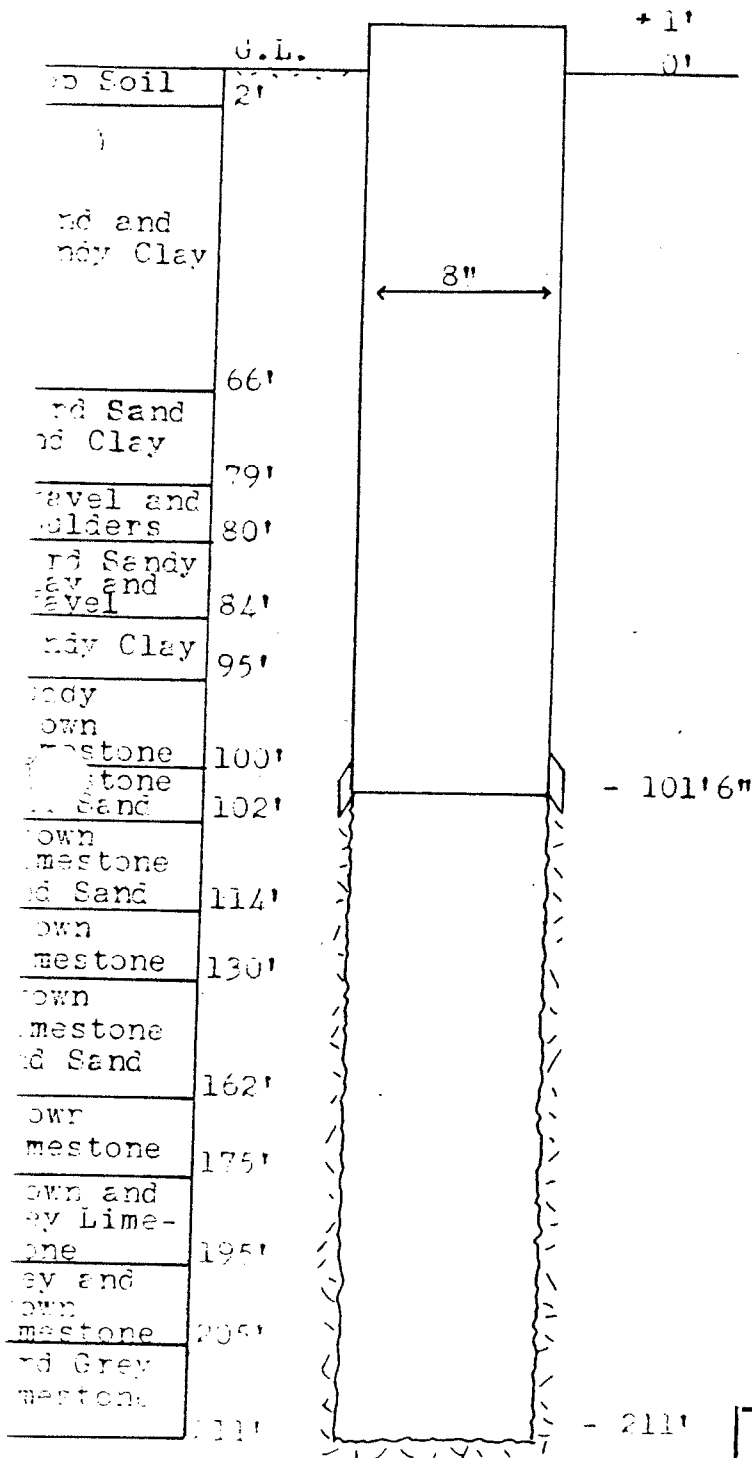
[ THE DIFFERENCE IS OUR PEOPLE ]

---

## Appendix B

### Well Records

#416



Well Material  
 Outer Casing 102'6" - 8" drive pipe  
 Inner Casing  
 Screen  
 Plug  
 Gravel

Pump  
 No. Setting BP-MB  
 No. Stages Length Bowl  
 Bowl Size  $\varnothing$  Lgth. Suction  
 Head Size Column  
 Materials or setting details other than standard  
 Impellers: Trim

Motor  
 Make Phase  
 H. P. Cycles  
 R. P. M. Volts  
 Type Amps.  
 Frame Serial  
 Bearing Nos.

Special Equipment

Well No. 1-59

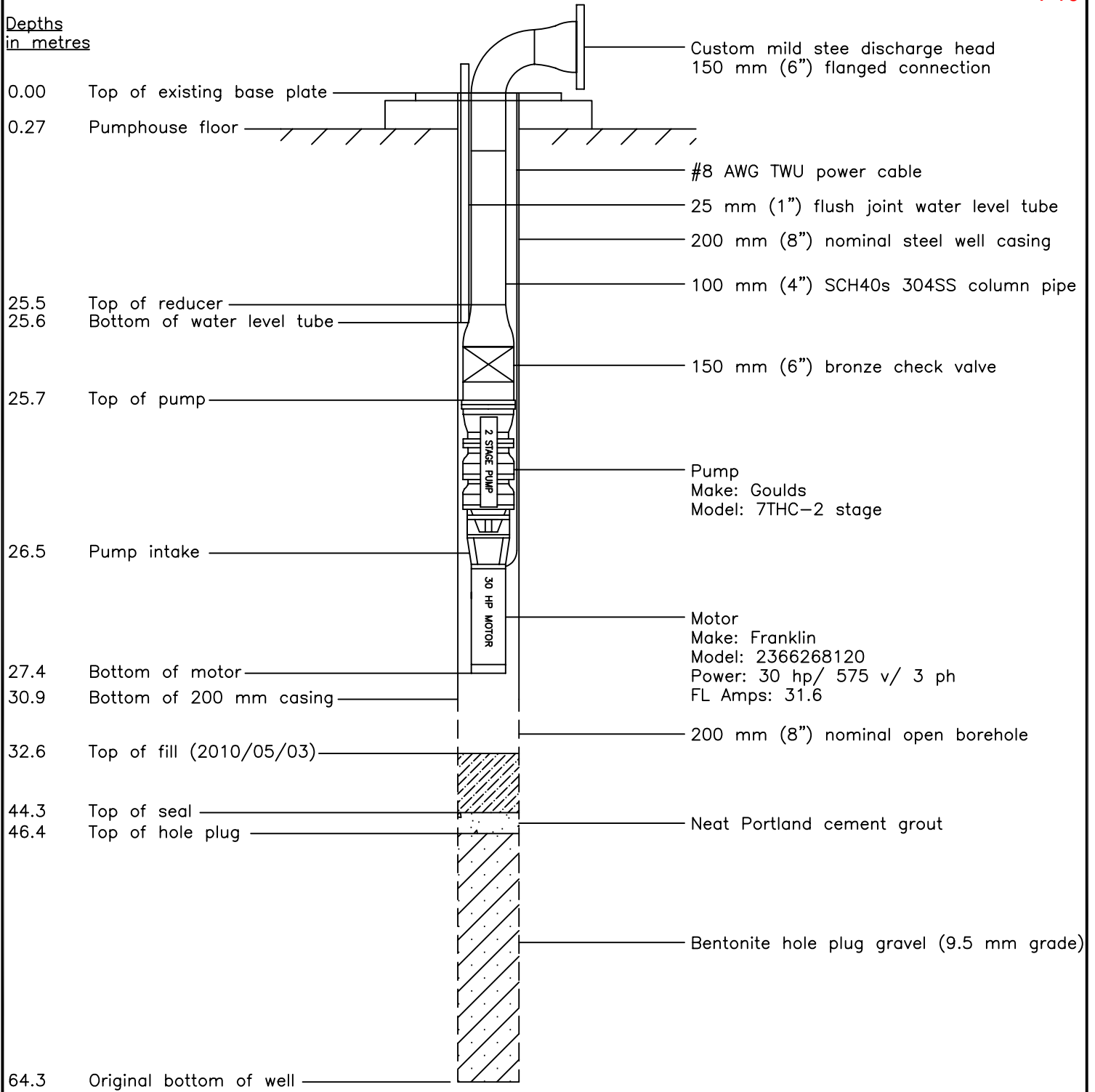
B.P. referred to original ground level  
 Clear depth below B.P.  
 Started 1/29/59 Final Test  
 Preliminary Test 2/21/59 Static Level 23'2"  
 Final Test Pumping Level 70'  
 Guarantee 1 GPM Capacity 300 IGPM  
 Contract Pressure # Pressure Pump  
 Length Air Line Main

P10 WELL #10 (GOETZ)

**INTERNATIONAL WATER SUPPLY LTD.**  
 MONTREAL LONDON, CANADA SASKATOON  
 OAKVILLE WATER SUPPLY CONTRACTORS VANCOUVER

PUBLIC UTILITIES COMMISSION  
 PERMISSION, ONTARIO  
 DRILLED BY I. Bauerlein DRAWN BY J.W.  
 INSTALLED BY APPROVED BY

Depths  
in metres



CLIENT

**Regional Municipality of Waterloo**

TITLE

**P10 Production Well  
Pump Installation (As-Installed)**

PROJECT No. **006-146**

G:\Lotowater Projects\006 RMOW\146 Cambridge Wells H3, H5 & P10\P10...\Pump Installation (P10).dwg

|         |           |                   |
|---------|-----------|-------------------|
| DESIGN  |           |                   |
| DRAWN   | <b>MG</b> | <b>2010/04/19</b> |
| CHECKED |           |                   |

REVISION No. 2010-04-19

SCALE **N.T.S.**

**FIGURE**

**1**

Measurements recorded in:  Metric  Imperial

NA.

Page 1 of 1

Well Owner's Information

First Name, Last Name/Organization (Region of Waterloo), E-mail Address, Mailing Address (150 Frederick St.), Municipality (Kitchener), Province (ON), Postal Code (N2G 4J3), Telephone No.

Well Location

Address of Well Location (375 Pinebush Rd.), Township (Cambridge City), Lot, Concession, County/District/Municipality (Waterloo), City/Town/Village (Cambridge), Province (Ontario), Postal Code, UTM Coordinates, Zone, Easting, Northing, Municipal Plan and Sublot Number, Other.

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From, To. Includes handwritten entry: Pinebush Well P10 Overdrilled and Casing Removed. Total Length of Casing Removed (99' 5") (8 5/8" OD). Lower Portion of Casing was Badly Corroded. Original Well Record # 65-132 (March 1959).

Annular Space table with columns: Depth Set at (m/ft) From, To; Type of Sealant Used (Material and Type); Volume Placed (m³/ft³). Includes handwritten entries: 0 100.3 Bentonite Chips 4650 lbs; 100.3 105.94 Well Gravel #3.

Method of Construction and Well Use checkboxes. Includes handwritten 'NA' for Other, specify.

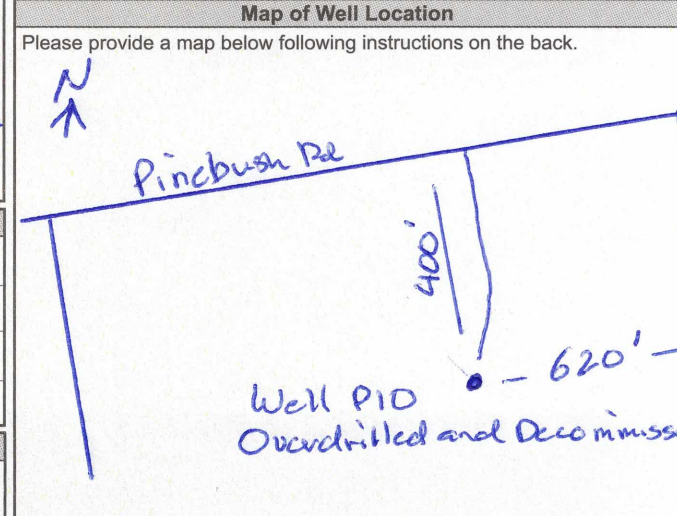
Construction Record - Casing table with columns: Inside Diameter (cm/in), Open Hole OR Material, Wall Thickness (cm/in), Depth (m/ft) From, To. Status of Well checkboxes.

Construction Record - Screen table with columns: Outside Diameter (cm/in), Material, Slot No., Depth (m/ft) From, To. Status of Well checkboxes.

Water Details and Hole Diameter tables. Water found at Depth, Kind of Water, Depth (m/ft) From, To, Diameter (cm/in). Includes handwritten '0 99 14"'. Well Contractor and Well Technician Information section below.

Well Contractor and Well Technician Information section. Business Name (SD HOPPER DRILLING), Business Address (3014 RD 119), Province (ON), Postal Code (N4K 1C9), Business E-mail Address (info@hopperwells.ca), Name of Well Technician (HOPPER, SHAWN), Date Submitted (2022/12/20).

Results of Well Yield Testing table. Columns: Draw Down (Time, Water Level), Recovery (Time, Water Level). Includes handwritten entries for pump intake, pumping rate, duration, and final water level.



Comments (P-10), Well owner's information package delivered (Yes/No), Date Package Delivered (2022/11/28), Date Work Completed (2022/11/28), Ministry Use Only (Audit No. 2400403, Received).

LOG OF DRILLING OPERATIONS

P10-TW2-09

Page 1 of 6



R.J. Burnside & Associates Limited  
15 Dundas, Georgetown, Ontario L2H 2K4  
Telephone 905 513 1321 Fax 519 911 4130

|  |   |  |
|--|---|--|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>P10 Test Well Construction</b> | Logged by: <b>S. Quinlan</b>               |
| Project No.: <b>MTA17230</b>                   | Location: <b>Pinebush Rd. Cambridge</b>         | Ground (m amsl): <b>313.17</b>             |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>12/21/2009</b>                 | Static Water Level (m amsl): <b>304.33</b> |
| Drilling Method: <b>Air Rotary</b>             | Date Completed: <b>1/10/2010</b>                | Sand Pack (m amsl): <b>NA</b>              |

| Depth Scale (ft) (m) | Stratigraphic Description  | Strat. Plot | Depth (m) | Diagram | SAMPLE |      |      | Depth Scale (ft) (m) |
|----------------------|--|-------------|-----------|---------|--------|------|------|----------------------|
|                      |  |             |           |         | Num.   | Type | Int. |                      |
|                      | Surface Elevation (m): <b>313.17</b>   |             |           |         |        |      |      |                      |
| 1.0                  | TOPSOIL - organics, brown fine sand and silt with trace gravel, moist.   |             | 0.87      |         | 51     | GRAB | G    | 1.0                  |
| 5.0                  | SILTY SAND - brown, soft, moist to wet.  |             | 3.28      |         | 52     | GRAB | G    | 2.0                  |
| 10.0                 | SAND - medium-grained sand, reddish brown, saturated.  |             | 3.97      |         | 53     | GRAB | G    | 3.0                  |
| 15.0                 | SILTY SAND - fine-grained reddish brown silty sand till, some stones and gravel (<20 mm diameter), saturated; intermittent hard, grey, silty clay layers 100 to 400 mm in thickness. |             | 8.91      |         | 54     | GRAB | G    | 4.0                  |
| 20.0                 | SILTY CLAY - hard grey silty clay, saturated.  |             | 8.94      |         | 55     | GRAB | G    | 5.0                  |
| 25.0                 | SILTY SAND - fine-grained reddish grey silty sand, trace gravel, dense, saturated; intermittent layers (<600 mm) of soft med. sand, trace fine gravel.                               |             | 15.84     |         | 56     | GRAB | G    | 6.0                  |
| 30.0                 | SANDY SILT - trace clay, grey/brown, dense.  |             | 20.42     |         | 57     | GRAB | G    | 7.0                  |
| 35.0                 | SILTY SAND with trace clay grey/brown.   |             | 20.73     |         | 58     | GRAB | G    | 8.0                  |
| 40.0                 | SANDY SILT - trace clay, grey/brown, dense.  |             | 21.84     |         | 59     | GRAB | G    | 9.0                  |
| 45.0                 | SILTY SAND with trace clay grey/brown.   |             | 22.88     |         | 60     | GRAB | G    | 10.0                 |
| 50.0                 | SANDY SILT - with trace clay, grey brown, dense.   |             | 23.18     |         | 61     | GRAB | G    | 11.0                 |
| 55.0                 | SAND - fine to medium, with trace of gravel, silt and clay, dark grey/brown.   |             |           |         | 62     | GRAB | G    | 12.0                 |
| 60.0                 |  |             |           |         | 63     | GRAB | G    | 13.0                 |
| 65.0                 |  |             |           |         | 64     | GRAB | G    | 14.0                 |
| 70.0                 |  |             |           |         | 65     | GRAB | G    | 15.0                 |
| 75.0                 |  |             |           |         | 66     | GRAB | G    | 16.0                 |
| 80.0                 |  |             |           |         | 67     | GRAB | G    | 17.0                 |
| 85.0                 |  |             |           | 68      | GRAB   | G    | 18.0 |                      |
| 90.0                 |  |             |           | 69      | GRAB   | G    | 19.0 |                      |
| 95.0                 |  |             |           | 70      | GRAB   | G    | 20.0 |                      |
| 100.0                |  |             |           | 71      | GRAB   | G    | 21.0 |                      |
| 105.0                |  |             |           | 72      | GRAB   | G    | 22.0 |                      |
| 110.0                |  |             |           | 73      | GRAB   | G    | 23.0 |                      |
| 115.0                |  |             |           | 74      | GRAB   | G    | 24.0 |                      |
| 120.0                |  |             |           | 75      | GRAB   | G    | 25.0 |                      |

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Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **10/18/2010**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

|                                |                             |                    |            |               |               |             |
|--------------------------------|-----------------------------|--------------------|------------|---------------|---------------|-------------|
| <b>LEGEND</b>                  | <b>MONITORING WELL DATA</b> | <b>SAMPLE TYPE</b> | AC         | Auger Cutting | SS            | Split Spoon |
| Water found @ time of drilling | Pipe: 20.3 cm dia. steel    | CS                 | Continuous | AR            | Air Rotary    |             |
| Static Water Level - 1/11/2010 | Screen: 20.3 cm open hole   | RC                 | Rock Core  | WC            | Wash Cuttings |             |

# LOG OF DRILLING OPERATIONS



R. J. Burnside & Associates (1998)  
15 Leavelle, Oshroffville, Ontario L0N 1J6  
Telephone (519) 941-3371 Fax (519) 941-8120

**P10-TW2-09**

Page 2 of 6

|  |   |  |
|--|---|--|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>P10 Test Well Construction</b> | Logged by: <b>S. Quinlan</b>               |
| Project No.: <b>MTA17230</b>                   | Location: <b>Pinebush Rd. Cambridge</b>         | Ground (m amsl): <b>313.17</b>             |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>12/21/2009</b>                 | Static Water Level (m amsl): <b>304.33</b> |
| Drilling Method: <b>Air Rotary</b>             | Date Completed: <b>1/10/2010</b>                | Sand Pack (m amsl): <b>NA</b>              |

| Depth Scale (ft) (m) | Stratigraphic Description  | Strat. Plot | Depth (m) | SAMPLE |      |      | Depth Scale (ft) (m) |
|----------------------|--|-------------|-----------|--------|------|------|----------------------|
|                      |  |             |           | Num.   | Type | Int. |                      |
|                      | Surface Elevation (m): <b>313.17</b>   |             |           |        |      |      |                      |
| 27.0                 | GRAVEL - with sand medium to coarse, grey/brown.<br>SAND - fine to medium, trace gravel, silt and clay, dark grey/brown. |             | 26.21     | 618    | GRAB | G    | 27.0                 |
| 28.0                 |  |             | 26.82     | 619    | GRAB | G    | 28.0                 |
| 30.0                 | DOLOSTONE - brown, very porous   |             | 28.67     | 620    | GRAB | G    | 28.0                 |
| 31.0                 |  |             | 28.67     | 621    | GRAB | G    | 31.0                 |
| 32.0                 |  |             | 28.67     | 622    | GRAB | G    | 32.0                 |
| 33.0                 |  |             | 28.67     | 623    | GRAB | G    | 34.0                 |
| 35.0                 |  |             | 28.67     | 624    | GRAB | G    | 35.0                 |
| 36.0                 |  |             | 28.67     | 625    | GRAB | G    | 36.0                 |
| 38.0                 | DOLOSTONE - grey brown, very porous, large voids.  |             | 38.92     | 626    | GRAB | G    | 38.0                 |
| 40.0                 |  |             | 38.92     | 627    | GRAB | G    | 40.0                 |
| 41.0                 |  |             | 38.92     | 628    | GRAB | G    | 42.0                 |
| 42.0                 |  |             | 38.92     | 629    | GRAB | G    | 43.0                 |
| 44.0                 | DOLOSTONE - tan, very porous, large voids. Large voids at 45.42 m and 49.68 m  |             | 44.30     | 630    | GRAB | G    | 44.0                 |
| 46.0                 |  |             | 44.30     | 631    | GRAB | G    | 46.0                 |
| 47.0                 |  |             | 44.30     | 632    | GRAB | G    | 47.0                 |
| 48.0                 |  |             | 44.30     | 633    | GRAB | G    | 48.0                 |
| 49.0                 |  |             | 44.30     | 634    | GRAB | G    | 50.0                 |
| 51.0                 |  |             | 44.30     | 635    | GRAB | G    | 51.0                 |
| 51.0                 | DOLOSTONE - grey, becoming less porous at 52.73 m, mottled. Large voids at 50.90 m, 51.51 m and 53.64 m                  |             | 50.90     |        |      |      | 51.0                 |

Prepared By: **S. Quinlan**      Checked By: **J. Baxter**      Date Prepared: **10/18/2010**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

|                                |                             |                    |               |
|--------------------------------|-----------------------------|--------------------|---------------|
| <b>LEGEND</b>                  | <b>MONITORING WELL DATA</b> | <b>SAMPLE TYPE</b> |               |
| Water found @ time of drilling | Pipe: 20.3 cm dia. steel    | AC                 | Auger Cutting |
| Static Water Level - 1/11/2010 | Screen: 20.3 cm open hole   | CS                 | Continuous    |
|                                |                             | RC                 | Rock Core     |
|                                |                             | SS                 | Split Spoon   |
|                                |                             | AR                 | Air Rotary    |
|                                |                             | WC                 | Wash Cuttings |

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# LOG OF DRILLING OPERATIONS



R. J. Burnside & Associates Limited  
15 Tavistock, Cambridge, Ontario N2H 1K5  
Telephone 613 231 1323 Fax 613 231 4120

**P10-TW2-09**

Page 3 of 6

|  |   |  |
|--|---|--|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>P10 Test Well Construction</b> | Logged by: <b>S. Quinlan</b>               |
| Project No.: <b>MTA17230</b>                   | Location: <b>Pinebush Rd. Cambridge</b>         | Ground (m amsl): <b>313.17</b>             |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>12/21/2009</b>                 | Static Water Level (m amsl): <b>304.33</b> |
| Drilling Method: <b>Air Rotary</b>             | Date Completed: <b>1/10/2010</b>                | Sand Pack (m amsl): <b>NA</b>              |

| Depth Scale<br>(ft) (m) | Stratigraphic Description  | Strat. Plot | Depth (m) | SAMPLE |      |       | Depth Scale<br>(ft) (m) |
|-------------------------|--|-------------|-----------|--------|------|-------|-------------------------|
|                         |  |             |           | Num.   | Type | Int.  |                         |
|                         | Surface Elevation (m): <b>313.17</b>   |             |           |        |      |       |                         |
| 178.0 - 53.0            | DOLOSTONE - grey, very porous, mottled. Large voids at 55.78 m, 56.69 m, 59.44 m, 61.57m, 64.00 m 65.22 m and 67.06 m. |             | 55.77     | 335    | GRAB | G     | 53.0                    |
| 180.0 - 54.0            |  |             | 56.69     | 336    | GRAB | G     | 54.0                    |
| 182.0 - 55.0            |  |             | 59.44     | 337    | GRAB | G     | 55.0                    |
| 184.0 - 56.0            |  |             | 61.57     | 338    | GRAB | G     | 56.0                    |
| 186.0 - 57.0            |  |             | 64.00     | 339    | GRAB | G     | 57.0                    |
| 188.0 - 58.0            |  |             | 65.22     | 340    | GRAB | G     | 58.0                    |
| 190.0 - 59.0            |  |             |           | 341    | GRAB | G     | 59.0                    |
| 192.0 - 60.0            |  |             |           | 342    | GRAB | G     | 60.0                    |
| 194.0 - 61.0            |  |             |           | 343    | GRAB | G     | 61.0                    |
| 196.0 - 62.0            |  |             |           | 344    | GRAB | G     | 62.0                    |
| 200.0 - 67.0            | DOLOSTONE - grey, becoming less porous, mottled. Open cavern at 73.46 m to 74.98 m.                                    |             | 73.46     | 345    | GRAB | G     | 67.0                    |
| 202.0 - 68.0            |  |             | 74.98     | 346    | GRAB | G     | 68.0                    |
| 204.0 - 69.0            |  |             |           | 347    | GRAB | G     | 69.0                    |
| 206.0 - 70.0            |  |             |           | 348    | GRAB | G     | 70.0                    |
| 208.0 - 71.0            |  |             |           | 349    | GRAB | G     | 71.0                    |
| 210.0 - 72.0            |  |             |           | 350    | GRAB | G     | 72.0                    |
| 212.0 - 73.0            |  |             |           | 351    | GRAB | G     | 73.0                    |
| 214.0 - 74.0            |  |             |           | 352    | GRAB | G     | 74.0                    |
| 216.0 - 75.0            |  |             |           | 353    | GRAB | G     | 75.0                    |
| 218.0 - 76.0            |  |             |           | 354    | GRAB | G     | 76.0                    |
| 220.0 - 77.0            | DOLOSTONE - tan, moderately porous. Horizontal fracture at 79.25 m.  |             | 79.25     | 355    | GRAB | G     | 77.0                    |
| 222.0 - 78.0            |  |             |           | 356    | GRAB | G     | 78.0                    |
| 224.0 - 79.0            |  |             |           |        |      | 79.0  |                         |
| 226.0 - 80.0            |  |             |           |        |      | 80.0  |                         |
| 228.0 - 81.0            |  |             |           |        |      | 81.0  |                         |
| 230.0 - 82.0            |  |             |           |        |      | 82.0  |                         |
| 232.0 - 83.0            |  |             |           |        |      | 83.0  |                         |
| 234.0 - 84.0            |  |             |           |        |      | 84.0  |                         |
| 236.0 - 85.0            |  |             |           |        |      | 85.0  |                         |
| 238.0 - 86.0            |  |             |           |        |      | 86.0  |                         |
| 240.0 - 87.0            |  |             |           |        |      | 87.0  |                         |
| 242.0 - 88.0            |  |             |           |        |      | 88.0  |                         |
| 244.0 - 89.0            |  |             |           |        |      | 89.0  |                         |
| 246.0 - 90.0            |  |             |           |        |      | 90.0  |                         |
| 248.0 - 91.0            |  |             |           |        |      | 91.0  |                         |
| 250.0 - 92.0            |  |             |           |        |      | 92.0  |                         |
| 252.0 - 93.0            |  |             |           |        |      | 93.0  |                         |
| 254.0 - 94.0            |  |             |           |        |      | 94.0  |                         |
| 256.0 - 95.0            |  |             |           |        |      | 95.0  |                         |
| 258.0 - 96.0            |  |             |           |        |      | 96.0  |                         |
| 260.0 - 97.0            |  |             |           |        |      | 97.0  |                         |
| 262.0 - 98.0            |  |             |           |        |      | 98.0  |                         |
| 264.0 - 99.0            |  |             |           |        |      | 99.0  |                         |
| 266.0 - 100.0           |  |             |           |        |      | 100.0 |                         |

Prepared By: **S. Quinlan**      Checked By: **J. Baxter**      Date Prepared: **10/18/2010**

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|   |  |  |
|---|--|--|
| <b>LEGEND</b><br>Water found @ time of drilling<br>Static Water Level - 1/11/2010 | <b>MONITORING WELL DATA</b><br>Pipe: 20.3 cm dia. steel<br>Screen: 20.3 cm open hole | <b>SAMPLE TYPE</b><br>AC  Auger Cutting      SS  Split Spoon<br>CS  Continuous      AR  Air Rotary<br>RC  Rock Core      WC  Wash Cuttings |
|---|--|--|

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# LOG OF DRILLING OPERATIONS



R.J. Burnside & Associates Limited  
15 Lawrence, Scarborough, Ontario M1B 2K4  
Telephone 416 941-1329 Fax 416 941-2130

**P10-TW2-09**

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|  |   |  |
|--|---|--|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>P10 Test Well Construction</b> | Logged by: <b>S. Quinlan</b>               |
| Project No.: <b>MTA17230</b>                   | Location: <b>Pinebush Rd. Cambridge</b>         | Ground (m amsl): <b>313.17</b>             |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>12/21/2009</b>                 | Static Water Level (m amsl): <b>304.33</b> |
| Drilling Method: <b>Air Rotary</b>             | Date Completed: <b>1/10/2010</b>                | Sand Pack (m amsl): <b>NA</b>              |

| Depth Scale<br>(ft) (m) | Stratigraphic Description  | Strat. Plot | Depth (m) | SAMPLE |      |      | Depth Scale<br>(ft) (m) |
|-------------------------|--|-------------|-----------|--------|------|------|-------------------------|
|                         |  |             |           | Num.   | Type | Int. |                         |
|                         | Surface Elevation (m): <b>313.17</b>   |             |           |        |      |      |                         |
| 79.0                    | DOLOSTONE - grey, moderately porous, large void at 81.08 m becoming mottled                            |             | 79.35     | 882    | GRAB | G    | 79.0                    |
| 80.0                    |  |             | 80.0      | 883    | GRAB | G    | 80.0                    |
| 81.0                    |  |             | 81.0      | 884    | GRAB | G    | 81.0                    |
| 82.0                    | DOLOSTONE - tan, horizontal fractures, moderately porous, richly fossiliferous. Large void at 89.61 m. |             | 82.80     | 885    | GRAB | G    | 82.0                    |
| 83.0                    |  |             | 83.0      | 886    | GRAB | G    | 83.0                    |
| 84.0                    |  |             | 84.0      | 887    | GRAB | G    | 84.0                    |
| 85.0                    | DOLOSTONE -grey, moderately porous, richly fossiliferous   |             | 87.36     | 888    | GRAB | G    | 85.0                    |
| 86.0                    |  |             | 86.0      | 889    | GRAB | G    | 86.0                    |
| 87.0                    |  |             | 87.0      | 890    | GRAB | G    | 87.0                    |
| 88.0                    | DOLOSTONE - tan, moderately porous, richly fossiliferous.  |             | 88.00     | 891    | GRAB | G    | 88.0                    |
| 89.0                    |  |             | 89.0      | 892    | GRAB | G    | 89.0                    |
| 90.0                    |  |             | 90.0      | 893    | GRAB | G    | 90.0                    |
| 91.0                    | DOLOSTONE - grey, slightly to moderately porous, mottled, richly fossiliferous                         |             | 96.32     | 894    | GRAB | G    | 91.0                    |
| 92.0                    |  |             | 92.0      | 895    | GRAB | G    | 92.0                    |
| 93.0                    |  |             | 93.0      | 896    | GRAB | G    | 93.0                    |
| 94.0                    |  |             |           | 897    | GRAB | G    | 94.0                    |
| 95.0                    |  |             |           | 898    | GRAB | G    | 95.0                    |
| 96.0                    |  |             |           | 899    | GRAB | G    | 96.0                    |
| 97.0                    |  |             |           | 900    | GRAB | G    | 97.0                    |
| 98.0                    |  |             |           | 901    | GRAB | G    | 98.0                    |
| 99.0                    |  |             |           | 902    | GRAB | G    | 99.0                    |
| 100.0                   |  |             |           | 903    | GRAB | G    | 100.0                   |
| 101.0                   |  |             |           | 904    | GRAB | G    | 101.0                   |
| 102.0                   |  |             |           | 905    | GRAB | G    | 102.0                   |
| 103.0                   |  |             |           | 906    | GRAB | G    | 103.0                   |
| 104.0                   |  |             |           | 907    | GRAB | G    | 104.0                   |
| 105.0                   |  |             |           | 908    | GRAB | G    | 105.0                   |

open hole bedrock

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Prepared By: **S. Quinlan**      Checked By: **J. Baxter**      Date Prepared: **10/18/2010**

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|                                |                             |                    |               |
|--------------------------------|-----------------------------|--------------------|---------------|
| <b>LEGEND</b>                  | <b>MONITORING WELL DATA</b> | <b>SAMPLE TYPE</b> |               |
| Water found @ time of drilling | Pipe: 20.3 cm dia. steel    | AC                 | Auger Cutting |
| Static Water Level - 1/11/2010 | Screen: 20.3 cm open hole   | CS                 | Continuous    |
|                                |                             | RC                 | Rock Core     |
|                                |                             | SS                 | Split Spoon   |
|                                |                             | AR                 | Air Rotary    |
|                                |                             | WC                 | Wash Cuttings |

# LOG OF DRILLING OPERATIONS

**P10-TW2-09**

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R. J. Burnside & Associates Limited  
151 Avenue, Burlington, Ontario L7R 3A5  
Telephone 905-335-1122 Fax 905-331-8120

|  |   |  |
|--|---|--|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>P10 Test Well Construction</b> | Logged by: <b>S. Quinlan</b>               |
| Project No.: <b>MTA17230</b>                   | Location: <b>Pinebush Rd. Cambridge</b>         | Ground (m amsl): <b>313.17</b>             |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>12/21/2009</b>                 | Static Water Level (m amsl): <b>304.33</b> |
| Drilling Method: <b>Air Rotary</b>             | Date Completed: <b>1/10/2010</b>                | Sand Pack (m amsl): <b>NA</b>              |

| Depth Scale<br>(ft) (m) | Stratigraphic Description   | Strat. Pict | Depth (m) | SAMPLE |      |      | Depth Scale<br>(ft) (m) |               |
|-------------------------|---|-------------|-----------|--------|------|------|-------------------------|---------------|
|                         |   |             |           | Num.   | Type | Int. |                         |               |
|                         | Surface Elevation (m): <b>313.17</b>  |             |           |        |      |      |                         |               |
| 345.0 - 105.0           | DOLOSTONE - tan, moderately porous becoming very porous starting at 105.77 m, mottled, vugs and slightly fossiliferous. Large void at 106.07 m. |             |           | 345.0  | 568  | GRAB | G                       | 345.0 - 105.0 |
| 350.0 - 106.0           |   |             |           | 350.0  | 570  | GRAB | G                       | 350.0 - 106.0 |
| 355.0 - 107.0           |   |             |           | 355.0  | 571  | GRAB | G                       | 355.0 - 107.0 |
| 360.0 - 108.0           |   |             |           | 360.0  | 572  | GRAB | G                       | 360.0 - 108.0 |
| 365.0 - 109.0           |   |             |           | 365.0  | 573  | GRAB | G                       | 365.0 - 109.0 |
| 370.0 - 110.0           | DOLOSTONE - grey, moderately porous, slightly fossiliferous   |             |           | 370.0  | 574  | GRAB | G                       | 370.0 - 110.0 |
| 375.0 - 111.0           | DOLOSTONE - tan, moderately porous, slightly fossiliferous.   |             |           | 375.0  | 575  | GRAB | G                       | 375.0 - 111.0 |
| 380.0 - 112.0           | DOLOSTONE - grey, slightly porous, mottled, slightly fossiliferous. Horizontal fracture at 117.35 m   |             |           | 380.0  | 576  | GRAB | G                       | 380.0 - 112.0 |
| 385.0 - 113.0           | DOLOSTONE - dark grey and white, mottled, slightly porous.  |             |           | 385.0  | 577  | GRAB | G                       | 385.0 - 113.0 |
| 390.0 - 114.0           |   |             |           | 390.0  | 578  | GRAB | G                       | 390.0 - 114.0 |
| 395.0 - 115.0           |   |             |           | 395.0  | 579  | GRAB | G                       | 395.0 - 115.0 |
| 400.0 - 116.0           |   |             |           | 400.0  | 580  | GRAB | G                       | 400.0 - 116.0 |
| 405.0 - 117.0           |   |             |           | 405.0  | 581  | GRAB | G                       | 405.0 - 117.0 |
| 410.0 - 118.0           |   |             |           | 410.0  | 582  | GRAB | G                       | 410.0 - 118.0 |
| 415.0 - 119.0           |   |             |           | 415.0  | 583  | GRAB | G                       | 415.0 - 119.0 |
| 420.0 - 120.0           |   |             |           | 420.0  | 584  | GRAB | G                       | 420.0 - 120.0 |
| 425.0 - 121.0           |   |             |           | 425.0  | 585  | GRAB | G                       | 425.0 - 121.0 |
| 430.0 - 122.0           |   |             |           | 430.0  |      |      |                         | 430.0 - 122.0 |
| 435.0 - 123.0           |   |             |           | 435.0  |      |      |                         | 435.0 - 123.0 |
| 440.0 - 124.0           |   |             |           | 440.0  |      |      |                         | 440.0 - 124.0 |
| 445.0 - 125.0           |   |             |           | 445.0  |      |      |                         | 445.0 - 125.0 |
| 450.0 - 126.0           |   |             |           | 450.0  |      |      |                         | 450.0 - 126.0 |
| 455.0 - 127.0           |   |             |           | 455.0  |      |      |                         | 455.0 - 127.0 |
| 460.0 - 128.0           |   |             |           | 460.0  |      |      |                         | 460.0 - 128.0 |
| 465.0 - 129.0           |   |             |           | 465.0  |      |      |                         | 465.0 - 129.0 |

open hole bedrock

Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **10/18/2010**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

|   |  |   |  |
|---|--|---|--|
| <b>LEGEND</b><br>Water found @ time of drilling<br>Static Water Level - 1/11/2010 | <b>MONITORING WELL DATA</b><br>Pipe: 20.3 cm dia. steel<br>Screen: 20.3 cm open hole | <b>SAMPLE TYPE</b> AC  Auger Cutting<br>CS  Continuous<br>RC  Rock Core | SS  Split Spoon<br>AR  Air Rotary<br>WC  Wash Cuttings |
|---|--|---|--|

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# LOG OF DRILLING OPERATIONS



R.J. Burnside & Associates Limited  
14 Sandown Court, Guelph, Ontario N1H 1S4  
Telephone 519-837-1332 Fax 519-837-4170

**P10-TW2-09**

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|  |   |  |
|--|---|--|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>P10 Test Well Construction</b> | Logged by: <b>S. Quinlan</b>               |
| Project No.: <b>MTA17230</b>                   | Location: <b>Pinebush Rd. Cambridge</b>         | Ground (m amsl): <b>313.17</b>             |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>12/21/2009</b>                 | Static Water Level (m amsl): <b>304.33</b> |
| Drilling Method: <b>Air Rotary</b>             | Date Completed: <b>1/10/2010</b>                | Sand Pack (m amsl): <b>NA</b>              |

| Depth Scale<br>(ft) (m)        | Stratigraphic Description                        | Strat. Plot | Depth (m) | Diagram                  | SAMPLE |      |      | Depth Scale<br>(ft) (m) |
|--------------------------------|--|-------------|-----------|--------------------------|--------|------|------|-------------------------|
|                                |  |             |           |                          | Num.   | Type | Int. |                         |
|                                | Surface Elevation (m): <b>313.17</b>             |             |           |                          |        |      |      |                         |
| 430.0 — 131.0<br>435.0 — 132.0 | <b>DOLOSTONE - tan, mottled, slightly porous</b> |             | 132.15    |                          | 586    | GRAB |      | 430.0 — 131.0           |
|                                |  |             |           | <b>open hole bedrock</b> | 587    | GRAB |      | 435.0 — 132.0           |

Prepared By: **S. Quinlan**      Checked By: **J. Baxter**      Date Prepared: **10/18/2010**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

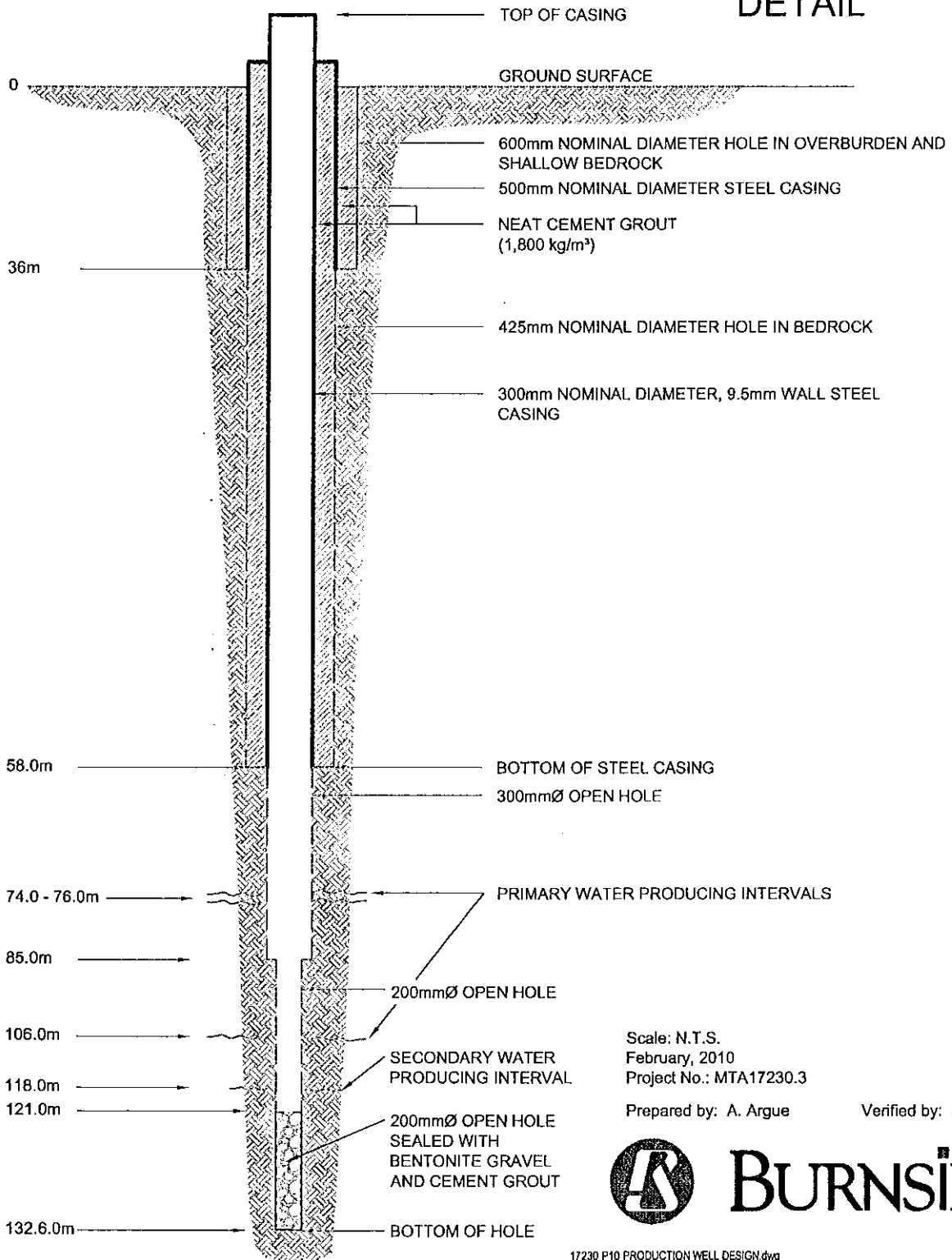
|  |   |  |
|--|---|--|
| <b>LEGEND</b>  | <b>MONITORING WELL DATA</b>   | <b>SAMPLE TYPE</b>   |
| ▽ Water found @ time of drilling<br>▽ Static Water Level - 1/11/2010 | Pipe: <b>20.3 cm dia. steel</b><br>Screen: <b>20.3 cm open hole</b> | AC  Auger Cutting      SS  Split Spoon<br>CS  Continuous      AR  Air Rotary<br>RC  Rock Core      WC  Wash Cuttings |

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# FIGURE 7 REGION OF WATERLOO CITY OF CAMBRIDGE WELL P10A CONSTRUCTION AND TESTING

## PRODUCTION WELL DETAIL

DEPTH (Metres  
Below Ground Surface)



Scale: N.T.S.  
February, 2010  
Project No.: MTA17230.3

Prepared by: A. Argue

Verified by: J. Baxter



# BURNSIDE

# Test Well: C-PB-TW3-11

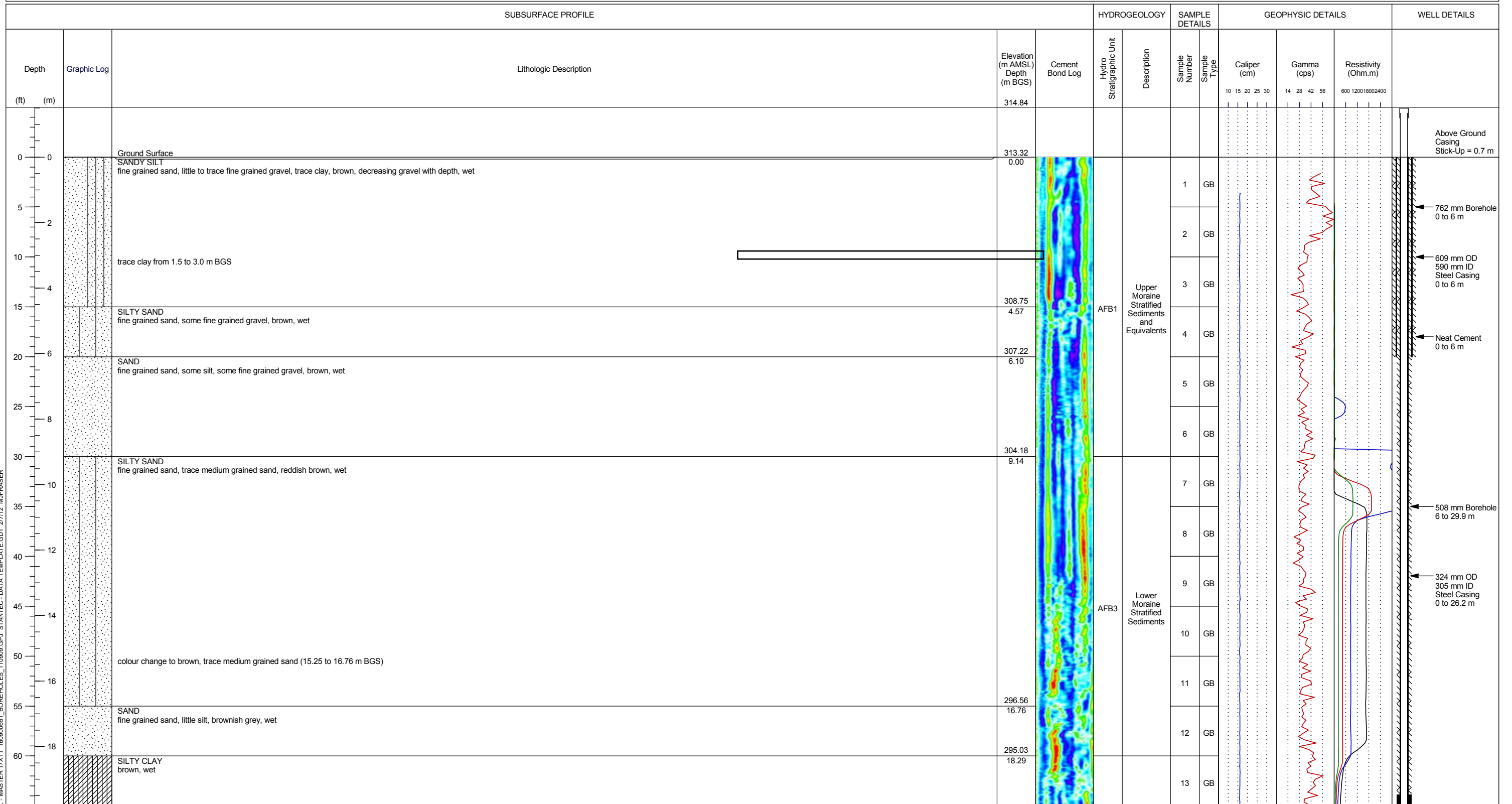
P10B

**Project:** Well Construction/Replacement  
**Client:** Region of Waterloo  
**Location:** Cambridge, ON  
**Number:** 160900651

**Field Investigator:** J. Koch  
**Contractor:** Gerrits Well Drilling  
**Drilling method:** Truck mount, DR24, air rotary  
**Date started/completed:** 08-Mar-2011 / 25-May-2011

**Ground surface elevation:** 313.32 m AMSL  
**Top of casing elevation:** 314.02 m AMSL  
**Easting:** 556943  
**Northing:** 4806851

## SUBSURFACE PROFILE



Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 GB - grab sample

m AMSL - metres above mean sea level  
 m BGS - metres below ground surface

GS - grain size analyzed grab sample  
 GB - grab sample

Geophysics completed on March 16, 2011  
 Two (2) gravel tubes installed to 23.8 m BGS

n/a - not available/applicable

Drawn By/Checked By: EH / LV



# Test Well: C-PB-TW3-11

Project: Well Construction/Replacement  
 Client: Region of Waterloo  
 Location: Cambridge, ON  
 Number: 160900651

Field Investigator: J. Koch  
 Contractor: Gerrits Well Drilling  
 Drilling method: Truck mount, DR24, air rotary  
 Date started/completed: 08-Mar-2011 / 25-May-2011

Ground surface elevation: 313.32 m AMSL  
 Top of casing elevation: 314.02 m AMSL  
 Easting: 556943  
 Northing: 4806851

| SUBSURFACE PROFILE   |             |  |   |                    |                                | HYDROGEOLOGY                        |                  | SAMPLE DETAILS |                     | GEOPHYSIC DETAILS                                   |                            |  | WELL DETAILS            |
|----------------------|-------------|--|---|--------------------|--------------------------------|-------------------------------------|------------------|----------------|---------------------|---|----------------------------|--|-------------------------|
| Depth<br>(ft)<br>(m) | Graphic Log | Lithologic Description   | Elevation<br>(m AMSL)<br>Depth<br>(m BGS) | Cement<br>Bond Log | Hydro<br>Stratigraphic Unit    | Description                         | Sample<br>Number | Sample<br>Type | Geophysical Details |   |                            | Well Details   |                         |
|                      |             |  |   |                    |                                |                                     |                  |                | Caliper<br>(cm)     | Gamma<br>(cps)                                      | Resistivity<br>(Ohm.m)     |  |                         |
| 20                   |             | SILTY CLAY<br>brown, wet   |   |                    | ATC1                           | Upper/Main<br>Catfish<br>Creek Till | 14               | GB             |                     |   |                            | Bentonite Chips<br>19.5 to 22.5 m  |                         |
| 70                   |             | CLAYEY GRAVEL<br>fine grained gravel, little fine grained sand, little silt, grey, wet                                     | 291.98<br>21.34                           |                    |                                |                                     | 15               | GB             |                     |   |                            |  | Top of Gravel<br>22.5 m |
| 75                   |             | GRAVELLY SAND<br>fine grained sand, little medium grained sand, trace coarse grained sand, fine grained gravel, brown, wet | 290.46<br>22.86                           |                    | AFD1                           | Pre-Catfish<br>Sand and<br>Gravel   | 16               | GB             |                     |   |                            | Top of Lead Pipe<br>25.3 m<br>K-Packer<br>Base of Casing<br>26.2 m<br>Top of Screen<br>26.5 m<br>483 mm Borehole<br>29.9 to 33.5 m |                         |
| 80                   |             | SAND<br>fine to medium grained sand, trace coarse grained sand, trace silt, trace fine grained gravel, brown, wet          | 288.94<br>24.38                           |                    |                                |                                     | 17               | GB             |                     |   |                            |  |                         |
| 85                   |             | GRAVELLY SAND<br>fine grained gravel, fine to medium grained sand, little coarse grained sand, brown, wet                  | 287.41<br>25.91                           |                    |                                |                                     | 18               | GS             |                     |   |                            |  |                         |
| 90                   |             | trace silt at 29.0 m BGS   |   |                    | 19                             | GS                                  |                  |                |                     | 286 mm diameter<br>No. 40 Slot<br>Telescopic Screen |                            |  |                         |
| 95                   |             | DOLOSTONE<br>upper 1 m of bedrock highly fractured<br>fracture producing water at 31.2 m BGS                               | 283.75<br>29.57                           |                    | 20                             | GB                                  |                  |                |                     |   |                            |  |                         |
| 100                  |             |  |   |                    |                                |                                     |                  |                |                     | Gravel Pack<br>#2 Morie<br>22.5 to 33.5 m           |                            |  |                         |
| 105                  |             |  |   |                    | Bedrock<br>Guelph<br>Formation |                                     |                  |                |                     |   | Bottom of Screen<br>33.5 m |  |                         |
| 110                  |             |  |   |                    |                                |                                     |                  |                |                     |   |                            | 152 mm Borehole<br>Natural Cave<br>33.5 to 35.1 m  |                         |
| 115                  |             | End of Borehole  | 278.27<br>35.05                           |                    |                                |                                     |                  |                |                     |   |                            |  |                         |

Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 GB - grab sample

n/a - not available/applicable

m AMSL - metres above mean sea level  
 m BGS - metres below ground surface

GS - grain size analyzed grab sample

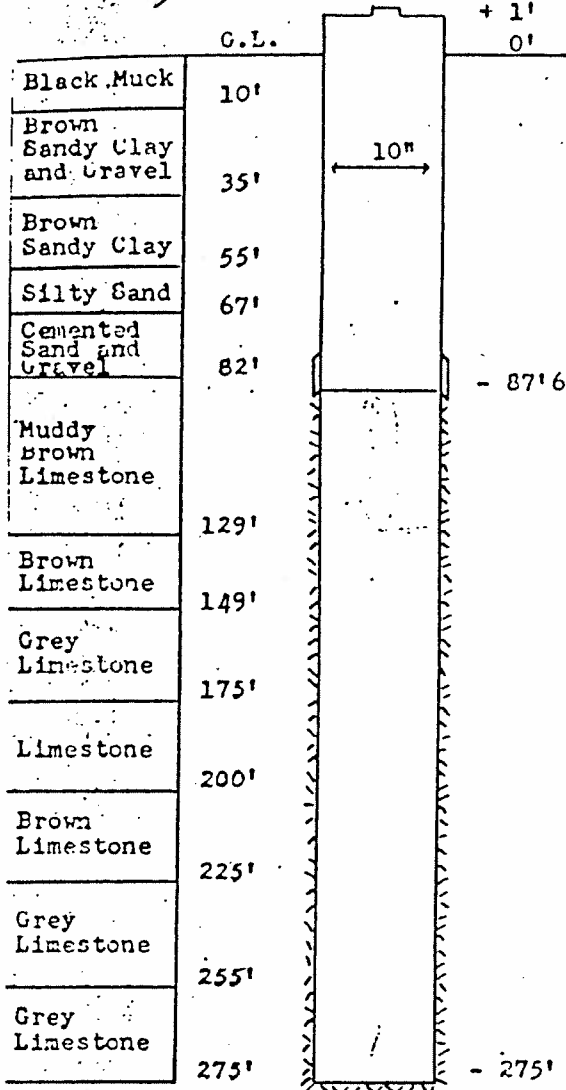
Geophysics completed on March 16, 2011  
 Two (2) gravel tubes installed to 23.8 m BGS

Drawn By/Checked By: EH / LV



STANTEC BOREHOLE AND WELL - MASTER TX11 - 160900651\_BOREHOLES\_110909.GPJ - STANTEC - DATA TEMPLATE.GDT 2/7/12 M.FRASER

*H417*



Well Material  
 Outer Casing 88' 6" of 10" drive pipe  
 Inner Casing 63'  
 Screen  
 Plug  
 Gravel

Pump  
 No. Setting BP-MB  
 No. Stages Length Bowl  
 Bowl Size & Lgth. Suction  
 Head Size Column  
 Materials or setting details other than standard  
 Impellers: Trim

Motor  
 Make Phase  
 H. P. Cycles  
 R. P. M. Volts  
 Type Amps.  
 Frame Serial  
 Bearing Nos.

Special Equipment

*P11*  
 Well No. 2-58

B. P. referred to original ground level  
 Clear depth below B. P.  
 Started 9/30/58 Final Test  
 Preliminary Test 10/27/58 Static Level 2' 11"  
 Final Test Pumping Level 27' 4"  
 Guarantee 1 GPM Capacity 400 1 G P.V.  
 Contract Pressure Pressure Pump  
 Length Air Line Main

**INTERNATIONAL WATER SUPPLY LTD.**  
 MONTREAL LONDON, CANADA SASKATOON  
 OAKVILLE WATER SUPPLY CONTRACTORS VANCOUVER

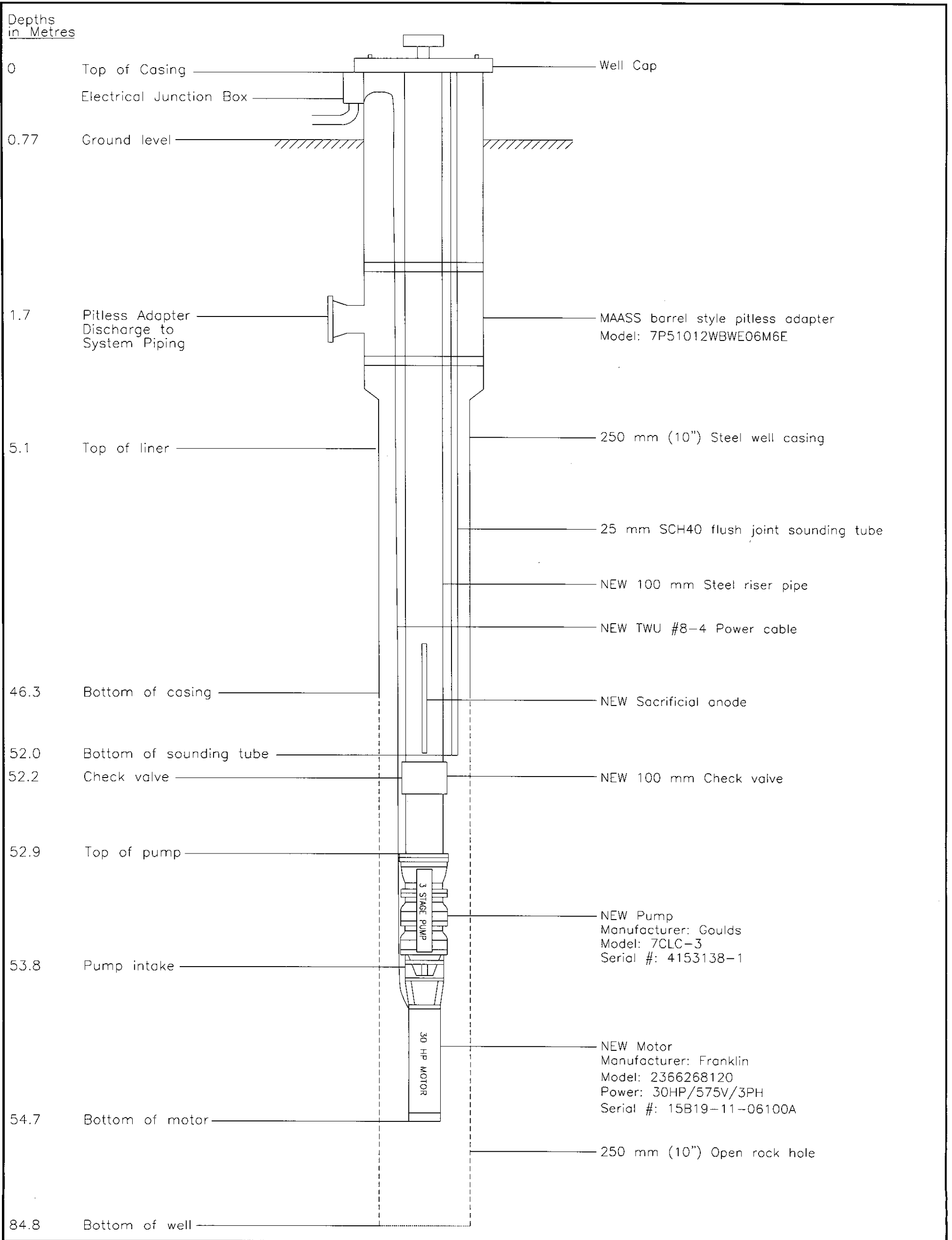
*With Well*

PRESTON, ONTARIO

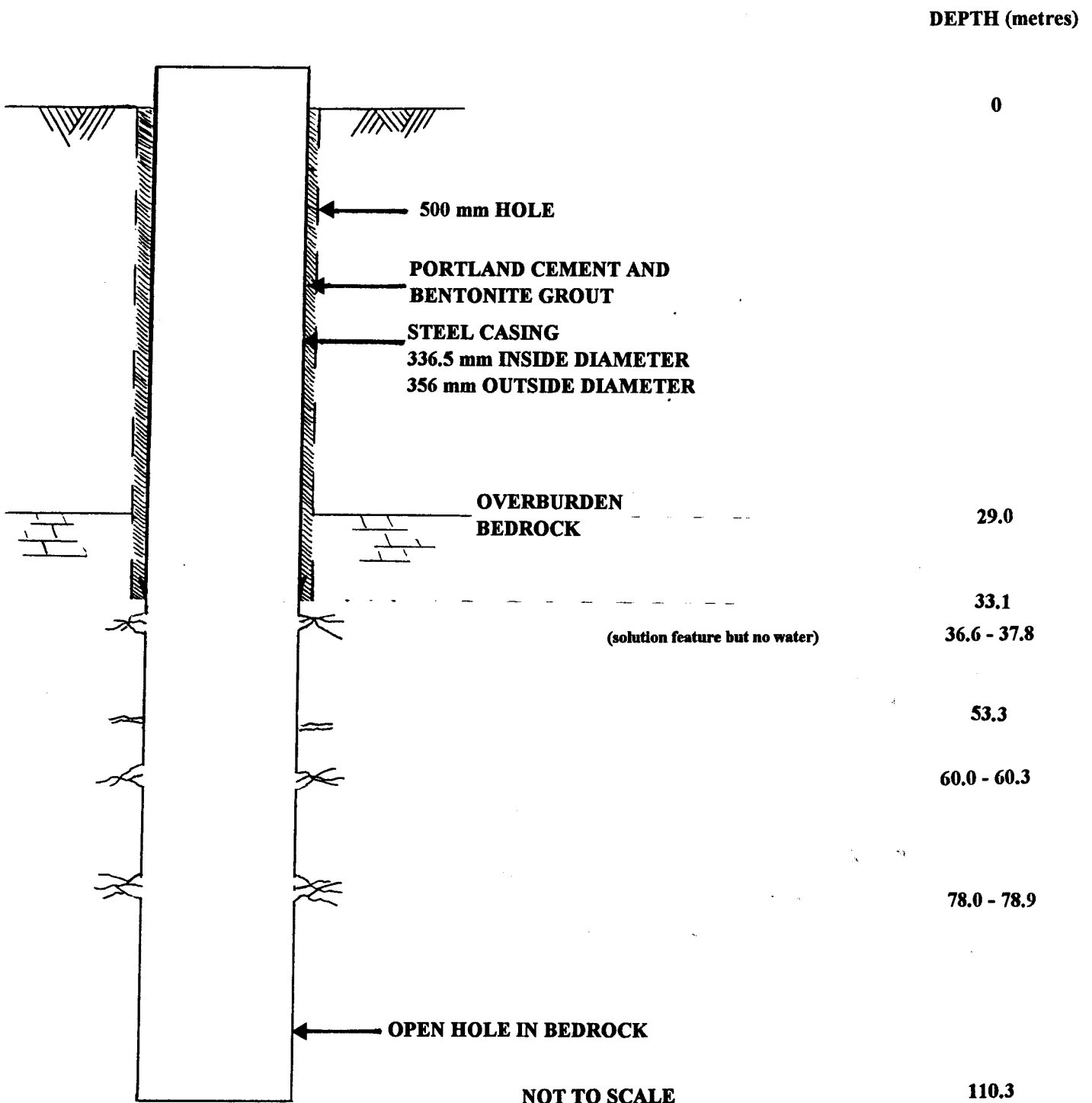
DRILLED BY D. Guerin DRAWN BY J.W.  
 INSTALLED BY APPROVED BY *[Signature]*

# LOTOWATER LTD



CAMBRIDGE WELL P11  
 "AS-CONSTRUCTED"



|   |               |   |   |             |
|---|---------------|---|---|-------------|
| <b>NOTES</b><br>(1) All measurements below top of casing which is 0.81 m above ground.<br>(2) All existing components unless specified NEW. |               |   | CLIENT<br>Regional Municipality of Waterloo |             |
|   |               |   | TITLE<br>Well P11 Pump Upgrade              |             |
| PROJECT No. 006-381   |               | G:\Lotowater Projects\006 Region of Waterloo\381 P11&17 Service\P11 Pump Installation Drawing.dwg |   |             |
| DESIGN  |               | REVISION No. 2017-02-15   | SCALE N.T.S.                                | FIGURE<br>4 |
| DRAWN   | EH 2014/10/17 |   |   |             |
| CHECKED   |               |   |   |             |



**EXPLANATION**

-  SOLUTION FEATURE
-  MAJOR SOLUTION FEATURE

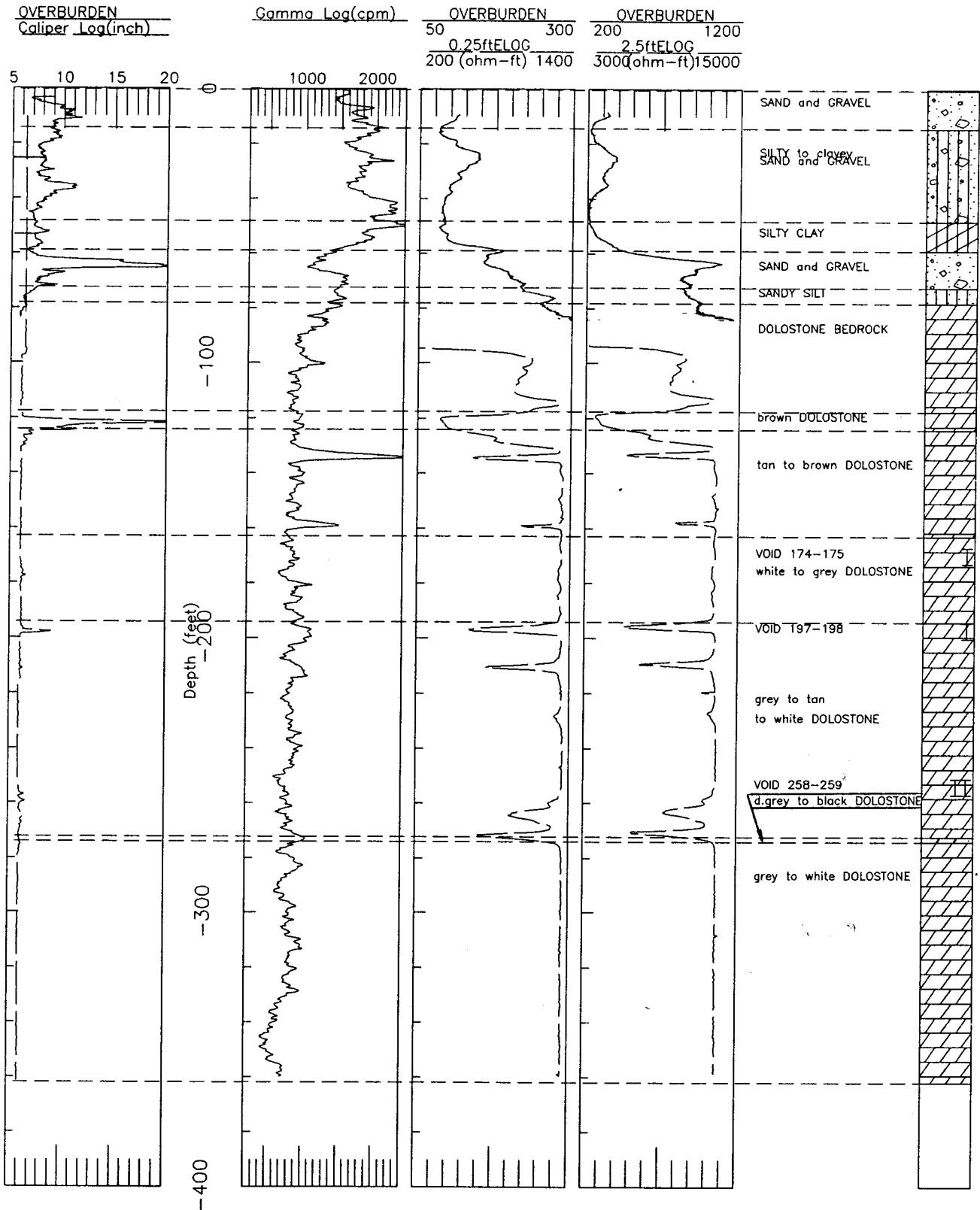
# LOTOWATER LTD.

THE REGIONAL MUNICIPALITY OF WATERLOO  
P17 CONSTRUCTION DETAILS

Project: 011-016

May 1994

FIGURE 4



# LOTOWATER LTD.

THE REGIONAL MUNICIPALITY OF WATERLOO  
GEOPHYSICAL AND LITHOLOGIC LOGS OF  
THE P17 PILOT HOLE

Well Name: p11 twin  
File Name: P17ROCK  
Location: cambridge  
Elevation: 0 Reference: Surface

Project: 011-016

May 1994

FIGURE 3



Ministry of the Environment

Well A 079177

Well Record Regulation 903 Ontario Water Resources Act

Page 1 of 1

Measurements recorded in: Metric Imperial

Well Owner's Information

Region of Waterloo, 150 Frederick St, N2A4T3, 519 575 4524

Well Location

Thompson Ar., 519 575 4524

Overburden and Bedrock Materials/Abandonment Sealing Record

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From, To. Handwritten entry: Well Record Documents Installation of a line in Municipal Well known as P17 with a 10" line. Remainder of well 1205" open hole to 363' bgl.

Annular Space table with columns: Depth Set at (m/ft) From, To, Type of Sealant Used, Volume Placed (m³/ft³). Handwritten entries for depths 0-11, 11-33.5, 33.5-44.5, 44.5-48.7.

Method of Construction and Well Use checkboxes. Includes options like Cable Tool, Rotary, Boring, etc.

Construction Record - Casing table with columns: Inside Diameter, Open Hole OR Material, Wall Thickness, Depth, Status of Well. Handwritten entries for 33.65 and 35.4 diameters.

Construction Record - Screen table with columns: Outside Diameter, Material, Slot No., Depth. Includes checkboxes for Water Supply, Test Hole, etc.

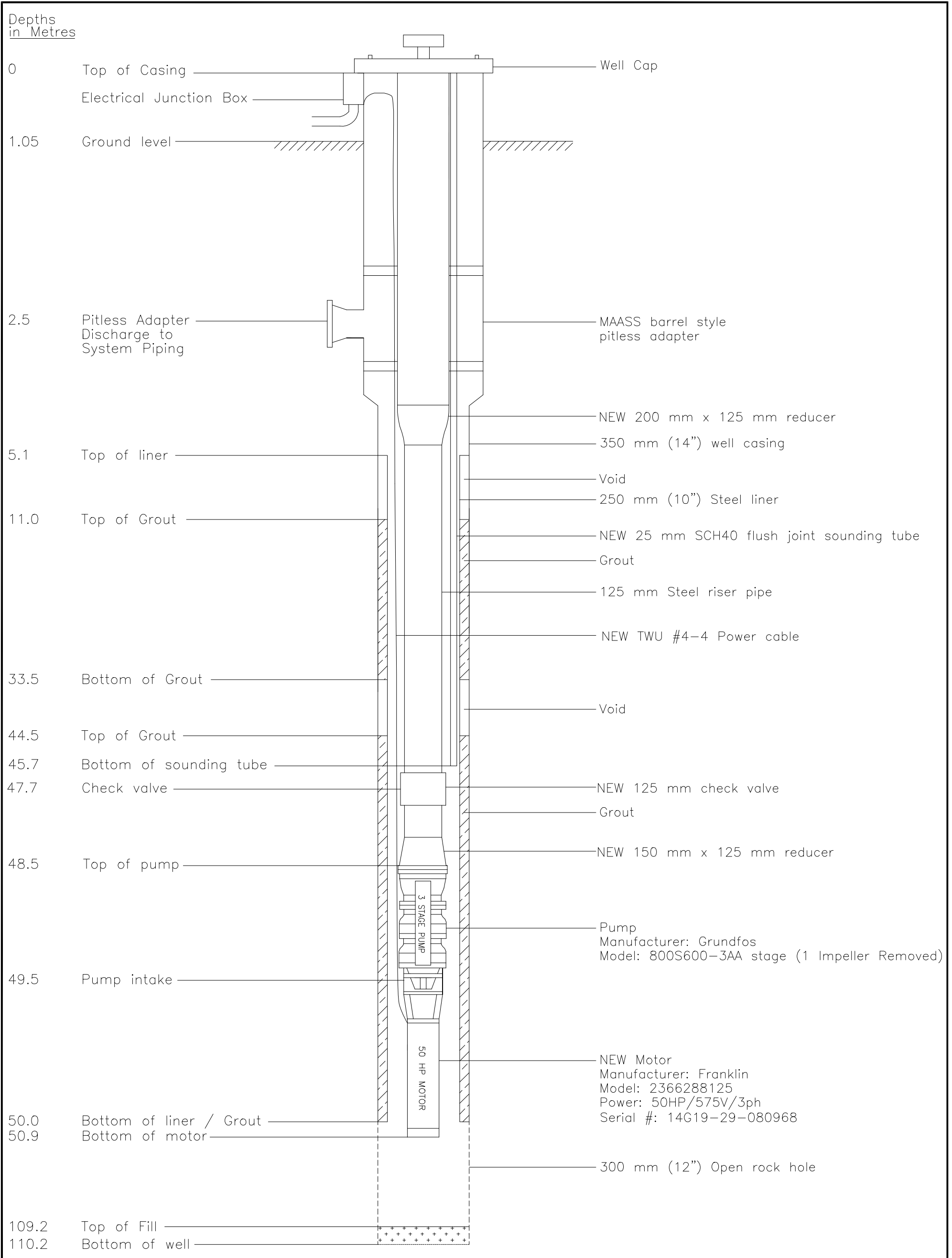
Water Details and Hole Diameter sections. Includes checkboxes for Fresh, Gas, Untested water and Depth/Diameter measurements.

Well Contractor and Well Technician Information section. Includes Business Name (Well Initiatives Limited), Address, Telephone, and Technician Name (Lasch Kim).

Results of Well Yield Testing table with columns: Draw Down (Time, Water Level), Recovery (Time, Water Level). Includes pumping rate of 1860 l/min/GPM and static level of 32.29m.

Map of Well Location showing Thompson Ar. and well location. Includes Ministry Use Only Audit No. 2137844 and Date Work Completed 20110616.

PRODUCTION WELL P17



**NOTES**

(1) All measurements below top of casing which is 1.05 m above ground.

(2) All existing components unless specified otherwise.

PROJECT No. 006-321

G:\Lotowater Projects\006 Region of Waterloo\321 P17 Emergency Repair\P17 Pump Installation Drawing.dwg

|         |    |            |              |            |
|---------|----|------------|--------------|------------|
| DESIGN  |    |            | REVISION No. | 2014/10/17 |
| DRAWN   | EH | 2014/10/17 |              |            |
| CHECKED |    |            |              |            |

|              |                                     |        |        |
|--------------|-------------------------------------|--------|--------|
| CLIENT       | Regional Municipality of Waterloo   |        |        |
| TITLE        | Clemens Mill Well Field<br>Well P17 |        |        |
| PROJECT No.  | 006-321                             | SCALE  | N.T.S. |
| REVISION No. | 2014/10/17                          | FIGURE | X      |

Well Initiatives Limited 7461 Wellington Rd. 18 Box 416 Elora ON, N0B 1S0  
 Telephone (519) 846-8289 Fax (519) 846-8281 Email info@wellinitiatives.com



## PUMP INSTALLATION RECORD

TECHNICIAN: D.R., R.A.

DATE: June 15, 2011

CLIENT: Region of Waterloo  
 WELL I.D. /LOCATION: P17

### PUMP INFORMATION

|                       |                       |                         |
|-----------------------|-----------------------|-------------------------|
| MAKE: Grundfos        | MODEL: 625S600-3      | SERIAL NUMBER:          |
| BOWL DIA.: 21.08cm    | NO. STAGES: 3         | DISCHARGE DIA.: 15.24cm |
| BOWL MAT'L: Stainless | IMP. MAT'L: Stainless | INTAKE B.B.P.: 47.69m   |

### MOTOR INFORMATION

|                 |                       |                              |
|-----------------|-----------------------|------------------------------|
| MAKE: Franklin  | MODEL NO.: 2366298125 | SERIAL NUMBER:               |
| DATE CODE: 05 K | MOTOR DIA.: 13.82cm   | HP: 60                       |
| VOLTS: 575      | PHASE: 3              | MAX. AMPS.: 72.8             |
| S.F.: 1.15      | KVA CODE: H           | BASE OF MOTOR B.B.P.: 49.25m |

### COLUMN PIPE INFORMATION

|                         |                         |                         |
|-------------------------|-------------------------|-------------------------|
| PIPE DIA.: 12.70cm      | THREAD TYPE: V          | WALL THICKNESS: schd 40 |
| PIPE MAT'L: Black Steel | TOTAL PIPE (FT): 44.81m | CHECK VALVE:            |

### WIRE INFORMATION

|               |                |                      |
|---------------|----------------|----------------------|
| WIRE SIZE: #4 | WIRE TYPE: AWG | TOTAL LENGTH: 47.24m |
|---------------|----------------|----------------------|

### WELL INFORMATION

|                      |                      |                       |
|----------------------|----------------------|-----------------------|
| WELL DEPTH: 110.64m  | LINER DIA.: 25.40 cm | CONSTRUCTION: bedrock |
| STATIC W.L.: 12.66 m |                      |                       |

LOG OF DRILLING OPERATIONS

PB-TW1-10



R. J. Burnside & Associates Limited  
 15 Townline, Orangeville, Ontario L9W 3R4  
 telephone (519) 941-5331 fax (519) 941-8120

|  |   |                               |
|--|---|-------------------------------|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>Pinebush Test Well</b>   | Logged by: <b>D. Soeting</b>  |
| Project No.: <b>MTA019051</b>                  | Location: <b>Pinebush Road, Cambridge</b> | Ground (m amsl):              |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>7/27/2010</b>            | Static Water Level (m amsl):  |
| Drilling Method: <b>Mud Rotary</b>             | Date Completed: <b>9/2/2010</b>           | Sand Pack (m amsl): <b>NA</b> |

| Depth Scale (ft) (m) | Stratigraphic Description   | Strat. Plot | Depth (m) | [Diagram]    | SAMPLE |      |      | Depth Scale (ft) (m) |
|----------------------|---|-------------|-----------|--------------|--------|------|------|----------------------|
|                      |   |             |           |              | Num.   | Type | Int. |                      |
| 0.0 - 1.0            | TOPSOIL - organics, loose, brown fine sand and silt with trace gravel, moist.       | [Symbol]    |           | steel casing |        |      |      |                      |
| 1.0 - 3.05           | SANDY SILT - trace organics, firm, brown fine sand and silt, trace gravel and clay. | [Symbol]    | 0.90      |              |        |      |      |                      |
| 3.05 - 5.79          | SANDY SILT and GRAVEL - compact, firm, brown fine sandy silt and gravel.            | [Symbol]    | 3.05      |              |        |      |      |                      |
| 5.79 - 6.70          | GRAVEL and CLAY - compact, firm brown fines with gravel.                            | [Symbol]    | 5.79      |              |        |      |      |                      |
| 6.70 - 14.0          | CLAY with SILT and trace STONES - brown, compact, hard.                             | [Symbol]    | 6.70      |              |        |      |      |                      |

B:\LOG GUELPH P:\GINT\PROJECTS\MTA019051.GPJ TEMPLATE.GDT 10/25/10

Prepared By: **D. Soeting** Checked By: **J. Baxter** Date Prepared: **10/20/2010**  
 This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

|   |                             |                        |                           |                         |
|---|-----------------------------|------------------------|---------------------------|-------------------------|
| <b>LEGEND</b>                           | <b>MONITORING WELL DATA</b> | <b>SAMPLE TYPE</b>     | AC [Symbol] Auger Cutting | SS [Symbol] Split Spoon |
| [Symbol] Water found @ time of drilling | Pipe: [Symbol]              | CS [Symbol] Continuous | AR [Symbol] Air Rotary    |                         |
| [Symbol] Static Water Level - 9/13/2010 | Screen: [Symbol]            | RC [Symbol] Rock Core  | WC [Symbol] Wash Cuttings |                         |

# LOG OF DRILLING OPERATIONS



R. J. Burnside & Associates Limited  
 15 Tewitona, Orangeville, Ontario L9W 3R4  
 telephone (519) 941-5331 fax (519) 941-8120

**PB-TW1-10**

Page 2 of 10

|  |   |                               |
|--|---|-------------------------------|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>Pinebush Test Well</b>   | Logged by: <b>D. Soeting</b>  |
| Project No.: <b>MTA019051</b>                  | Location: <b>Pinebush Road, Cambridge</b> | Ground (m amsl):              |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>7/27/2010</b>            | Static Water Level (m amsl):  |
| Drilling Method: <b>Mud Rotary</b>             | Date Completed: <b>9/2/2010</b>           | Sand Pack (m amsl): <b>NA</b> |

| Depth Scale<br>(ft) (m) | Stratigraphic Description                                       | Strat. Plot | Depth (m) | [Diagram] | SAMPLE |      |      | Depth Scale<br>(ft) (m) |
|-------------------------|---|-------------|-----------|-----------|--------|------|------|-------------------------|
|                         |   |             |           |           | Num.   | Type | Int. |                         |
| 50.0                    |   |             |           |           |        |      |      | 50.0                    |
| 16.0                    |   |             |           |           |        |      |      | 16.0                    |
| 55.0                    | CLAY - brown clay with some silt layers - brown, compact, hard. |             | 16.80     |           |        |      |      | 55.0                    |
| 17.0                    |   |             |           |           |        |      |      | 17.0                    |
| 18.0                    |   |             |           |           |        |      |      | 18.0                    |
| 60.0                    |   |             |           |           |        |      |      | 60.0                    |
| 19.0                    |   |             |           |           |        |      |      | 19.0                    |
| 65.0                    |   |             |           |           |        |      |      | 65.0                    |
| 20.0                    |   |             |           |           |        |      |      | 20.0                    |
| 21.0                    |   |             |           |           |        |      |      | 21.0                    |
| 70.0                    |   |             |           |           |        |      |      | 70.0                    |
| 22.0                    |   |             |           |           |        |      |      | 22.0                    |
| 75.0                    |   |             |           |           |        |      |      | 75.0                    |
| 23.0                    |   |             |           |           |        |      |      | 23.0                    |
| 24.0                    |   |             |           |           |        |      |      | 24.0                    |
| 80.0                    | TILL - grey clay till, fine gravel; compact, hard.              |             | 24.38     |           |        |      |      | 80.0                    |
| 25.0                    |   |             |           |           |        |      |      | 25.0                    |
| 26.0                    |   |             |           |           |        |      |      | 26.0                    |
| 85.0                    |   |             |           |           |        |      |      | 85.0                    |
| 27.0                    |   |             |           |           |        |      |      | 27.0                    |
| 90.0                    |   |             |           |           |        |      |      | 90.0                    |
| 28.0                    |   |             |           |           |        |      |      | 28.0                    |
| 29.0                    |   |             |           |           |        |      |      | 29.0                    |
| 95.0                    | SAND - grey medium sand; firm.                                  |             | 29.56     |           |        |      |      | 95.0                    |
| 29.0                    |   |             |           |           |        |      |      | 29.0                    |

steel casing

Prepared By: **D. Soeting** Checked By: **J. Baxter** Date Prepared: **10/20/2010**  
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|   |   |                                      |                   |
|---|---|--------------------------------------|-------------------|
| <b>LEGEND</b><br>Water found @ time of drilling<br>Static Water Level - 9/13/2010 | <b>MONITORING WELL DATA</b><br>Pipe:<br>Screen: | <b>SAMPLE TYPE</b> AC  Auger Cutting | SS  Split Spoon   |
|   |   | CS  Continuous                       | AR  Air Rotary    |
|   |   | RC  Rock Core                        | WC  Wash Cuttings |

BHLOG GUELPH P:\GINT\PROJECTS\MMTA019051.GPJ\TEMPLATE.GDT 10/25/10

# LOG OF DRILLING OPERATIONS

**PB-TW1-10**

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R. J. Burnside & Associates Limited  
 15 Townsend, Orangeville, Ontario L9W 3R4  
 telephone (518) 941-5331 fax (518) 941-8120

|  |   |                               |
|--|---|-------------------------------|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>Pinebush Test Well</b>   | Logged by: <b>D. Soeting</b>  |
| Project No.: <b>MTA019051</b>                  | Location: <b>Pinebush Road, Cambridge</b> | Ground (m amsl):              |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>7/27/2010</b>            | Static Water Level (m amsl):  |
| Drilling Method: <b>Mud Rotary</b>             | Date Completed: <b>9/2/2010</b>           | Sand Pack (m amsl): <b>NA</b> |

| Depth Scale<br>(ft) (m) | Stratigraphic Description  | Strat. Plot          | Depth (m) | [Diagram] | SAMPLE |      |      |       | Depth Scale<br>(ft) (m) |
|-------------------------|--|----------------------|-----------|-----------|--------|------|------|-------|-------------------------|
|                         |  |                      |           |           | Num.   | Type | Int. |       |                         |
| 100.0                   | TILL - grey clay till, fine gravel, trace stones; compact, hard; increasing sand content with depth. | [Stratigraphic Plot] | 31.09     | [Diagram] |        |      |      |       | 100.0                   |
| 31.0                    |  |                      |           |           |        |      |      |       | 31.0                    |
| 105.0                   |  |                      |           |           |        |      |      |       | 105.0                   |
| 32.0                    |  |                      |           |           |        |      |      |       | 32.0                    |
| 33.0                    |  |                      |           |           |        |      |      |       | 33.0                    |
| 110.0                   |  |                      |           |           |        |      |      |       | 110.0                   |
| 34.0                    |  |                      |           |           |        |      |      |       | 34.0                    |
| 115.0                   |  |                      |           |           |        |      |      |       | 115.0                   |
| 35.0                    |  |                      |           |           |        |      |      |       | 35.0                    |
| 36.0                    |  |                      |           |           |        |      |      |       | 36.0                    |
| 120.0                   |  |                      |           |           | 120.0  |      |      |       |                         |
| 37.0                    |  |                      |           |           | 37.0   |      |      |       |                         |
| 125.0                   |  |                      |           |           | 125.0  |      |      |       |                         |
| 38.0                    |  |                      |           |           | 38.0   |      |      |       |                         |
| 130.0                   |  |                      |           |           | 130.0  |      |      |       |                         |
| 40.0                    |  |                      |           |           | 40.0   |      |      |       |                         |
| 135.0                   |  |                      |           |           | 135.0  |      |      |       |                         |
| 41.0                    |  |                      |           |           | 41.0   |      |      |       |                         |
| 140.0                   |  |                      |           |           | 140.0  |      |      |       |                         |
| 42.0                    |  |                      |           |           | 42.0   |      |      |       |                         |
| 145.0                   |  |                      |           |           | 145.0  |      |      |       |                         |
| 44.0                    |  |                      |           |           | 44.0   |      |      |       |                         |
| 145.0                   | DOLOSTONE - mottled grey and brown; very porous, some voids.   |                      | 44.20     |           |        |      |      | 145.0 |                         |

steel casing

Prepared By: **D. Soeting** Checked By: **J. Baxter** Date Prepared: **10/20/2010**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

|  |                             |  |
|--|-----------------------------|--|
| <b>LEGEND</b>  | <b>MONITORING WELL DATA</b> | <b>SAMPLE TYPE</b>   |
| Water found @ time of drilling<br>Static Water Level - 9/13/2010 | Pipe:<br>Screen:            | AC  Auger Cutting<br>CS  Continuous<br>RC  Rock Core<br>SS  Split Spoon<br>AR  Air Rotary<br>WC  Wash Cuttings |

B:\LOG GUELPH\PROJECTS\MMTA019051.GPJ TEMPLATE.GDT 10/25/10

# LOG OF DRILLING OPERATIONS



R. J. Burnside & Associates Limited  
 15 Tewinns, Orangeville, Ontario L9W 3R4  
 telephone (519) 941-5331 fax (519) 941-8120

**PB-TW1-10**

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|  |   |                               |
|--|---|-------------------------------|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>Pinebush Test Well</b>   | Logged by: <b>D. Soeting</b>  |
| Project No.: <b>MTA019051</b>                  | Location: <b>Pinebush Road, Cambridge</b> | Ground (m amsl):              |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>7/27/2010</b>            | Static Water Level (m amsl):  |
| Drilling Method: <b>Mud Rotary</b>             | Date Completed: <b>9/2/2010</b>           | Sand Pack (m amsl): <b>NA</b> |

| Depth Scale<br>(ft) (m) | Stratigraphic Description   | Strat. Plot | Depth (m) | Diagram | SAMPLE |      |      | Depth Scale<br>(ft) (m) |
|-------------------------|---|-------------|-----------|---------|--------|------|------|-------------------------|
|                         |   |             |           |         | Num.   | Type | Int. |                         |
| 150.0<br>46.0           |   |             |           |         |        |      |      | 150.0<br>46.0           |
| 155.0<br>47.0           |   |             |           |         |        |      |      | 155.0<br>47.0           |
| 160.0<br>48.0           |   |             |           |         |        |      |      | 160.0<br>48.0           |
| 165.0<br>49.0           |   |             |           |         |        |      |      | 165.0<br>49.0           |
| 170.0<br>50.0           |   |             |           |         |        |      |      | 170.0<br>50.0           |
| 175.0<br>51.0           |   |             |           |         |        |      |      | 175.0<br>51.0           |
| 180.0<br>52.0           | DOLOSTONE - mottled grey and brown; moderately porous; some small voids throughout; vugs at 54.1. |             | 51.82     |         |        |      |      | 180.0<br>52.0           |
| 185.0<br>53.0           |   |             |           |         |        |      |      | 185.0<br>53.0           |
| 190.0<br>54.0           |   |             |           |         |        |      |      | 190.0<br>54.0           |
| 195.0<br>55.0           |   |             |           |         |        |      |      | 195.0<br>55.0           |
| 185.0<br>56.0           |   |             |           |         |        |      |      | 185.0<br>56.0           |
| 180.0<br>57.0           | DOLOSTONE - grey with trace brown mottling; slightly porous, trace vugs and voids.                |             | 57.00     |         |        |      |      | 180.0<br>57.0           |
| 175.0<br>58.0           |   |             |           |         |        |      |      | 175.0<br>58.0           |
| 170.0<br>59.0           |   |             |           |         |        |      |      | 170.0<br>59.0           |
| 165.0<br>59.0           |   |             |           |         |        |      |      | 165.0<br>59.0           |

Prepared By: **D. Soeting** Checked By: **J. Baxter** Date Prepared: **10/20/2010**

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**LEGEND**

- Water found @ time of drilling
- Static Water Level - 9/13/2010

**MONITORING WELL DATA**

Pipe:  
Screen:

**SAMPLE TYPE**

- AC Auger Cutting
- CS Continuous
- RC Rock Core
- SS Split Spoon
- AR Air Rotary
- WC Wash Cuttings

B:\LOG GUELPH P:\GINT\PROJECTS\MIMTA019051.GPJ\TEMPLATE.GDT 10/25/10

# LOG OF DRILLING OPERATIONS

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R. J. Burnside & Associates Limited  
 15 Townsend, Draperville, Ontario L9W 3R4  
 telephone (519) 941-5331 fax (519) 941-8120

|  |   |                               |
|--|---|-------------------------------|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>Pinebush Test Well</b>   | Logged by: <b>D. Soeting</b>  |
| Project No.: <b>MTA019051</b>                  | Location: <b>Pinebush Road, Cambridge</b> | Ground (m amsl):              |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>7/27/2010</b>            | Static Water Level (m amsl):  |
| Drilling Method: <b>Mud Rotary</b>             | Date Completed: <b>9/2/2010</b>           | Sand Pack (m amsl): <b>NA</b> |

| Depth Scale<br>(ft) (m) | Stratigraphic Description  | Strat. Plot | Depth (m) | Diagram           | SAMPLE |      |      | Depth Scale<br>(ft) (m) |
|-------------------------|--|-------------|-----------|-------------------|--------|------|------|-------------------------|
|                         |  |             |           |                   | Num.   | Type | Int. |                         |
| 200.0 - 61.0            |  |             |           |                   |        |      |      | 200.0 - 61.0            |
| 205.0 - 62.0            | DOLOSTONE - darker grey colour, some brown mottling increasing with depth; some voids throughout; vugs at 67.4   |             | 62.00     |                   |        |      |      | 205.0 - 62.0            |
| 210.0 - 64.0            |  |             |           |                   |        |      |      | 210.0 - 64.0            |
| 215.0 - 65.0            |  |             |           |                   |        |      |      | 215.0 - 65.0            |
| 220.0 - 67.0            | DOLOSTONE - lighter grey colour, trace mottling; slightly porous.  |             | 67.40     | open hole bedrock |        |      |      | 220.0 - 67.0            |
| 225.0 - 68.0            |  |             |           |                   |        |      |      | 225.0 - 68.0            |
| 230.0 - 70.0            |  |             |           |                   |        |      |      | 230.0 - 70.0            |
| 235.0 - 71.0            | DOLOSTONE - grey with some tan mottling; very porous, large voids and vugs; horizontal ring features at 71.7 m and 72.0 m; small caverns at 71.3 m and 72.2 m, and 74.3 m; vugs at 73.9 m. |             | 71.00     |                   |        |      |      | 235.0 - 71.0            |
| 240.0 - 73.0            |  |             |           |                   |        |      |      | 240.0 - 73.0            |
| 245.0 - 74.0            |  |             |           |                   |        |      |      | 245.0 - 74.0            |

Prepared By: **D. Soeting** Checked By: **J. Baxter** Date Prepared: **10/20/2010**

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|                                |                             |                    |                   |                 |
|--------------------------------|-----------------------------|--------------------|-------------------|-----------------|
| <b>LEGEND</b>                  | <b>MONITORING WELL DATA</b> | <b>SAMPLE TYPE</b> | AC  Auger Cutting | SS  Split Spoon |
| Water found @ time of drilling | Pipe:                       | CS  Continuous     | AR  Air Rotary    |                 |
| Static Water Level - 9/13/2010 | Screen:                     | RC  Rock Core      | WC  Wash Cuttings |                 |

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# LOG OF DRILLING OPERATIONS

**PB-TW1-10**

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R. J. Burnside & Associates Limited  
15 Tewin Drive, Orangeville, Ontario L9W 3R4  
telephone (519) 941-5331 fax (519) 941-8120



|  |   |                               |
|--|---|-------------------------------|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>Pinebush Test Well</b>   | Logged by: <b>D. Soeting</b>  |
| Project No.: <b>MTA019051</b>                  | Location: <b>Pinebush Road, Cambridge</b> | Ground (m amsl):              |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>7/27/2010</b>            | Static Water Level (m amsl):  |
| Drilling Method: <b>Mud Rotary</b>             | Date Completed: <b>9/2/2010</b>           | Sand Pack (m amsl): <b>NA</b> |

| Depth Scale<br>(ft) (m) | Stratigraphic Description   | Strat. Plot | Depth (m) | [Diagram] | SAMPLE |      |      | Depth Scale<br>(ft) (m) |
|-------------------------|---|-------------|-----------|-----------|--------|------|------|-------------------------|
|                         |   |             |           |           | Num.   | Type | Int. |                         |
| 76.0                    |   |             |           |           |        |      |      | 76.0                    |
| 77.0                    |   |             |           |           |        |      |      | 77.0                    |
| 77.11                   | DOLOSTONE - grey with trace tan layers; moderately porous, small voids; some fossils.   | [Pattern]   | 77.11     |           |        |      |      | 77.11                   |
| 78.0                    |   |             |           |           |        |      |      | 78.0                    |
| 79.0                    |   |             |           |           |        |      |      | 79.0                    |
| 80.0                    |   |             |           |           |        |      |      | 80.0                    |
| 81.0                    |   |             |           |           |        |      |      | 81.0                    |
| 82.0                    |   |             |           |           |        |      |      | 82.0                    |
| 83.0                    |   |             |           |           |        |      |      | 83.0                    |
| 84.0                    |   |             |           |           |        |      |      | 84.0                    |
| 84.70                   | DOLOSTONE - grey and tan mottled; increased porosity, large voids and vugs, horizontal and small vertical fractures;                                      | [Pattern]   | 84.70     |           |        |      |      | 84.70                   |
| 86.0                    |   |             |           |           |        |      |      | 86.0                    |
| 86.10                   | DOLOSTONE - grey, trace tan colour with depth; moderately porous increasing with depth; small to medium voids; some fossils; horizontal fracture at 96 m. | [Pattern]   | 86.10     |           |        |      |      | 86.10                   |
| 87.0                    |   |             |           |           |        |      |      | 87.0                    |
| 88.0                    |   |             |           |           |        |      |      | 88.0                    |
| 89.0                    |   |             |           |           |        |      |      | 89.0                    |
| 90.0                    |   |             |           |           |        |      |      | 90.0                    |
| 91.0                    |   |             |           |           |        |      |      | 91.0                    |
| 92.0                    |   |             |           |           |        |      |      | 92.0                    |
| 93.0                    |   |             |           |           |        |      |      | 93.0                    |
| 94.0                    |   |             |           |           |        |      |      | 94.0                    |
| 95.0                    |   |             |           |           |        |      |      | 95.0                    |
| 96.0                    |   |             |           |           |        |      |      | 96.0                    |
| 97.0                    |   |             |           |           |        |      |      | 97.0                    |
| 98.0                    |   |             |           |           |        |      |      | 98.0                    |
| 99.0                    |   |             |           |           |        |      |      | 99.0                    |
| 100.0                   |   |             |           |           |        |      |      | 100.0                   |

open hole bedrock

Prepared By: **D. Soeting** Checked By: **J. Baxter** Date Prepared: **10/20/2010**

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**LEGEND**

- Water found @ time of drilling
- Static Water Level - 9/13/2010

**MONITORING WELL DATA**

Pipe:  
Screen:

**SAMPLE TYPE**

- AC Auger Cutting
- CS Continuous
- RC Rock Core
- SS Split Spoon
- AR Air Rotary
- WC Wash Cuttings

B:\LOG GUELPH P:\GINT\PROJECTS\MMTA019051.GPJ\TEMPLATE.GDT 10/25/10

# LOG OF DRILLING OPERATIONS

R. J. Burnside & Associates Limited  
 15 Townsend, Orangeville, Ontario L9W 3R4  
 telephone (519) 941-5331 fax (519) 941-9120

**PB-TW1-10**

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|  |   |                               |
|--|---|-------------------------------|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>Pinebush Test Well</b>   | Logged by: <b>D. Soeting</b>  |
| Project No.: <b>MTA019051</b>                  | Location: <b>Pinebush Road, Cambridge</b> | Ground (m amsl):              |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>7/27/2010</b>            | Static Water Level (m amsl):  |
| Drilling Method: <b>Mud Rotary</b>             | Date Completed: <b>9/2/2010</b>           | Sand Pack (m amsl): <b>NA</b> |

| Depth Scale<br>(ft) (m)  | Stratigraphic Description   | Strat. Plot       | Depth (m) | [Diagram]         | SAMPLE |      |      | Depth Scale<br>(ft) (m)  |
|--|---|-------------------|-----------|-------------------|--------|------|------|--|
|  |   |                   |           |                   | Num.   | Type | Int. |  |
| 91.0<br>300.0<br>92.0<br>305.0<br>93.0<br>94.0<br>310.0<br>95.0<br>315.0<br>96.0<br>97.0<br>320.0<br>98.0<br>325.0<br>99.0<br>100.0<br>330.0<br>101.0<br>335.0<br>102.0<br>103.0<br>340.0<br>104.0 | DOLOSTONE - light grey; very porous; trace small voids; richly fossiliferous. | [Hatched pattern] | 96.00     | [Diagram]         |        |      |      | 91.0<br>300.0<br>92.0<br>305.0<br>93.0<br>94.0<br>310.0<br>95.0<br>315.0<br>96.0<br>97.0<br>320.0<br>98.0<br>325.0<br>99.0<br>100.0<br>330.0<br>101.0<br>335.0<br>102.0<br>103.0<br>340.0<br>104.0 |
|  |   |                   |           | open hole bedrock |        |      |      |  |

Prepared By: **D. Soeting** Checked By: **J. Baxter** Date Prepared: **10/20/2010**

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**LEGEND**

- Water found @ time of drilling
- Static Water Level - 9/13/2010

**MONITORING WELL DATA**

Pipe:  
Screen:

**SAMPLE TYPE**

- AC Auger Cutting
- CS Continuous
- RC Rock Core
- SS Split Spoon
- AR Air Rotary
- WC Wash Cuttings

BHLOG GUELPH P:\GINT\PROJECTS\MMT\A019051.GPJ TEMPLATE.GDT 10/25/10

# LOG OF DRILLING OPERATIONS

**PB-TW1-10**

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R.J. Burnside & Associates Limited  
 15 Tevonia, Orangeville, Ontario L9W 3R4  
 telephone (519) 941-5331 fax (519) 941-8120

|  |   |                               |
|--|---|-------------------------------|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>Pinebush Test Well</b>   | Logged by: <b>D. Soeting</b>  |
| Project No.: <b>MTA019051</b>                  | Location: <b>Pinebush Road, Cambridge</b> | Ground (m amsl):              |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>7/27/2010</b>            | Static Water Level (m amsl):  |
| Drilling Method: <b>Mud Rotary</b>             | Date Completed: <b>9/2/2010</b>           | Sand Pack (m amsl): <b>NA</b> |

| Depth Scale<br>(ft) (m) | Stratigraphic Description | Strat. Plot | Depth (m) | SAMPLE |      |      | Depth Scale<br>(ft) (m) |
|-------------------------|---------------------------|-------------|-----------|--------|------|------|-------------------------|
|                         |                           |             |           | Num.   | Type | Int. |                         |
| 345.0                   |                           |             |           |        |      |      | 345.0                   |
| 106.0                   |                           |             |           |        |      |      | 106.0                   |
| 350.0                   |                           |             |           |        |      |      | 350.0                   |
| 107.0                   |                           |             |           |        |      |      | 107.0                   |
| 108.0                   |                           |             |           |        |      |      | 108.0                   |
| 355.0                   |                           |             |           |        |      |      | 355.0                   |
| 109.0                   |                           |             |           |        |      |      | 109.0                   |
| 360.0                   |                           |             |           |        |      |      | 360.0                   |
| 110.0                   |                           |             |           |        |      |      | 110.0                   |
| 111.0                   |                           |             |           |        |      |      | 111.0                   |
| 365.0                   |                           |             |           |        |      |      | 365.0                   |
| 112.0                   |                           |             |           |        |      |      | 112.0                   |
| 370.0                   |                           |             |           |        |      |      | 370.0                   |
| 113.0                   |                           |             |           |        |      |      | 113.0                   |
| 114.0                   |                           |             |           |        |      |      | 114.0                   |
| 375.0                   |                           |             |           |        |      |      | 375.0                   |
| 115.0                   |                           |             |           |        |      |      | 115.0                   |
| 380.0                   |                           |             |           |        |      |      | 380.0                   |
| 116.0                   |                           |             |           |        |      |      | 116.0                   |
| 117.0                   |                           |             |           |        |      |      | 117.0                   |
| 385.0                   |                           |             |           |        |      |      | 385.0                   |
| 118.0                   |                           |             |           |        |      |      | 118.0                   |
| 390.0                   |                           |             |           |        |      |      | 390.0                   |
| 118.0                   |                           |             |           |        |      |      | 119.0                   |

open hole bedrock

Prepared By: **D. Soeting** Checked By: **J. Baxter** Date Prepared: **10/20/2010**

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|   |   |                                      |                   |
|---|---|--------------------------------------|-------------------|
| <b>LEGEND</b><br>Water found @ time of drilling<br>Static Water Level - 9/13/2010 | <b>MONITORING WELL DATA</b><br>Pipe:<br>Screen: | <b>SAMPLE TYPE</b> AC  Auger Cutting | SS  Split Spoon   |
|   |   | CS  Continuous                       | AR  Air Rotary    |
|   |   | RC  Rock Core                        | WC  Wash Cuttings |

BH LOG GJELPH P:\GINT\PROJECTS\MTA019051.GPJ TEMPLATE.GDT 10/25/10

# LOG OF DRILLING OPERATIONS

**PB-TW1-10**

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R. J. Burnside & Associates Limited  
 15 Tewitara, Orangeville, Ontario L9W 3R4  
 telephone (518) 941-5331 fax (518) 941-8120



|  |   |                               |
|--|---|-------------------------------|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>Pinebush Test Well</b>   | Logged by: <b>D. Soeting</b>  |
| Project No.: <b>MTA019051</b>                  | Location: <b>Pinebush Road, Cambridge</b> | Ground (m amsl):              |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>7/27/2010</b>            | Static Water Level (m amsl):  |
| Drilling Method: <b>Mud Rotary</b>             | Date Completed: <b>9/2/2010</b>           | Sand Pack (m amsl): <b>NA</b> |

| Depth Scale<br>(ft) (m) | Stratigraphic Description  | Strat. Plot | Depth (m) | [Diagram] | SAMPLE |      |      | Depth Scale<br>(ft) (m) |
|-------------------------|--|-------------|-----------|-----------|--------|------|------|-------------------------|
|                         |  |             |           |           | Num.   | Type | Int. |                         |
| 395.0                   |  |             |           |           |        |      |      | 395.0                   |
| 121.0                   |  |             |           |           |        |      |      | 121.0                   |
| 400.0                   |  |             |           |           |        |      |      | 400.0                   |
| 122.0                   |  |             |           |           |        |      |      | 122.0                   |
| 123.0                   |  |             |           |           |        |      |      | 123.0                   |
| 405.0                   |  |             |           |           |        |      |      | 405.0                   |
| 124.0                   |  |             |           |           |        |      |      | 124.0                   |
| 410.0                   |  |             |           |           |        |      |      | 410.0                   |
| 125.0                   |  |             |           |           |        |      |      | 125.0                   |
| 126.0                   |  |             |           |           |        |      |      | 126.0                   |
| 415.0                   |  |             |           |           |        |      |      | 415.0                   |
| 127.0                   |  |             |           |           |        |      |      | 127.0                   |
| 420.0                   |  |             |           |           |        |      |      | 420.0                   |
| 128.0                   |  |             |           |           |        |      |      | 128.0                   |
| 129.0                   |  |             |           |           |        |      |      | 129.0                   |
| 425.0                   |  |             |           |           |        |      |      | 425.0                   |
| 130.0                   |  |             |           |           |        |      |      | 130.0                   |
| 430.0                   |  |             |           |           |        |      |      | 430.0                   |
| 131.0                   |  |             |           |           |        |      |      | 131.0                   |
| 132.0                   |  |             |           |           |        |      |      | 132.0                   |
| 435.0                   |  |             |           |           |        |      |      | 435.0                   |
| 133.0                   |  |             | 133.00    |           |        |      |      | 133.0                   |
| 440.0                   | <b>DOLOSTONE - light to dark grey with depth; horizontal fractures at 133.9 m, 138.8 m, 141.2 m, 142.0 m, 142.6 m; richly fossiliferous; moderate porosity, trace small voids.</b> |             |           |           |        |      |      | 440.0                   |
| 134.0                   |  |             |           |           |        |      |      | 134.0                   |

open hole bedrock

Prepared By: **D. Soeting** Checked By: **J. Baxter** Date Prepared: **10/20/2010**

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|                                |                             |                    |                   |                 |
|--------------------------------|-----------------------------|--------------------|-------------------|-----------------|
| <b>LEGEND</b>                  | <b>MONITORING WELL DATA</b> | <b>SAMPLE TYPE</b> | AC  Auger Cutting | SS  Split Spoon |
| Water found @ time of drilling | Pipe:                       | CS  Continuous     | AR  Air Rotary    |                 |
| Static Water Level - 9/13/2010 | Screen:                     | RC  Rock Core      | WC  Wash Cuttings |                 |

B:\LOG GUELPH P:\GINT\PROJECTS\MMTA019051.GPJ\TEMPLATE.GDT 10/25/10

# LOG OF DRILLING OPERATIONS

**PB-TW1-10**

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R.J. Burnside & Associates Limited  
 15 Taverville, Orangeville, Ontario L9W 3P4  
 telephone (519) 941-5331 fax (519) 941-8120

|  |   |                               |
|--|---|-------------------------------|
| Client: <b>Region of Waterloo</b>              | Project Name: <b>Pinebush Test Well</b>   | Logged by: <b>D. Soeting</b>  |
| Project No.: <b>MTA019051</b>                  | Location: <b>Pinebush Road, Cambridge</b> | Ground (m amsl):              |
| Drilling Co.: <b>Davidson Drilling Limited</b> | Date Started: <b>7/27/2010</b>            | Static Water Level (m amsl):  |
| Drilling Method: <b>Mud Rotary</b>             | Date Completed: <b>9/2/2010</b>           | Sand Pack (m amsl): <b>NA</b> |

| Depth Scale<br>(ft) (m) | Stratigraphic Description  | Strat. Plot | Depth (m) | [Diagram] | SAMPLE |      |      | Depth Scale<br>(ft) (m) |
|-------------------------|--|-------------|-----------|-----------|--------|------|------|-------------------------|
|                         |  |             |           |           | Num.   | Type | Int. |                         |
| 445.0<br>136.0          |  |             |           |           |        |      |      | 445.0<br>136.0          |
| 450.0<br>137.0          |  |             |           |           |        |      |      | 450.0<br>137.0          |
| 455.0<br>138.0          |  |             |           |           |        |      |      | 455.0<br>138.0          |
| 460.0<br>139.0          |  |             |           |           |        |      |      | 460.0<br>139.0          |
| 465.0<br>140.0          | <b>DOLOSTONE - grey, trace voids, slightly porous, no vugs or fossils.</b> |             | 140.00    |           |        |      |      | 465.0<br>140.0          |
| 470.0<br>141.0          |  |             |           |           |        |      |      | 470.0<br>141.0          |
| 475.0<br>142.0          |  |             |           |           |        |      |      | 475.0<br>142.0          |
| 480.0<br>143.0          | <b>SHALE - blue shale, hard.</b>   |             | 143.00    |           |        |      |      | 480.0<br>143.0          |
| 485.0<br>144.0          |  |             |           |           |        |      |      | 485.0<br>144.0          |
| 490.0<br>145.0          |  |             |           |           |        |      |      | 490.0<br>145.0          |
| 495.0<br>146.0          |  |             |           |           |        |      |      | 495.0<br>146.0          |

open hole bedrock

Prepared By: **D. Soeting** Checked By: **J. Baxter** Date Prepared: **10/20/2010**

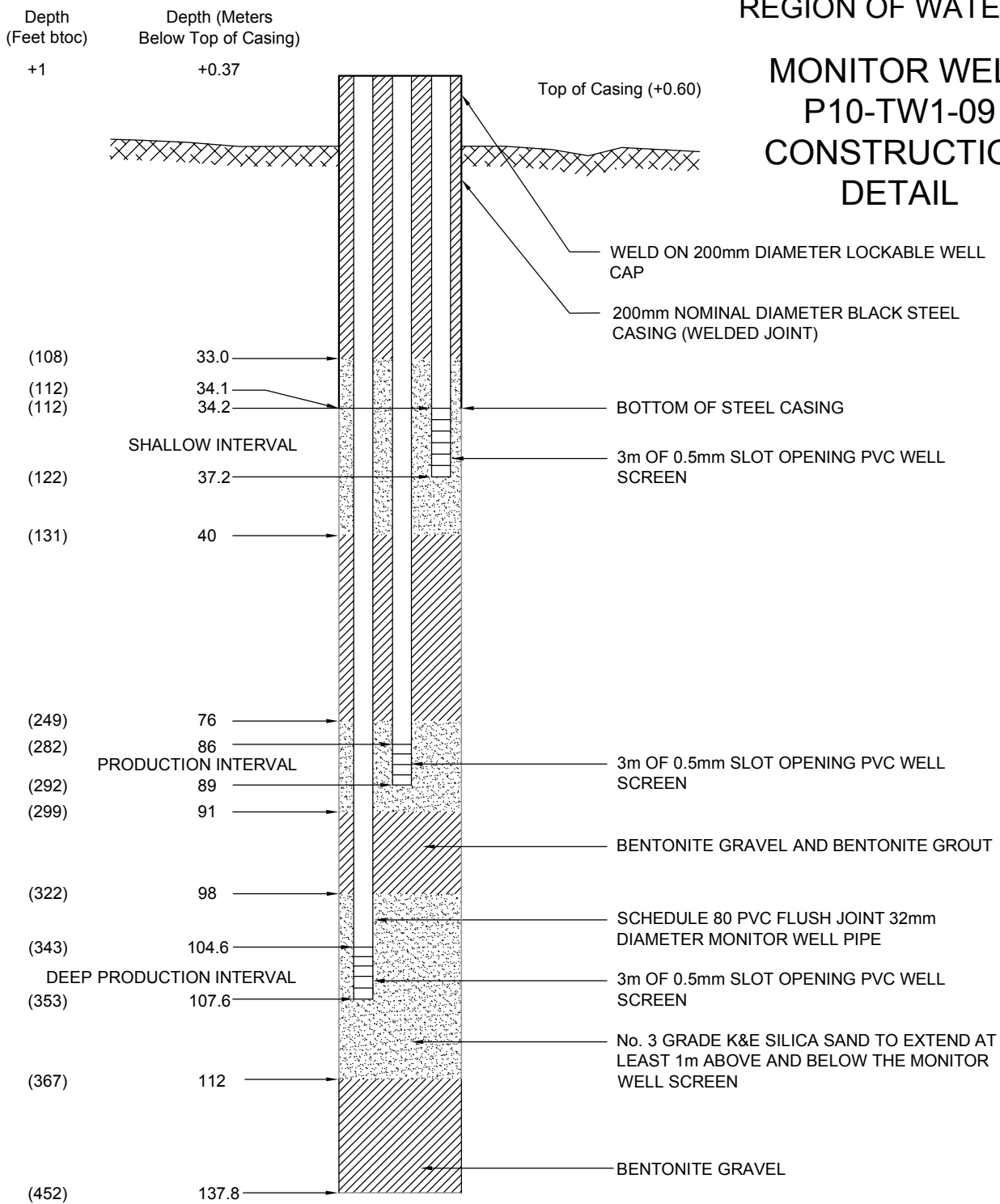
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|                                |                             |                    |                   |                   |
|--------------------------------|-----------------------------|--------------------|-------------------|-------------------|
| <b>LEGEND</b>                  | <b>MONITORING WELL DATA</b> | <b>SAMPLE TYPE</b> | AC  Auger Cutting | SS  Split Spoon   |
| Water found @ time of drilling | Pipe:                       | CS  Continuous     | AR  Air Rotary    | WC  Wash Cuttings |
| Static Water Level - 9/13/2010 | Screen:                     | RC  Rock Core      |                   |                   |

BH LOG GUELPH P:\GINT\PROJECTS\MIMTA019051.GPJ TEMPLATE.GDT 10/25/10

REGION OF WATERLOO

MONITOR WELL  
P10-TW1-09  
CONSTRUCTION  
DETAIL



February 2010  
N.T.S.  
FILE NO.: MTA17230.3

NOTES:  
DEPTHS SHOWN ARE NOT TO SCALE



LOG OF DRILLING OPERATIONS



R. J. Burnside & Associates Limited  
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 telephone (519) 941-5331 fax (519) 941-8120

**P10-TW1D-10**

Page 1 of 2

|  |  |                              |
|--|--|------------------------------|
| Client: <b>Region of Waterloo</b>      | Project Name: <b>Cambridge Well Optimization</b> | Logged by: <b>S. Quinlan</b> |
| Project No.: <b>MTA17230</b>           | Location: <b>Cambridge</b>                       | Ground (m amsl):             |
| Drilling Co.: <b>Pro Core Drilling</b> | Date Started: <b>4/16/2010</b>                   | Static Water Level (m amsl): |
| Drilling Method: <b>PQ Coring</b>      | Date Completed: <b>4/19/2010</b>                 | Sand Pack (m amsl):          |

| Depth Scale<br>(ft) (m) | Stratigraphic Description   | Strat. Plot | Depth (m) | Diagram | SAMPLE |      |      |         | Depth Scale<br>(ft) (m) |
|-------------------------|---|-------------|-----------|---------|--------|------|------|---------|-------------------------|
|                         |   |             |           |         | Num.   | Type | Int. | %Recov. |                         |
|                         | TOPSOIL - organics, brown fine sand and silt with trace gravel, moist.  |             |           |         | 1      | SS   |      | 37      |                         |
| 1.0                     | SILTY SAND - brown, soft, moist to wet.   |             | 0.87      |         | 2      | SS   |      | 91      | 1.0                     |
| 5.0                     |   |             |           |         | 3      | SS   |      | 83      | 5.0                     |
| 2.0                     |   |             |           |         | 4      | SS   |      | 83      | 2.0                     |
| 10.0                    |   |             |           |         | 5      | CS   |      | 100     | 10.0                    |
| 3.0                     | SAND - medium-grained sand, redish brown, saturated.  |             | 3.28      |         | 6      | CS   |      | 97      | 3.0                     |
| 4.0                     | SILTY SAND - fine-grained redish brown silty sand till, some stones and gravel (<20 mm diameter), saturated; intermittent hard, grey, silty clay layers 100 to 400 mm in thickness. |             | 3.67      |         | 7      | CS   |      | 18      | 4.0                     |
| 15.0                    |   |             |           |         | 8      | CS   |      | 77      | 15.0                    |
| 5.0                     |   |             |           |         | 9      | CS   |      | 100     | 5.0                     |
| 20.0                    |   |             |           |         | 10     | CS   |      | 100     | 20.0                    |
| 6.0                     | SILTY CLAY - hard grey silty clay, saturated.   |             | 8.31      |         | 11     | CS   |      | 70      | 6.0                     |
| 7.0                     | SILTY SAND - fine-grained redish grey silty sand, trace gravel, dense, saturated; intermittent layers (<600 mm) of soft med. sand, trace fine gravel.                               |             | 8.64      |         | 12     | CS   |      | 100     | 7.0                     |
| 25.0                    |   |             |           |         | 13     | CS   |      | 100     | 25.0                    |
| 8.0                     |   |             |           |         |        |      |      | 8.0     |                         |
| 30.0                    |   |             |           |         |        |      |      | 30.0    |                         |
| 9.0                     |   |             |           |         |        |      |      | 9.0     |                         |
| 10.0                    |   |             |           |         |        |      |      | 10.0    |                         |
| 35.0                    |   |             |           |         |        |      |      | 35.0    |                         |
| 11.0                    |   |             |           |         |        |      |      | 11.0    |                         |
| 40.0                    |   |             |           |         |        |      |      | 40.0    |                         |
| 12.0                    |   |             |           |         |        |      |      | 12.0    |                         |
| 45.0                    |   |             |           |         |        |      |      | 45.0    |                         |
| 13.0                    |   |             |           |         |        |      |      | 13.0    |                         |
| 14.0                    |   |             |           |         |        |      |      | 14.0    |                         |

Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **5/19/2010**  
 This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

|                                |  |                    |
|--------------------------------|--|--------------------|
| <b>LEGEND</b>                  | <b>MONITORING WELL DATA</b>            | <b>SAMPLE TYPE</b> |
| Water found @ time of drilling | Pipe: <b>51 mm dia. PVC</b>            | AC  Auger Cutting  |
| Static Water Level -           | Screen: <b>51 mm dia. PVC #10 slot</b> | CS  Continuous     |
|                                |  | RC  Rock Core      |
|                                |  | SS  Split Spoon    |
|                                |  | AR  Air Rotary     |
|                                |  | WC  Wash Cuttings  |

B:\LOG GUELPH\PROJECTS\MMTA17230\10ANDH5OVERBURDEN.GPJ\_TEMPLATE.GDT 27/8/10

# LOG OF DRILLING OPERATIONS



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**P10-TW1D-10**

Page 2 of 2

|  |  |                              |
|--|--|------------------------------|
| Client: <b>Region of Waterloo</b>      | Project Name: <b>Cambridge Well Optimization</b> | Logged by: <b>S. Quinlan</b> |
| Project No.: <b>MTA17230</b>           | Location: <b>Cambridge</b>                       | Ground (m amsl):             |
| Drilling Co.: <b>Pro Core Drilling</b> | Date Started: <b>4/16/2010</b>                   | Static Water Level (m amsl): |
| Drilling Method: <b>PQ Coring</b>      | Date Completed: <b>4/19/2010</b>                 | Sand Pack (m amsl):          |

| Depth Scale<br>(ft) (m) | Stratigraphic Description  | Strat. Plot      | Depth (m)  | Diagram                                 | SAMPLE           |       |      |         | Depth Scale<br>(ft) (m) |
|-------------------------|--|------------------|--|---|------------------|-------|------|---------|-------------------------|
|                         |  |                  |  |   | Num.             | Type  | Int. | %Recov. |                         |
| 50.0                    | SANDY SILT - trace clay, grey/brown, dense.                                  | [X pattern]      | 15.54  | [Diagram showing grout zone]            |                  |       |      |         | 50.0                    |
| 16.0                    |  |                  | 14   |   | CS               |       | 100  | 16.0    |                         |
| 55.0                    |  |                  | 15   |   | CS               |       | 100  | 17.0    |                         |
| 17.0                    |  |                  | 16   |   | CS               |       | 100  | 18.0    |                         |
| 18.0                    | SILTY SAND with trace clay grey/brown.                                       | [X pattern]      | 20.42  | [Diagram showing bentonite seal zone]   |                  |       |      |         | 60.0                    |
| 19.0                    |  |                  | 17   |   | CS               |       | 100  | 19.0    |                         |
| 60.0                    | SANDY SILT - trace clay, grey/brown, dense.                                  | [X pattern]      | 20.73  | [Diagram showing bentonite seal zone]   |                  |       |      |         | 65.0                    |
| 18.0                    | SILTY SAND with trace clay grey/brown.                                       | [X pattern]      | 21.64  |   | 18               | CS    |      | 80      | 21.0                    |
| 19.0                    | SANDY SILT - with trace clay, grey brown, dense.                             | [X pattern]      | 22.59  |   | 19               | CS    |      | 70      | 22.0                    |
| 65.0                    | SAND - fine to medium, with trace of gravel, silt and clay, dark grey/brown. | [Dotted pattern] | 23.16  | [Diagram showing silica sand pack zone] |                  |       |      |         | 70.0                    |
| 20.0                    |  |                  | 20   |   | CS               |       | 100  | 20.0    |                         |
| 70.0                    | GRAVEL - with sand medium to coarse, grey/brown.                             | [Circle pattern] | 26.21  |   | 21               | CS    |      | 70      | 75.0                    |
| 19.0                    |  |                  | SAND - fine to medium, trace gravel, silt and clay, dark grey/brown. |   | [Dotted pattern] | 26.82 |      |         |                         |
| 23.0                    |  |                  | 27.74  |   |                  |       |      |         | 85.0                    |
| 24.0                    |  |                  | 27.74  |   |                  |       |      |         | 26.0                    |
| 25.0                    |  |                  |  |   |                  |       |      |         | 27.0                    |
| 26.0                    |  |                  |  |   |                  |       |      |         | 90.0                    |

Prepared By: **S. Quinlan**      Checked By: **J. Baxter**      Date Prepared: **5/19/2010**

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|   |  |  |
|---|--|--|
| <b>LEGEND</b><br>Water found @ time of drilling<br>Static Water Level - | <b>MONITORING WELL DATA</b><br>Pipe: <b>51 mm dia. PVC</b><br>Screen: <b>51 mm dia. PVC #10 slot</b> | <b>SAMPLE TYPE</b><br>AC  Auger Cutting      SS  Split Spoon<br>CS  Continuous      AR  Air Rotary<br>RC  Rock Core      WC  Wash Cuttings |
|---|--|--|

B:\LOG GUELPH\PROJECTS\M\MTA17230\10ANDH5OVERBURDEN.GPJ TEMPLATE.GDT 27/8/10

LOG OF DRILLING OPERATIONS

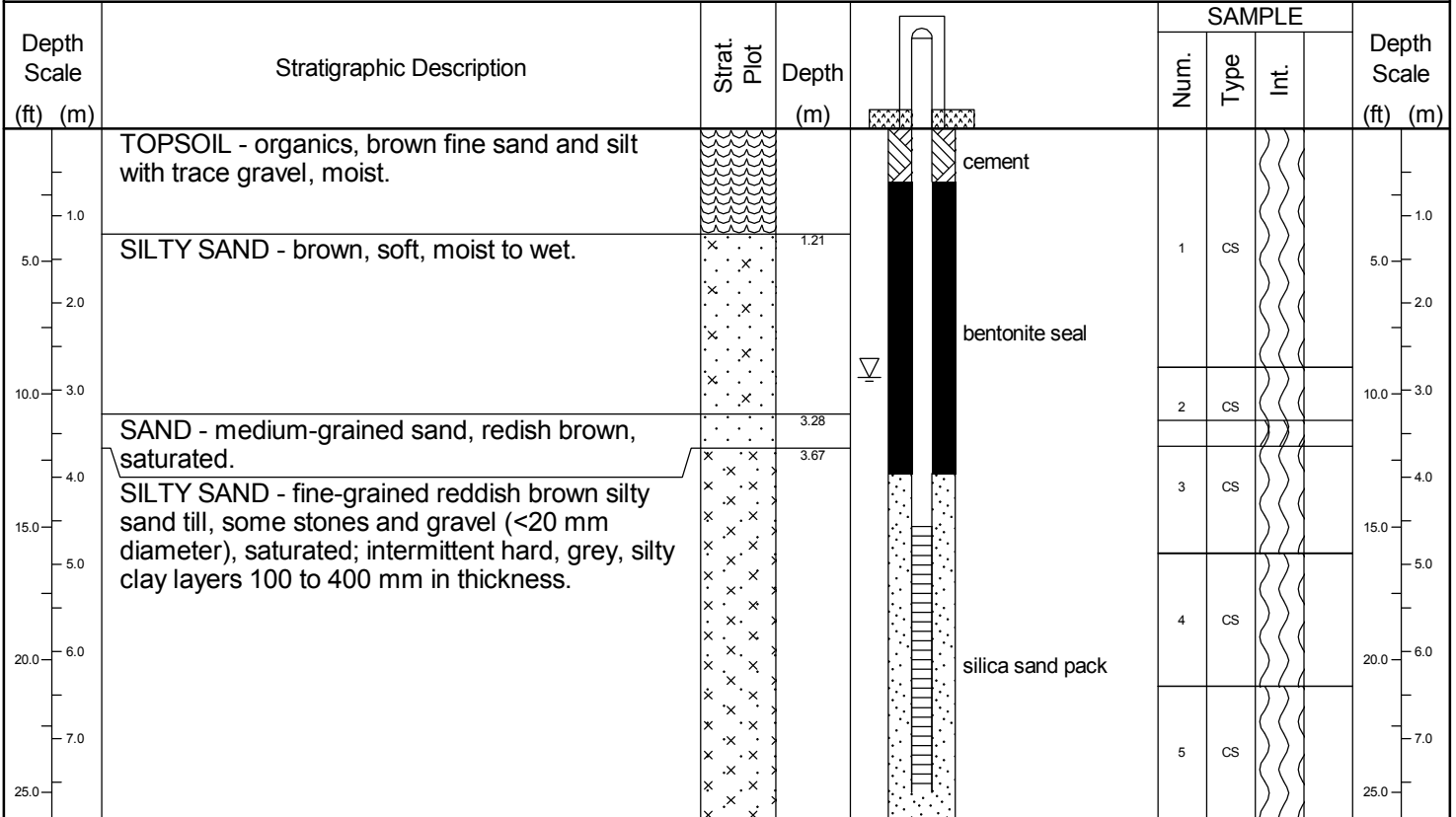


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**P10-TW1E-10**

Page 1 of 1

|  |  |                              |
|--|--|------------------------------|
| Client: <b>Region of Waterloo</b>      | Project Name: <b>Cambridge Well Optimization</b> | Logged by: <b>S. Quinlan</b> |
| Project No.: <b>MTA17230</b>           | Location: <b>Cambridge</b>                       | Ground (m amsl):             |
| Drilling Co.: <b>Pro Core Drilling</b> | Date Started: <b>4/20/2010</b>                   | Static Water Level (m amsl): |
| Drilling Method: <b>PQ Coring</b>      | Date Completed: <b>4/20/2010</b>                 | Sand Pack (m amsl):          |



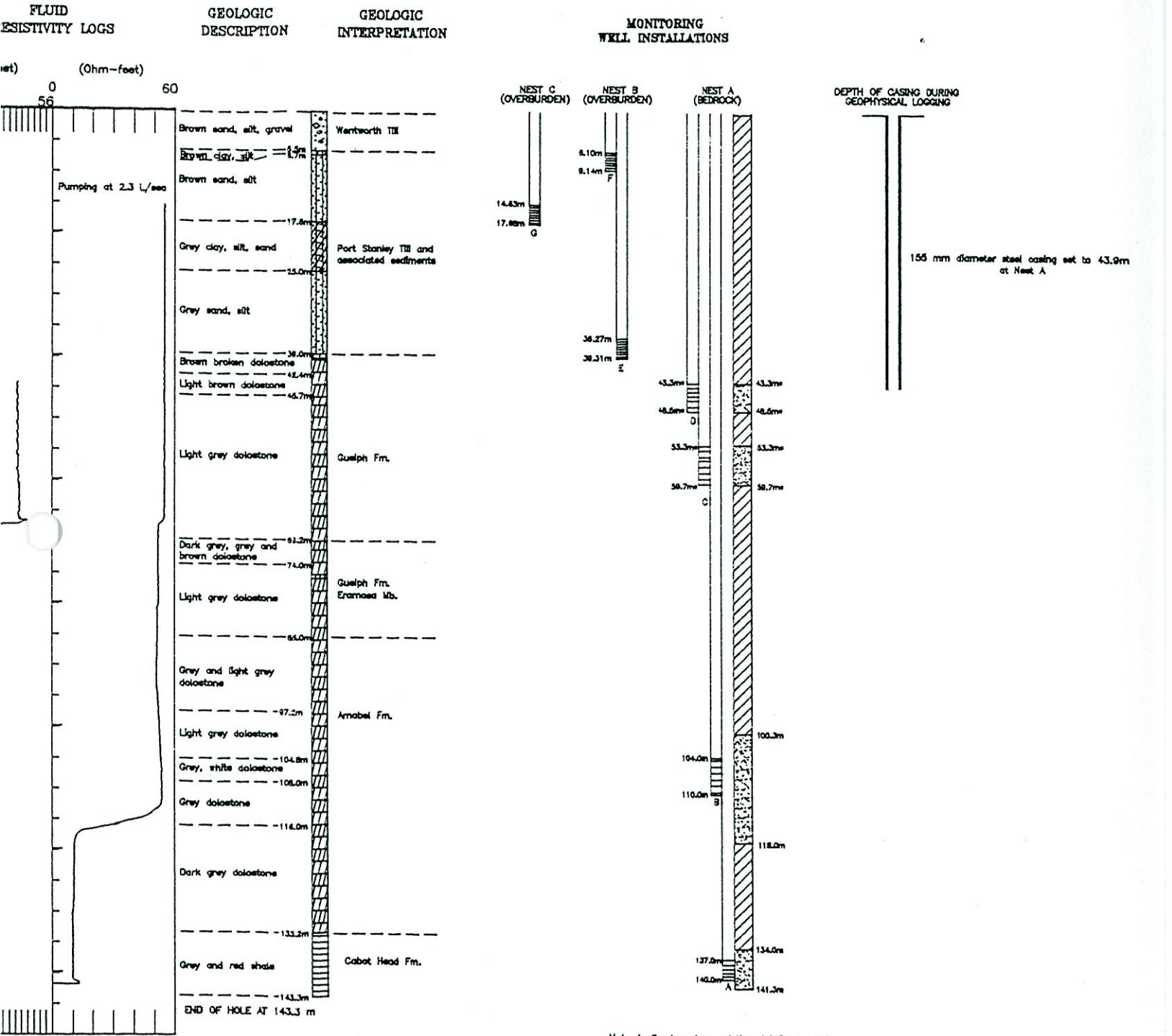
BHLOG GUELPH.P:\GINT\PROJECTS\MMTA17230\10ANDH5OVERBURDEN.GPJ TEMPLATE.GDT 27/8/10

Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **5/19/2010**  
 This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

|  |   |  |
|--|---|--|
| <b>LEGEND</b>  | <b>MONITORING WELL DATA</b>   | <b>SAMPLE TYPE</b>   |
| ▽ Water found @ time of drilling<br>▽ Static Water Level - | Pipe: <b>51 mm dia. PVC</b><br>Screen: <b>51 mm dia. PVC #10 slot</b> | AC [Auger Cutting]    SS [Split Spoon]<br>CS [Continuous]    AR [Air Rotary]<br>RC [Rock Core]      WC [Wash Cuttings] |

OW5-94  
9200572

TEST HOLE/MONITORING WELL OW5/94



Note 1: Sand pack completion details are not known for overburden monitors  
 Note 2: \* Indicates completion details are approximate

APPROXIMATE GROUND ELEVATION = 318.0 m A.S.L.  
 MEASURING POINT ELEVATION FOR BEDROCK MONITORS A AND B (TOP OF CASING) = 315.85 m A.S.L.  
 MEASURING POINT ELEVATION FOR BEDROCK MONITORS C AND D (TOP OF CASING) = 315.92 m A.S.L.  
 MEASURING POINT ELEVATION FOR OVERBURDEN MONITORS E AND F (TOP OF CASING) = 315.84 m A.S.L.  
 MEASURING POINT ELEVATION FOR OVERBURDEN MONITOR G (TOP OF CASING) = 315.84 m A.S.L.

PROJECT: 05-1112-010(1000)  
 LOCATION: N 4804173.7 ;E 559589.2

**BOREHOLE LOG OF: CMOW2-06**

SHEET 1 OF 3  
 DATUM: Geodetic

DRILLING DATE: June 6 to June 13, 2006  
 DRILL RIG: Air Rotary  
 DRILLING CONTRACTOR: Gerrits Drilling Ltd.

| DEPTH SCALE METRES | DESCRIPTION   | SYMBOLIC LOG | ELEV.<br>DEPTH (m) | GEOPHYSICAL RECORD |    |    |    | PIEZOMETER OR STANDPIPE INSTALLATION |    |    |    |   |   |   |     |  |  |  |  |
|--------------------|---|--------------|--------------------|--------------------|----|----|----|--------------------------------------|----|----|----|---|---|---|-----|--|--|--|--|
|                    |   |              |                    | GAMMA (cps)        |    |    |    | CONDUCTIVITY (mS/m)                  |    |    |    |   |   |   |     |  |  |  |  |
|                    |   |              |                    | 20                 | 40 | 60 | 80 | 10                                   | 20 | 30 | 40 | F | E | D | CBA |  |  |  |  |
| 0                  | GROUND SURFACE  |              | 300.66             |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
|                    | (TOPSOIL) brown ORGANIC SILT, rootlets  |              | 0.00               |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
|                    | Brown CLAY, with SANDY GRAVEL (TILL)  |              | 0.61               |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 5                  | Brown SILTY SAND and GRAVEL (TILL) and trace cobbles, heterogeneous, moist, compact, subrounded to subangular gravel  |              | 297.61             |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
|                    |   |              | 3.05               |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 15                 | Brown-grey SAND and GRAVEL, some cobbles, porous, fairly clean, angular to subrounded<br>Fine to coarse gravel from 15. m to 15.5 m depth   |              | 286.03             |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
|                    |   |              | 14.63              |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 20                 | Medium brown, fine SAND, some coarse sand, uniform, homogeneous, loose  |              | 280.24             |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
|                    |   |              | 20.42              |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 25                 | Fine to medium sand, trace cobbles and occasional boulder from 24.4 to 25.0 m depth   |              | 275.67             |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
|                    |   |              | 24.99              |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
|                    | Brown-grey fine SAND and GRAVEL, some silty clay, very dense, heterogeneous (TILL)  |              | 273.53             |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
|                    | Brown SILTY SAND and gravel grading to coarse gravel, heterogeneous   |              | 272.01             |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
|                    |   |              | 28.65              |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 30                 | Buff brown DOLOMITE, fractured, moderately weathered, massive, fine grained (Guelph Fm)   |              | 270.18             |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
|                    |   |              | 30.48              |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 35                 | Brown/greyish brown DOLOMITE, crystalline, weakly laminated, trace micro vugs, moderately to well indurated, blocky to platy chips (Guelph Fm)<br>Intermittent thin fractures from 32 m to 36.6 m depth |              |                    |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 40                 |   |              |                    |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 45                 |   |              |                    |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 50                 |   |              |                    |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |

CONTINUED NEXT PAGE

MIS-HYD 003 05-1112-010.GPJ GAL-MISS.GDT 4/23/07

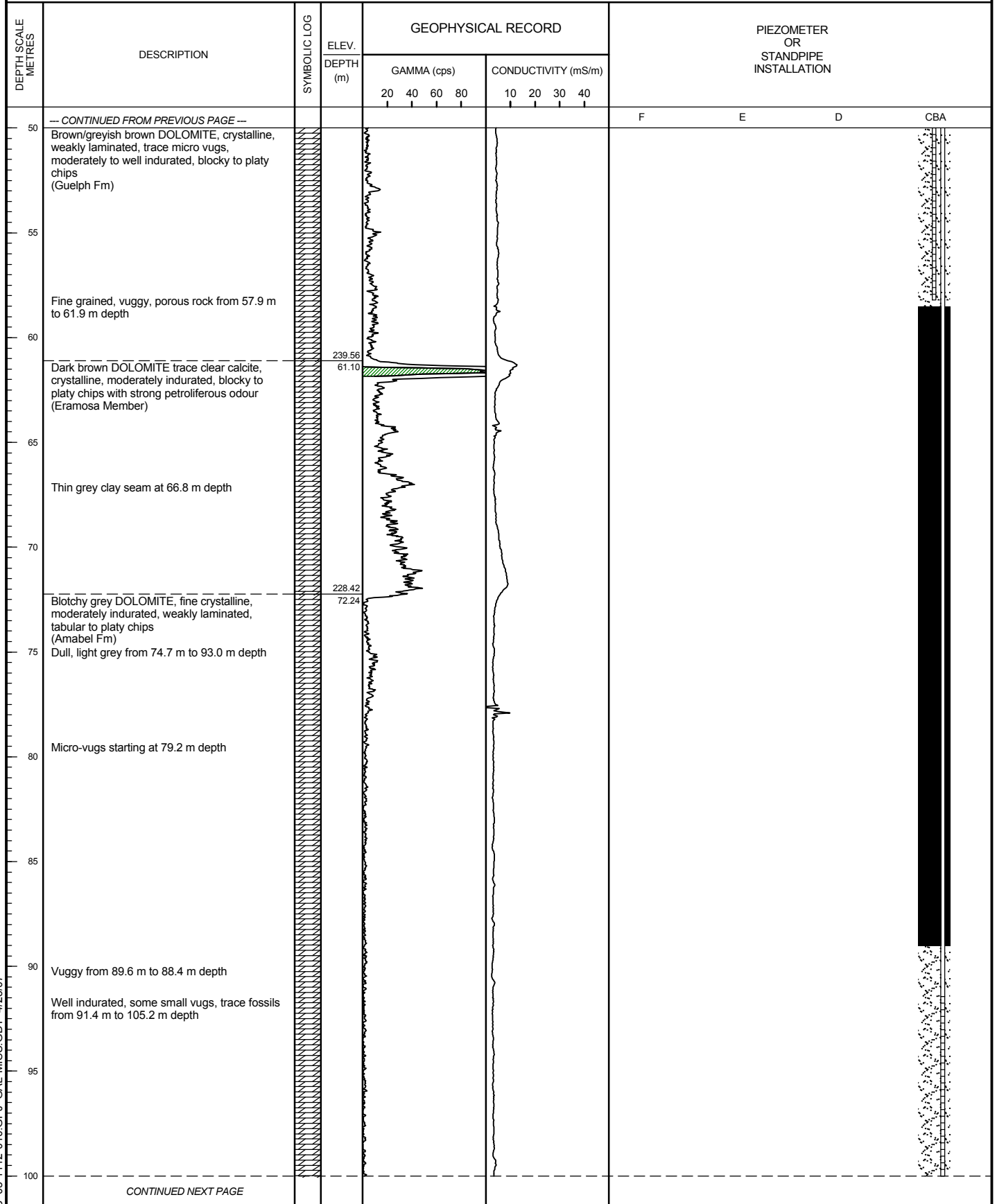


PROJECT: 05-1112-010(1000)  
 LOCATION: N 4804173.7 ;E 559589.2

# BOREHOLE LOG OF: CMOW2-06

SHEET 2 OF 3  
 DATUM: Geodetic

DRILLING DATE: June 6 to June 13, 2006  
 DRILL RIG: Air Rotary  
 DRILLING CONTRACTOR: Gerrits Drilling Ltd.



MIS-HYD 003 05-1112-010.GPJ GAL-MISS.GDT 4/23/07

DEPTH SCALE  
 1 : 250



LOGGED: AI  
 CHECKED:

PROJECT: 05-1112-010(1000)  
 LOCATION: N 4804173.7 ;E 559589.2

# BOREHOLE LOG OF: CMOW2-06

SHEET 3 OF 3  
 DATUM: Geodetic

DRILLING DATE: June 6 to June 13, 2006  
 DRILL RIG: Air Rotary  
 DRILLING CONTRACTOR: Gerrits Drilling Ltd.

| DEPTH SCALE METRES | DESCRIPTION  | SYMBOLIC LOG | ELEV. DEPTH (m)                                | GEOPHYSICAL RECORD |    |    |    | PIEZOMETER OR STANDPIPE INSTALLATION |    |    |    |   |   |   |     |  |  |  |  |
|--------------------|--|--------------|--|--------------------|----|----|----|--------------------------------------|----|----|----|---|---|---|-----|--|--|--|--|
|                    |  |              |  | GAMMA (cps)        |    |    |    | CONDUCTIVITY (mS/m)                  |    |    |    |   |   |   |     |  |  |  |  |
|                    |  |              |  | 20                 | 40 | 60 | 80 | 10                                   | 20 | 30 | 40 | F | E | D | CBA |  |  |  |  |
| 100                | --- CONTINUED FROM PREVIOUS PAGE ---<br>Blotchy grey DOLOMITE, fine crystalline, moderately indurated, weakly laminated, tabular to platy chips (Amabel Fm)                |              |  |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
|                    | Small fracture or vug at 103.3 m depth   |              |  |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 105                | Becoming darker grey colour and weakly laminated<br>Trace fossils from 106.7 m to 111.3 m depth<br>Trace fine sulphides from 108.2 m to 109.7 m depth                      |              |  |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 110                |  |              |  |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 115                | Dark grey DOLOMITE, disseminated fine sulphides, platy to flaggy chips, crystalline contains thin shale lined fractures<br>Grey SHALE (Rochester Fm)<br>Dark grey DOLOMITE |              | 184.86<br>115.80<br>183.16<br>117.50<br>118.25 |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 120                | Dull brownish-gray DOLOMITE, interbedded green, soft shale, black mottling, disseminated sulphides, thinly laminated, platy chips<br>END OF BOREHOLE                       |              | 180.86<br>119.80<br>179.46<br>121.20           |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 125                |  |              |  |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 130                |  |              |  |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 135                |  |              |  |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 140                |  |              |  |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 145                |  |              |  |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |
| 150                |  |              |  |                    |    |    |    |                                      |    |    |    |   |   |   |     |  |  |  |  |

MIS-HYD 003 05-1112-010.GPJ GAL-MISS.GDT 4/23/07



# LOG OF DRILLING OPERATIONS



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**P10-TW1-09**

Page 1 of 6

|                                       |   |  |
|---------------------------------------|---|--|
| Client: <b>Region of Waterloo</b>     | Project Name: <b>P10 Test Well Construction</b> | Logged by: <b>S. Quinlan</b>               |
| Project No.: <b>MTA16513.1</b>        | Location: <b>Pinebush Rd. Cambridge</b>         | Ground (m amsl): <b>-314</b>               |
| Drilling Co.: <b>Well Initiatives</b> | Date Started: <b>10/15/2009</b>                 | Static Water Level (m amsl): <b>-304.5</b> |
| Drilling Method: <b>Mud Rotary</b>    | Date Completed: <b>10/22/2009</b>               | Sand Pack (m amsl): <b>NA</b>              |

| Depth Scale<br>(ft) (m) | Stratigraphic Description          | Strat. Plot          | Depth (m) | Diagram   | SAMPLE |      |      | Depth Scale<br>(ft) (m) |
|-------------------------|------------------------------------|----------------------|-----------|-----------|--------|------|------|-------------------------|
|                         |                                    |                      |           |           | Num.   | Type | Int. |                         |
|                         | Surface Elevation (m): <b>-314</b> |                      |           |           |        |      |      |                         |
| 1.0                     | SILTY CLAY - brown                 | [Stratigraphic Plot] |           | [Diagram] | 81     | GRAB | G    | 1.0                     |
| 5.0                     |                                    |                      |           |           | 82     | GRAB | G    | 2.0                     |
| 10.0                    |                                    |                      |           |           | 83     | GRAB | G    | 3.0                     |
| 15.0                    |                                    |                      |           |           | 84     | GRAB | G    | 4.0                     |
| 20.0                    |                                    |                      |           |           | 85     | GRAB | G    | 5.0                     |
| 25.0                    |                                    |                      |           |           | 86     | GRAB | G    | 6.0                     |
| 30.0                    |                                    |                      |           |           | 87     | GRAB | G    | 7.0                     |
| 35.0                    |                                    |                      |           |           | 88     | GRAB | G    | 8.0                     |
| 40.0                    |                                    |                      |           |           | 89     | GRAB | G    | 9.0                     |
| 45.0                    |                                    |                      |           |           | 90     | GRAB | G    | 10.0                    |
| 50.0                    | CLAY - with silt, brown            | [Stratigraphic Plot] | 19.90     | [Diagram] | 91     | GRAB | G    | 11.0                    |
| 55.0                    |                                    |                      |           |           | 92     | GRAB | G    | 12.0                    |
| 60.0                    |                                    |                      |           |           | 93     | GRAB | G    | 13.0                    |
| 65.0                    |                                    |                      |           |           | 94     | GRAB | G    | 14.0                    |
| 70.0                    |                                    |                      |           |           | 95     | GRAB | G    | 15.0                    |
| 75.0                    |                                    |                      |           |           | 96     | GRAB | G    | 16.0                    |
| 80.0                    |                                    |                      |           |           | 97     | GRAB | G    | 17.0                    |
| 85.0                    | SILTY CLAY - brown                 | [Stratigraphic Plot] | 23.50     | [Diagram] | 98     | GRAB | G    | 18.0                    |
| 90.0                    |                                    |                      |           |           | 99     | GRAB | G    | 19.0                    |
| 95.0                    | GRAVEL - with sand, brown          | [Stratigraphic Plot] | 24.10     | [Diagram] | 100    | GRAB | G    | 20.0                    |
| 100.0                   |                                    |                      |           |           | 101    | GRAB | G    | 21.0                    |
| 105.0                   | SILT - with sand and gravel, brown | [Stratigraphic Plot] | 25.30     | [Diagram] | 102    | GRAB | G    | 22.0                    |
| 110.0                   |                                    |                      |           |           | 103    | GRAB | G    | 23.0                    |

steel casing

Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **12/2/2009**

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|  |   |  |
|--|---|--|
| <b>LEGEND</b><br>Water found @ time of drilling<br>Static Water Level - 10/27/2009 | <b>MONITORING WELL DATA</b><br>Pipe: 15.9 cm dia. steel<br>Screen: 15.6 cm dia. open hole | <b>SAMPLE TYPE AC</b> Auger Cutting<br>CS  Continuous<br>RC  Rock Core<br>SS  Split Spoon<br>AR  Air Rotary<br>WC  Wash Cuttings |
|--|---|--|

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# LOG OF DRILLING OPERATIONS

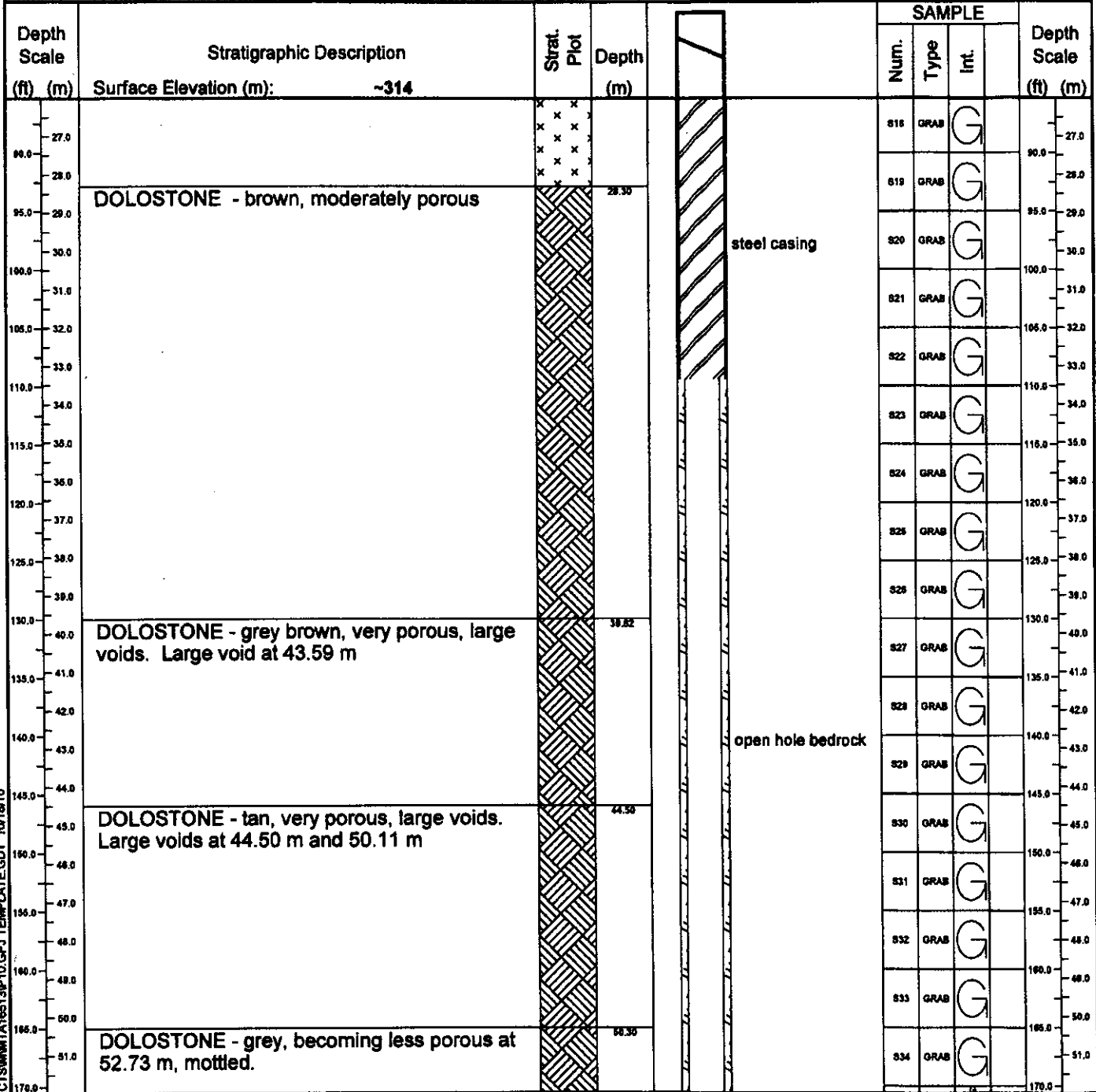


R.J. Burnside & Associates Ltd. Inc.  
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Telephone (519) 941-5331 Fax (519) 941-6120

**P10-TW1-09**

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|                                       |   |  |
|---------------------------------------|---|--|
| Client: <b>Region of Waterloo</b>     | Project Name: <b>P10 Test Well Construction</b> | Logged by: <b>S. Quinlan</b>               |
| Project No.: <b>MTA16513.1</b>        | Location: <b>Pinebush Rd. Cambridge</b>         | Ground (m amsl): <b>~314</b>               |
| Drilling Co.: <b>Well Initiatives</b> | Date Started: <b>10/15/2009</b>                 | Static Water Level (m amsl): <b>~304.5</b> |
| Drilling Method: <b>Mud Rotary</b>    | Date Completed: <b>10/22/2009</b>               | Sand Pack (m amsl): <b>NA</b>              |



Prepared By: **S. Quinlan**      Checked By: **J. Baxter**      Date Prepared: **12/2/2009**  
 This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

|                                 |                                       |                       |               |
|---------------------------------|---------------------------------------|-----------------------|---------------|
| <b>LEGEND</b>                   | <b>MONITORING WELL DATA</b>           | <b>SAMPLE TYPE AC</b> |               |
| Water found @ time of drilling  | Pipe: <b>15.9 cm dia. steel</b>       | Auger Cutting         | Split Spoon   |
| Static Water Level - 10/27/2009 | Screen: <b>15.6 cm dia. open hole</b> | Continuous            | Air Rotary    |
|                                 |                                       | Rock Core             | Wash Cuttings |

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# LOG OF DRILLING OPERATIONS

**P10-TW1-09**

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R.J. Burnside & Associates Ltd. No. 1  
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Telephone (519) 941-5331 Fax (519) 941-8120

|                                       |   |  |
|---------------------------------------|---|--|
| Client: <b>Region of Waterloo</b>     | Project Name: <b>P10 Test Well Construction</b> | Logged by: <b>S. Quinlan</b>               |
| Project No.: <b>MTA16513.1</b>        | Location: <b>Pinebush Rd. Cambridge</b>         | Ground (m amsl): <b>~314</b>               |
| Drilling Co.: <b>Well Initiatives</b> | Date Started: <b>10/15/2009</b>                 | Static Water Level (m amsl): <b>~304.5</b> |
| Drilling Method: <b>Mud Rotary</b>    | Date Completed: <b>10/22/2009</b>               | Sand Pack (m amsl): <b>NA</b>              |

| Depth Scale (ft) (m) | Stratigraphic Description                  | Strat. Plot | Depth (m) | SAMPLE |      |      | Depth Scale (ft) (m) |
|----------------------|--|-------------|-----------|--------|------|------|----------------------|
|                      |  |             |           | Num.   | Type | Int. |                      |
|                      | Surface Elevation (m): <b>~314</b>         |             |           |        |      |      |                      |
| 53.0                 |  |             |           | 535    | GRAB | G    | 53.0                 |
| 54.0                 |  |             |           | 536    | GRAB | G    | 54.0                 |
| 55.0                 |  |             |           | 537    | GRAB | G    | 55.0                 |
| 56.0                 |  |             |           | 538    | GRAB | G    | 56.0                 |
| 57.0                 |  |             |           | 539    | GRAB | G    | 57.0                 |
| 58.0                 |  |             |           | 540    | GRAB | G    | 58.0                 |
| 59.0                 |  |             |           | 541    | GRAB | G    | 59.0                 |
| 60.0                 |  |             |           | 542    | GRAB | G    | 60.0                 |
| 61.0                 |  |             |           | 543    | GRAB | G    | 61.0                 |
| 62.0                 |  |             |           | 544    | GRAB | G    | 62.0                 |
| 63.0                 |  |             |           | 545    | GRAB | G    | 63.0                 |
| 64.0                 |  |             |           | 546    | GRAB | G    | 64.0                 |
| 65.0                 |  |             |           | 547    | GRAB | G    | 65.0                 |
| 66.0                 |  |             |           | 548    | GRAB | G    | 66.0                 |
| 67.0                 |  |             |           | 549    | GRAB | G    | 67.0                 |
| 68.0                 |  |             |           | 550    | GRAB | G    | 68.0                 |
| 69.0                 |  |             |           | 551    | GRAB | G    | 69.0                 |
| 70.0                 |  |             |           |        |      |      | 70.0                 |
| 71.0                 |  |             |           |        |      |      | 71.0                 |
| 72.0                 |  |             |           |        |      |      | 72.0                 |
| 73.0                 |  |             |           |        |      |      | 73.0                 |
| 74.0                 |  |             |           |        |      |      | 74.0                 |
| 75.0                 |  |             |           |        |      |      | 75.0                 |
| 76.0                 |  |             |           |        |      |      | 76.0                 |
| 77.0                 | <b>DOLOSTONE - tan, moderately porous.</b> |             | 76.20     |        |      |      | 77.0                 |
| 78.0                 |  |             |           |        |      |      | 78.0                 |
| 79.0                 |  |             |           |        |      |      | 79.0                 |
| 80.0                 |  |             |           |        |      |      | 80.0                 |
| 81.0                 |  |             |           |        |      |      | 81.0                 |
| 82.0                 |  |             |           |        |      |      | 82.0                 |
| 83.0                 |  |             |           |        |      |      | 83.0                 |
| 84.0                 |  |             |           |        |      |      | 84.0                 |
| 85.0                 |  |             |           |        |      |      | 85.0                 |
| 86.0                 |  |             |           |        |      |      | 86.0                 |
| 87.0                 |  |             |           |        |      |      | 87.0                 |
| 88.0                 |  |             |           |        |      |      | 88.0                 |
| 89.0                 |  |             |           |        |      |      | 89.0                 |
| 90.0                 |  |             |           |        |      |      | 90.0                 |
| 91.0                 |  |             |           |        |      |      | 91.0                 |
| 92.0                 |  |             |           |        |      |      | 92.0                 |
| 93.0                 |  |             |           |        |      |      | 93.0                 |
| 94.0                 |  |             |           |        |      |      | 94.0                 |
| 95.0                 |  |             |           |        |      |      | 95.0                 |
| 96.0                 |  |             |           |        |      |      | 96.0                 |
| 97.0                 |  |             |           |        |      |      | 97.0                 |
| 98.0                 |  |             |           |        |      |      | 98.0                 |
| 99.0                 |  |             |           |        |      |      | 99.0                 |
| 100.0                |  |             |           |        |      |      | 100.0                |
| 101.0                |  |             |           |        |      |      | 101.0                |
| 102.0                |  |             |           |        |      |      | 102.0                |
| 103.0                |  |             |           |        |      |      | 103.0                |
| 104.0                |  |             |           |        |      |      | 104.0                |
| 105.0                |  |             |           |        |      |      | 105.0                |
| 106.0                |  |             |           |        |      |      | 106.0                |
| 107.0                |  |             |           |        |      |      | 107.0                |
| 108.0                |  |             |           |        |      |      | 108.0                |
| 109.0                |  |             |           |        |      |      | 109.0                |
| 110.0                |  |             |           |        |      |      | 110.0                |
| 111.0                |  |             |           |        |      |      | 111.0                |
| 112.0                |  |             |           |        |      |      | 112.0                |
| 113.0                |  |             |           |        |      |      | 113.0                |
| 114.0                |  |             |           |        |      |      | 114.0                |
| 115.0                |  |             |           |        |      |      | 115.0                |
| 116.0                |  |             |           |        |      |      | 116.0                |
| 117.0                |  |             |           |        |      |      | 117.0                |
| 118.0                |  |             |           |        |      |      | 118.0                |
| 119.0                |  |             |           |        |      |      | 119.0                |
| 120.0                |  |             |           |        |      |      | 120.0                |
| 121.0                |  |             |           |        |      |      | 121.0                |
| 122.0                |  |             |           |        |      |      | 122.0                |
| 123.0                |  |             |           |        |      |      | 123.0                |
| 124.0                |  |             |           |        |      |      | 124.0                |
| 125.0                |  |             |           |        |      |      | 125.0                |

open hole bedrock

Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **12/2/2009**

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|  |   |  |  |
|--|---|--|--|
| <b>LEGEND</b><br>Water found @ time of drilling<br>Static Water Level - 10/27/2009 | <b>MONITORING WELL DATA</b><br>Pipe: 15.9 cm dia. steel<br>Screen: 15.6 cm dia. open hole | <b>SAMPLE TYPE AC</b> Auger Cutting<br>Continuous<br>Rock Core | Split Spoon<br>Air Rotary<br>Wash Cuttings |
|--|---|--|--|

BHLOG GUELPH P:\GINT\PROJECTS\MMTA\G16513\P10.GPJ TEMPLATE GDT (01/18/10)

# LOG OF DRILLING OPERATIONS

**P10-TW1-09**

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|                                       |   |  |
|---------------------------------------|---|--|
| Client: <b>Region of Waterloo</b>     | Project Name: <b>P10 Test Well Construction</b> | Logged by: <b>S. Quinlan</b>               |
| Project No.: <b>MTA16513.1</b>        | Location: <b>Pinebush Rd. Cambridge</b>         | Ground (m amsl): <b>~314</b>               |
| Drilling Co.: <b>Well Initiatives</b> | Date Started: <b>10/15/2009</b>                 | Static Water Level (m amsl): <b>~304.5</b> |
| Drilling Method: <b>Mud Rotary</b>    | Date Completed: <b>10/22/2009</b>               | Sand Pack (m amsl): <b>NA</b>              |

| Depth Scale (ft) (m) | Stratigraphic Description   | Strat. Plot | Depth (m) | SAMPLE |      |      | Depth Scale (ft) (m) |
|----------------------|---|-------------|-----------|--------|------|------|----------------------|
|                      |   |             |           | Num.   | Type | Int. |                      |
|                      | Surface Elevation (m): <b>~314</b>  |             |           |        |      |      |                      |
| 79.0                 | DOLOSTONE - grey, moderately porous, large void at 81.08 m becoming mottled   |             | 79.55     | 852    | GRAB | G    | 79.0                 |
| 80.0                 |   |             | 853       | GRAB   | G    | 80.0 |                      |
| 81.0                 |   |             | 854       | GRAB   | G    | 81.0 |                      |
| 82.0                 |   |             | 855       | GRAB   | G    | 82.0 |                      |
| 83.0                 | DOLOSTONE - tan, horizontal fractures, moderately porous, richly fossiliferous. Large open area from 85.95 m to 86.87 m |             | 84.12     | 856    | GRAB | G    | 84.0                 |
| 85.0                 |   |             | 857       | GRAB   | G    | 85.0 |                      |
| 86.0                 |   |             | 858       | GRAB   | G    | 86.0 |                      |
| 87.0                 | DOLOSTONE -grey, moderately porous, richly fossiliferous  |             | 87.28     | 859    | GRAB | G    | 87.0                 |
| 88.0                 | DOLOSTONE - tan, moderately porous, richly fossiliferous.   |             | 89.06     | 860    | GRAB | G    | 89.0                 |
| 90.0                 |   |             | 861       | GRAB   | G    | 90.0 |                      |
| 91.0                 | DOLOSTONE - grey, slightly to moderately porous, mottled, richly fossiliferous  |             | 96.32     | 862    | GRAB | G    | 91.0                 |
| 92.0                 |   |             | 863       | GRAB   | G    | 92.0 |                      |
| 93.0                 |   |             | 864       | GRAB   | G    | 93.0 |                      |
| 94.0                 |   |             | 865       | GRAB   | G    | 94.0 |                      |
| 95.0                 |   |             | 866       | GRAB   | G    | 95.0 |                      |
| 96.0                 |   |             | 867       | GRAB   | G    | 96.0 |                      |
| 97.0                 |   |             | 868       | GRAB   | G    | 97.0 |                      |
| 98.0                 |   |             | 869       | GRAB   | G    | 98.0 |                      |
| 99.0                 |   |             |           |        |      |      |                      |
| 100.0                |   |             |           |        |      |      |                      |
| 101.0                |   |             |           |        |      |      |                      |
| 102.0                |   |             |           |        |      |      |                      |
| 103.0                |   |             |           |        |      |      |                      |
| 104.0                |   |             |           |        |      |      |                      |

open hole bedrock

Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **12/2/2009**

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|                                 |                                       |                       |               |             |
|---------------------------------|---------------------------------------|-----------------------|---------------|-------------|
| <b>LEGEND</b>                   | <b>MONITORING WELL DATA</b>           | <b>SAMPLE TYPE AC</b> | Auger Cutting | Split Spoon |
| Water found @ time of drilling  | Pipe: <b>15.9 cm dia. steel</b>       | CS                    | Continuous    | AR          |
| Static Water Level - 10/27/2009 | Screen: <b>15.6 cm dia. open hole</b> | RC                    | Rock Core     | WC          |

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# LOG OF DRILLING OPERATIONS



R.J. Burnside & Associates Ltd.  
 15 Tavolara, Orangeville, Ontario L9W 3M4  
 Telephone (519) 941-5331 Fax (519) 941-6120

**P10-TW1-09**

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|                                       |   |  |
|---------------------------------------|---|--|
| Client: <b>Region of Waterloo</b>     | Project Name: <b>P10 Test Well Construction</b> | Logged by: <b>S. Quinlan</b>               |
| Project No.: <b>MTA16513.1</b>        | Location: <b>Pinebush Rd. Cambridge</b>         | Ground (m amsl): <b>~314</b>               |
| Drilling Co.: <b>Well Initiatives</b> | Date Started: <b>10/15/2009</b>                 | Static Water Level (m amsl): <b>~304.6</b> |
| Drilling Method: <b>Mud Rotary</b>    | Date Completed: <b>10/22/2009</b>               | Sand Pack (m amsl): <b>NA</b>              |

| Depth Scale (ft) (m) | Stratigraphic Description  | Strat. Plot | Depth (m) | SAMPLE |      |      | Depth Scale (ft) (m) |
|----------------------|--|-------------|-----------|--------|------|------|----------------------|
|                      |  |             |           | Num.   | Type | Int. |                      |
|                      | Surface Elevation (m): <b>~314</b>   |             |           |        |      |      |                      |
| 345.0 - 105.0        | DOLOSTONE - tan, moderately porous becoming very porous starting at 105.77 m, mottled, vugs and slightly fossiliferous | [Pattern]   |           | 569    | GRAB | G    | 345.0 - 106.0        |
| 350.0 - 106.0        |  |             |           | 570    | GRAB | G    | 350.0 - 106.0        |
| 355.0 - 107.0        |  |             |           | 571    | GRAB | G    | 355.0 - 107.0        |
| 360.0 - 108.0        |  |             |           | 572    | GRAB | G    | 360.0 - 108.0        |
| 365.0 - 109.0        |  |             |           | 573    | GRAB | G    | 365.0 - 109.0        |
| 370.0 - 110.0        | DOLOSTONE - grey, moderately porous, slightly fossiliferous  | [Pattern]   | 110.84    | 574    | GRAB | G    | 370.0 - 110.0        |
| 375.0 - 111.0        |  |             |           | 575    | GRAB | G    | 375.0 - 111.0        |
| 380.0 - 112.0        |  |             |           | 576    | GRAB | G    | 380.0 - 112.0        |
| 385.0 - 113.0        | DOLOSTONE - tan, moderately porous, slightly fossiliferous   | [Pattern]   | 113.39    | 577    | GRAB | G    | 385.0 - 113.0        |
| 390.0 - 114.0        |  |             |           | 578    | GRAB | G    | 390.0 - 114.0        |
| 395.0 - 115.0        |  |             |           | 579    | GRAB | G    | 395.0 - 115.0        |
| 400.0 - 116.0        | DOLOSTONE - grey, slightly porous, mottled, slightly fossiliferous   | [Pattern]   | 116.82    | 580    | GRAB | G    | 400.0 - 116.0        |
| 405.0 - 117.0        |  |             |           | 581    | GRAB | G    | 405.0 - 117.0        |
| 410.0 - 118.0        |  |             |           | 582    | GRAB | G    | 410.0 - 118.0        |
| 415.0 - 119.0        |  |             |           | 583    | GRAB | G    | 415.0 - 119.0        |
| 420.0 - 120.0        |  |             |           | 584    | GRAB | G    | 420.0 - 120.0        |
| 425.0 - 121.0        |  |             |           | 585    | GRAB | G    | 425.0 - 121.0        |
| 430.0 - 122.0        |  |             |           |        |      |      |                      |
| 435.0 - 123.0        |  |             |           |        |      |      |                      |
| 440.0 - 124.0        |  |             |           |        |      |      |                      |
| 445.0 - 125.0        | DOLOSTONE - dark grey and white, mottled, slightly porous.   | [Pattern]   | 124.36    |        |      |      |                      |
| 450.0 - 126.0        |  |             |           |        |      |      |                      |
| 455.0 - 127.0        |  |             |           |        |      |      |                      |
| 460.0 - 128.0        |  |             |           |        |      |      |                      |
| 465.0 - 129.0        |  |             |           |        |      |      |                      |
| 470.0 - 130.0        |  |             |           |        |      |      |                      |

open hole bedrock

Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **12/2/2009**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

|                                 |                                       |                    |                   |                 |
|---------------------------------|---------------------------------------|--------------------|-------------------|-----------------|
| <b>LEGEND</b>                   | <b>MONITORING WELL DATA</b>           | <b>SAMPLE TYPE</b> | AC  Auger Cutting | SS  Split Spoon |
| Water found @ time of drilling  | Pipe: <b>15.9 cm dia. steel</b>       | CS  Continuous     | AR  Air Rotary    |                 |
| Static Water Level - 10/27/2009 | Screen: <b>15.6 cm dia. open hole</b> | RC  Rock Core      | WC  Wash Cuttings |                 |

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# LOG OF DRILLING OPERATIONS

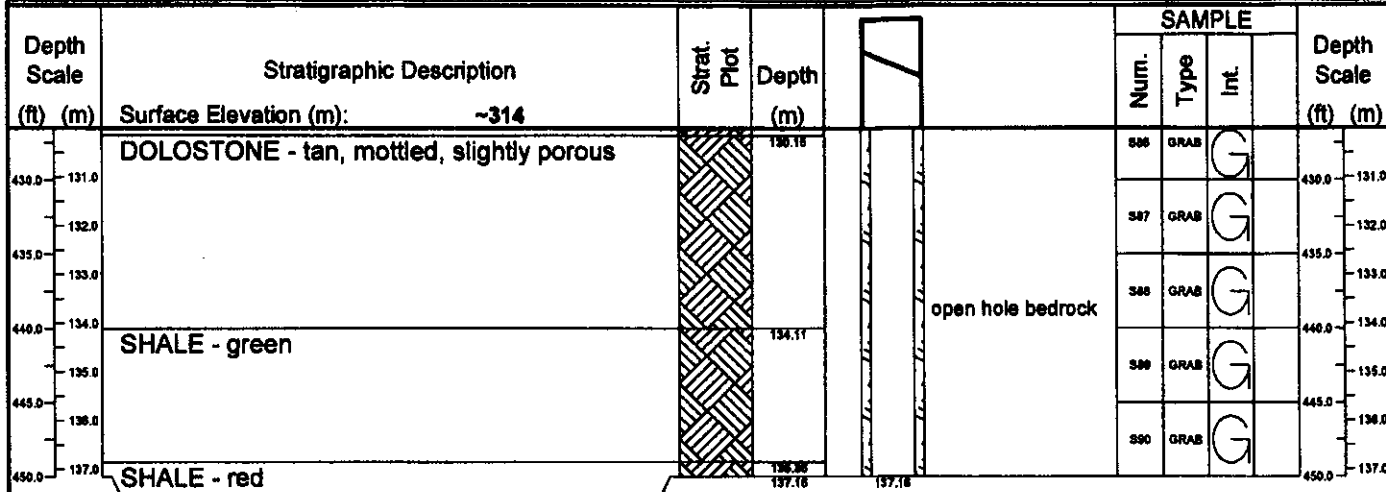
P10-TW1-09

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R.J. Burnside & Associates Limited  
 15 Terraviva, Orangeville, Ontario L9W 3P4  
 telephone (519) 941-5331 fax (519) 941-8120

|                                       |   |  |
|---------------------------------------|---|--|
| Client: <b>Region of Waterloo</b>     | Project Name: <b>P10 Test Well Construction</b> | Logged by: <b>S. Quinlan</b>               |
| Project No.: <b>MTA16513.1</b>        | Location: <b>Pinebush Rd. Cambridge</b>         | Ground (m amsl): <b>~314</b>               |
| Drilling Co.: <b>Well Initiatives</b> | Date Started: <b>10/15/2009</b>                 | Static Water Level (m amsl): <b>~304.5</b> |
| Drilling Method: <b>Mud Rotary</b>    | Date Completed: <b>10/22/2009</b>               | Sand Pack (m amsl): <b>NA</b>              |



Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **12/2/2009**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

|  |   |   |
|--|---|---|
| <b>LEGEND</b><br>Water found @ time of drilling<br>Static Water Level - 10/27/2009 | <b>MONITORING WELL DATA</b><br>Pipe: 15.9 cm dia. steel<br>Screen: 15.8 cm dia. open hole | <b>SAMPLE TYPE AC</b><br>Auger Cutting<br>Continuous<br>Rock Core<br>Split Spoon<br>Air Rotary<br>Wash Cuttings |
|--|---|---|

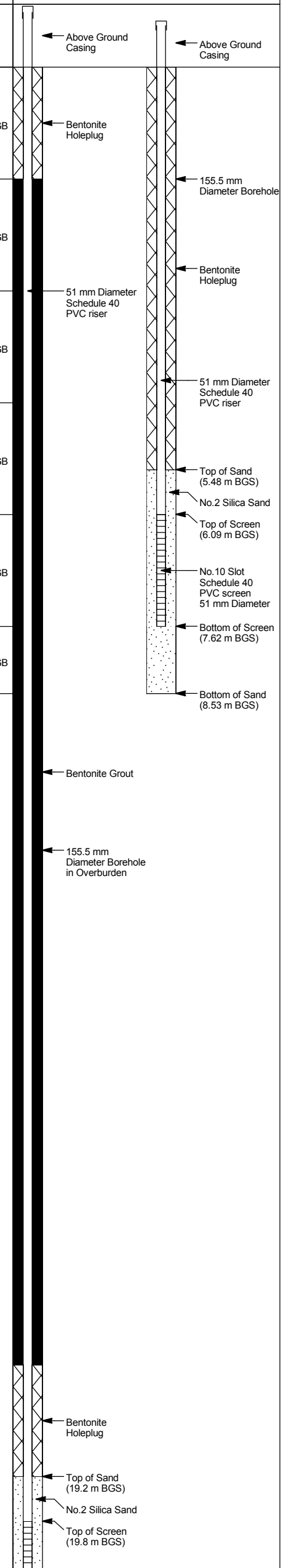
BH LOG GUELPH PROJECT SWM MTA16513 SP10.GPJ TEMPLATE.GOT 10/18/10

### Monitoring Well: C-PB-OW1AB-11

**Project:** Well Construction/Replacement  
**Client:** Region of Waterloo  
**Location:** Cambridge, ON  
**Number:** 160900651

**Field investigator:** E. Hayman  
**Contractor:** Gerrits Well Drilling  
**Drilling method:** Truck mount, DR24, air rotary  
**Date started/completed:** 26-Jul-2011 / 29-Jul-2011

| SUBSURFACE PROFILE   |  |                        |   | HYDROGEOLOGY                |  | SAMPLE DETAILS   |                | WELL DETAILS   |  |
|----------------------|--|------------------------|---|-----------------------------|--|------------------|----------------|--|--|
| Depth<br>(ft)<br>(m) | Graphic Log  | Lithologic Description | Elevation<br>(m AMSL)<br>Depth<br>(m BGS) | Hydro<br>Stratigraphic Unit | Description  | Sample<br>Number | Sample<br>Type | Name:<br>C-PB-OW1A-11<br>GS Elev: 307.39 m AMSL<br>TOC Elev: 308.25 m AMSL<br>Easting: 557123<br>Northing: 4806116<br>Stick-up: 0.86 m | Name:<br>C-PB-OW1B-11<br>GS Elev: 307.44 m AMSL<br>TOC Elev: 308.10 m AMSL<br>Easting: 557123<br>Northing: 4806119<br>Stick-up: 0.66 m |
| 0                    | Ground Surface   |                        | 307.39<br>0.00                            |                             |  |                  |                |  |  |
| 0 - 5                | TOPSOIL<br>medium to coarse sand and little gravel, brown (7.5 YR 4/3), gravel varies in colour, non-uniform, dry, subrounded gravel   |                        | 305.86<br>1.52                            |                             |  | 1                | GB             |  |  |
| 5 - 20               | SAND and GRAVEL<br>medium to coarse sand, small to large few gravel, brown (7.5 YR 4/3), gravel varies in colour, non-uniform, dry to moist, subrounded to rounded gravel<br><br>wet at 3.05 m BGS |                        | 301.29<br>6.10                            | AFB1/<br>AFB3               | Upper and Lower Moraine Stratified Sediments and Equivalents | 2<br>3<br>4      | GB<br>GB<br>GB |  |  |
| 20 - 25              | SAND<br>fine to medium sand, trace silt, brown (7.5 YR 4/3), wet   |                        | 299.77<br>7.62                            |                             |  | 5                | GB             |  |  |
| 25 - 60              | SILTY SAND<br>fine sand and silt, brown (7.5 YR 4/3), wet  |                        | 289.10<br>18.29                           | ATC1                        | Upper/Main Catfish Creek Till                                | 6                | GB             |  |  |
| 60 - 65              | SAND<br>fine to coarse grained, some gravel  |                        |   |                             |  |                  |                |  |  |



Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 GB - grab sample  
 n/a - not available

m AMSL - metres above mean sea level  
 mBGS - metres below ground surface



STANTEC BOREHOLE AND WELL - CLUST 11X17 160900651\_BOREHOLES\_110909.GPJ STANTEC - DATA TEMPLATE.GDT 1/20/12 AVANDENHOFF



ALIPER

GAMMA

RESISTIVITY  
(0.08 m Electrode Spacing)

RESISTIVITY  
(0.08 m Electrode Spacing)

C-PB-OW1-92

GRADE

EM-OW1BC-92

114990

GRAVE. LL

PEAT, ORGANIC MATERIAL

CLAY, SILT, VERY FINE SAND

FINE TO VERY FINE SAND, SILT, FINE GRAVEL

CLAY, SILT

SILT, VERY FINE SAND, CLAY

SAND, GRAVEL

TILL, COBBLES

SAND, GRAVEL

SAND, GRAVEL, TILL

BEDROCK - DOLOSTONE

OW1-C-92

OW1-B-92

Depth Below Grade (feet)

100

**LEGEND**



2m Silica Sand Pack



0.25mm Slot PVC Monitor Well Screen

Well Screen Intervals Isolated and Sealed with Bentonite Gravel

1 foot = 0.3048 metres

# LOTOWATER LTD.

REGIONAL MUNICIPALITY OF WATERLOO

Clemens Mill Aquifer Study

Cambridge, Ontario

OVERBURDEN LOGS AND WELL COMPLETION

INTERVALS AT OW1/92

Project: 006-024

March 1993

# Monitoring Well: C-PB-OW1-22

**Project:** Cambridge East Drilling  
**Client:** Region of Waterloo  
**Location:** Township of Puslinch; Concession 2, Puslinch, east of Wellington Rd 32  
**Number:** 160900968

**Field Investigator:** S. Hutchinson  
**Contractor:** Aardvark Drilling Inc.  
**Drilling method:** CME 75 truck mount - Hollow Stem Auger/PQ Mud Rotary/HQ  
**Date started/completed:** 04-Jan-2022 / 24-Jan-2022

| SUBSURFACE PROFILE |  |   |                                     | HYDROGEOLOGY         |                             | SAMPLE DETAILS               |               |             |             |     |     | GEOPHYSIC DETAILS   |              |             |                     | WELL DETAILS      |   |   |                               |
|--------------------|--|---|-------------------------------------|----------------------|-----------------------------|------------------------------|---------------|-------------|-------------|-----|-----|---------------------|--------------|-------------|---------------------|-------------------|---|---|-------------------------------|
| Depth (ft)         | Graphic Log                                  | Lithologic Description  | Elevation (m AMSL)<br>Depth (m BGS) | Optical<br>Televiwer | Hydro<br>Stratigraphic Unit | Description                  | Sample Number | Sample Type | Recovery    | SCR | RQD | Fractures per 1.52m | Caliper (cm) | Gamma (cps) | Resistivity (Ohm.m) | Static Flow (m/s) | Name:<br>Location:<br>GS Elev:<br>TOC Elev:<br>Easting:<br>Northing:<br>Stick-up:         | Name:<br>Location:<br>GS Elev:<br>TOC Elev:<br>Easting:<br>Northing:<br>Stick-up:         |                               |
| 0                  |  | Ground Surface  | 312.87                              |                      |                             |                              |               |             |             |     |     |                     |              |             |                     |                   | C-PB-OW1-22A<br>9207772A<br>312.57 m AMSL<br>313.25 m AMSL<br>4808506<br>560859<br>0.68 m | C-PB-OW1-22H<br>9207772H<br>312.69 m AMSL<br>313.46 m AMSL<br>4808506<br>560862<br>0.77 m |                               |
| 0                  | TOPSOIL                                      | Organics, fine- to medium-grained sand, trace fine gravel, very dark greyish brown (10YR 3/2), moist, loose.  | 0.00                                |                      |                             |                              | A             | SS          | 17"<br>71%  | n/a | n/a | n/a                 |              |             |                     |                   |   | Bentonite Holeplug Outside of 114 mm Casing 0 to 0.6 m                                    | Bentonite Holeplug 0 to 3.1 m |
| 0                  | SILTY SAND                                   | Fine-grained sand, fine to coarse gravel, subangular to angular, brown (10YR 5/3), moist, loose.  | 312.42                              |                      |                             |                              | B             | SS          | 16"<br>16%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 2                  |  |   | 310.13                              |                      |                             |                              | C             | SS          | 25"<br>67%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 2                  |  |   | 310.13                              |                      |                             |                              |               |             | 104%        |     |     |                     |              |             |                     |                   |   |   |                               |
| 4                  | GRAVEL                                       | Fine to coarse gravel, some silt and sand, trace cobbles, subangular, dark yellowish brown (10YR4/4), wet, loose  | 2.44                                |                      | AFA2                        | Outwash sand and gravel      | 1             | PQ          | 26"<br>100% | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 4                  |  |   |                                     |                      |                             |                              | 2             | PQ          | 58"<br>100% | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 6                  |  |   |                                     |                      |                             |                              | 3             | PQ          | 52"<br>87%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 6                  |  |   |                                     |                      |                             |                              | 4             | PQ          | 30"<br>50%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 8                  |  |   | 304.09                              |                      |                             |                              | 5             | PQ          | 35"<br>58%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 8                  |  |   | 8.48                                |                      |                             |                              | 6             | PQ          | 13"<br>22%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 10                 | SILT   | some fine grained sand, trace fine to coarse gravel, subangular to subrounded, dark yellowish-brown ( 10 YR 4/4), wet loose, poorly graded.   |                                     |                      | ATB1                        | Silty to clayey till         | 7             | PQ          | 51"<br>85%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 10                 |  | Stiff at 10.7 m, returns to soft at 11.4 m.   |                                     |                      |                             |                              | 8             | PQ          | 57"<br>95%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 12                 |  |   | 300.28                              |                      |                             |                              |               |             |             |     |     |                     |              |             |                     |                   |   |   |                               |
| 12                 | CLAYEY SILT                                  | Trace fine-grained sand, trace fine- to coarse-gravel, subrounded, brown (7.5 YR 4/3), moist, stiff.  | 12.29                               |                      |                             |                              | 9             | PQ          | 51"<br>85%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 12                 |  |   | 298.85                              |                      |                             |                              | 10            | PQ          | 53"<br>88%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 14                 | SAND   | Fine-grained sand, some silt, light brownish-grey (10 YR 6/2), moist to wet, firm.<br>Small (<2 mm) laminations of silt (dark-grey 10 YR 4/1), moist to wet, loose (14.1 to 14.4 m)<br>Medium-grained sand beginning at 14.4 m.<br>Trace fine-gravel beginning at 15.4 m, subangular to subrounded. | 13.72                               |                      |                             |                              | 11            | PQ          | 38"<br>63%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 14                 |  |   | 296.32                              |                      |                             |                              | 12            | PQ          | 24"<br>40%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 16                 | GRAVEL                                       | Some medium-grained sand, subrounded, greyish-brown (10 YR 5/2), poorly graded.   | 16.25                               |                      |                             |                              | 13            | PQ          | 46"<br>77%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 16                 |  |   | 292.45                              |                      |                             |                              | 14            | PQ          | 56"<br>93%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 18                 | SAND   | Fine-grained sand with trace silt, subrounded, dark yellowish-brown (10 YR 4/4), firm, wet.<br>Medium-coarse grained sand, soft from 20.6 to 21.7 m.  | 20.12                               |                      | AFB1                        | Moraine stratified sediments | 15            | PQ          | 60"<br>100% | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 18                 |  |   | 290.04                              |                      |                             |                              | 16            | PQ          | 60"<br>100% | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 20                 | GRAVELY SAND                                 | Medium- to coarse-sand, subrounded, brown (10 YR 4/3), wet, soft, well graded.  | 22.53                               |                      |                             |                              | 17            | PQ          | 31"<br>52%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 20                 | GRAVEL & COBBLES (matrix likely washed away) | Fine- to coarse-gravel, rounded to subangular, loose, well graded   | 22.86                               |                      |                             |                              | 18            | PQ          | 47"<br>78%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 20                 |  |   | 284.99                              |                      |                             |                              | 19            | PQ          | 60"<br>100% | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 22                 |  |   | 281.30                              |                      |                             |                              | 20            | PQ          | 33"<br>55%  | n/a | n/a | n/a                 |              |             |                     |                   |   |   |                               |
| 22                 |  |   | 31.27                               |                      |                             |                              |               |             |             |     |     |                     |              |             |                     |                   |   |   |                               |
| 24                 | CLAY TILL                                    | Some silt, grey (10 YR 5/1), moist, hard, homogeneous.  | 27.58                               |                      |                             |                              |               |             |             |     |     |                     |              |             |                     |                   |   |   |                               |
| 24                 |  | Wet from 29.9 to 30.4 m.  |                                     |                      | ATB2                        | Silty to clayey till         |               |             |             |     |     |                     |              |             |                     |                   |   |   |                               |

Screen Interval: 96.93 - 99.97; 22.56 - 25.60 m BGS  
 Sand Pack Interval: 21.79 - 25.60 m BGS  
 Well Seal Interval: 0.00 - 21.79 m BGS

Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 SS - split-spoon sample  
 PQ - wireline continuous core sample  
 n/a - not available/applicable

Geophysical testing was completed by Lotwater Technical Services Inc. within the open bedrock borehole at C-PB-OW1-22A from January 27 to 28, 2022. Gamma counts within the overburden are based on testing within the PVC casing at C-PB-OW1-22H on March 30, 2022.



# Monitoring Well: C-PB-OW1-22

**Project:** Cambridge East Drilling  
**Client:** Region of Waterloo  
**Location:** Township of Puslinch; Concession 2, Puslinch, east of Wellington Rd 32  
**Number:** 160900968

**Field Investigator:** S. Hutchinson  
**Contractor:** Aardvark Drilling Inc.  
**Drilling method:** CME 75 truck mount - Hollow Stem Auger/PQ Mud Rotary/HQ  
**Date started/completed:** 04-Jan-2022 / 24-Jan-2022

| SUBSURFACE PROFILE |           |             |   | HYDROGEOLOGY                        |                       |                                | SAMPLE DETAILS                  |                  |                |             |              |              | GEOPHYSIC DETAILS      |                 |                |                        | WELL DETAILS         |   |   |   |
|--------------------|-----------|-------------|---|-------------------------------------|-----------------------|--------------------------------|---------------------------------|------------------|----------------|-------------|--------------|--------------|------------------------|-----------------|----------------|------------------------|----------------------|---|---|---|
| Depth (ft)         | Depth (m) | Graphic Log | Lithologic Description  | Elevation (m AMSL)<br>Depth (m BGS) | Optical<br>Televiewer | Hydro<br>Stratigraphic<br>Unit | Description                     | Sample<br>Number | Sample<br>Type | Recovery    | SCR          | RQD          | Fractures<br>per 1.52m | Caliper<br>(cm) | Gamma<br>(cps) | Resistivity<br>(Ohm.m) | Static Flow<br>(m/s) | Name:<br>Location:<br>GS Elev:<br>TOC Elev:<br>Easting:<br>Northing:<br>Stick-up: | Name:<br>Location:<br>GS Elev:<br>TOC Elev:<br>Easting:<br>Northing:<br>Stick-up: |   |
| 105                | 32        |             | CLAY-GRAVEL TILL<br>Some silt, fine to coarse gravel, grey (10YR 5/1), subangular to subrounded, wet, soft, well graded.                              | 280.74<br>31.83                     |                       |                                |                                 | 21               | PQ             | 47"<br>78%  | 36.5"<br>61% | 34"<br>57%   | 4                      |                 |                |                        |                      |   | C-PB-OW1-22A<br>9207772A<br>312.57 m AMSL   | C-PB-OW1-22H<br>9207772H<br>312.69 m AMSL |
| 110                | 34        |             | SANDY SILT<br>some gravel, dark grey (10YR 4/1) subrounded, wet, soft, well graded.   | 280.08                              |                       |                                |                                 | 22               | PQ             | 51"<br>85%  | 51"<br>85%   | 48.5"<br>81% | 7                      |                 |                |                        |                      |   | 313.25 m AMSL   | 313.46 m AMSL                             |
| 115                | 36        |             | GUELPH FORMATION<br>Dolostone, dark grey/brown, coral, sponges, crinoids  | 32.49                               |                       | Guelph<br>Formation            |                                 | BR1              | HQ             | 63"<br>100% | 60"<br>95%   | 49"<br>78%   | 6                      |                 |                |                        |                      |   |   |   |
| 120                | 38        |             |   |                                     | BR2                   |                                | HQ                              | 61"<br>100%      | 59"<br>97%     | 54"<br>89%  | 5            |              |                        |                 |                |                        |                      |   |   |   |
| 125                | 40        |             |   |                                     | BR3                   |                                | HQ                              | 60"<br>100%      | 60"<br>100%    | 60"<br>100% | 1            |              |                        |                 |                |                        |                      |   |   |   |
| 130                | 42        |             |   |                                     | BR4                   |                                | HQ                              | 60"<br>100%      | 59"<br>98%     | 60"<br>100% | 4            |              |                        |                 |                |                        |                      |   |   |   |
| 135                | 44        |             |   |                                     | BR5                   |                                | HQ                              | 58"<br>97%       | 57"<br>95%     | 55"<br>92%  | 4            |              |                        |                 |                |                        |                      |   |   |   |
| 140                | 46        |             |   |                                     | BR6                   |                                | HQ                              | 62"<br>103%      | 60"<br>100%    | 58"<br>97%  | 3            |              |                        |                 |                |                        |                      |   |   |   |
| 145                | 48        |             |   |                                     | BR7                   |                                | HQ                              | 59"<br>98%       | 58"<br>97%     | 59"<br>98%  | 1            |              |                        |                 |                |                        |                      |   |   |   |
| 150                | 50        |             | Fossiliferous from 44.7 to 47.7 m.<br>Flow profile indicates 25% of flow from 45.4 to 52.3 m.   | 263.19<br>49.38                     |                       |                                | Reformatory<br>Quarry<br>Member |                  | BR8            | HQ          | 61"<br>102%  | 60"<br>100%  | 61"<br>102%            | 1               |                |                        |                      |   |   |   |
| 155                | 52        |             | ERAMOSIA FORMATION, REFORMATORY QUARRY MEMBER<br>Dolostone, brown to dark brown, vuggy, mineralization in vugs  | 260.30<br>52.27                     |                       |                                |                                 | BR9              | HQ             | 60"<br>100% | 57.5"<br>96% | 51"<br>85%   | 7                      |                 |                |                        |                      |   |   |   |
| 160                | 54        |             | ERAMOSIA FORMATION, VINEMOUNT MEMBER<br>Dark brown to black, fine crystalline, horizontally thinly bedded dolostone. Petroliferous odour when broken. |                                     |                       | BR10                           |                                 | HQ               | 62"<br>103%    | 60"<br>100% | 56"<br>93%   | 6            |                        |                 |                |                        |                      |   |   |   |
| 165                | 56        |             |   |                                     |                       | Vinemount<br>Member            |                                 | BR11             | HQ             | 55"<br>95%  | 53"<br>91%   | 49"<br>85%   | 6                      |                 |                |                        |                      |   |   |   |
| 170                | 58        |             |   |                                     | BR12                  |                                | HQ                              | 60"<br>100%      | 52"<br>87%     | 51"<br>85%  | 8            |              |                        |                 |                |                        |                      |   |   |   |
| 175                | 60        |             |   |                                     | BR13                  |                                | HQ                              | 61"<br>102%      | 60"<br>100%    | 58"<br>97%  | 4            |              |                        |                 |                |                        |                      |   |   |   |
| 180                | 62        |             |   |                                     | BR14                  |                                | HQ                              | 60"<br>100%      | 56"<br>93%     | 57"<br>95%  | 4            |              |                        |                 |                |                        |                      |   |   |   |
| 185                | 64        |             |   |                                     |                       | Goat Island<br>Formation       |                                 | BR15             | HQ             | 58"<br>97%  | 56"<br>93%   | 58"<br>97%   | 7                      |                 |                |                        |                      |   |   |   |
| 190                | 66        |             | GOAT ISLAND FORMATION, ANCASTER MEMBER<br>Finely crystalline dolostone, thinly bedded, grey. Black chert nodules.                                     | 253.44<br>59.13                     |                       |                                | BR16                            | HQ               | 60"<br>100%    | 60"<br>100% | 60"<br>100%  | 4            |                        |                 |                |                        |                      |   |   |   |
| 195                | 68        |             |   |                                     | BR17                  |                                | HQ                              | 60"<br>100%      | 45"<br>75%     | 41"<br>68%  | 6            |              |                        |                 |                |                        |                      |   |   |   |
| 200                | 70        |             |   |                                     | BR18                  |                                | HQ                              | 60"<br>100%      | 54"<br>90%     | 47"<br>78%  | 4            |              |                        |                 |                |                        |                      |   |   |   |
| 205                | 72        |             | GASPORT FORMATION<br>Dolostone, alternating blue grey crinoidal reef mound with light grey coquinas   | 249.78<br>62.79                     |                       |                                |                                 |                  |                |             |              |              |                        |                 |                |                        |                      |   |   |   |

← Bentonite Grout  
35.5 to 39.0 m

← 96 mm Borehole  
Diameter  
35.5 to 122.4 m

← Bentonite  
Holeplug  
(Pel-Plug)  
39.0 to 95.9 m

Screen Interval: 96.93 - 99.97; 22.56 - 25.60 m BGS  
 Sand Pack Interval: 21.79 - 25.60 m BGS  
 Well Seal Interval: 0.00 - 21.79 m BGS

Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 SS - split-spoon sample  
 PQ - wireline continuous core sample  
 n/a - not available/applicable

Geophysical testing was completed by Lotowater  
 Technical Services Inc. within the open bedrock  
 borehole at C-PB-OW1-22A from January 27 to 28,  
 2022. Gamma counts within the overburden are  
 based on testing within the PVC casing at  
 C-PB-OW1-22H on March 30, 2022.



# Monitoring Well: C-PB-OW1-22

**Project:** Cambridge East Drilling  
**Client:** Region of Waterloo  
**Location:** Township of Puslinch; Concession 2, Puslinch, east of Wellington Rd 32  
**Number:** 160900968

**Field Investigator:** S. Hutchinson  
**Contractor:** Aardvark Drilling Inc.  
**Drilling method:** CME 75 truck mount - Hollow Stem Auger/PQ Mud Rotary/HQ  
**Date started/completed:** 04-Jan-2022 / 24-Jan-2022

| SUBSURFACE PROFILE |             |  |                                    | HYDROGEOLOGY      |                          | SAMPLE DETAILS |               |             |             |            |             | GEOPHYSIC DETAILS   |              |             |                     | WELL DETAILS      |                    |                        |                         |                         |
|--------------------|-------------|--|------------------------------------|-------------------|--------------------------|----------------|---------------|-------------|-------------|------------|-------------|---------------------|--------------|-------------|---------------------|-------------------|--------------------|------------------------|-------------------------|-------------------------|
| Depth (ft)         | Graphic Log | Lithologic Description   | Elevation (m AMSL) / Depth (m BGS) | Optical Televiwer | Hydro Stratigraphic Unit | Description    | Sample Number | Sample Type | Recovery    | SCR        | RQD         | Fractures per 1.52m | Caliper (cm) | Gamma (cps) | Resistivity (Ohm.m) | Static Flow (m/s) | Name: C-PB-OW1-22A | Name: C-PB-OW1-22H     |                         |                         |
| 210                | 64          | GASPORT FORMATION<br>Dolostone, alternating blue grey crinoidal reef mound with light grey coquinas<br><br>Flow profile indicates 10% of flow from 69.9 m to 74.9 m. This interval contains a relatively high concentration of fractures (up to 3 cm thick) relative to the rest of the formation.<br><br>Flow profile indicates 20% of flow from 79.0 m to 83.3 m. This interval contains an elevated concentration of fractures relative to the rest of the formation.<br><br>Flow profile indicates 40% of flow between 94 and 99 m, concurrent with several fractures in a coquina interval. |                                    |                   | Gasport Formation        |                | BR19          | HQ          | 60"<br>100% | 59"<br>98% | 60"<br>100% | 2                   |              |             |                     |                   | Location: 9207772A | Location: 9207772H     |                         |                         |
| 215                | 66          |  | BR20                               | HQ                |                          | 60"<br>100%    | 57"<br>95%    | 57"<br>95%  | 3           |            |             |                     |              |             |                     |                   |                    | GS Elev: 312.57 m AMSL | GS Elev: 312.69 m AMSL  |                         |
| 220                | 68          |  | BR21                               | HQ                |                          | 60"<br>100%    | 58"<br>97%    | 59"<br>98%  | 2           |            |             |                     |              |             |                     |                   |                    |                        | TOC Elev: 313.25 m AMSL | TOC Elev: 313.46 m AMSL |
| 225                | 70          |  | BR22                               | HQ                |                          | 62"<br>100%    | 62"<br>100%   | 62"<br>100% | 1           |            |             |                     |              |             |                     |                   |                    |                        | Easting: 4808506        | Easting: 4808506        |
| 230                | 72          |  | BR23                               | HQ                |                          | 58"<br>100%    | 57"<br>98%    | 55"<br>95%  | 3           |            |             |                     |              |             |                     |                   |                    |                        | Northing: 560859        | Northing: 560862        |
| 235                | 74          |  | BR24                               |                   |                          | 62"<br>100%    | 60"<br>97%    | 59"<br>95%  | 1           |            |             |                     |              |             |                     |                   |                    |                        | Stick-up: 0.68 m        | Stick-up: 0.77 m        |
| 240                | 76          |  | BR25                               | HQ                |                          | 59"<br>102%    | 49"<br>85%    | 41"<br>71%  | 5           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 245                | 78          |  | BR26                               | HQ                |                          | 60"<br>100%    | 57"<br>95%    | 56"<br>93%  | 2           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 250                | 80          |  | BR27                               | HQ                |                          | 61"<br>102%    | 61"<br>102%   | 61"<br>102% | 1           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 255                | 82          |  | BR28                               | HQ                |                          | 60"<br>100%    | 60"<br>100%   | 60"<br>100% | 0           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 260                | 84          |  | BR29                               | HQ                |                          | 60"<br>100%    | 59"<br>98%    | 59"<br>98%  | 2           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 265                | 86          |  | BR30                               | HQ                |                          | 60"<br>100%    | 57"<br>95%    | 59"<br>98%  | 2           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 270                | 88          |  | BR31                               | HQ                |                          | 60"<br>100%    | 60"<br>100%   | 60"<br>100% | 0           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 275                | 90          |  | BR32                               | HQ                |                          | 60"<br>100%    | 55"<br>92%    | 56"<br>93%  | 4           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 280                | 92          |  | BR33                               | HQ                |                          | 60"<br>100%    | 59"<br>98%    | 55"<br>92%  | 2           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 285                | 94          |  | BR34                               | HQ                |                          | 61"<br>102%    | 58"<br>97%    | 61"<br>102% | 4           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 290                | 96          |  | BR35                               | HQ                |                          | 59"<br>98%     | 59"<br>98%    | 59"<br>98%  | 1           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 295                | 98          |  | BR36                               | HQ                |                          | 53"<br>100%    | 52"<br>98%    | 50"<br>94%  | 2           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 300                | 100         |  | BR37                               | HQ                |                          | 55"<br>100%    | 55"<br>100%   | 53"<br>96%  | 2           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 305                | 102         |  | BR38                               | HQ                |                          | 60"<br>100%    | 59"<br>98%    | 58"<br>97%  | 2           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |
| 310                | 104         |  | BR39                               | HQ                |                          | 73"<br>100%    | 73"<br>100%   | 73"<br>100% | 1           |            |             |                     |              |             |                     |                   |                    |                        |                         |                         |

← 96 mm Borehole Diameter  
 35.5 to 122.4 m  
 Bentonite Holeplug (Pel-Plug)  
 39.0 to 95.9 m

STANTEC BOREHOLE AND WELL - MASTER TX11 - 160900968-20221007 CAMBRIDGE EAST LOGS GPI DATA TEMPLATE\_ENVS\_CA\_140725.GDT 3/13/23 AHEALEY

Screen Interval: 96.93 - 99.97; 22.56 - 25.60 m BGS  
 Sand Pack Interval: 21.79 - 25.60 m BGS  
 Well Seal Interval: 0.00 - 21.79 m BGS

Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 SS - split-spoon sample  
 PQ - wireline continuous core sample  
 n/a - not available/applicable

Geophysical testing was completed by Lotwater Technical Services Inc. within the open bedrock borehole at C-PB-OW1-22A from January 27 to 28, 2022. Gamma counts within the overburden are based on testing within the PVC casing at C-PB-OW1-22H on March 30, 2022.



# Monitoring Well: C-PB-OW1-22

**Project:** Cambridge East Drilling  
**Client:** Region of Waterloo  
**Location:** Township of Puslinch; Concession 2, Puslinch, east of Wellington Rd 32  
**Number:** 160900968

**Field Investigator:** S. Hutchinson  
**Contractor:** Aardvark Drilling Inc.  
**Drilling method:** CME 75 truck mount - Hollow Stem Auger/PQ Mud Rotary/HQ  
**Date started/completed:** 04-Jan-2022 / 24-Jan-2022

| SUBSURFACE PROFILE |                                  |   |                                     | HYDROGEOLOGY          |                             |                       | SAMPLE DETAILS |             |             |             |             |                     | GEOPHYSIC DETAILS |             |                     |                   | WELL DETAILS  |   |  |  |
|--------------------|----------------------------------|---|-------------------------------------|-----------------------|-----------------------------|-----------------------|----------------|-------------|-------------|-------------|-------------|---------------------|-------------------|-------------|---------------------|-------------------|---|---|--|--|
| Depth (ft)         | Graphic Log                      | Lithologic Description  | Elevation (m AMSL)<br>Depth (m BGS) | Optical<br>Televiewer | Hydro<br>Stratigraphic Unit | Description           | Sample Number  | Sample Type | Recovery    | SCR         | RQD         | Fractures per 1.52m | Caliper (cm)      | Gamma (cps) | Resistivity (Ohm.m) | Static Flow (m/s) | Name: C-PB-OW1-22A<br>Location: 9207772A<br>GS Elev: 312.57 m AMSL<br>TOC Elev: 313.25 m AMSL<br>Easting: 4808506<br>Northing: 560859<br>Stick-up: 0.68 m | Name: C-PB-OW1-22H<br>Location: 9207772H<br>GS Elev: 312.69 m AMSL<br>TOC Elev: 313.46 m AMSL<br>Easting: 4808506<br>Northing: 560862<br>Stick-up: 0.77 m |  |  |
| 315                | [Graphic Log: Gasport Formation] | GASPORT FORMATION<br>Dolostone, alternating blue grey crinoidal reef mound with light grey coquinas |                                     | [Optical Televiewer]  | -                           | -                     | BR40           | HQ          | 59"<br>98%  | 58"<br>97%  | 59"<br>98%  | 2                   | [Caliper]         | [Gamma]     | [Resistivity]       | [Static Flow]     | No.2 Silica Sand<br>95.9 to 99.9 m  | No. 10 Slot<br>60 mm OD<br>PVC Screen<br>96.9 to 99.9 m   |  |  |
| 320                |                                  |   | BR41                                |                       |                             |                       | HQ             | 61"<br>102% | 60"<br>100% | 61"<br>102% | 1           |                     |                   |             |                     |                   |   |   |  |  |
| 325                |                                  |   | BR42                                |                       |                             |                       | HQ             | 59"<br>98%  | 52"<br>87%  | 55"<br>92%  | 3           |                     |                   |             |                     |                   |   |   |  |  |
| 330                |                                  |   | BR43                                |                       |                             |                       | HQ             | 59"<br>98%  | 59"<br>98%  | 57"<br>95%  | 1           |                     |                   |             |                     |                   |   |   |  |  |
| 335                |                                  |   | BR44                                |                       |                             |                       | HQ             | 56"<br>93%  | 55"<br>92%  | 53"<br>88%  | 3           |                     |                   |             |                     |                   |   |   |  |  |
| 340                |                                  |   | BR45                                |                       |                             |                       | HQ             | 60"<br>100% | 60"<br>100% | 60"<br>100% | 1           |                     |                   |             |                     |                   |   |   |  |  |
| 345                |                                  |   | BR46                                |                       |                             |                       | HQ             | 60"<br>100% | 59"<br>98%  | 60"<br>100% | 2           |                     |                   |             |                     |                   |   |   |  |  |
| 350                |                                  |   | BR47                                |                       |                             |                       | HQ             | 60"<br>100% | 58"<br>97%  | 60"<br>100% | 1           |                     |                   |             |                     |                   |   |   |  |  |
| 355                |                                  |   | BR48                                |                       |                             |                       | HQ             | 60"<br>100% | 58"<br>97%  | 58"<br>97%  | 2           |                     |                   |             |                     |                   |   |   |  |  |
| 360                |                                  |   | BR49                                |                       |                             |                       | HQ             | 60"<br>100% | 58"<br>97%  | 60"<br>100% | 2           |                     |                   |             |                     |                   |   |   |  |  |
| 365                |                                  | ROCHESTER FORMATION<br>Dark grey shale  | 201.39<br>111.18<br>201.32          |                       |                             | Rochester Formation   | BR50           | HQ          | 60"<br>100% | 57"<br>95%  | 57"<br>95%  | 2                   |                   |             |                     |                   |   |   |  |  |
| 370                |                                  | IRONDEQUOIT FORMATION<br>Dolostone, fine crystalline, medium bedded, grey to light grey             | 111.25<br>200.40                    |                       |                             | Irondequoit Formation | BR51           | HQ          | 60"<br>100% | 60"<br>100% | 60"<br>100% | 1                   |                   |             |                     |                   |   |   |  |  |
| 375                |                                  | ROCKWAY FORMATION<br>Greenish-grey argillaceous dolostone with thin shaly partings                  | 112.17<br>199.18                    |                       |                             | Rockway Formation     |                |             |             |             |             |                     |                   |             |                     |                   |   |   |  |  |
| 375                |                                  | MERRITTON FORMATION<br>Pinkish-brown, bioturbated, finely crystalline, dolostone, pyrite rich       | 113.39<br>197.66                    |                       |                             | Merritton Formation   | BR52           | HQ          | 53"<br>88%  | 50"<br>83%  | 48"<br>80%  | 4                   |                   |             |                     |                   |   |   |  |  |
| 380                |                                  | CABOT HEAD FORMATION<br>Grey/green to red/maroon, shale   | 114.91                              |                       |                             | Cabot Head Formation  | BR53           | HQ          | 57"<br>97%  | 56"<br>95%  | 49"<br>83%  | 6                   |                   |             |                     |                   |   |   |  |  |
| 385                |                                  |   |                                     |                       | BR54                        |                       | HQ             | 61"<br>100% | 60"<br>98%  | 44"<br>72%  | 10          |                     |                   |             |                     |                   |   |   |  |  |
| 390                |                                  |   |                                     |                       | BR55                        |                       | HQ             | 60"<br>100% | 59"<br>98%  | 54"<br>90%  | 5           |                     |                   |             |                     |                   |   |   |  |  |
| 395                |                                  |   |                                     |                       | BR56                        |                       | HQ             | 58"<br>97%  | 57"<br>95%  | 47"<br>78%  | 7           |                     |                   |             |                     |                   |   |   |  |  |
| 400                |                                  |   |                                     |                       | BR57                        |                       | HQ             | 60"<br>100% | 60"<br>100% | 50"<br>83%  | 8           |                     |                   |             |                     |                   |   |   |  |  |
| 405                |                                  | End of Borehole   | 190.19<br>122.38                    |                       |                             |                       |                |             |             |             |             |                     |                   |             |                     |                   |   |   |  |  |

STANTEC BOREHOLE AND WELL - MASTER TX11 - 160900968-20221007 CAMBRIDGE EAST LOGS GPI DATA TEMPLATE\_ENVS\_CA\_140725.GDT 3/13/23 AHEALEY

DRAWN

Screen Interval: 96.93 - 99.97; 22.56 - 25.60 m BGS  
 Sand Pack Interval: 21.79 - 25.60 m BGS  
 Well Seal Interval: 0.00 - 21.79 m BGS

Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 SS - split-spoon sample  
 PQ - wireline continuous core sample  
 n/a - not available/applicable

Geophysical testing was completed by Lotowater Technical Services Inc. within the open bedrock borehole at C-PB-OW1-22A from January 27 to 28, 2022. Gamma counts within the overburden are based on testing within the PVC casing at C-PB-OW1-22H on March 30, 2022.



# Monitoring Well: C-PB-OW2-22

**Project:** Cambridge East Drilling  
**Client:** Region of Waterloo  
**Location:** Township of Puslinch; Concession 1, Puslinch, east of Sideroad 10  
**Number:** 160900968

**Field Investigator:** S. Hutchinson/ R. Baker  
**Contractor:** Aardvark Drilling Inc.  
**Drilling method:** CME 75 truck mount - Hollow Stem Auger/PQ Mud Rotary/HQ  
**Date started/completed:** 31-Jan-2022 / 14-Feb-2022

| SUBSURFACE PROFILE   |             |                        |   | HYDROGEOLOGY         |                                |             | SAMPLE DETAILS   |                |          |      |       |                        | GEOPHYSIC DETAILS |                |                        | WELL DETAILS   |  |  |  |  |  |
|--|-------------|------------------------|---|----------------------|--------------------------------|-------------|------------------|----------------|----------|------|-------|------------------------|-------------------|----------------|------------------------|--|--|--|--|--|--|
| Depth<br>(ft)<br>(m)   | Graphic Log | Lithologic Description | Elevation<br>(m AMSL)<br>Depth<br>(m BGS) | Optical<br>Televiwer | Hydro<br>Stratigraphic<br>Unit | Description | Sample<br>Number | Sample<br>Type | Recovery | SCR  | RQD   | Fractures<br>per 1.52m | Caliper<br>(cm)   | Gamma<br>(cps) | Resistivity<br>(Ohm.m) | Name: C-PB-OW2-22-A  |  |  |  |  |  |
|  |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        | Name: C-PB-OW2-22-B  |  |  |  |  |  |
| Name: C-PB-OW2-22-A<br>Location: 9207773A<br>GS Elev: 302.42 m AMSL<br>TOC Elev: 303.28 m AMSL<br>Easting: 4806872<br>Northing: 562939<br>Stick-up: 0.86 m |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        | Name: C-PB-OW2-22-B<br>Location: 9207773B<br>GS Elev: 302.67 m AMSL<br>TOC Elev: 303.07 m AMSL<br>Easting: 4806874<br>Northing: 562938<br>Stick-up: 0.40 m |  |  | Name: C-PB-OW2-22-C<br>Location: 9207773C<br>GS Elev: 302.38 m AMSL<br>TOC Elev: 303.26 m AMSL<br>Easting: 4806870<br>Northing: 562937<br>Stick-up: 0.88 m |  |  |
| 0  |             | Ground Surface         | 302.72                                    |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        |  |  |  |  |  |  |
| 0  |             |                        | 302.42                                    |                      |                                |             | A                | SS             | n/a      | n/a  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 0  |             |                        | 0.00                                      |                      |                                |             | B                | SS             | n/a      | n/a  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 0  |             |                        | 301.68                                    |                      |                                |             | C                | SS             | n/a      | n/a  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 0  |             |                        | 0.74                                      |                      |                                |             |                  | N/A            | n/a      | n/a  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 1  |             |                        |   |                      |                                |             | 1                | PQ             | 24"      | 40%  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 2  |             |                        |   |                      |                                |             | 2                | PQ             | 31"      | 52%  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 3  |             |                        |   |                      |                                |             | 3                | PQ             | 27"      | 45%  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 4  |             |                        |   |                      |                                |             | 4                | PQ             | 22"      | 37%  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 5  |             |                        |   |                      |                                |             | 5                | PQ             | 54"      | 90%  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 6  |             |                        |   |                      |                                |             | 6                | PQ             | 46"      | 77%  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 7  |             |                        |   |                      |                                |             | 7                | PQ             | 12"      | 20%  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 8  |             |                        |   |                      |                                |             | 8                | PQ             | n/a      | n/a  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 9  |             |                        |   |                      |                                |             | 9                | PQ             | 25"      | 42%  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 10   |             |                        |   |                      |                                |             | 10               | PQ             | 60"      | 100% | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 11   |             |                        |   |                      |                                |             | 11               | PQ             | 42"      | 70%  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 12   |             |                        |   |                      |                                |             | 12               | PQ             | 60"      | 100% | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 13   |             |                        |   |                      |                                |             | 13               | PQ             | 52"      | 87%  | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 14   |             |                        |   |                      |                                |             | 14               | PQ             | 60"      | 100% | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 15   |             |                        |   |                      |                                |             | 15               | PQ             | 60"      | 100% | n/a   | n/a                    |                   |                |                        |  |  |  |  |  |  |
| 16   |             |                        |   |                      |                                |             | BR1              | HQ             | 60"      | 100% | 55"   | 92%                    | 48"               | 80%            | 9                      |  |  |  |  |  |  |
| 17   |             |                        |   |                      |                                |             | BR2              | HQ             | 60"      | 100% | 58.5" | 98%                    | 56"               | 93%            | 4                      |  |  |  |  |  |  |
| 18   |             |                        |   |                      |                                |             | BR3              | HQ             | 60"      | 100% | 57"   | 95%                    | 57.5"             | 96%            | 3                      |  |  |  |  |  |  |
| 19   |             |                        |   |                      |                                |             | BR4              | HQ             | 61.5"    | 59"  | 59.5" |                        |                   | 4              |                        |  |  |  |  |  |  |
| 20   |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        |  |  |  |  |  |  |
| 21   |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        |  |  |  |  |  |  |
| 22   |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        |  |  |  |  |  |  |
| 23   |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        |  |  |  |  |  |  |
| 24   |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        |  |  |  |  |  |  |
| 25   |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        |  |  |  |  |  |  |
| 26   |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        |  |  |  |  |  |  |
| 27   |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        |  |  |  |  |  |  |
| 28   |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        |  |  |  |  |  |  |
| 29   |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        |  |  |  |  |  |  |
| 30   |             |                        |   |                      |                                |             |                  |                |          |      |       |                        |                   |                |                        |  |  |  |  |  |  |

STANTEC BOREHOLE AND WELL - MASTER TX11 - 160900968-20221007\_CAMBRIDGE\_EAST\_LOGS\_GPI\_DATA\_TEMPLATE\_ENVS\_CA\_140725.GDT 3/13/23 AHEALEY

Screen Interval: 71.93 - 75.59; 35.96 - 39.01; 15.24 - 16.76 m BGS  
 Sand Pack Interval: 14.63 - 17.07 m BGS  
 Well Seal Interval: 0.61 - 14.63 m BGS

Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 SS - split-spoon sample  
 PQ - wireline continuous core sample  
 n/a - not available/applicable

Geophysical testing was completed by Lotwater Technical Services Inc. within the open bedrock borehole at C-PB-OW2-22A from February 23 to 24, 2022. Gamma counts within the overburden are based on testing within the PVC casing at C-PB-OW2-22C on March 25, 2022.



# Monitoring Well: C-PB-OW2-22

**Project:** Cambridge East Drilling  
**Client:** Region of Waterloo  
**Location:** Township of Puslinch; Concession 1, Puslinch, east of Sideroad 10  
**Number:** 160900968

**Field Investigator:** S. Hutchinson/ R. Baker  
**Contractor:** Aardvark Drilling Inc.  
**Drilling method:** CME 75 truck mount - Hollow Stem Auger/PQ Mud Rotary/HQ  
**Date started/completed:** 31-Jan-2022 / 14-Feb-2022

| SUBSURFACE PROFILE |             |  |                                     | HYDROGEOLOGY          |                                | SAMPLE DETAILS                  |                  |                |               |               |               | GEOPHYSIC DETAILS      |                 |                | WELL DETAILS           |   |   |   |
|--------------------|-------------|--|-------------------------------------|-----------------------|--------------------------------|---------------------------------|------------------|----------------|---------------|---------------|---------------|------------------------|-----------------|----------------|------------------------|---|---|---|
| Depth (ft)         | Graphic Log | Lithologic Description   | Elevation (m AMSL)<br>Depth (m BGS) | Optical<br>Televiewer | Hydro<br>Stratigraphic<br>Unit | Description                     | Sample<br>Number | Sample<br>Type | Recovery      | SCR           | RQD           | Fractures<br>per 1.52m | Caliper<br>(cm) | Gamma<br>(cps) | Resistivity<br>(Ohm.m) | Name:<br>C-PB-OW2-22-A<br>Location:<br>9207773A<br>GS Elev:<br>302.42 m AMSL<br>TOC Elev:<br>303.28 m AMSL<br>Easting:<br>4806872<br>Northing:<br>562939<br>Stick-up:<br>0.86 m | Name:<br>C-PB-OW2-22-B<br>Location:<br>9207773B<br>GS Elev:<br>302.67 m AMSL<br>TOC Elev:<br>303.07 m AMSL<br>Easting:<br>4806874<br>Northing:<br>562938<br>Stick-up:<br>0.40 m | Name:<br>C-PB-OW2-22-C<br>Location:<br>9207773C<br>GS Elev:<br>302.38 m AMSL<br>TOC Elev:<br>303.26 m AMSL<br>Easting:<br>4806870<br>Northing:<br>562937<br>Stick-up:<br>0.88 m |
| 105                | 32          | ERAMOSA FORMATION, REFORMATORY QUARRY MEMBER<br>Dolostone, light grey/brown, coral-stromatoporoid wackestone to grainstone | 270.13<br>32.29                     |                       |                                |                                 | BR5              | HQ             | 60"<br>100%   | 48"<br>80%    | 51.5"<br>86%  | 5                      |                 |                |                        |   |   |   |
| 110                | 34          |  |                                     |                       |                                |                                 | BR6              | HQ             | 60"<br>100%   | 57.5"<br>96%  | 58"<br>97%    | 1                      |                 |                |                        |   |   |   |
| 115                | 36          | Possible seismite bed from 35.8 m to 37.8 m  |                                     |                       |                                |                                 | BR7              | HQ             | 58"<br>97%    | 45"<br>75%    | 47.5"<br>79%  | 6                      |                 |                |                        |   |   |   |
| 120                | 38          |  |                                     |                       |                                |                                 | BR8              | HQ             | 59"<br>98%    | 42"<br>70%    | 44"<br>73%    | 5                      |                 |                |                        |   |   |   |
| 125                | 40          | Within open borehole, static and pumping flow profile indicated outward flow of water from 35 to 45 m                      |                                     |                       |                                | Reformatory<br>Quarry<br>Member | BR9              | HQ             | 60"<br>100%   | 52"<br>87%    | 57"<br>95%    | 5                      |                 |                |                        |   |   |   |
| 130                | 42          |  |                                     |                       |                                |                                 | BR10             | HQ             | 61"<br>102%   | 60"<br>100%   | 60"<br>100%   | 1                      |                 |                |                        |   |   |   |
| 135                | 44          | dolostone, light grey/brown, vuggy, mineralization in vugs from 42.9 to 44.3 m   |                                     |                       |                                |                                 | BR11             | HQ             | 56"<br>93%    | 57"<br>95%    | 57"<br>95%    | 5                      |                 |                |                        |   |   |   |
| 140                | 46          |  |                                     |                       |                                |                                 | BR12             | HQ             | 61"<br>102%   | 53"<br>88%    | 53.5"<br>89%  | 5                      |                 |                |                        |   |   |   |
| 145                | 48          | ERAMOSA FORMATION, VINEMOUNT MEMBER<br>Dark brown to black, horizontal, thinly bedded dolostone with shale partings        | 258.12<br>44.30                     |                       |                                |                                 | BR13             | HQ             | 61.5"<br>103% | 58"<br>97%    | 60"<br>100%   | 8                      |                 |                |                        |   |   |   |
| 150                | 50          |  |                                     |                       |                                |                                 | BR14             | HQ             | 59"<br>98%    | 58"<br>97%    | 56.5"<br>94%  | 4                      |                 |                |                        |   |   |   |
| 155                | 52          |  |                                     |                       |                                |                                 | BR15             | HQ             | 61"<br>102%   | 60"<br>100%   | 60"<br>100%   | 2                      |                 |                |                        |   |   |   |
| 160                | 54          |  |                                     |                       |                                | Vinemount<br>Member             | BR16             | HQ             | 57"<br>95%    | 43"<br>72%    | 41"<br>68%    | 9                      |                 |                |                        |   |   |   |
| 165                | 56          |  |                                     |                       |                                |                                 | BR17             | HQ             | 63"<br>105%   | 59"<br>98%    | 60"<br>100%   | 3                      |                 |                |                        |   |   |   |
| 170                | 58          |  |                                     |                       |                                |                                 | BR18             | HQ             | 60"<br>100%   | 59"<br>98%    | 59.5"<br>99%  | 2                      |                 |                |                        |   |   |   |
| 175                | 60          |  |                                     |                       |                                |                                 | BR19             | HQ             | 60"<br>100%   | 54.5"<br>91%  | 55"<br>92%    | 6                      |                 |                |                        |   |   |   |
| 180                | 62          | GOAT ISLAND FORMATION, ANCASTER MEMBER<br>Dolostone, dark brown to black, fine crystalline, horizontally thinly bedded     | 247.43<br>54.99                     |                       |                                |                                 | BR20             | HQ             | 60"<br>100%   | 59.5"<br>99%  | 59.5"<br>99%  | 2                      |                 |                |                        |   |   |   |
| 185                | 64          | light brown, medium bedded   |                                     |                       |                                | Goat Island<br>Member           | BR21             | HQ             | 60"<br>100%   | 59"<br>98%    | 59.5"<br>99%  | 1                      |                 |                |                        |   |   |   |
| 190                | 66          |  |                                     |                       |                                |                                 | BR22             | HQ             | 59"<br>98%    | 54"<br>90%    | 55"<br>92%    | 2                      |                 |                |                        |   |   |   |
| 195                | 68          | GASPORT FORMATION<br>Dolostone, alternating blue grey crinoidal reef mound with light grey coquinas                        | 243.92<br>58.50                     |                       |                                |                                 | BR23             | HQ             | 61"<br>102%   | 60.5"<br>101% | 60.8"<br>101% | 0                      |                 |                |                        |   |   |   |
| 200                | 70          |  |                                     |                       |                                |                                 | BR24             | HQ             | 59"<br>98%    | 58"<br>97%    | 57"<br>95%    | 1                      |                 |                |                        |   |   |   |
| 205                | 72          |  |                                     |                       |                                |                                 | BR25             | HQ             | 60"           | 54"           | 58"           | 1                      |                 |                |                        |   |   |   |

← No. 2 Silica Sand  
35.1 m to 39.0 m

← No. 10 Slot  
60 mm OD  
PVC Screen  
35.9 to 39.0 m

← 96 mm Borehole  
Diameter  
25.9 to 106.8 m  
Holeplug  
(Pel-Plug)  
25.9 to 71.2 m

STANTEC BOREHOLE AND WELL - MASTER TX11 - 160900968-20221007\_CAMBRIDGE\_EAST\_LOGS.GPJ DATA TEMPLATE\_ENVS\_CA\_140725.GDT 3/13/23 AHEALEY

Screen Interval: 71.93 - 75.59; 35.96 - 39.01; 15.24 - 16.76 m BGS  
 Sand Pack Interval: 14.63 - 17.07 m BGS  
 Well Seal Interval: 0.61 - 14.63 m BGS

Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 SS - split-spoon sample  
 PQ - wireline continuous core sample  
 n/a - not available/applicable

Geophysical testing was completed by Lotwater Technical Services Inc. within the open bedrock borehole at C-PB-OW2-22A from February 23 to 24, 2022. Gamma counts within the overburden are based on testing within the PVC casing at C-PB-OW2-22C on March 25, 2022.

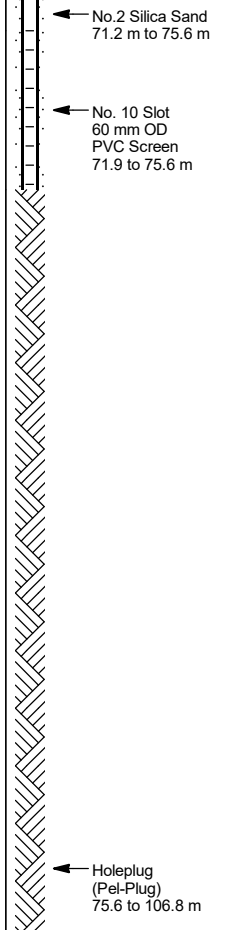


# Monitoring Well: C-PB-OW2-22

**Project:** Cambridge East Drilling  
**Client:** Region of Waterloo  
**Location:** Township of Puslinch; Concession 1, Puslinch, east of Sideroad 10  
**Number:** 160900968

**Field Investigator:** S. Hutchinson/ R. Baker  
**Contractor:** Aardvark Drilling Inc.  
**Drilling method:** CME 75 truck mount - Hollow Stem Auger/PQ Mud Rotary/HQ  
**Date started/completed:** 31-Jan-2022 / 14-Feb-2022

| SUBSURFACE PROFILE |           |             |  | HYDROGEOLOGY                        |                       | SAMPLE DETAILS              |             |               |              |              |       | GEOPHYSIC DETAILS |                     |              | WELL DETAILS |                     |  |  |  |  |  |  |  |  |
|--------------------|-----------|-------------|--|-------------------------------------|-----------------------|-----------------------------|-------------|---------------|--------------|--------------|-------|-------------------|---------------------|--------------|--------------|---------------------|--|--|--|--|--|--|--|--|
| Depth (ft)         | Depth (m) | Graphic Log | Lithologic Description   | Elevation (m AMSL)<br>Depth (m BGS) | Optical<br>Televiewer | Hydro<br>Stratigraphic Unit | Description | Sample Number | Sample Type  | Recovery     | SCR   | RQD               | Fractures per 1.52m | Caliper (cm) | Gamma (cps)  | Resistivity (Ohm.m) | Name: C-PB-OW2-22-A<br>Location: 9207773A<br>GS Elev: 302.42 m AMSL<br>TOC Elev: 303.28 m AMSL<br>Easting: 4806872<br>Northing: 562939<br>Stick-up: 0.86 m | Name: C-PB-OW2-22-B<br>Location: 9207773B<br>GS Elev: 302.67 m AMSL<br>TOC Elev: 303.07 m AMSL<br>Easting: 4806874<br>Northing: 562938<br>Stick-up: 0.40 m | Name: C-PB-OW2-22-C<br>Location: 9207773C<br>GS Elev: 302.38 m AMSL<br>TOC Elev: 303.26 m AMSL<br>Easting: 4806870<br>Northing: 562937<br>Stick-up: 0.88 m |  |  |  |  |  |
| 210                | 64        |             | GASPORT FORMATION<br>Dolostone, alternating blue grey crinoidal reef mound with light grey coquinas<br><br>Flow profile indicated about 60% of flow from 71 to 76 m. |                                     |                       | Gasport Formation           |             |               | 100%         | 90%          | 97%   |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 215                | 66        |             |  | BR26                                |                       |                             | HQ          | 59"<br>98%    | 53"<br>88%   | 57"<br>95%   | 2     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 220                | 68        |             |  | BR27                                |                       |                             | HQ          | 62"<br>103%   | 60"<br>100%  | 61"<br>102%  | 2     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 225                | 70        |             |  | BR28                                |                       |                             | HQ          | 60"<br>100%   | 58.5"<br>98% | 59"<br>98%   | 1     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 230                | 72        |             |  | BR29                                |                       |                             | HQ          | 59"<br>98%    | 58"<br>97%   | 58.5"<br>98% | 1     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 235                | 74        |             |  | BR30                                |                       |                             | HQ          | 60"<br>100%   | 57"<br>95%   | 54"<br>90%   | 3     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 240                | 76        |             |  | BR31                                |                       |                             | HQ          | 60"<br>100%   | 57.5"<br>96% | 59"<br>98%   | 3     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 245                | 78        |             |  | BR32                                |                       |                             | HQ          | 60"<br>100%   | 59"<br>98%   | 56.5"<br>94% | 1     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 250                | 80        |             |  | BR33                                |                       |                             | HQ          | 59.5"<br>99%  | 54.5"<br>91% | 54.5"<br>91% | 4     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 255                | 82        |             |  | BR34                                |                       |                             | HQ          | 60"<br>100%   | 58"<br>97%   | 58"<br>97%   | 2     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 260                | 84        |             |  | BR35                                |                       |                             | HQ          | 58"<br>97%    | 54.5"<br>91% | 52.5"<br>88% | 2     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 265                | 86        |             |  | BR36                                |                       |                             | HQ          | 61"<br>102%   | 59.5"<br>99% | 58.5"<br>98% | 2     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 270                | 88        |             |  | BR37                                |                       |                             | HQ          | 60"<br>100%   | 55.5"<br>93% | 57"<br>95%   | 2     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 275                | 90        |             |  | BR38                                |                       |                             | HQ          | 60"<br>100%   | 56.5"<br>94% | 56.5"<br>94% | 3     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 280                | 92        |             |  | BR39                                |                       |                             | HQ          | 60"<br>100%   | 56.5"<br>94% | 57"<br>95%   | 4     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 285                | 94        |             |  | BR40                                |                       |                             | HQ          | 55"<br>92%    | 53.5"<br>89% | 54"<br>90%   | 1     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 290                | 96        |             |  | BR41                                |                       |                             | HQ          | 61"<br>102%   | 57"<br>95%   | 55"<br>92%   | 3     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 295                | 98        |             |  | BR42                                |                       |                             | HQ          | 60.5"<br>101% | 58.5"<br>98% | 53.5"<br>89% | 4     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 300                | 100       |             |  | BR43                                |                       |                             | HQ          | 63"<br>105%   | 61"<br>102%  | 62"<br>103%  | 2     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 305                | 102       |             |  | BR44                                |                       |                             | HQ          | 59"<br>98%    | 58"<br>97%   | 58.5"<br>98% | 0     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
| 310                | 104       |             |  | BR45                                |                       |                             | HQ          | 60"<br>100%   | 57.5"<br>96% | 54.5"<br>91% | 6     |                   |                     |              |              |                     |  |  |  |  |  |  |  |  |
|                    |           |             |  |                                     |                       |                             |             | BR46          | HQ           | 61"          | 58.5" | 60"               | 3                   |              |              |                     |  |  |  |  |  |  |  |  |



STANTEC BOREHOLE AND WELL - MASTER TX11 - 160900968-20221007 CAMBRIDGE EAST LOGS GPI DATA TEMPLATE\_ENVS\_CA\_140725.GDT 3/13/23 AHEALEY

Screen Interval: 71.93 - 75.59; 35.96 - 39.01; 15.24 - 16.76 m BGS  
 Sand Pack Interval: 14.63 - 17.07 m BGS  
 Well Seal Interval: 0.61 - 14.63 m BGS

Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 SS - split-spoon sample  
 PQ - wireline continuous core sample  
 n/a - not available/applicable

Geophysical testing was completed by Lotwater Technical Services Inc. within the open bedrock borehole at C-PB-OW2-22A from February 23 to 24, 2022. Gamma counts within the overburden are based on testing within the PVC casing at C-PB-OW2-22C on March 25, 2022.



# Monitoring Well: C-PB-OW2-22

**Project:** Cambridge East Drilling  
**Client:** Region of Waterloo  
**Location:** Township of Puslinch; Concession 1, Puslinch, east of Sideroad 10  
**Number:** 160900968

**Field Investigator:** S. Hutchinson/ R. Baker  
**Contractor:** Aardvark Drilling Inc.  
**Drilling method:** CME 75 truck mount - Hollow Stem Auger/PQ Mud Rotary/HQ  
**Date started/completed:** 31-Jan-2022 / 14-Feb-2022

| SUBSURFACE PROFILE |             |   |   | HYDROGEOLOGY         |                             | SAMPLE DETAILS |                  |                |                          |      |             | GEOPHYSIC DETAILS      |                 |                | WELL DETAILS           |  |  |  |               |               |   |
|--------------------|-------------|---|---|----------------------|-----------------------------|----------------|------------------|----------------|--------------------------|------|-------------|------------------------|-----------------|----------------|------------------------|--|--|--|---------------|---------------|---|
| Depth (ft)         | Graphic Log | Lithologic Description  | Elevation (m AMSL)<br>Depth (m BGS)   | Optical<br>Televiwer | Hydro<br>Stratigraphic Unit | Description    | Sample<br>Number | Sample<br>Type | Recovery                 | SCR  | RQD         | Fractures<br>per 1.52m | Caliper<br>(cm) | Gamma<br>(cps) | Resistivity<br>(Ohm.m) | Name:<br>Location:<br>GS Elev:<br>TOC Elev:<br>Easting:<br>Northing:<br>Stick-up:  | Name:<br>Location:<br>GS Elev:<br>TOC Elev:<br>Easting:<br>Northing:<br>Stick-up:  | Name:<br>Location:<br>GS Elev:<br>TOC Elev:<br>Easting:<br>Northing:<br>Stick-up:  |               |               |   |
| 315                |             | GASPORT FORMATION<br>Dolostone, alternating blue grey crinoidal reef mound with light grey coquinas |   |                      | -                           |                |                  |                | 102%                     | 98%  | 100%        |                        |                 |                |                        | Name: C-PB-OW2-22-A<br>Location: 9207773A<br>GS Elev: 302.42 m AMSL<br>TOC Elev: 303.28 m AMSL<br>Easting: 4806872<br>Northing: 562939<br>Stick-up: 0.86 m | Name: C-PB-OW2-22-B<br>Location: 9207773B<br>GS Elev: 302.67 m AMSL<br>TOC Elev: 303.07 m AMSL<br>Easting: 4806874<br>Northing: 562938<br>Stick-up: 0.40 m | Name: C-PB-OW2-22-C<br>Location: 9207773C<br>GS Elev: 302.38 m AMSL<br>TOC Elev: 303.26 m AMSL<br>Easting: 4806870<br>Northing: 562937<br>Stick-up: 0.88 m |               |               |   |
| 320                |             |   |   |                      |                             |                |                  |                | BR47                     | HQ   | 60"<br>100% | 59.5"<br>99%           |                 |                |                        |  |  |  | 59.8"<br>100% | 0             |   |
| 325                |             |   |   |                      |                             |                |                  |                | BR48                     | HQ   | 60"<br>100% | 59"<br>98%             |                 |                |                        |  |  |  | 59.5"<br>99%  | 1             |   |
| 330                |             |   |   |                      |                             |                | 202.50           |                |                          | BR49 | HQ          | 61"<br>102%            |                 |                |                        |  |  |  | 60"<br>100%   | 60.5"<br>101% | 3 |
| 335                |             |   | ROCHESTER FORMATION<br>Dark grey shale  |                      |                             |                | 100.20<br>202.14 |                | Rochester<br>Formation   |      |             |                        |                 |                |                        |  |  |  |               |               |   |
|                    |             |   | IRONDEQUOIT FORMATION<br>Dolostone, fine crystalline, medium bedded, grey to light grey |                      |                             |                | 100.28<br>201.23 |                | Irondequoit<br>Formation | BR50 | HQ          | 59.5"<br>99%           |                 |                |                        |  |  |  | 58.5"<br>98%  | 59"<br>98%    | 4 |
|                    |             |   | ROCKWAY FORMATION<br>Greenish-grey argillaceous dolostone with thin shaley partings     |                      |                             |                | 101.19<br>200.46 |                | Rockway<br>Formation     |      |             |                        |                 |                |                        |  |  |  |               |               |   |
|                    |             |   | MERRITON FORMATION<br>Pinkish-brown, bioturbated, finely crystalline, dolostone         |                      |                             |                | 101.96<br>198.76 |                | Merriton<br>Formation    | BR51 | HQ          | 59"<br>98%             |                 |                |                        |  |  |  | 58.5"<br>98%  | 56.5"<br>94%  | 3 |
|                    |             |   | CABOT HEAD FORMATION<br>Grey/green to red/maroon, shale                                 |                      |                             |                | 103.66           |                | Cabot Head<br>Formation  | BR52 | HQ          | 59"<br>98%             |                 |                |                        |  |  |  | 59.8"<br>100% | 54.5"<br>91%  | 8 |
| 350                |             |   | End of Borehole   |                      |                             |                | 195.61<br>106.81 |                |                          | BR53 | HQ          | 60.5"<br>101%          |                 |                |                        |  |  |  | 60"<br>100%   | 56"<br>93%    | 4 |

Holeplug  
(Pel-Plug)  
75.6 to 106.8 m

DRAFT

Screen Interval: 71.93 - 75.59; 35.96 - 39.01; 15.24 - 16.76 m BGS  
 Sand Pack Interval: 14.63 - 17.07 m BGS  
 Well Seal Interval: 0.61 - 14.63 m BGS

Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 SS - split-spoon sample  
 PQ - wireline continuous core sample  
 n/a - not available/applicable

Geophysical testing was completed by Lotowater Technical Services Inc. within the open bedrock borehole at C-PB-OW2-22A from February 23 to 24, 2022. Gamma counts within the overburden are based on testing within the PVC casing at C-PB-OW2-22C on March 25, 2022.



# Monitoring Well: C-PB-OW3-22

**Project:** Cambridge East Drilling  
**Client:** Region of Waterloo  
**Location:** Township of Puslinch; Ellis Rd, Cambridge (near Puslinch Lake Golf Course)  
**Number:** 160900968

**Field Investigator:** R. Baker  
**Contractor:** Aardvark Drilling Inc.  
**Drilling method:** CME 75 track mount - Hollow Stem Auger/PQ Mud Rotary/HQ  
**Date started/completed:** 17-Feb-2022 / 12-Apr-2022

| SUBSURFACE PROFILE |             |   |                                     | HYDROGEOLOGY       |                          | SAMPLE DETAILS                      |               |             |               |              |              | GEOPHYSIC DETAILS   |             | WELL DETAILS        |  |  |  |
|--------------------|-------------|---|-------------------------------------|--------------------|--------------------------|-------------------------------------|---------------|-------------|---------------|--------------|--------------|---------------------|-------------|---------------------|--|--|--|
| Depth (ft)         | Graphic Log | Lithologic Description  | Elevation (m AMSL)<br>Depth (m BGS) | Optical Televiewer | Hydro Stratigraphic Unit | Description                         | Sample Number | Sample Type | Recovery      | SCR          | ROD          | Fractures per 1.52m | Gamma (cps) | Resistivity (Ohm.m) | Name: C-PB-OW3-22-A<br>Location: 9207774A<br>GS Elev: 303.40 m AMSL<br>TOC Elev: 303.97 m AMSL<br>Easting: 4808938<br>Northing: 558312<br>Stick-up: 0.57 m | Name: C-PB-OW3-22-B<br>Location: 9207774B<br>GS Elev: 303.55 m AMSL<br>TOC Elev: 304.02 m AMSL<br>Easting: 4808939<br>Northing: 558316<br>Stick-up: 0.47 m | Name: C-PB-OW3-22-C<br>Location: 9207774C<br>GS Elev: 303.45 m AMSL<br>TOC Elev: 304.44 m AMSL<br>Easting: 4808937<br>Northing: 558309<br>Stick-up: 0.99 m |
| 0                  |             | Ground Surface  | 303.70<br>303.40<br>0.00            |                    |                          |                                     |               |             |               |              |              |                     |             |                     |  |  |  |
| 4                  |             | SAND, GRAVEL AND COBBLES<br>Fine, medium and coarse sand, small, medium and coarse gravel, well graded, sub-angular, sand matrix washed away.   | 299.59<br>3.81                      |                    |                          |                                     | 1             | PQ          | 19"<br>32%    | n/a          | n/a          | n/a                 |             |                     |  |  |  |
| 8                  |             | SILTY SAND<br>Fine and medium grained sand, some coarse sand, trace gravel, grayish brown (10YR 5/2)<br>0.1 m of firm silt at 8.8 m and 9.0 m.<br>Increase in coarse sand and gravel 10.13 m to 10.36 m | 294.87<br>8.53                      |                    |                          |                                     | 2             | PQ          | 48"<br>80%    | n/a          | n/a          | n/a                 |             |                     |  |  |  |
| 10                 |             | SILTY SAND, GRAVEL AND COBBLES<br>fine, medium and coarse sand, small, medium, and coarse gravel, some silt, well graded, sub-angular, silty sand matrix washed away.                                   | 292.73<br>10.67                     |                    | AFA2                     | Outwash deposits of sand and gravel | 3             | PQ          | 29"<br>48%    | n/a          | n/a          | n/a                 |             |                     |  |  |  |
| 12                 |             |   |                                     |                    |                          |                                     | 4             | PQ          | 30"<br>50%    | n/a          | n/a          | n/a                 |             |                     |  |  |  |
| 14                 |             |   |                                     |                    |                          |                                     | 5             | PQ          | 26"<br>43%    | n/a          | n/a          | n/a                 |             |                     |  |  |  |
| 16                 |             |   |                                     |                    |                          |                                     | 6             | PQ          | 38"<br>63%    | n/a          | n/a          | n/a                 |             |                     |  |  |  |
| 18                 |             |   |                                     |                    |                          |                                     | 7             | PQ          | 58"<br>97%    | n/a          | n/a          | n/a                 |             |                     |  |  |  |
| 20                 |             |   |                                     |                    |                          |                                     | 8             | PQ          | 36"<br>60%    | n/a          | n/a          | n/a                 |             |                     |  |  |  |
| 22                 |             |   |                                     |                    |                          |                                     | 9             | N/A         | 0"<br>0%      | n/a          | n/a          | n/a                 |             |                     |  |  |  |
| 24                 |             |   |                                     |                    |                          |                                     | 10            | PQ          | 2"<br>3%      | n/a          | n/a          | n/a                 |             |                     |  |  |  |
| 26                 |             |   |                                     |                    |                          |                                     | 11            | PQ          | 30"<br>50%    | n/a          | n/a          | n/a                 |             |                     |  |  |  |
| 28                 |             |   |                                     |                    |                          |                                     |               | N/A         | n/a           | n/a          | n/a          | n/a                 |             |                     |  |  |  |
| 30                 |             |   |                                     |                    |                          |                                     |               |             |               |              |              |                     |             |                     |  |  |  |
| 26                 |             | GUELPH FORMATION<br>Dolostone, light grey/brown, grainstone to packstone  | 277.80<br>25.60                     |                    |                          |                                     | BR1           | HQ          | 28.8"<br>100% | 27.5"<br>95% | 28.5"<br>99% | 2                   |             |                     |  |  |  |
| 28                 |             |   |                                     |                    |                          |                                     | BR2           | HQ          | 61.5"<br>103% | 56"<br>93%   | 53.5"<br>89% | 6                   |             |                     |  |  |  |
| 30                 |             |   |                                     |                    |                          |                                     | BR3           | HQ          | 62"<br>103%   | 55"<br>92%   | 41.5"<br>69% | 10                  |             |                     |  |  |  |
|                    |             |   |                                     |                    |                          |                                     | BR4           | HQ          | 59"<br>98%    | 53"<br>88%   | 47"<br>78%   | 10                  |             |                     |  |  |  |

STANTEC BOREHOLE AND WELL - MASTER TX11 - 160900968-20221007\_CAMBRIDGE\_EAST\_LOGS\_GPI\_DATA\_TEMPLATE\_ENVS\_CA\_140725\_GDT\_3/13/23\_AHEALEY

DRAFT

Screen Interval: 67.06 - 70.10; 40.69 - 43.74; 16.84 - 18.36 m BGS  
 Sand Pack Interval: 15.54 - 20.73 m BGS  
 Well Seal Interval: 0.61 - 15.54 m BGS

Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 PQ - wireline continuous core sample  
 n/a - not available/applicable

Geophysical testing was completed by Lotwater Technical Services Inc. within the open bedrock borehole at C-PB-OW3-22A from March 22 to April 7, 2022. Gamma counts within the overburden are based on testing within the PVC casing at C-PB-OW3-22C on March 25, 2022.

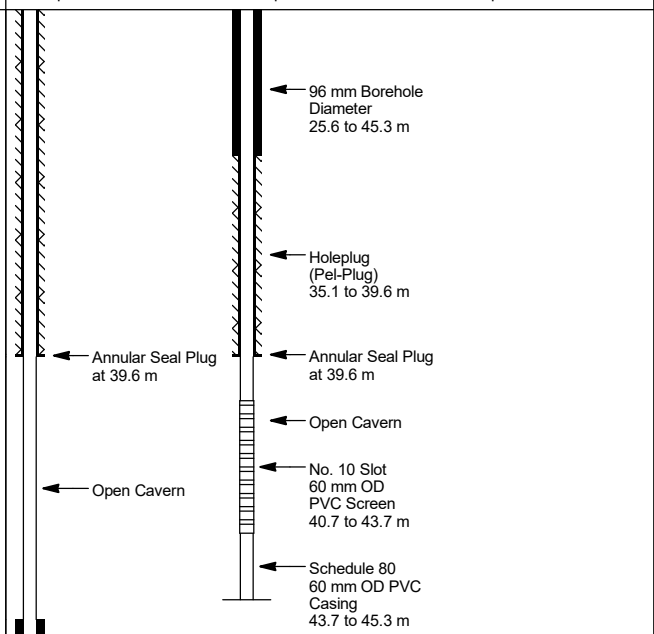


# Monitoring Well: C-PB-OW3-22

**Project:** Cambridge East Drilling  
**Client:** Region of Waterloo  
**Location:** Township of Puslinch; Ellis Rd, Cambridge (near Puslinch Lake Golf Course)  
**Number:** 160900968

**Field Investigator:** R. Baker  
**Contractor:** Aardvark Drilling Inc.  
**Drilling method:** CME 75 track mount - Hollow Stem Auger/PQ Mud Rotary/HQ  
**Date started/completed:** 17-Feb-2022 / 12-Apr-2022

| SUBSURFACE PROFILE |             |   |                                     | HYDROGEOLOGY         |                                 | SAMPLE DETAILS |                  |                |               |              |              | GEOPHYSIC DETAILS      |                | WELL DETAILS           |   |   |   |     |
|--------------------|-------------|---|-------------------------------------|----------------------|---------------------------------|----------------|------------------|----------------|---------------|--------------|--------------|------------------------|----------------|------------------------|---|---|---|-----|
| Depth (ft)         | Graphic Log | Lithologic Description  | Elevation (m AMSL)<br>Depth (m BGS) | Optical<br>Televiwer | Hydro<br>Stratigraphic Unit     | Description    | Sample<br>Number | Sample<br>Type | Recovery      | SCR          | ROD          | Fractures<br>per 1.52m | Gamma<br>(cps) | Resistivity<br>(Ohm.m) | Name:<br>C-PB-OW3-22-A<br>Location: 9207774A<br>GS Elev: 303.40 m AMSL<br>TOC Elev: 303.97 m AMSL<br>Easting: 4808938<br>Northing: 558312<br>Stick-up: 0.57 m | Name:<br>C-PB-OW3-22-B<br>Location: 9207774B<br>GS Elev: 303.55 m AMSL<br>TOC Elev: 304.02 m AMSL<br>Easting: 4808939<br>Northing: 558316<br>Stick-up: 0.47 m | Name:<br>C-PB-OW3-22-C<br>Location: 9207774C<br>GS Elev: 303.45 m AMSL<br>TOC Elev: 304.44 m AMSL<br>Easting: 4808937<br>Northing: 558309<br>Stick-up: 0.99 m |     |
| 105                | 32          | GUELPH FORMATION<br>Dolostone, light grey/brown, grainstone to packstone  |                                     |                      | Guelph<br>Formation             |                | BR5              | HQ             | 60.5"<br>101% | 56.5"<br>94% | 54"<br>90%   | 6                      |                |                        |   |   |   |     |
| 110                | 34          |   |                                     |                      |                                 |                | BR6              | HQ             | 61"<br>102%   | 58"<br>97%   | 58"<br>97%   | 4                      |                |                        |   |   |   |     |
| 115                | 36          |   |                                     |                      |                                 |                | BR7              | HQ             | 59"<br>98%    | 51"<br>85%   | 48"<br>80%   | 9                      |                |                        |   |   |   |     |
| 120                | 38          |   |                                     |                      |                                 |                | BR8              | HQ             | 60"<br>100%   | 46"<br>77%   | 45"<br>75%   | 7                      |                |                        |   |   |   |     |
| 125                | 38          | ERAMOSIA FORMATION, REFORMATORY QUARRY MEMBER<br>Dolostone, dark gray, vuggy, mineralization in vugs<br><br>Cavern observed in A borehole from 42.4 to 43.3 m and B borehole from 41.1 m to 45.3 m.<br>Voids, up to 30 cm thick, were observed in A borehole from 43.3 m to 47.3 m<br><br>coral-stromatoporoid wackestone to grainstone from 49.5 m to 58.8 m | 265.30<br>38.10                     |                      | Reformatory<br>Quarry<br>Member |                | BR9              | HQ             | 60"<br>100%   | 41"<br>68%   | 49"<br>82%   | 3                      |                |                        |   |   |   |     |
| 130                | 40          |   |                                     |                      |                                 |                | BR10             | HQ             | 63"<br>105%   | 53"<br>88%   | 55.5"<br>93% | 4                      |                |                        |   |   |   |     |
| 135                | 42          |   |                                     |                      |                                 |                | BR11             | HQ             | 50"<br>83%    | 38"<br>63%   | 42"<br>70%   | 5                      |                |                        |   |   |   |     |
| 140                | 44          |   |                                     |                      |                                 |                |                  |                | N/A           | n/a          | n/a          | n/a                    |                |                        |   |   |   | n/a |
| 145                | 44          |   |                                     |                      |                                 |                | BR12             | HQ             | 22"<br>37%    | 7"<br>12%    | 45"<br>75%   | 4                      |                |                        |   |   |   |     |
| 150                | 46          |   |                                     |                      |                                 |                | BR13             | HQ             | 41"<br>68%    | 22"<br>37%   | 26"<br>43%   | 3                      |                |                        |   |   |   |     |
| 155                | 48          |   |                                     |                      |                                 |                | BR14             | HQ             | 54"<br>90%    | 13"<br>22%   | 12"<br>20%   | 18                     |                |                        |   |   |   |     |
| 160                | 50          |   |                                     |                      |                                 |                | BR15             | HQ             | 60"<br>100%   | 32"<br>53%   | 23"<br>38%   | 10                     |                |                        |   |   |   |     |
| 165                | 52          |   |                                     |                      |                                 |                | BR16             | HQ             | 60"<br>100%   | 39"<br>65%   | 41"<br>68%   | 8                      |                |                        |   |   |   |     |
| 170                | 54          |   |                                     |                      |                                 |                | BR17             | HQ             | 58"<br>97%    | 32"<br>53%   | 31"<br>52%   | 12                     |                |                        |   |   |   |     |
| 175                | 56          |   |                                     |                      |                                 |                | BR18             | HQ             | 59"<br>98%    | 50"<br>83%   | 51"<br>85%   | 5                      |                |                        |   |   |   |     |
| 180                | 58          | BR19  | HQ                                  | 60"<br>100%          | 51"<br>85%                      | 52"<br>87%     | 4                |                |               |              |              |                        |                |                        |   |   |   |     |
| 185                | 58          | BR20  | HQ                                  | 62.5"<br>104%        | 54"<br>90%                      | 62"<br>103%    | 3                |                |               |              |              |                        |                |                        |   |   |   |     |
| 190                | 58          | BR21  | HQ                                  | 60"<br>100%          | 56"<br>93%                      | 56.5"<br>94%   | 2                |                |               |              |              |                        |                |                        |   |   |   |     |
| 195                | 60          | ERAMOSIA FORMATION, VINEMOUNT MEMBER<br>Dark brown to black, horizontal, thinly bedded dolostone with shale partings  | 244.57<br>58.83<br>244.42           |                      | Vinemount<br>Member             |                | BR22             | HQ             | 56"<br>93%    | 39"<br>65%   | 40.5"<br>68% | 5                      |                |                        |   |   |   |     |
| 200                | 62          | GOAT ISLAND FORMATION<br>Dolostone with crinoids, brachiopods, and pinhole texture alternating with dark blue grey dolostone interpreted as small reef mounds   | 58.98                               |                      |                                 |                | BR23             | HQ             | 60"<br>100%   | 55"<br>92%   | 57"<br>95%   | 3                      |                |                        |   |   |   |     |
| 205                | 62          |   |                                     |                      |                                 |                | BR24             | HQ             | 60"<br>100%   | 44"<br>73%   | 49"<br>82%   | 4                      |                |                        |   |   |   |     |
|                    |             |   |                                     |                      |                                 |                | BR25             | HQ             | 60"<br>100%   | 37"<br>62%   | 35"<br>58%   | 3                      |                |                        |   |   |   |     |



Screen Interval: 67.06 - 70.10; 40.69 - 43.74; 16.84 - 18.36 m BGS  
 Sand Pack Interval: 15.54 - 20.73 m BGS  
 Well Seal Interval: 0.61 - 15.54 m BGS

Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 PQ - wireline continuous core sample  
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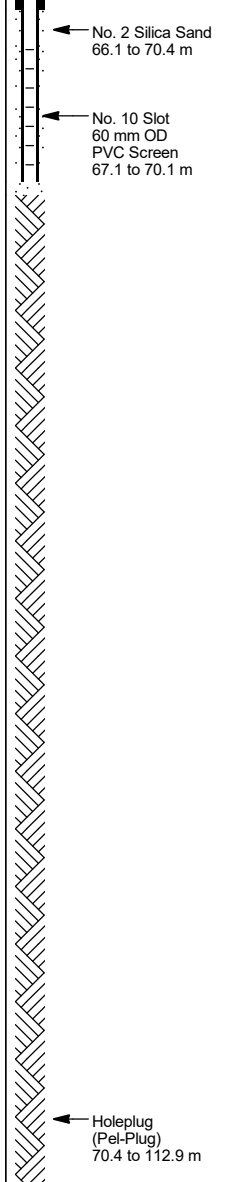


# Monitoring Well: C-PB-OW3-22

**Project:** Cambridge East Drilling  
**Client:** Region of Waterloo  
**Location:** Township of Puslinch; Ellis Rd, Cambridge (near Puslinch Lake Golf Course)  
**Number:** 160900968

**Field Investigator:** R. Baker  
**Contractor:** Aardvark Drilling Inc.  
**Drilling method:** CME 75 track mount - Hollow Stem Auger/PQ Mud Rotary/HQ  
**Date started/completed:** 17-Feb-2022 / 12-Apr-2022

| SUBSURFACE PROFILE |             |   |                                     | HYDROGEOLOGY         |                             | SAMPLE DETAILS           |                  |                |               |              |               | GEOPHYSIC DETAILS      |                | WELL DETAILS           |   |   |   |
|--------------------|-------------|---|-------------------------------------|----------------------|-----------------------------|--------------------------|------------------|----------------|---------------|--------------|---------------|------------------------|----------------|------------------------|---|---|---|
| Depth (ft)         | Graphic Log | Lithologic Description  | Elevation (m AMSL)<br>Depth (m BGS) | Optical<br>Televiwer | Hydro<br>Stratigraphic Unit | Description              | Sample<br>Number | Sample<br>Type | Recovery      | SCR          | ROD           | Fractures<br>per 1.52m | Gamma<br>(cps) | Resistivity<br>(Ohm.m) | Name:<br>C-PB-OW3-22-A<br>Location: 9207774A<br>GS Elev: 303.40 m AMSL<br>TOC Elev: 303.97 m AMSL<br>Easting: 4808938<br>Northing: 558312<br>Stick-up: 0.57 m | Name:<br>C-PB-OW3-22-B<br>Location: 9207774B<br>GS Elev: 303.55 m AMSL<br>TOC Elev: 304.02 m AMSL<br>Easting: 4808939<br>Northing: 558316<br>Stick-up: 0.47 m | Name:<br>C-PB-OW3-22-C<br>Location: 9207774C<br>GS Elev: 303.45 m AMSL<br>TOC Elev: 304.44 m AMSL<br>Easting: 4808937<br>Northing: 558309<br>Stick-up: 0.99 m |
| 210                | 64          | GOAT ISLAND FORMATION<br>Dolostone with crinoids, brachiopods, and pinhole texture alternating with dark blue grey dolostone interpreted as small reef mounds   |                                     |                      |                             |                          | BR26             | HQ             | 60"<br>100%   | 52"<br>87%   | 47"<br>78%    | 6                      |                |                        |   |   |   |
| 215                | 66          |   |                                     |                      |                             |                          | BR27             | HQ             | 60"<br>100%   | 40"<br>67%   | 43"<br>72%    | 4                      |                |                        |   |   |   |
| 220                | 68          |   |                                     |                      |                             |                          | BR28             | HQ             | 60"<br>100%   | 33"<br>55%   | 41"<br>68%    | 6                      |                |                        |   |   |   |
| 225                | 70          |   |                                     |                      |                             |                          | BR29             | HQ             | 60"<br>100%   | 43"<br>72%   | 43"<br>72%    | 6                      |                |                        |   |   |   |
| 230                | 72          |   |                                     |                      |                             | Goat Island<br>Formation | BR30             | HQ             | 60"<br>100%   | 45"<br>75%   | 47"<br>78%    | 9                      |                |                        |   |   |   |
| 235                | 74          |   |                                     |                      |                             |                          | BR31             | HQ             | 60"<br>100%   | 56"<br>93%   | 55.5"<br>93%  | 5                      |                |                        |   |   |   |
| 240                | 76          |   |                                     |                      |                             |                          | BR32             | HQ             | 60"<br>100%   | 59"<br>98%   | 59.5"<br>99%  | 1                      |                |                        |   |   |   |
| 245                | 78          |   |                                     |                      |                             |                          | BR33             | HQ             | 60"<br>100%   | 57"<br>95%   | 57.5"<br>96%  | 3                      |                |                        |   |   |   |
| 250                | 80          |   |                                     |                      |                             |                          | BR34             | HQ             | 58"<br>97%    | 43"<br>72%   | 53"<br>88%    | 3                      |                |                        |   |   |   |
| 255                | 82          |   |                                     |                      |                             |                          | BR35             | HQ             | 61"<br>102%   | 53"<br>88%   | 54"<br>90%    | 4                      |                |                        |   |   |   |
| 260                | 84          |   |                                     |                      |                             |                          | BR36             | HQ             | 54"<br>90%    | 50.5"<br>84% | 52.5"<br>88%  | 1                      |                |                        |   |   |   |
| 265                | 86          |   |                                     |                      |                             |                          | BR37             | HQ             | 62"<br>103%   | 55.5"<br>93% | 55"<br>92%    | 5                      |                |                        |   |   |   |
| 270                | 88          |   |                                     |                      |                             |                          | BR38             | HQ             | 61"<br>102%   | 55"<br>92%   | 55"<br>92%    | 4                      |                |                        |   |   |   |
| 275                | 90          | Deformed bed about 30 cm thick with clasts at base of unit<br>GASPORT FORMATION<br>Dolostone, alternating blue/grey reef mounds with light grey/cream coquinas that include crinoids, bryozoans, and bivalves | 219.28<br>84.12                     |                      |                             |                          | BR39             | HQ             | 57.5"<br>96%  | 47"<br>78%   | 49"<br>82%    | 6                      |                |                        |   |   |   |
| 280                | 92          |   |                                     |                      |                             |                          | BR40             | HQ             | 61"<br>102%   | 55"<br>92%   | 58"<br>97%    | 3                      |                |                        |   |   |   |
| 285                | 94          |   |                                     |                      |                             |                          | BR41             | HQ             | 61"<br>102%   | 58"<br>97%   | 59"<br>98%    | 2                      |                |                        |   |   |   |
| 290                | 96          |   |                                     |                      |                             |                          | BR42             | HQ             | 60.5"<br>101% | 55.5"<br>93% | 57"<br>95%    | 5                      |                |                        |   |   |   |
| 295                | 98          |   |                                     |                      |                             |                          | BR43             | HQ             | 58"<br>97%    | 48"<br>80%   | 48"<br>80%    | 5                      |                |                        |   |   |   |
| 300                | 100         |   |                                     |                      |                             |                          | BR44             | HQ             | 62"<br>103%   | 61"<br>102%  | 61.5"<br>103% | 0                      |                |                        |   |   |   |
| 305                | 102         |   |                                     |                      |                             |                          | BR45             | HQ             | 60"<br>100%   | 57"<br>95%   | 57"<br>95%    | 2                      |                |                        |   |   |   |
| 310                | 104         |   |                                     |                      |                             | Gasport                  | BR46             | HQ             | 59"<br>98%    | 58.5"<br>98% | 58.5"<br>98%  | 0                      |                |                        |   |   |   |



DRAFT

Screen Interval: 67.06 - 70.10; 40.69 - 43.74; 16.84 - 18.36 m BGS  
 Sand Pack Interval: 15.54 - 20.73 m BGS  
 Well Seal Interval: 0.61 - 15.54 m BGS

Notes:  
 m AMSL - metres above mean sea level  
 m BGS - metres below ground surface  
 m BTOC - metres below top of casing  
 PQ - wireline continuous core sample  
 n/a - not available/applicable

Geophysical testing was completed by Lotwater Technical Services Inc. within the open bedrock borehole at C-PB-OW3-22A from March 22 to April 7, 2022. Gamma counts within the overburden are based on testing within the PVC casing at C-PB-OW3-22C on March 25, 2022.



# Monitoring Well: C-PB-OW3-22

**Project:** Cambridge East Drilling  
**Client:** Region of Waterloo  
**Location:** Township of Puslinch; Ellis Rd, Cambridge (near Puslinch Lake Golf Course)  
**Number:** 160900968

**Field Investigator:** R. Baker  
**Contractor:** Aardvark Drilling Inc.  
**Drilling method:** CME 75 track mount - Hollow Stem Auger/PQ Mud Rotary/HQ  
**Date started/completed:** 17-Feb-2022 / 12-Apr-2022

| SUBSURFACE PROFILE |             |   |                                     | HYDROGEOLOGY       |                          | SAMPLE DETAILS        |               |             |               |              |               | GEOPHYSIC DETAILS   |             | WELL DETAILS        |  |  |  |
|--------------------|-------------|---|-------------------------------------|--------------------|--------------------------|-----------------------|---------------|-------------|---------------|--------------|---------------|---------------------|-------------|---------------------|--|--|--|
| Depth (ft)         | Graphic Log | Lithologic Description  | Elevation (m AMSL)<br>Depth (m BGS) | Optical Televiewer | Hydro Stratigraphic Unit | Description           | Sample Number | Sample Type | Recovery      | SCR          | ROD           | Fractures per 1.52m | Gamma (cps) | Resistivity (Ohm.m) | Name: C-PB-OW3-22-A<br>Location: 9207774A<br>GS Elev: 303.40 m AMSL<br>TOC Elev: 303.97 m AMSL<br>Easting: 4808938<br>Northing: 558312<br>Stick-up: 0.57 m | Name: C-PB-OW3-22-B<br>Location: 9207774B<br>GS Elev: 303.55 m AMSL<br>TOC Elev: 304.02 m AMSL<br>Easting: 4808939<br>Northing: 558316<br>Stick-up: 0.47 m | Name: C-PB-OW3-22-C<br>Location: 9207774C<br>GS Elev: 303.45 m AMSL<br>TOC Elev: 304.44 m AMSL<br>Easting: 4808937<br>Northing: 558309<br>Stick-up: 0.99 m |
| 315                | 96          | GASPORT FORMATION<br>Dolostone, alternating blue/grey reef mounds with light grey/cream coquinas that include crinoids, bryozoans, and bivalves |                                     |                    |                          | Formation             | BR47          | HQ          | 60"<br>100%   | 57"<br>95%   | 58"<br>97%    | 2                   |             |                     |  |  |  |
| 320                | 98          |   |                                     |                    |                          |                       | BR48          | HQ          | 61"<br>102%   | 55"<br>92%   | 57"<br>95%    | 3                   |             |                     |  |  |  |
| 325                | 100         |   |                                     |                    |                          |                       | BR49          | HQ          | 59"<br>98%    | 54.5"<br>91% | 55"<br>92%    | 4                   |             |                     |  |  |  |
| 330                | 102         |   |                                     |                    |                          |                       | BR50          | HQ          | 58"<br>97%    | 57"<br>95%   | 57.5"<br>96%  | 0                   |             |                     |  |  |  |
| 335                | 104         |   |                                     |                    |                          |                       | BR51          | HQ          | 62"<br>103%   | 51"<br>85%   | 52.5"<br>88%  | 4                   |             |                     |  |  |  |
| 340                | 106         |   |                                     |                    |                          |                       | BR52          | HQ          | 60"<br>100%   | 59.5"<br>99% | 59.8"<br>100% | 0                   |             |                     |  |  |  |
| 345                | 108         |   |                                     |                    |                          |                       | BR53          | HQ          | 61"<br>102%   | 58.5"<br>98% | 56.5"<br>94%  | 4                   |             |                     |  |  |  |
| 350                | 108         | ROCHESTER FORMATION<br>Dark grey shale  | 196.80<br>106.60<br>196.72          |                    | -                        | Rochester Formation   | BR54          | HQ          | 60"<br>100%   | 57"<br>95%   | 56"<br>93%    | 8                   |             |                     |  |  |  |
| 355                | 110         | IRONDEQUOIT FORMATION<br>Dolostone, fine crystalline, medium bedded, grey to light grey   | 106.68<br>195.20                    |                    | -                        | Irondequoit Formation | BR55          | HQ          | 61"<br>102%   | 59"<br>98%   | 57.5"<br>96%  | 4                   |             |                     |  |  |  |
| 360                | 110         | ROCKWAY FORMATION<br>Greenish-grey argillaceous dolostone with thin shaley partings   | 108.20<br>194.28                    |                    | -                        | Rockway Formation     | BR56          | HQ          | 60.5"<br>101% | 58"<br>97%   | 48.5"<br>81%  | 7                   |             |                     |  |  |  |
| 365                | 112         | MERRITON FORMATION<br>Pinkish-brown, bioturbated, finely crystalline, dolostone, pyrite rich  | 109.12<br>192.61<br>110.79          |                    | -                        | Merriton Formation    | BR57          | HQ          | 62"<br>103%   | 58"<br>97%   | 45"<br>75%    | 13                  |             |                     |  |  |  |
| 370                | 112         | CABOT HEAD FORMATION<br>Grey/green to red/maroon, shale   | 190.52<br>112.88                    |                    | -                        | Cabot Head Formation  |               |             |               |              |               |                     |             |                     |  |  |  |
| 375                | 114         | End of Borehole   |                                     |                    |                          |                       |               |             |               |              |               |                     |             |                     |  |  |  |

DRAWN

Screen Interval: 67.06 - 70.10; 40.69 - 43.74; 16.84 - 18.36 m BGS  
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 PQ - wireline continuous core sample  
 n/a - not available/applicable

Geophysical testing was completed by Lotowater Technical Services Inc. within the open bedrock borehole at C-PB-OW3-22A from March 22 to April 7, 2022. Gamma counts within the overburden are based on testing within the PVC casing at C-PB-OW3-22C on March 25, 2022.



STANTEC BOREHOLE AND WELL - MASTER TX11 - 160900968-20221007 CAMBRIDGE EAST LOGS.GPJ DATA TEMPLATE\_ENVS\_CA\_140725.GDT 3/13/23 AHEALEY

**Table B1: Construction Details**

| <b>Monitoring Well ID</b> | <b>Year Built</b> | <b>Screened Depth (mbgs)</b> | <b>Screened Formation</b>          | <b>Closest Production well Distance (m)</b> |
|---------------------------|-------------------|------------------------------|------------------------------------|---|
| C-PB-OW5-94-A             | 1994              | 137.0-140.0                  | Cabot Head                         | 1355 (P11)                                  |
| C-PB-OW5-94-B             | 1994              | 104.0-110.0                  | Middle Gasport                     | 1355 (P11)                                  |
| C-PB-OW5-94-C             | 1994              | 53.3-59.7                    | Lower Guelph to Reformatory Quarry | 1355 (P11)                                  |
| C-PB-OW5-94-D             | 1994              | 43.3-48.3                    | Upper to Middle Guelph             | 1355 (P11)                                  |
| C-PB-OW5-94-E             | 1994              | 36.3-39.3                    | ATC1                               | 1355 (P11)                                  |
| C-PB-OW5-94-F             | 1994              | 6.1-9.1                      | AFA2                               | 1355 (P11)                                  |
| C-PB-OW5-94-G             | 1994              | 14.8-17.8                    | ATA1                               | 1355 (P11)                                  |
| C-PB-OW2-06-A             | 2006              | 91.44-109.8                  | Upper Gasport to Cabot Head        | 1,581 (P10A)                                |
| C-PB-OW2-06-B             | 2006              | 48.9-55.0                    | Lower Guelph to Reformatory Quarry | 1,581 (P10A)                                |
| C-PB-OW2-06-C             | 2006              | 33.5-44.4                    | Guelph to Contact                  | 1,581 (P10A)                                |
| C-PB-OW2-06-D             | 2006              | 33.2-36.3                    | ATB3                               | 1,581 (P10A)                                |
| C-PB-OW2-06-E             | 2006              | 25.0-28.0                    | ATB3                               | 1,581 (P10A)                                |
| C-PB-OW2-06-F             | 2006              | 14.0-17.1                    | AFA2                               | 1,581 (P10A)                                |
| C-PB-OW1-09-A             | 2009              | 104.6-107.6                  | Middle Gasport                     | 10 (P10B)                                   |
| C-PB-OW1-09-B             | 2009              | 86.0-89.0                    | Upper Gasport                      | 10 (P10B)                                   |

| <b>Monitoring Well ID</b> | <b>Year Built</b> | <b>Screened Depth (mbgs)</b> | <b>Screened Formation</b>     | <b>Closest Production well Distance (m)</b> |
|---------------------------|-------------------|------------------------------|-------------------------------|---|
| C-PB-OW1-09-C             | 2009              | 34.1-37.2                    | Upper to Middle Guelph        | 10 (P10B)                                   |
| C-PB-OW1-09-D             | 2009              | 25.6-28.7                    | ATB1                          | 10 (P10B)                                   |
| C-PB-OW1-09-E             | 2009              | 4.5-7.6                      | ATB1                          | 10 (P10B)                                   |
| C-PB-OW1-11-A             | 2011              | 19.8-22.9                    | ATB3/AFB3/ATC1                | 7 (P17)                                     |
| C-PB-OW1-11-B             | 2011              | 6.1-7.6                      | ATB1                          | 7 (P17)                                     |
| C-PB-OW1-92-A             | 1992              | 29.5-84.1                    | Upper Guelph to Upper Gasport | 195 (P17)                                   |
| C-PB-OW1-92-B             | 1992              | 18.3-21.3                    | AFB1 to ATB3                  | 195 (P17)                                   |
| C-PB-OW1-92-C             | 1992              | 7.3-10.4                     | ATB1                          | 195 (P17)                                   |
| C-PB-OW1-22-A             | 2022              | 96.9-99.9                    | Gasport                       | 4,230 (P19)                                 |
| C-PB-OW1-22-B             | 2022              | 80.7-80.8                    | Gasport                       | 4,230 (P19)                                 |
| C-PB-OW1-22-C             | 2022              | 70.9-71.0                    | Gasport                       | 4,230 (P19)                                 |
| C-PB-OW1-22-D             | 2022              | 63.9-64                      | Gasport                       | 4,230 (P19)                                 |
| C-PB-OW1-22-E             | 2022              | 52.3-52.4                    | Vinemount                     | 4,230 (P19)                                 |
| C-PB-OW1-22-F             | 2022              | 46.9-47                      | Guelph                        | 4,230 (P19)                                 |
| C-PB-OW1-22-G             | 2022              | 43.5-43.6                    | Guelph                        | 4,230 (P19)                                 |
| C-PB-OW1-22-H             | 2022              | 22.6-25.6                    | AFB1                          | 4,230 (P19)                                 |
| C-PB-OW2-22-A             | 2022              | 71.9-75.6                    | Gasport                       | 4,653 (G19)                                 |

| <b>Monitoring Well ID</b>          | <b>Year Built</b> | <b>Screened Depth (mbgs)</b> | <b>Screened Formation</b> | <b>Closest Production well Distance (m)</b> |
|------------------------------------|-------------------|------------------------------|---------------------------|---|
| C-PB-OW2-22-B                      | 2022              | 35.9-39                      | Reformatory Quarry        | 4,653 (G19)                                 |
| C-PB-OW2-22-C                      | 2022              | 15.2-16.8                    | AFA2                      | 4,653 (G19)                                 |
| C-PB-OW3-22-A                      | 2022              | 67.1-70.1                    | Goat Island               | 2,360 (P19)                                 |
| C-PB-OW3-22-B                      | 2022              | 40.7-43.7                    | Reformatory Quarry        | 2,360 (P19)                                 |
| C-PB-OW3-22-C                      | 2022              | 16.8-18.4                    | AFA2                      | 2,360 (P19)                                 |
| <b>Piezometer Monitoring ID</b>    | <b>Year Built</b> | <b>Screened Depth (mbgs)</b> | <b>Screened Formation</b> | <b>Closest Production well Distance (m)</b> |
| C-PB-DP1-21-A                      | 2021              | 2.1-2.5                      | Shallow Overburden        | 1,800 (P10A)                                |
| C-PB-DP1-21-B                      | 2021              | 1.0-1.4                      | Shallow Overburden        | 1,800 (P10A)                                |
| C-PB-DP3-21-A                      | 2021              | 2.1-2.6                      | Shallow Overburden        | 2,810 (P19)                                 |
| C-PB-DP3-21-B                      | 2021              | 1.3-1.7                      | Shallow Overburden        | 2,810 (P19)                                 |
| C-PB-DP5-22-A                      | 2022              | 2.0-2.4                      | Shallow Overburden        | 2,610 (P19)                                 |
| C-PB-DP5-22-B                      | 2022              | 1.1-1.5                      | Shallow Overburden        | 2,610 (P19)                                 |
| <b>Surface Water Monitoring ID</b> | <b>Year Built</b> |                              |                           | <b>Closest Production well Distance (m)</b> |
| C-PB-SW3-21-Z                      | 2021              |                              |                           | 2,810 (P19)                                 |
| C-PB-SW5-21-Z                      | 2021              |                              |                           | 2,610 (P19)                                 |



**BURNSIDE**

[ THE DIFFERENCE IS OUR PEOPLE ]

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## Appendix C

### Monitoring Data (Pumped Volumes and Hydrographs)



TABLE C-1  
WELL FIELD WATER PRODUCTION SUMMARY  
REGION OF WATERLOO - 2025 GROUNDWATER MONITORING REPORT

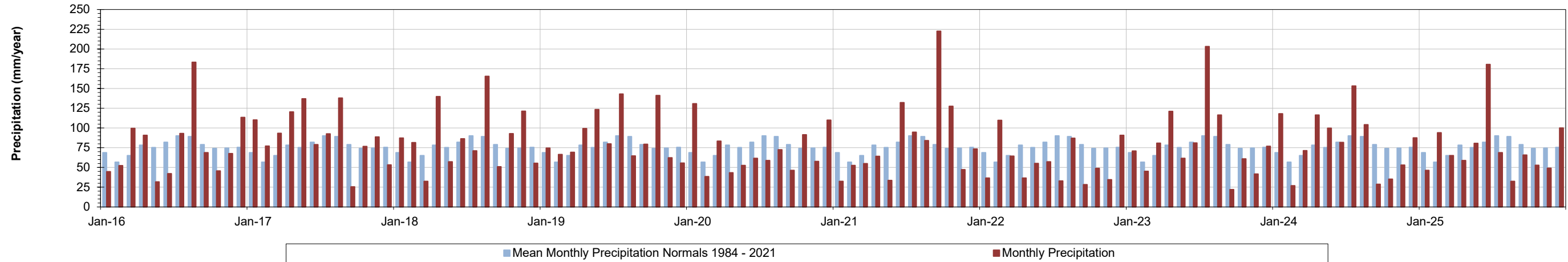


| Well Field    | Major or Minor Supply | Production Well Name    | Status         | Permit to Take Water Details   |  |                       | 2021 Production Summary                                   |  |                    | 2022 Production Summary                                   |  |                    | 2023 Production Summary                                   |  |                    | 2024 Production Summary                                   |  |                    | 2025 Production Summary                                   |  |                    |                |              |
|---------------|-----------------------|-------------------------|----------------|--|--|-----------------------|---|--|--------------------|---|--|--------------------|---|--|--------------------|---|--|--------------------|---|--|--------------------|----------------|--------------|
|               |                       |                         |                | MOE Permit Number <sup>1</sup>   | Permitted Capacity (total m <sup>3</sup> /year)* | Permitted Rate (L/s)* | Total Production Well Volume (total m <sup>3</sup> /year) | Average Daily Rate (m <sup>3</sup> /day) | Average Rate (L/s) | Total Production Well Volume (total m <sup>3</sup> /year) | Average Daily Rate (m <sup>3</sup> /day) | Average Rate (L/s) | Total Production Well Volume (total m <sup>3</sup> /year) | Average Daily Rate (m <sup>3</sup> /day) | Average Rate (L/s) | Total Production Well Volume (total m <sup>3</sup> /year) | Average Daily Rate (m <sup>3</sup> /day) | Average Rate (L/s) | Total Production Well Volume (total m <sup>3</sup> /year) | Average Daily Rate (m <sup>3</sup> /day) | Average Rate (L/s) |                |              |
| Pinebush East | Major                 | P10                     | Decommissioned | 7858-BXUUUH  | Combind Rate for 7858-BXUUUH                     |                       | 680,107   | 1,863                                    | 22                 | 580,945   | 1,592                                    | 18                 | 0   | 0  | 0                  | -   | -  | -                  | -   | -  | -                  |                |              |
|               |                       | P10A                    | Primary        | 7858-BXUUUH  |  |                       | 0   | 0  | 0                  | 0   | 0  | 0                  | 0   | 0  | 0                  | 7,440   | 0  | 0                  | 153   | 0  | 0                  |                |              |
|               |                       | P10B                    | Primary        | 7858-BXUUUH  |  |                       | 0   | 0  | 0                  | 0   | 0  | 0                  | 0   | 0  | 490,481            | 0   | 0  | 673,322            | 0   | 0  | 504,515            | 1,382          | 16.0         |
|               |                       | P11                     | Primary        | 7858-BXUUUH  |  |                       | 155,873   | 427                                      | 5                  | 138,236   | 379                                      | 4                  | 50,725  | 139                                      | 2                  | 95,078  | 260                                      | 3                  | 0   | 0  | 0                  | 0              |              |
|               |                       | P17                     | Primary        | 7858-BXUUUH  |  |                       | 79  | 0  | 0                  | 45,385  | -  | -                  | 23,727  | 65                                       | 1                  | 106,665   | 292                                      | 3                  | 196,640   | 539                                      | 6                  | 6              |              |
|               |                       | P19                     | Primary        | 7858-BXUUUH  |  |                       |   | 4,053,007                                | 161                | 0   | 0  | 0                  | 0   | 0  | 0                  | 37,464  | 103                                      | 1                  | 2   | 0  | 0                  | 0              |              |
|               |                       | <b>Well Field Total</b> |                |  |  |                       |   | <b>4,053,007</b>                         | <b>161</b>         | <b>836,059</b>  | <b>2,291</b>                             | <b>27</b>          | <b>764,566</b>  | <b>2,095</b>                             | <b>24</b>          | <b>564,933</b>  | <b>1,548</b>                             | <b>18</b>          | <b>919,969</b>  | <b>2,520</b>                             | <b>29</b>          | <b>701,310</b> | <b>1,921</b> |
|               |                       |                         |                | *The combined taking from wells shall not exceed an annual daily average of 11,104,128 L/day |  |                       |   |  |                    |   |  |                    |   |  |                    |   |  |                    |   |  |                    |                |              |

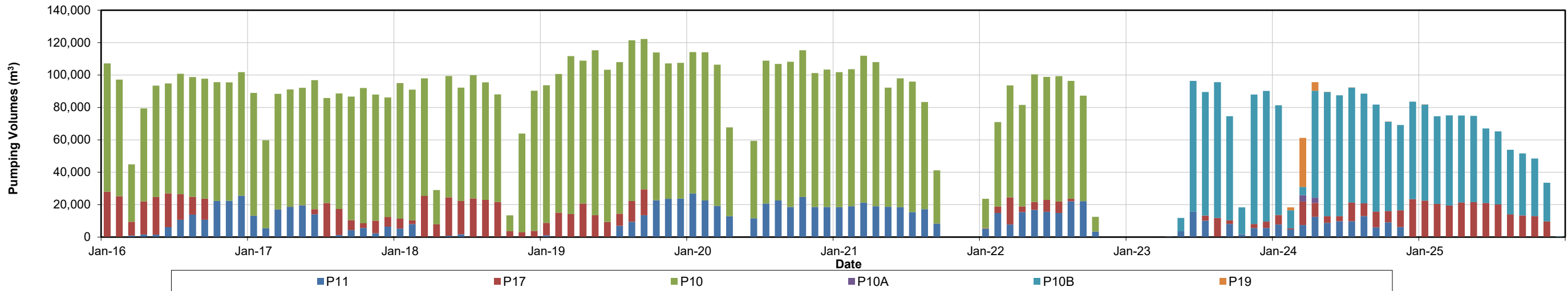
Notes:  
 - = no applicable data  
 n/a = data not available  
 \* = rates and volumes based on permitted L/day

REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

**Actual versus Mean Monthly Precipitation**  
Weather Station - Shades Mills Dam Weather Station

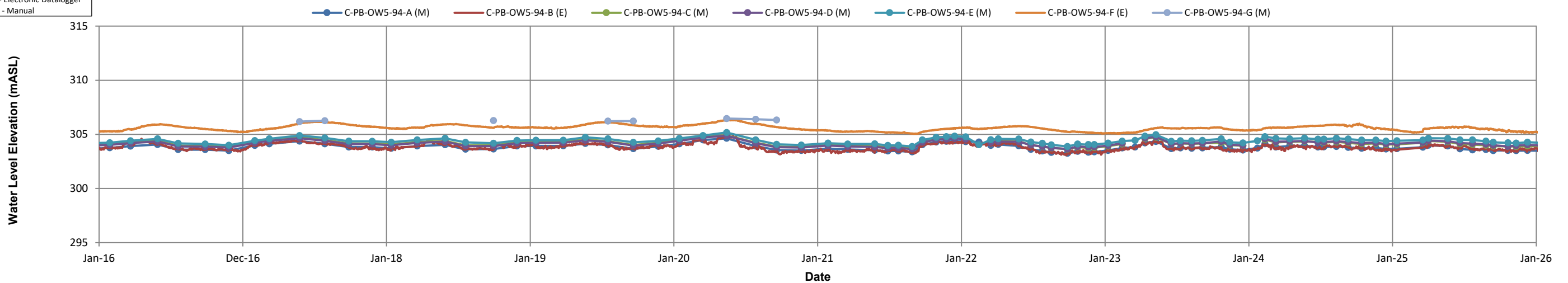


**Monthly Total Pumped Volumes**  
PINEBUSH EAST WELL FIELD



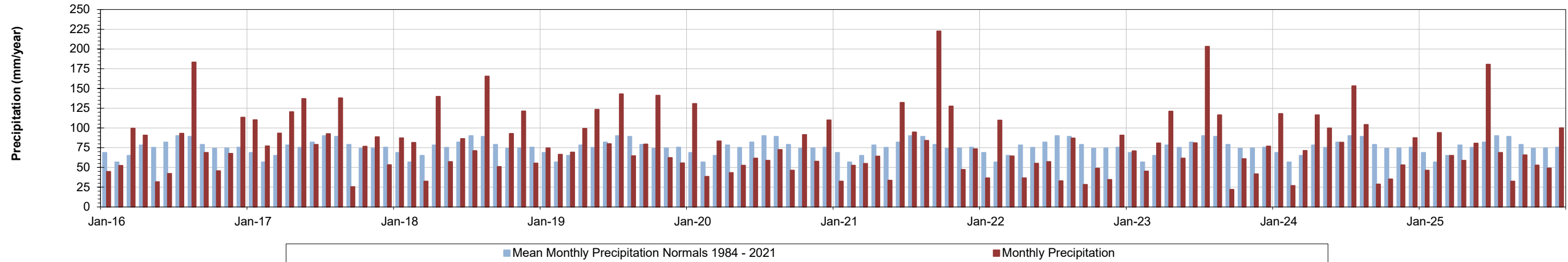
**PINEBUSH EAST WELL FIELD**

Current Measure Method  
(E) - Electronic Datalogger  
(M) - Manual

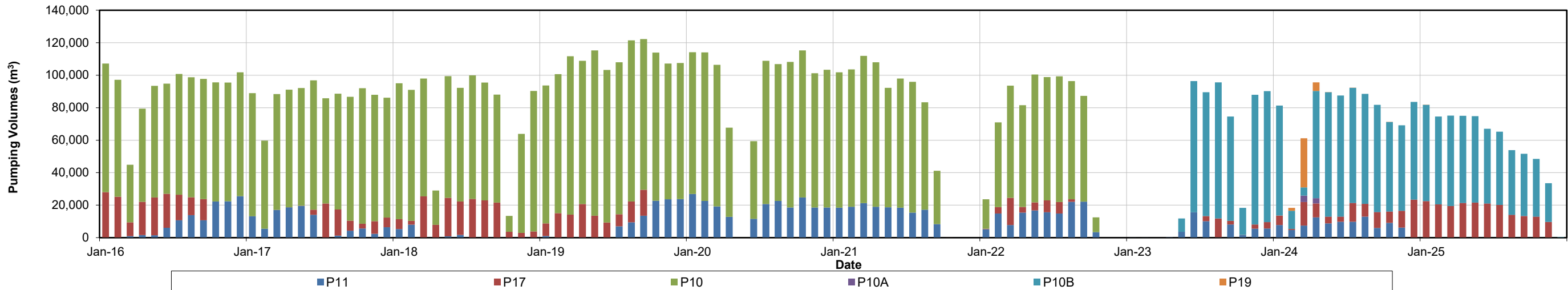


REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

**Actual versus Mean Monthly Precipitation**  
Weather Station - Shades Mills Dam Weather Station

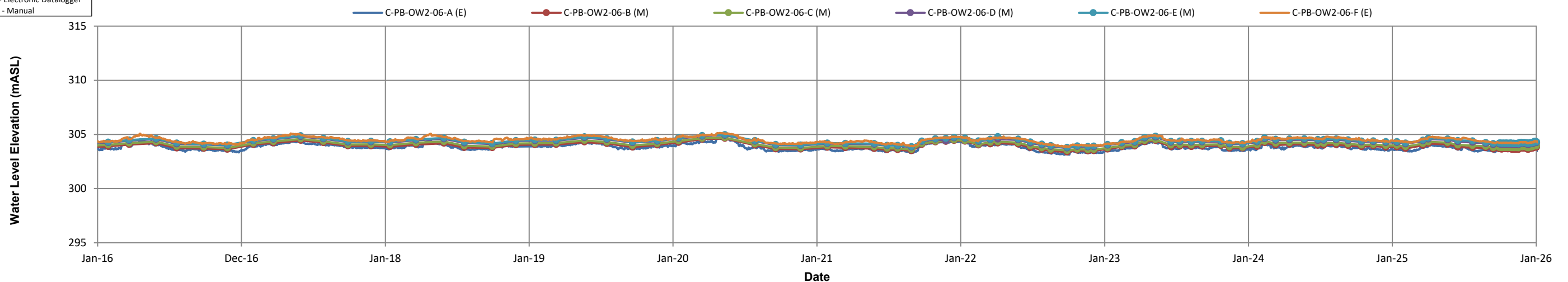


**Monthly Total Pumped Volumes**  
PINEBUSH EAST WELL FIELD



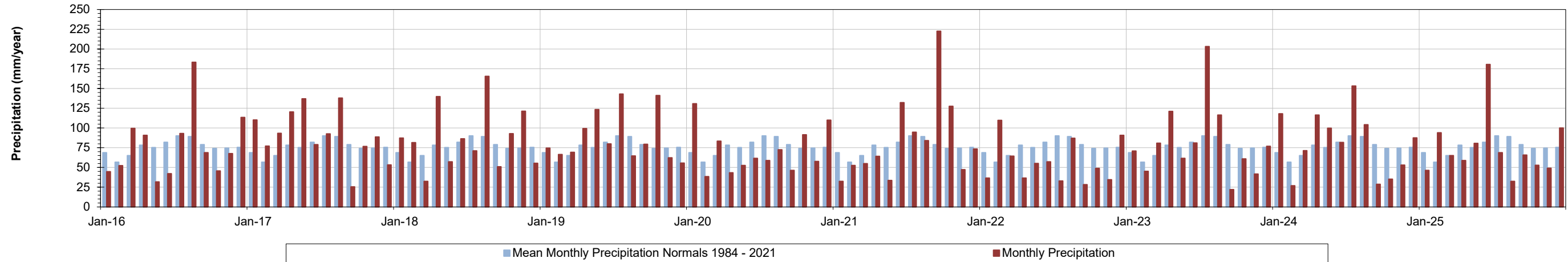
**PINEBUSH EAST WELL FIELD**

Current Measure Method  
(E) - Electronic Datalogger  
(M) - Manual

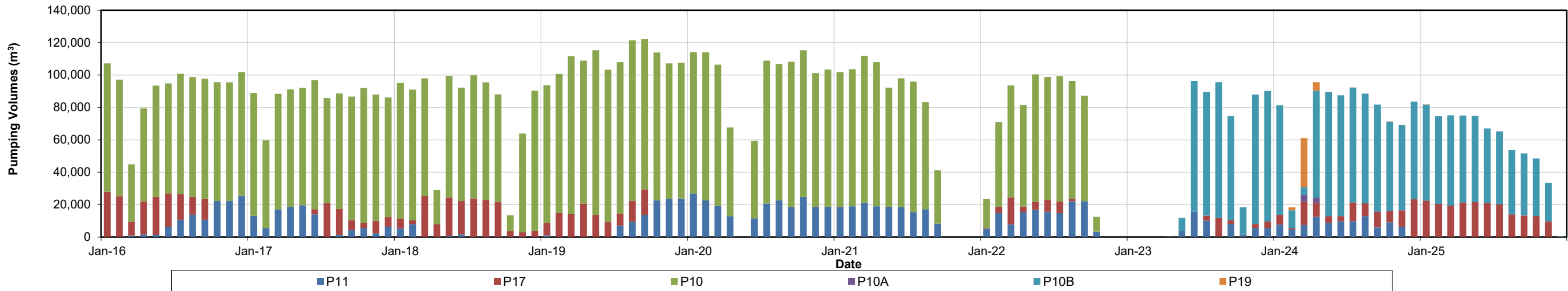


REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

**Actual versus Mean Monthly Precipitation**  
Weather Station - Shades Mills Dam Weather Station

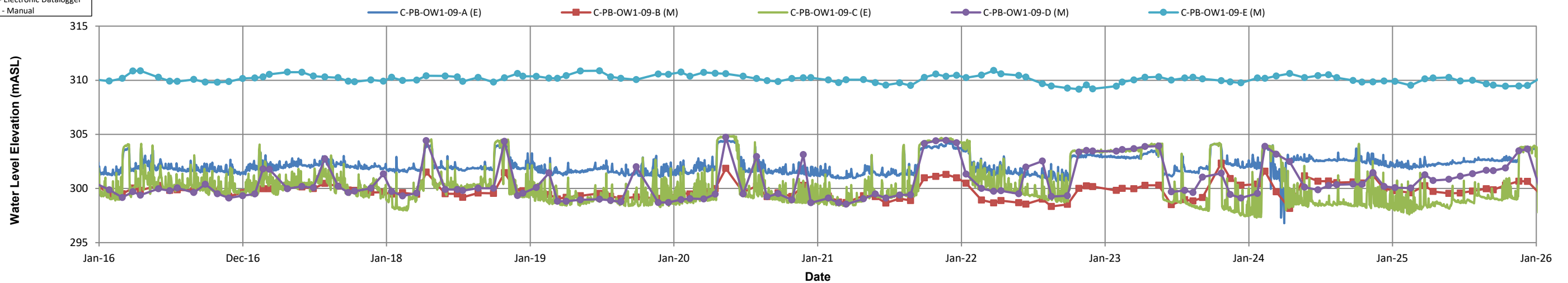


**Monthly Total Pumped Volumes**  
PINEBUSH EAST WELL FIELD



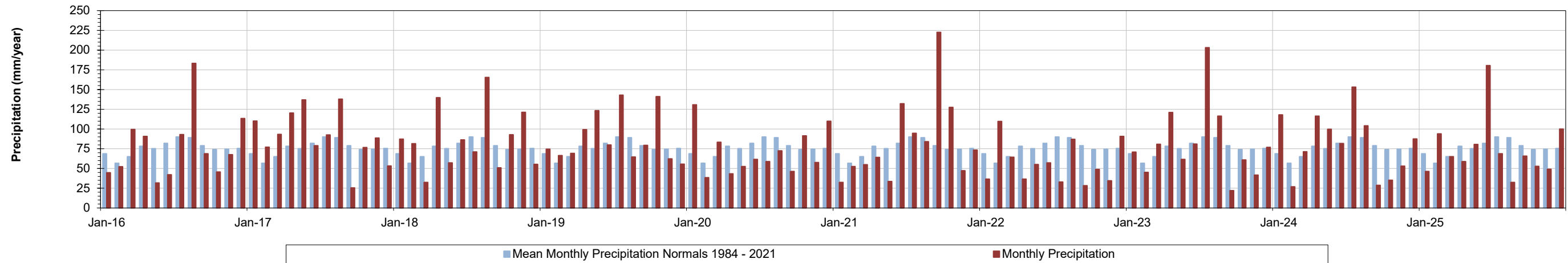
**PINEBUSH EAST WELL FIELD**

Current Measure Method  
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(M) - Manual

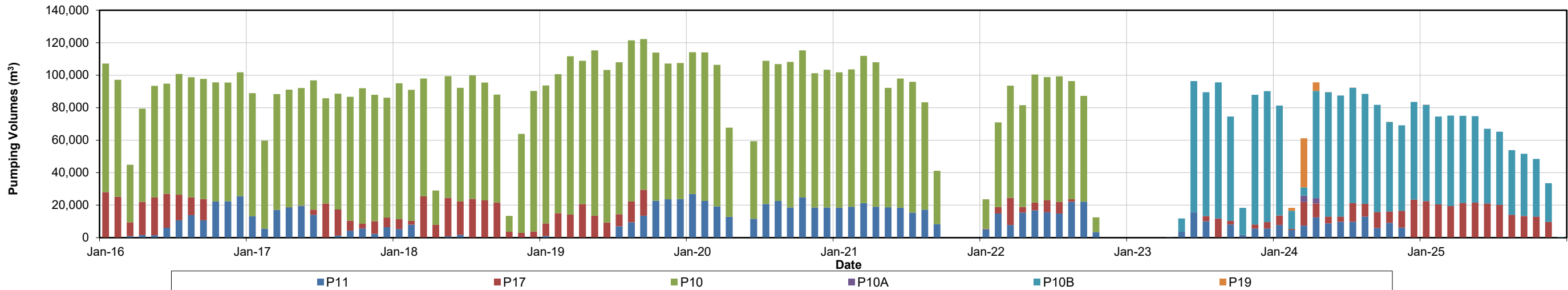


REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

**Actual versus Mean Monthly Precipitation**  
Weather Station - Shades Mills Dam Weather Station

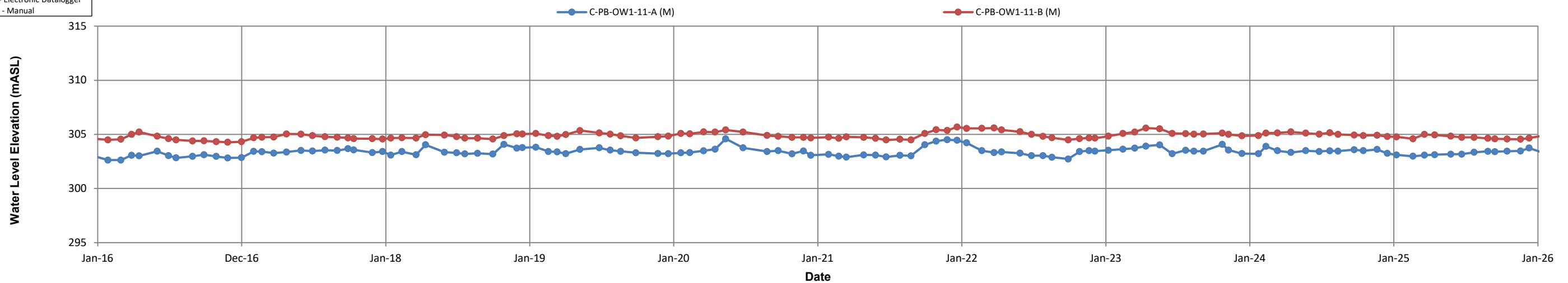


**Monthly Total Pumped Volumes**  
PINEBUSH EAST WELL FIELD



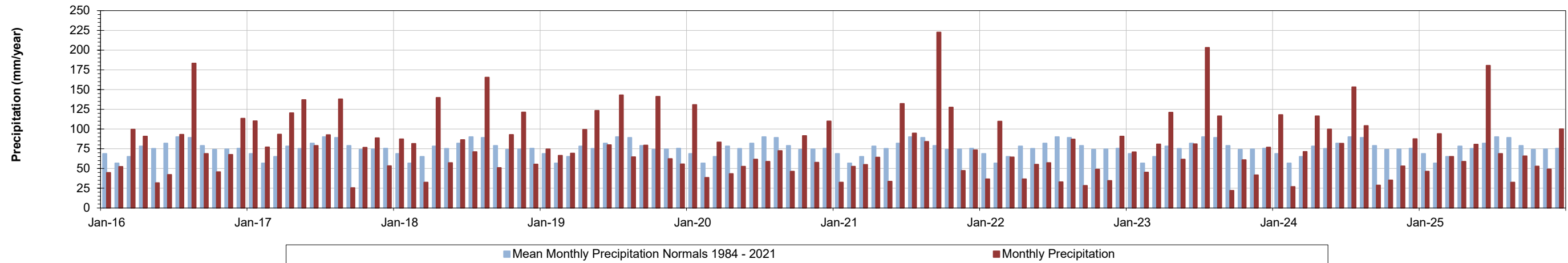
**PINEBUSH EAST WELL FIELD**

Current Measure Method  
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(M) - Manual

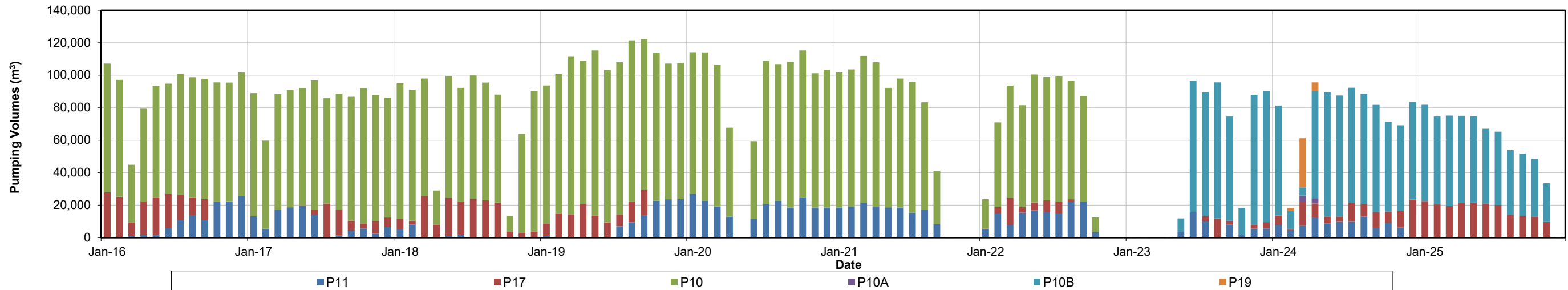


REGION OF WATERLOO  
 2025 GROUNDWATER MONITORING REPORT -  
 PINEBUSH EAST WELL FIELD

**Actual versus Mean Monthly Precipitation**  
 Weather Station - Shades Mills Dam Weather Station

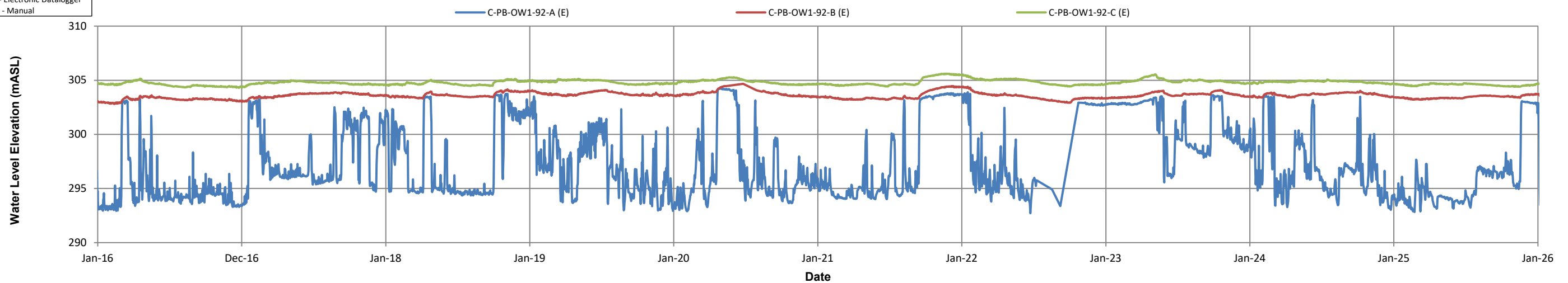


**Monthly Total Pumped Volumes**  
 PINEBUSH EAST WELL FIELD



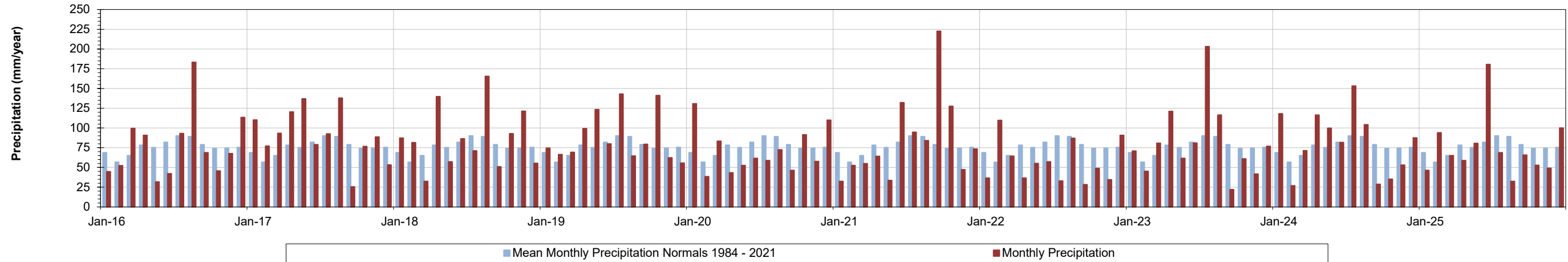
**PINEBUSH EAST WELL FIELD**

Current Measure Method  
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 (M) - Manual

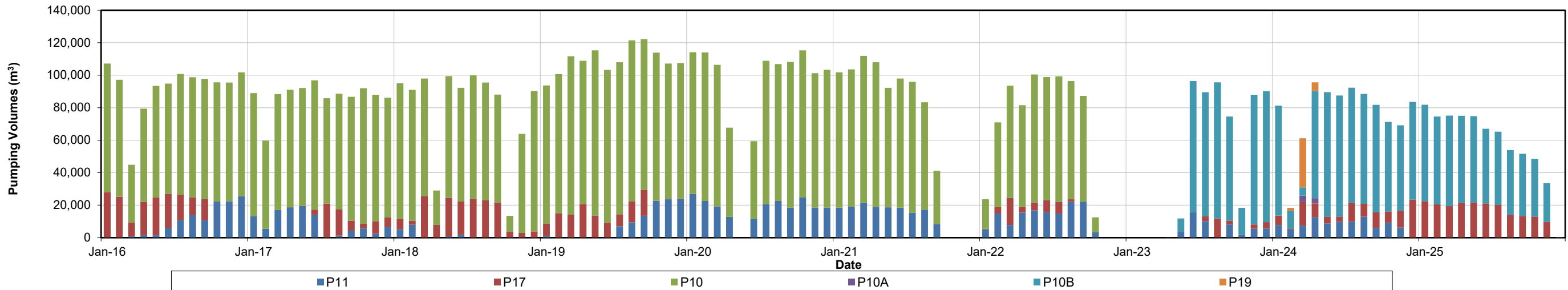


REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

**Actual versus Mean Monthly Precipitation**  
Weather Station - Shades Mills Dam Weather Station

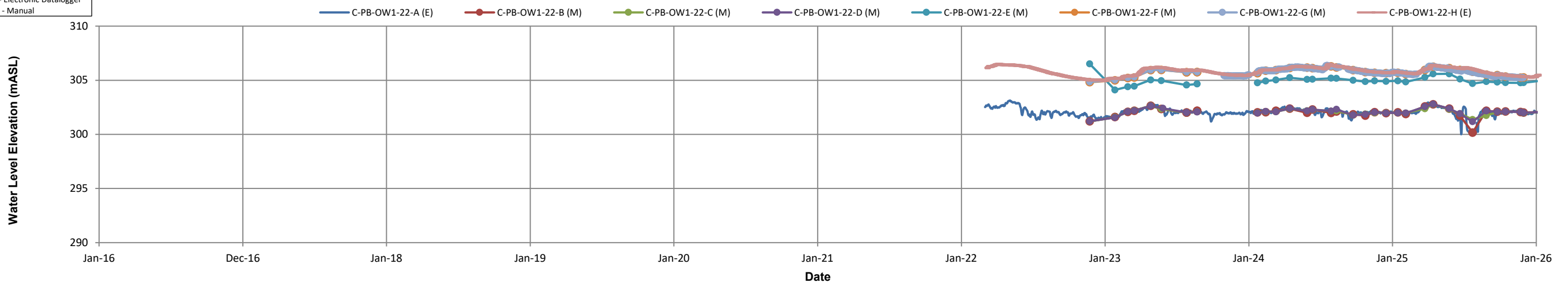


**Monthly Total Pumped Volumes**  
PINEBUSH EAST WELL FIELD



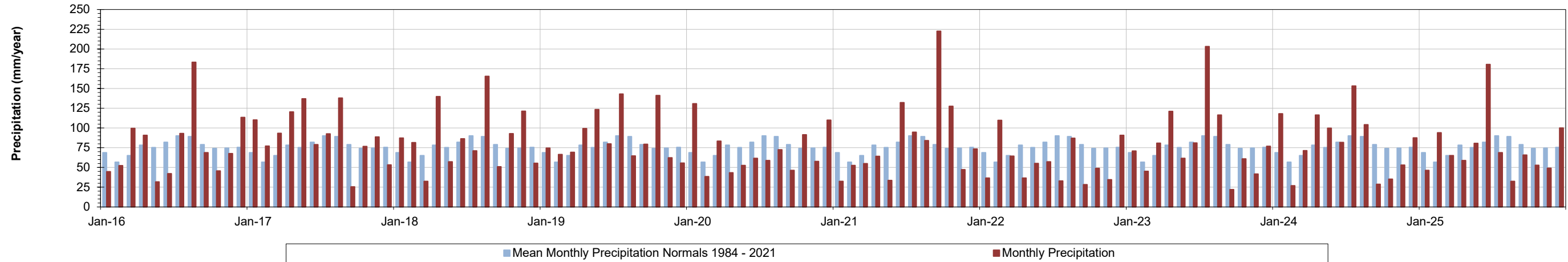
**PINEBUSH EAST WELL FIELD**

Current Measure Method  
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(M) - Manual

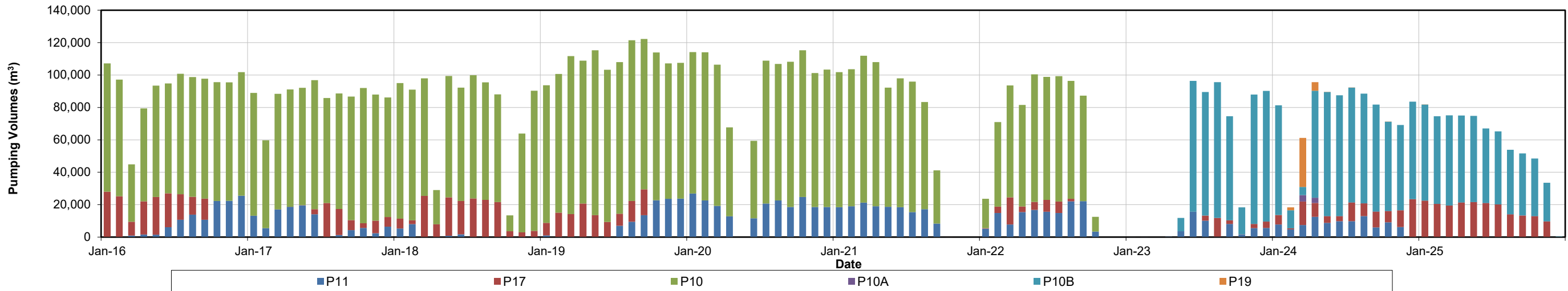


REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

**Actual versus Mean Monthly Precipitation**  
Weather Station - Shades Mills Dam Weather Station

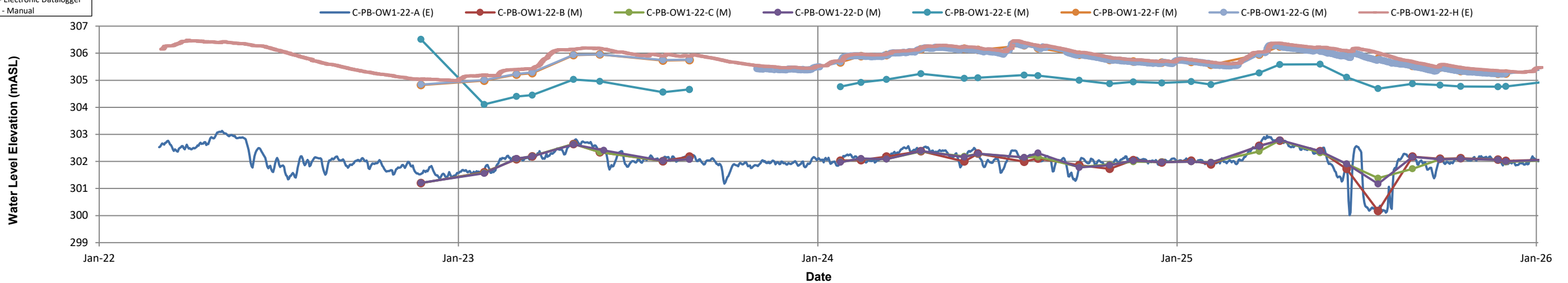


**Monthly Total Pumped Volumes**  
PINEBUSH EAST WELL FIELD



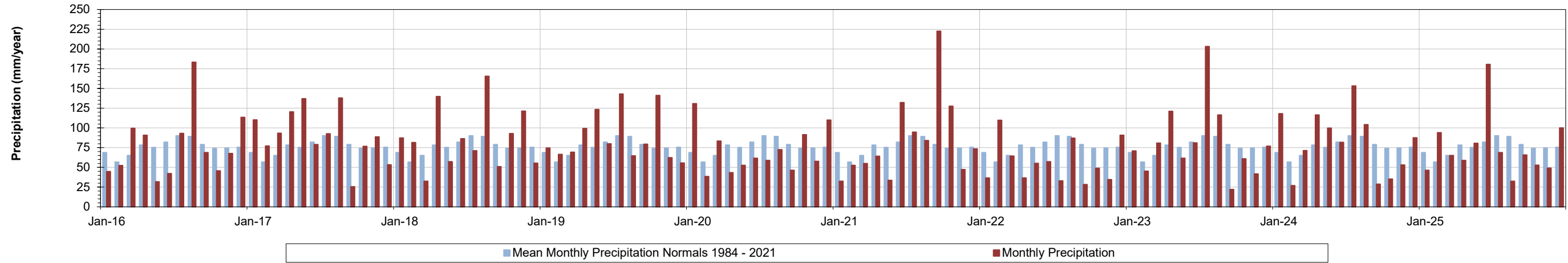
**PINEBUSH EAST WELL FIELD**

Current Measure Method  
(E) - Electronic Datalogger  
(M) - Manual

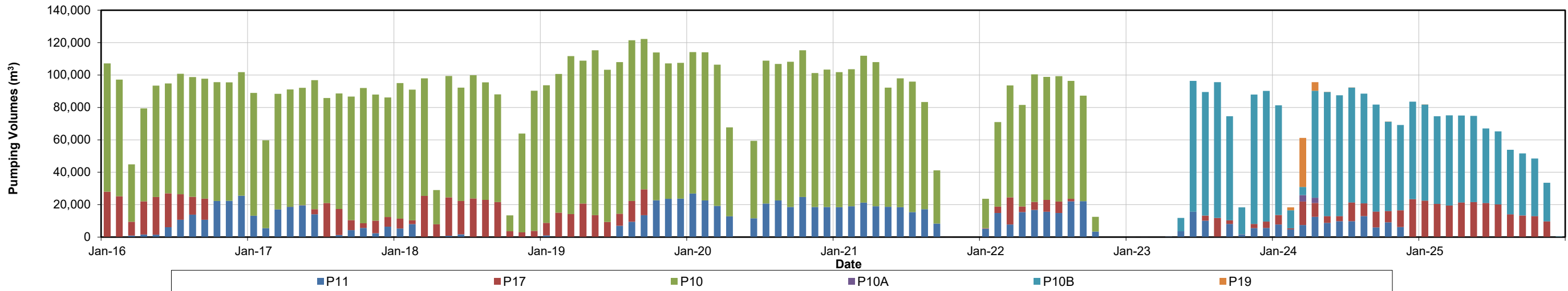


REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

**Actual versus Mean Monthly Precipitation**  
Weather Station - Shades Mills Dam Weather Station

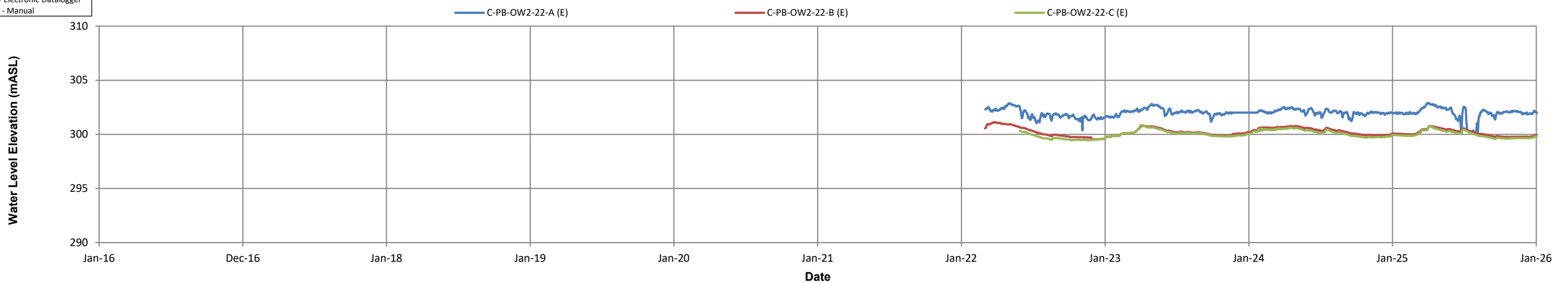


**Monthly Total Pumped Volumes**  
PINEBUSH EAST WELL FIELD



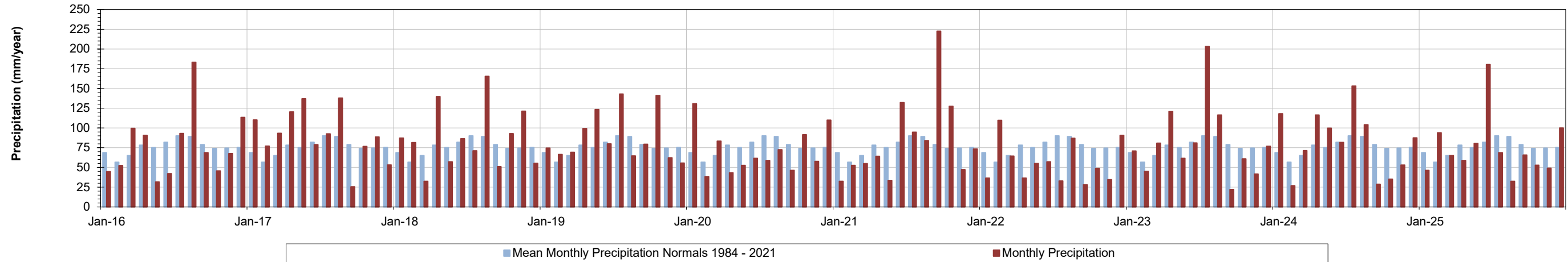
**PINEBUSH EAST WELL FIELD**

Current Measure Method  
(E) - Electronic Datalogger  
(M) - Manual

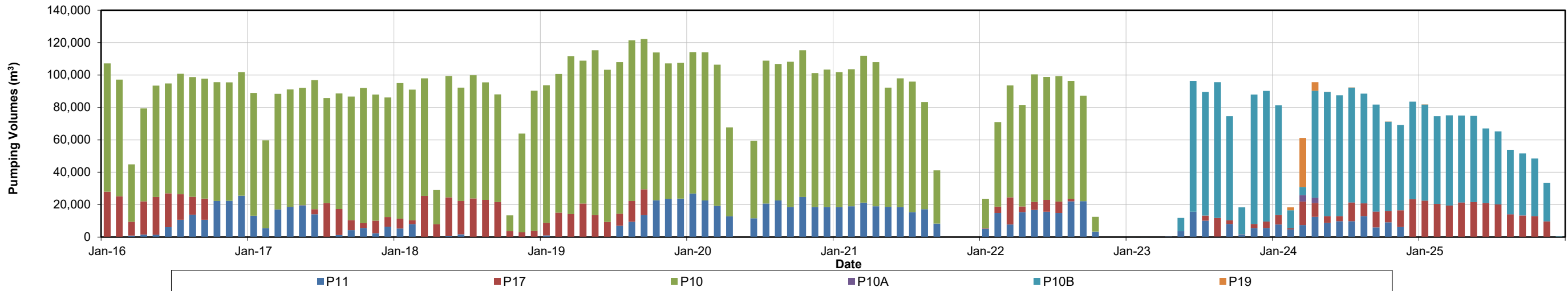


REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

**Actual versus Mean Monthly Precipitation**  
Weather Station - Shades Mills Dam Weather Station

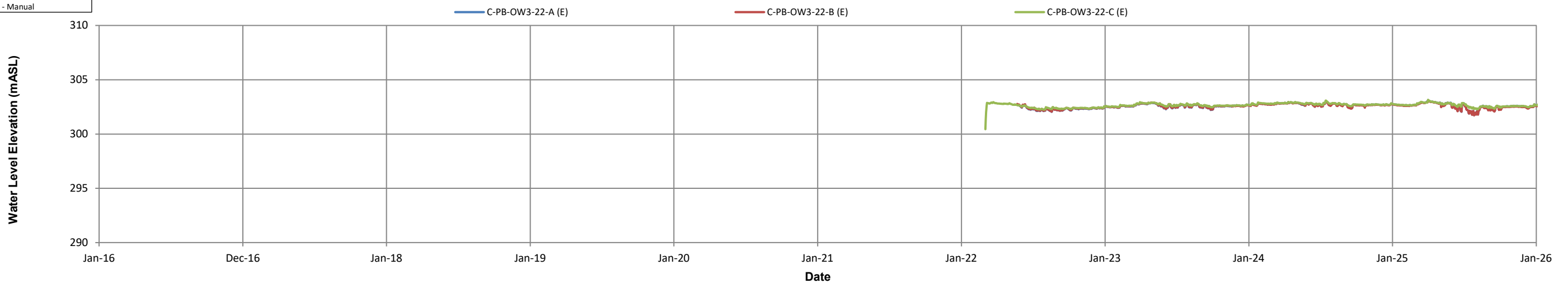


**Monthly Total Pumped Volumes**  
PINEBUSH EAST WELL FIELD



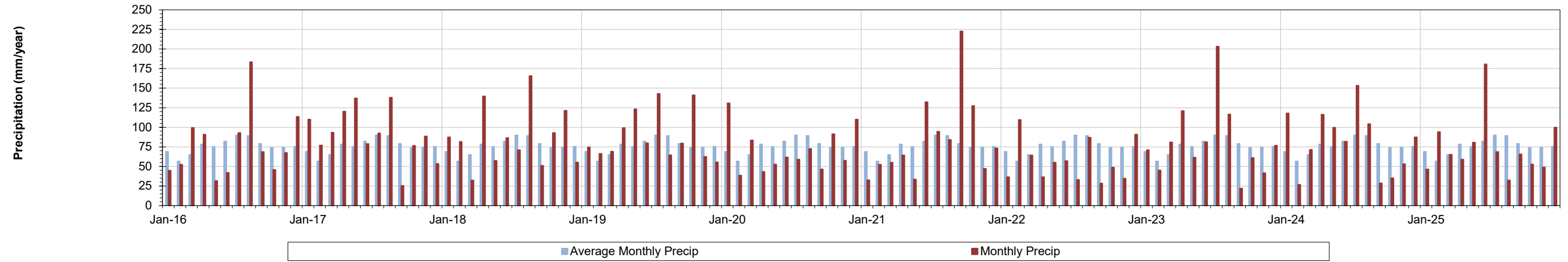
**PINEBUSH EAST WELL FIELD**

Current Measure Method  
(E) - Electronic Datalogger  
(M) - Manual

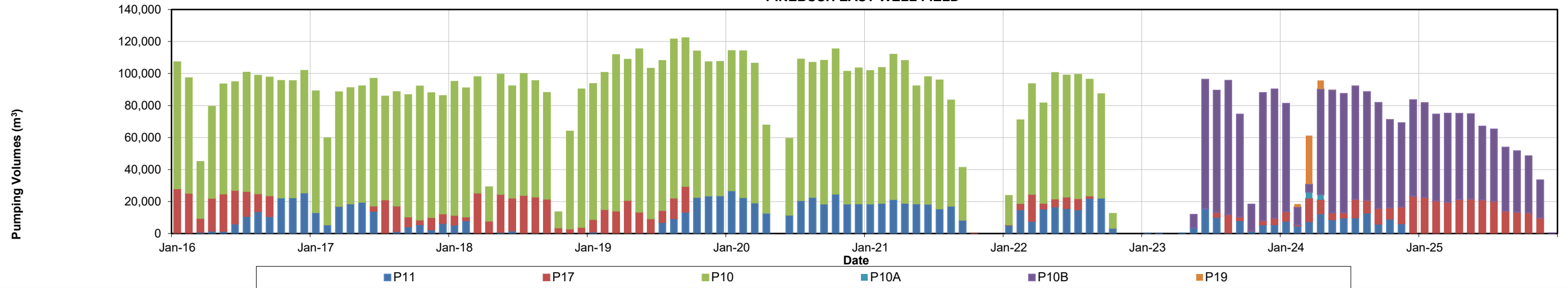


REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

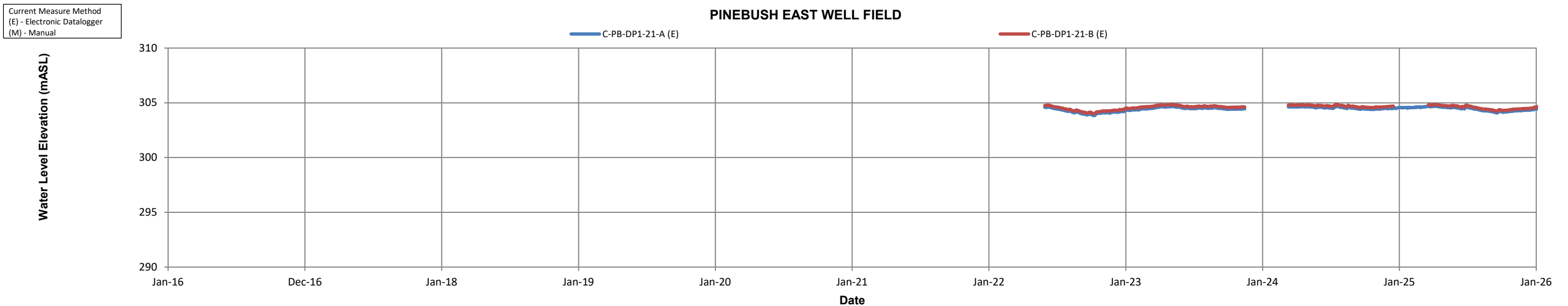
**Actual versus Mean Monthly Precipitation**  
Weather Station - Shades Mills Dam Weather Station



**Monthly Total Pumped Volumes**  
PINEBUSH EAST WELL FIELD

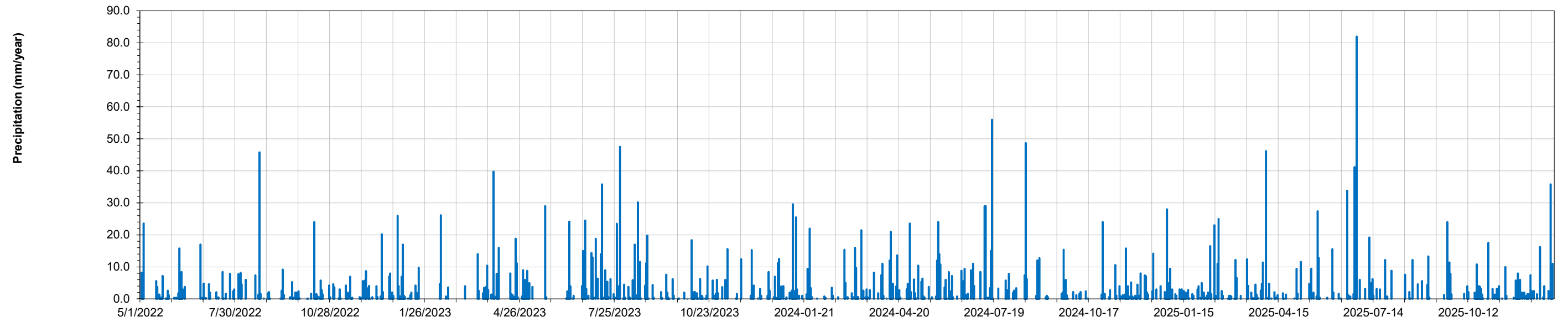


**PINEBUSH EAST WELL FIELD**



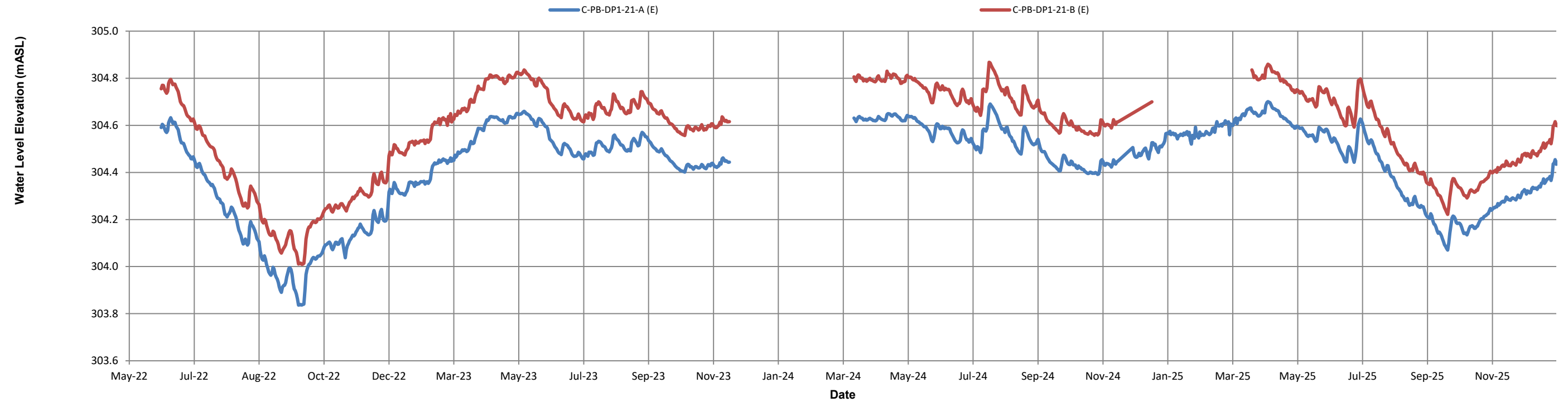
REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

Daily Precipitation  
Weather Station - Shades Mills Dam Weather Station



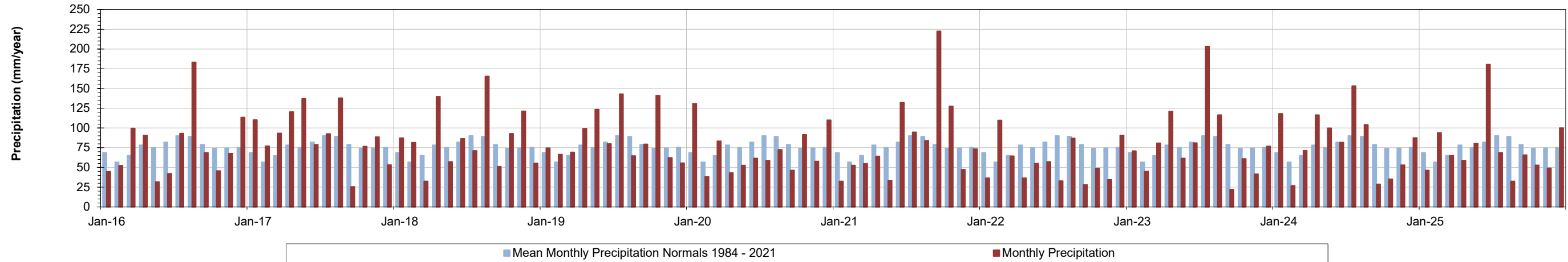
Current Measure Method  
(E) - Electronic Datalogger  
(M) - Manual

PINEBUSH EAST WELL FIELD

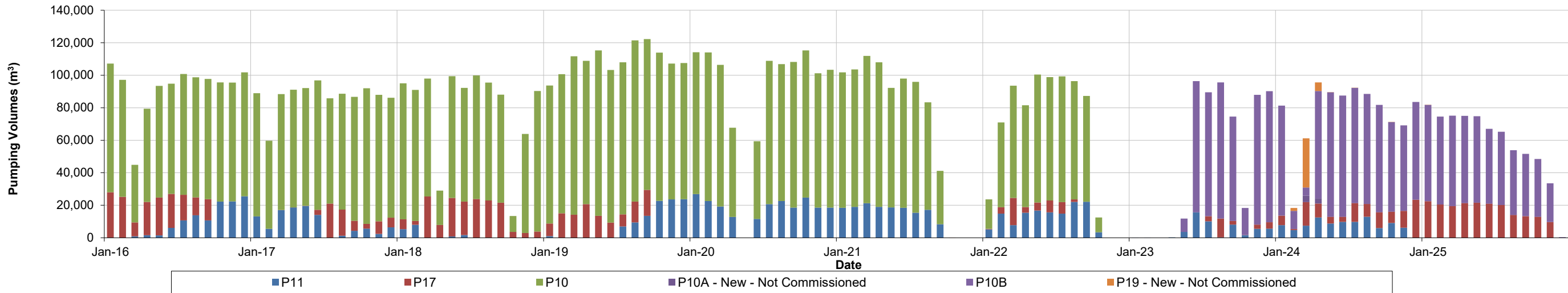


REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

**Actual versus Mean Monthly Precipitation**  
Weather Station - Shades Mills Dam Weather Station

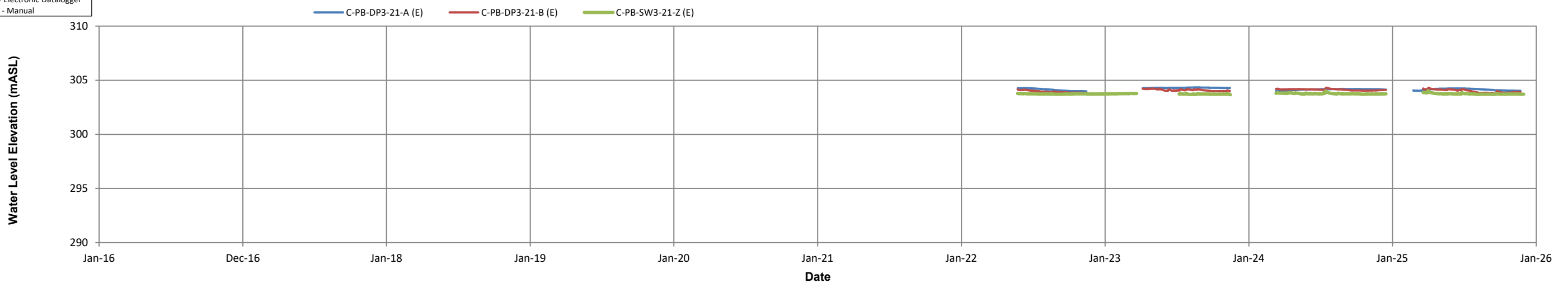


**Monthly Total Pumped Volumes**  
PINEBUSH EAST WELL FIELD



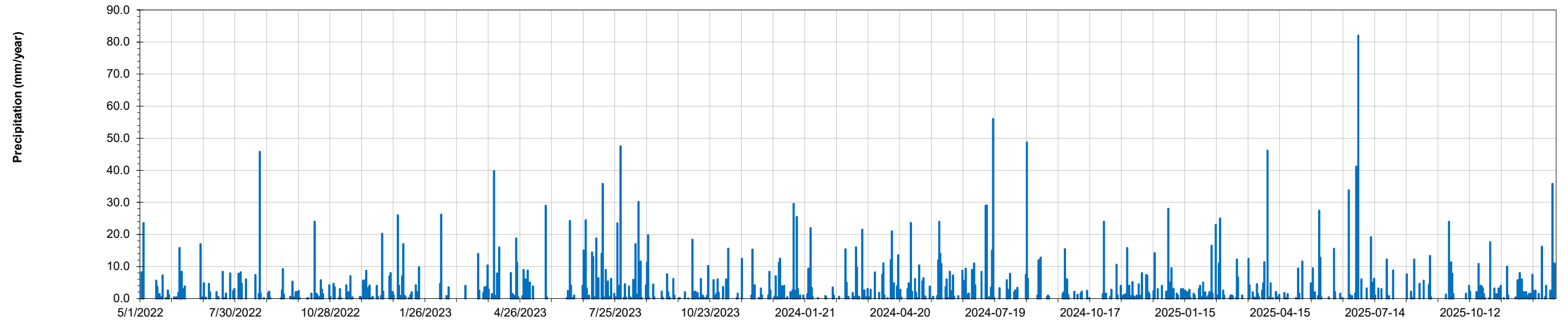
**PINEBUSH EAST WELL FIELD**

Current Measure Method  
(E) - Electronic Datalogger  
(M) - Manual



REGION OF WATERLOO  
 2025 GROUNDWATER MONITORING REPORT -  
 PINEBUSH EAST WELL FIELD

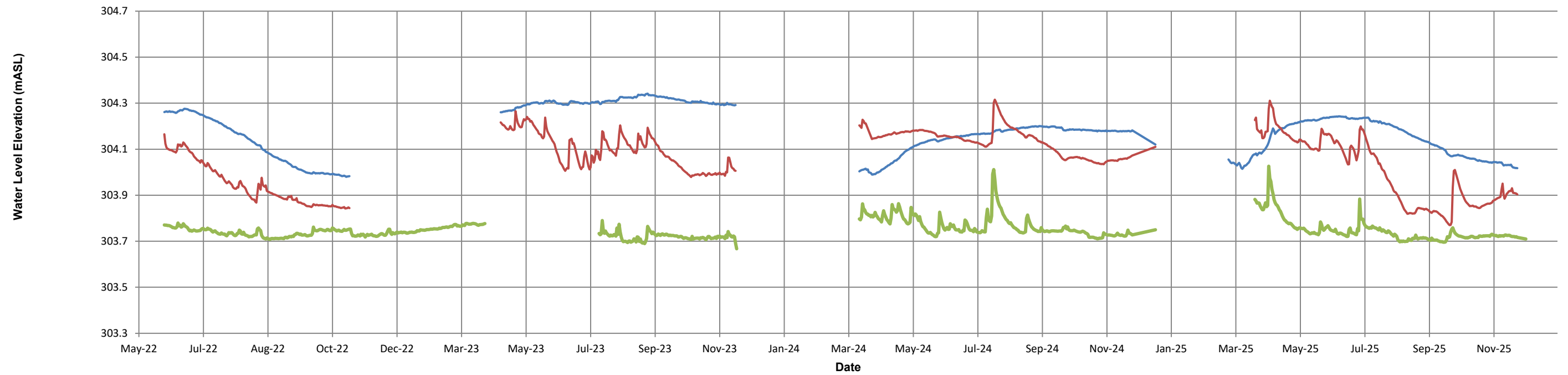
**Daily Precipitation**  
 Weather Station - Shades Mills Dam Weather Station



Current Measure Method  
 (E) - Electronic Datalogger  
 (M) - Manual

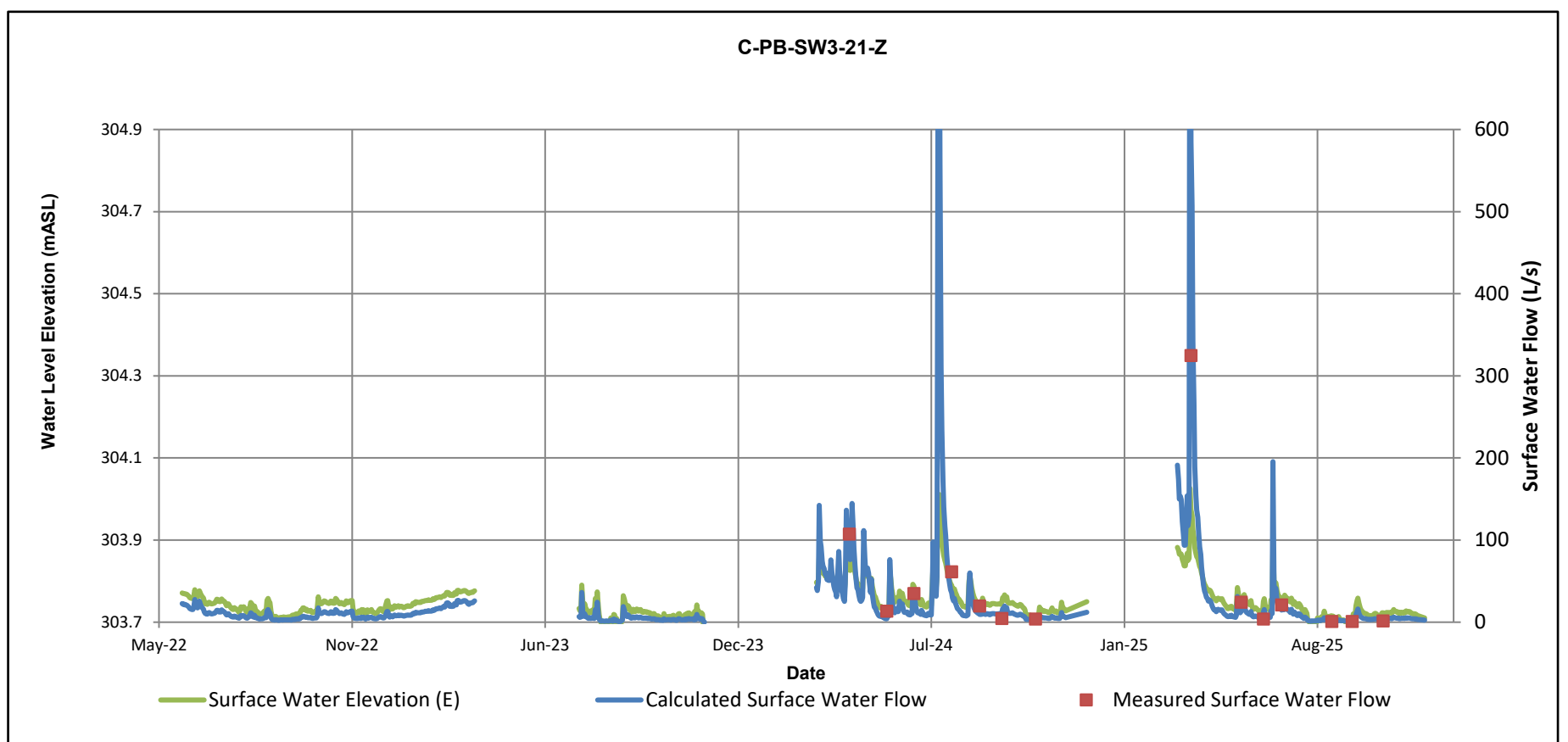
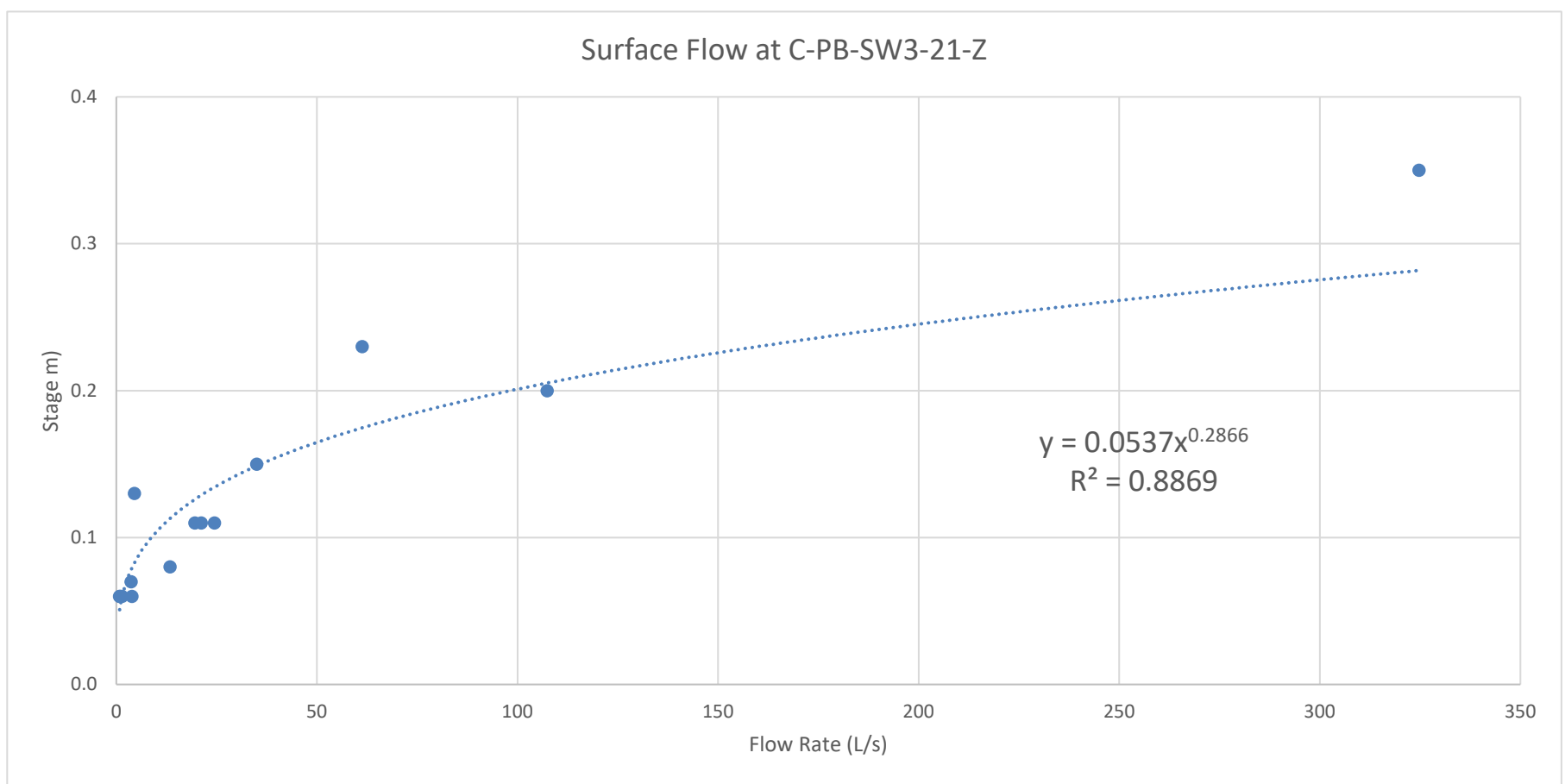
**PINEBUSH EAST WELL FIELD**

— C-PB-DP3-21-A (E) — C-PB-DP3-21-B (E) — C-PB-SW3-21-Z (E)



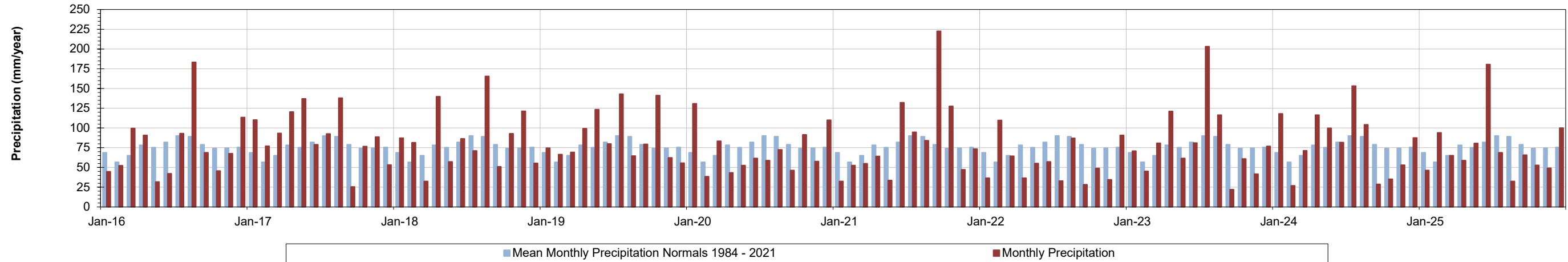
REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

| Date      | Stage (m) | Stream Flow (L/s) |
|-----------|-----------|-------------------|
| 15-Apr-24 | 0.20      | 107.4             |
| 24-May-24 | 0.08      | 13.4              |
| 21-Jun-24 | 0.15      | 35.0              |
| 30-Jul-24 | 0.23      | 61.3              |
| 28-Aug-24 | 0.11      | 19.6              |
| 20-Sep-24 | 0.13      | 4.5               |
| 25-Oct-24 | 0.06      | 3.9               |
| 4-Apr-25  | 0.35      | 324.7             |
| 26-May-25 | 0.11      | 24.4              |
| 18-Jun-25 | 0.07      | 3.7               |
| 7-Jul-25  | 0.11      | 21.2              |
| 28-Aug-25 | 0.06      | 0.9               |
| 18-Sep-25 | 0.06      | 0.8               |
| 20-Oct-25 | 0.06      | 1.4               |

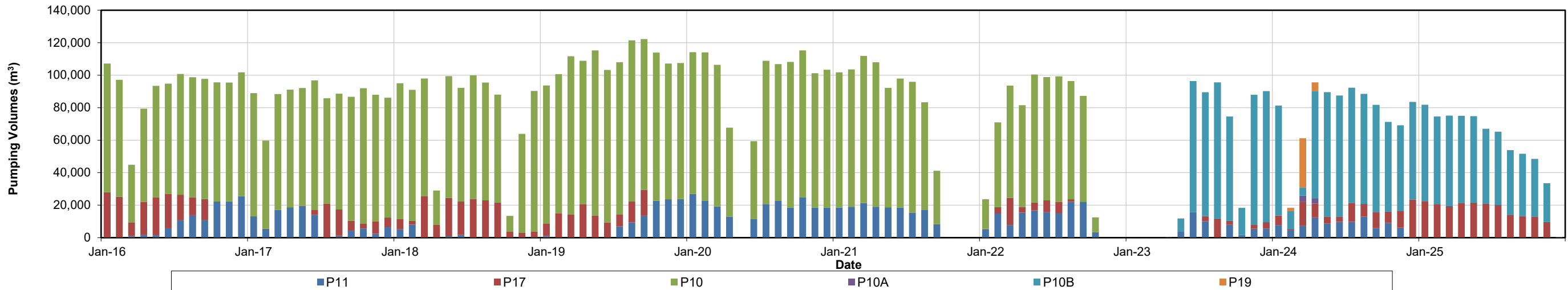


REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

**Actual versus Mean Monthly Precipitation**  
Weather Station - Shades Mills Dam Weather Station

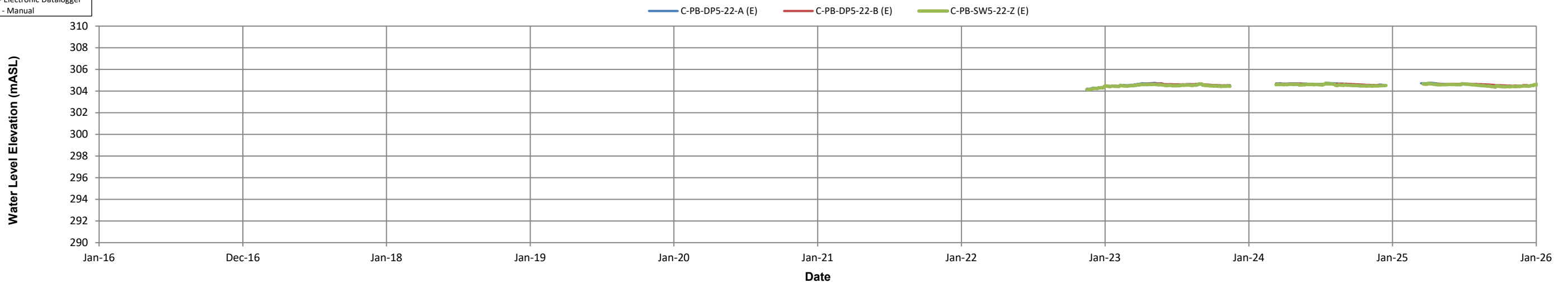


**Monthly Total Pumped Volumes**  
PINEBUSH EAST WELL FIELD



**PINEBUSH EAST WELL FIELD**

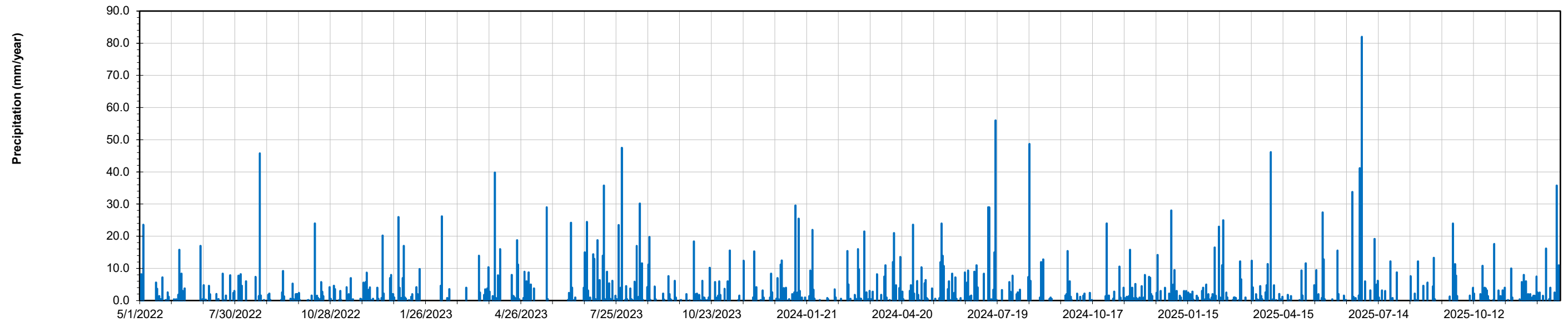
Current Measure Method  
(E) - Electronic Datalogger  
(M) - Manual



REGION OF WATERLOO  
2025 GROUNDWATER MONITORING REPORT -  
PINEBUSH EAST WELL FIELD

Daily Precipitation

Weather Station - Shades Mills Dam Weather Station



PINEBUSH EAST WELL FIELD

Current Measure Method  
(E) - Electronic Datalogger  
(M) - Manual

— C-PB-DP5-22-A (E) — C-PB-DP5-22-B (E) — C-PB-SW5-22-Z (E)





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## Appendix D

### Precipitation Data

**Table D-1  
Precipitation Variation from Average  
Region of Waterloo - 2025 Groundwater Monitoring Report**

| Year | Kitchener/Waterloo Weather Station<br>Established 1966 |   |                 |
|------|--|---|-----------------|
|      | Annual Precipitation (mm)                              | 30-yr NORMAL Precipitation 1981-2010 (mm) | Difference (mm) |
|      | 2016   | 748                                       | 851             |
| 2017 | 818  | 851                                       | -33             |
| 2018 | 749  | 851                                       | -102            |
| 2019 | 695  | 851                                       | -156            |
| 2020 | 689  | 851                                       | -162            |
| 2021 | 772  | 851                                       | -79             |
| 2022 | 438  | 851                                       | -413            |
| 2023 | 813  | 851                                       | -38             |
| 2024 | 874  | 851                                       | 23              |
| 2025 | 723  | 851                                       | -128            |

| Year | University of Waterloo Station<br>Established 1988 |                                      |                 |
|------|--|--------------------------------------|-----------------|
|      | Annual Precipitation (mm)                          | Average Precipitation 1998-2024 (mm) | Difference (mm) |
|      | 2016   | 891                                  | 871             |
| 2017 | 989  | 871                                  | 118             |
| 2018 | 950  | 871                                  | 79              |
| 2019 | 923  | 871                                  | 52              |
| 2020 | 953  | 871                                  | 82              |
| 2021 | 1022   | 871                                  | 151             |
| 2022 | 578  | 871                                  | -293            |
| 2023 | 959  | 871                                  | 88              |
| 2024 | 763  | 871                                  | -108            |
| 2025 | 943  | 871                                  | 72              |

| Year | Shand Dam<br>Established 1939 |                                      |                 |
|------|-------------------------------|--------------------------------------|-----------------|
|      | Annual Precipitation (mm)     | Average Precipitation 1940-2025 (mm) | Difference (mm) |
|      | 2016                          | 976                                  | 926             |
| 2017 | 1093                          | 926                                  | 167             |
| 2018 | 849                           | 926                                  | -77             |
| 2019 | 1081                          | 926                                  | 155             |
| 2020 | 1017                          | 926                                  | 91              |
| 2021 | 876                           | 926                                  | -50             |
| 2022 | 798                           | 926                                  | -128            |
| 2023 | 1015                          | 926                                  | 89              |
| 2024 | 994                           | 926                                  | 68              |
| 2025 | 995                           | 926                                  | 69              |

| Year | Conestogo Dam<br>Established 1961 |                                      |                 |
|------|-----------------------------------|--------------------------------------|-----------------|
|      | Annual Precipitation (mm)         | Average Precipitation 1961-2025 (mm) | Difference (mm) |
|      | 2016                              | 983                                  | 990             |
| 2017 | 1210                              | 990                                  | 220             |
| 2018 | 962                               | 990                                  | -28             |
| 2019 | 992                               | 990                                  | 2               |
| 2020 | 1021                              | 990                                  | 31              |
| 2021 | 975                               | 990                                  | -15             |
| 2022 | 907                               | 990                                  | -83             |
| 2023 | 1053                              | 990                                  | 63              |
| 2024 | 972                               | 990                                  | -18             |
| 2025 | 1025                              | 990                                  | 35              |

| Year | Woolwich Dam<br>Established 1960 |                                      |                 |
|------|----------------------------------|--------------------------------------|-----------------|
|      | Annual Precipitation (mm)        | Average Precipitation 1960-2025 (mm) | Difference (mm) |
|      | 2016                             | 844                                  | 835             |
| 2017 | 986                              | 835                                  | 151             |
| 2018 | 869                              | 835                                  | 34              |
| 2019 | 824                              | 835                                  | -11             |
| 2020 | 862                              | 835                                  | 27              |
| 2021 | 649                              | 835                                  | -186            |
| 2022 | 668                              | 835                                  | -167            |
| 2023 | 859                              | 835                                  | 24              |
| 2024 | 793                              | 835                                  | -42             |
| 2025 | 732                              | 835                                  | -103            |

| Year | Shade's Mills Dam<br>Established 1960 |                                      |                 |
|------|---------------------------------------|--------------------------------------|-----------------|
|      | Annual Precipitation (mm)             | Average Precipitation 1960-2025 (mm) | Difference (mm) |
|      | 2016                                  | 934                                  | 909             |
| 2017 | 1092                                  | 909                                  | 183             |
| 2018 | 1042                                  | 909                                  | 133             |
| 2019 | 1059                                  | 909                                  | 150             |
| 2020 | 848                                   | 909                                  | -62             |
| 2021 | 1020                                  | 909                                  | 111             |
| 2022 | 682                                   | 909                                  | -227            |
| 2023 | 982                                   | 909                                  | 73              |
| 2024 | 976                                   | 909                                  | 67              |
| 2025 | 895                                   | 909                                  | -14             |

| Year | Laurel Dam<br>Established 1960 |                                      |                 |
|------|--------------------------------|--------------------------------------|-----------------|
|      | Annual Precipitation (mm)      | Average Precipitation 1960-2025 (mm) | Difference (mm) |
|      | 2016                           | 985                                  | 938             |
| 2017 | 1062                           | 938                                  | 124             |
| 2018 | 1071                           | 938                                  | 133             |
| 2019 | 940                            | 938                                  | 2               |
| 2020 | 938                            | 938                                  | 0               |
| 2021 | 1027                           | 938                                  | 89              |
| 2022 | 689                            | 938                                  | -249            |
| 2023 | 921                            | 938                                  | -17             |
| 2024 | 907                            | 938                                  | -31             |
| 2025 | 894                            | 938                                  | -44             |

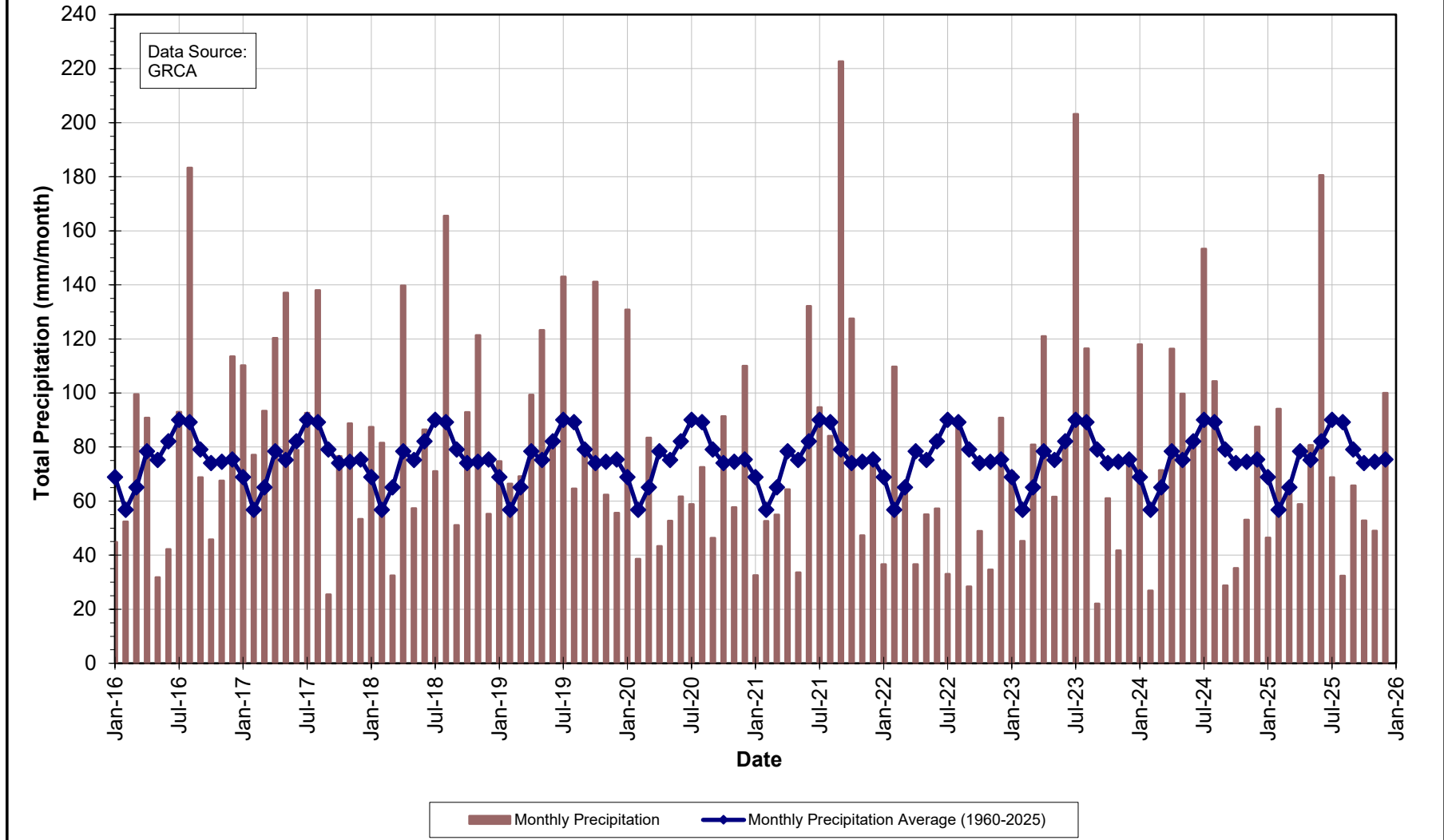
| Year | Roseville Weather Station<br>Established 1972 |   |                 |
|------|---|---|-----------------|
|      | Annual Precipitation (mm)                     | 30-yr NORMAL Precipitation 1981-2010 (mm) | Difference (mm) |
|      | 2016  | 899                                       | 919             |
| 2017 | 882   | 919                                       | -37             |
| 2018 | 905   | 919                                       | -14             |
| 2019 | 957   | 919                                       | 38              |
| 2020 | 817   | 919                                       | -102            |
| 2021 | 832   | 919                                       | -87             |
| 2022 | 637   | 919                                       | -282            |
| 2023 | 945   | 919                                       | 26              |
| 2024 | 856   | 919                                       | -63             |
| 2025 | 786   | 919                                       | -133            |

**NOTES:**

WIA station data is not subject to review by the National Climate Archives, therefore, undergoes very limited quality checking.  
GRCA Dam stations data is not reviewed extensively and undergoes limited quality checking.

Region of Waterloo – 2025 Groundwater Monitoring Report

Figure D.1  
Shade's Mills Dam  
Monthly Precipitation





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## Appendix E

### Monitoring Program Overview

## GROUNDWATER LEVEL MONITORING PROGRAM PROCEDURES

### E.1 Overview

The Region of Waterloo (Region) collects water level measurements at specific monitoring wells to ensure sustainable long-term water supply and to meet monitoring and reporting requirements for the Region's water-taking permits. The goal of the program is to manage and protect the Region's groundwater supply and to assess the potential impact of municipal pumping on the groundwater and surface water resources in the Region. The ongoing collection and assessment of groundwater level data is integral to assess any changes to the water resources that may occur due to pumping.

#### E.1.1 Production Well Pumping and Water Levels

In 2023 the Region managed approximately 132 production wells with status defined as:

- Commissioned – Active wells
- New Not-Commissioned – Well are inactive or locked out until future demand or repairs/maintenance of other wells requires activating them

The well fields are referred to as Urban (Kitchener, Waterloo, and Cambridge) and Rural (North Dumfries, Woolwich, Wilmot, and Wellesley). Well fields in Kitchener, Waterloo, and Cambridge are referred to as the Integrated Urban System (IUS).

The Region's active production wells are monitored through the Region's SCADA (Supervisory Control and Data Acquisition) system, which reads and records the volume pumped on a daily basis. A few wells do not have their own meter but are combined with other nearby well(s) in the well field and the combined flow is divided into a record for each source. Water level measurements are obtained from the production wells where required. All manual measurements are obtained using either an air line or a water level tape.

### E.1.2 Monitoring Wells and Surface Water levels

Water levels are measured at monitoring wells and at some surface water features. The objective of this monitoring is to collect data to ensure that the Region's water taking has minimal impact on the environment and on private water takers.

Water levels in the Region's monitoring wells are measured either electronically or manually. Most of the wells that are monitored electronically use datalogger equipment manufactured by *In-Situ Inc.*® LevelTROLLs® and RuggedTROLLs®, as well as, by *Van Essen Instruments (formerly Schlumberger Water Services)* Mini-Divers®, Micro-Divers®, and TD-Divers®; or by *Solinst*® Levelloggers®. The datalogger pressure sensor models used may be either vented (gauged) or non-vented (absolute) for *In-Situ Inc.*®; whereas, for *Van Essen Instruments* and for *Solinst*®, non-vented (absolute) models are used. Barometric dataloggers by each manufacturer suspended in select well locations are also used with the non-vented (absolute) models to provide the required barometric pressure compensation necessary in producing the water level data. Manual monitoring is done using a *Solinst*® and/or *Heron Instruments Inc.* electronic water level meter with both visual and audio indicators.

The electronically monitored wells are typically measured every hour, with increased frequency as required. At the hourly frequency, the following trends can be distinguished in an individual monitoring well:

- Seasonal climate trends;
- Water level changes in the aquifer that is being pumped;
- Water level changes in aquifers connected to the pumped aquifer; and
- Individual precipitation events in unconfined aquifers.

The manually monitored wells are measured once per month. At this frequency only the first three responses listed above can be distinguished.

### E.1.3 Climatological Data

To evaluate the reaction of water levels to changes in climatic conditions, precipitation data are monitored at various locations throughout the Region. Within the Region of Waterloo, climate data is collected by Environment Canada at the Region of Waterloo International Airport (WIA) and the Roseville weather station, by the Grand River Conservation Authority (GRCA) at various Dam locations and by the University of Waterloo at a weather station located on the north campus.

## **E.2 Groundwater Level Collection Protocols**

### **E.2.1 Groundwater Level Monitoring Network Summary Well Checklist**

A well checklist and data entry spreadsheet are prepared of all the measuring points where water levels will be collected on a monthly basis. The checklist and spreadsheet are organized by well field so wells in close proximity are grouped together and indicates whether locations are measured with electronic dataloggers or manual measurements only. Once a well is visited, data is entered in the spreadsheet and the well is checked off the list; thus, the checklist and spreadsheet provides an obvious indication that work is unfinished if a location is unchecked and has no data.

### **E.2.2 Well Inspection**

Upon visiting a well for the first time, the well/casing/equipment details are noted, photos taken, and GPS coordinates are recorded in a field book and/or in the monthly data entry spreadsheet. Well/casing/equipment details includes: location, access, condition, materials, diameters, casing security, surface seal condition, requiring repair or not, well/casing stickup measurements from ground level, well total depth, and the type of datalogger and/or sampling equipment installed. Any notable deficiencies, concerns, problems, or changes in the well condition are recorded in a field book and/or in the monthly data entry spreadsheet, as well as, photos are taken. Also, any observed activities taking place around or near the well that are worth noting are recorded in a field book and/or in the monthly data entry spreadsheet.

### **E.2.3 Monitoring Well Manual Water Level Measurement Procedure**

- Unlock well casing and open well casing lid.
- Remove well cap (if present).
- Use an Electronic Water Level meter and lower the probe down the well until the meter beeps to indicate the probe has encountered water.
- The probe is raised up until the beep of the meter stops, indicating the probe is now above the water.
- Then the probe is slowly lowered down until the probe just contacts the water level surface causing the meter to beep.
- At this point the depth (in meters) is read off the water level meter tape from the measuring point of the well (in most cases is the top of the casing or pipe) and this provides the water level depth below the measuring point.
- The date, time, and water level depth measured is recorded in a field book and/or in the monthly data entry spreadsheet.
- This procedure is repeated for each of the well screens inside the well casing.

- Replace well caps.
- Close well casing lid and lock well casing.

#### **E.2.4 Downloading of Water Levels from Electronic Dataloggers Procedure**

##### **For Non-Vented (Absolute) Datalogger Models:**

*In-Situ Inc.*® LevelTROLLs® and RuggedTROLLs®, *Van Essen Instruments Divers*®, and *Solinst*® Levelloggers®

- Prior to downloading data from the datalogger, a manual water level is measured in each well screen containing a datalogger.
- The datalogger is pulled out of the well, unthreaded from the cap that is attached to a wire cable and connected to (or placed in) the corresponding datalogger communication device. The communication device is connected to a laptop/tablet PC or a RuggedReader® Handheld PC and the associated datalogger software is started.
- Water level data stored in the datalogger is subsequently downloaded and viewed using the datalogger software and saved on the hard drive/memory.
- Note: downloading data from the datalogger does not automatically stop the datalogger from recording.
- The status of the datalogger is viewed and checked for correct operation and to confirm that the datalogger is hanging in the well water within its operating range.
- Select datalogger details such as the battery level and free/used memory are recorded in a field book and/or in the monthly data entry spreadsheet.
- If the datalogger does not require restarting to free up memory or to change the sample rate, then the datalogger is removed from the communication device and is threaded back onto its cap and lowered back down the well on the wire cable.
- If the datalogger does require restarting to free up memory or to change the sample rate, then the datalogger is stopped, reprogrammed, and restarted using the datalogger software and, as a result, erases the previous data stored in memory on the datalogger.
- This procedure is repeated for each datalogger within each of the well screens inside the well casing.
- After all the non-vented (absolute) dataloggers have been downloaded then the Barometric dataloggers are downloaded following the same procedure as above.

**For Vented (Gauged) Datalogger Models:***In-Situ Inc.*® LevelTROLLs®

- Prior to downloading data from the datalogger, a manual water level is measured in each well screen containing a datalogger.
- The desiccant tube is unconnected from the datalogger cable.
- The datalogger cable is connected to a communication cable device that is connected to a laptop/tablet PC or a RuggedReader® Handheld PC and the datalogger software is started.
- Water level data stored in the datalogger is subsequently downloaded and viewed using the datalogger software and saved on the hard drive/memory.
- Note: downloading data from the datalogger does not automatically stop the datalogger from recording.
- The status of the datalogger is viewed and checked for correct operation and to confirm that the datalogger is hanging in the well water within its operating range.
- Select datalogger details such as the battery level, free/used memory, and desiccant condition (colour) are recorded in a field book and/or in the monthly data entry spreadsheet.
- The desiccant tube condition is checked and replaced if necessary.
- If the datalogger does not require restarting to free up memory or to change the sample rate, then the communication cable device is disconnected from the datalogger cable and the desiccant tube is reconnected.
- If the datalogger does require restarting to free up memory or to change the sample rate, then the datalogger is stopped, reprogrammed, and restarted using the datalogger software and, as a result, erases the previous data stored in memory on the datalogger.
- This procedure is repeated for each datalogger within each of the well screens inside the well casing.

**E.2.5 Data Entry and Processing into the Burnside MS ACCESS/SQL® Database**

- All field data collected (i.e. date, time, manual water level depth measured, comments) and recorded for each well screen and datalogger in a field book is entered into the monthly data entry spreadsheet, unless already entered in the field using a laptop/tablet PC.
- The monthly data entry spreadsheet is checked and reviewed prior to importing the data into a database table using Burnside Water Level Data Tools software. Manual water level depth values are converted into water level elevation values using the software during this import process.
- Any associated well notes, comments, and datalogger details are entered into a database table under the appropriate well and screen.

## 2025 Groundwater Level Monitoring Program Report – APPENDIX E

- Water level data from the dataloggers downloaded to a laptop/tablet PC or a RuggedReader® Handheld PC are transferred to Burnside file folder network upon returning to the office.
- These datalogger water level data files are subsequently read and the data is imported into a database table using Burnside Water Level Data Tools software.
- Using Burnside Water Level Data Tools software, the datalogger water level data are reviewed and processed (as described below) resulting in corrected water level depth values and corrected water level elevation values that are stored in a database table.
- *For Non-Vented (Absolute) Datalogger Models:*  
Datalogger water level data is first barometric pressure compensated using selected Barometric datalogger data, then a manual water level depth value measured at the time of the most recent download is applied and used to convert the barometric compensated water level data into corrected water level depth values, which are converted into water level elevation values that are appended to a database table.
- *For Vented (Gauged) Datalogger Models:*  
A manual water level depth value measured at the time of the most recent download is applied to the datalogger water level data to convert the water level data into corrected water level depth values, which are converted into water level elevation values that are appended to a database table.
- Temperature data recorded by the dataloggers are also imported into a database table.
- Hydrographs are subsequently created for each well and screen from the water level elevation data in the database for review and presentation. If there are some data points that are erroneous, then these data points are marked as non-reportable (invalid) within the database and/or are removed resulting in them not being plotted on the hydrographs.
- An updated data file is provided to the Region on a quarterly basis for upload into their eWRAS EQUIS database.

