



BURNSIDE

**2025 Biennial Groundwater Monitoring
Report - Blair Well Field (G4 and G4A)**

The Region of Waterloo



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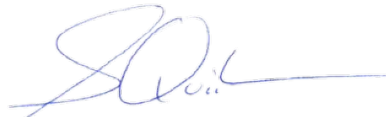
**June 2026
HA0464020.2024**

Distribution List

No. of Hard Copies	PDF	Email	Organization Name
0	Yes	Yes	The Ministry of Environment, Conservation and Parks (MECP)
0	Yes	Yes	The Region of Waterloo

Record of Revisions

Revision	Date	Description
0	April 2026	Draft Submission to the Region of Waterloo
1	June 2026	Submission to the MECP

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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) 5134-BW6LJX was replaced by P-300-2229080479 Version: 2.0 on March 28, 2024 the Blair Well Field (G4 and G4A) permit requires submission of a well field specific biennial report to the Ministry of Environment, Conservation and Parks (MECP) which documents production well pumping volumes and water levels in specific monitoring wells during 2024 and 2025. This report has been prepared to meet the reporting condition (4.3) of the PTTW for 2024 and 2025. A copy of the PTTW is included in Appendix A.

The location of the Blair Well Field is shown in Figure 1 and the production wells in Cambridge are shown in Figure 2 with the monitoring network for G4 and G4A 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 the 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 the Blair Well Field (G4 and G4A) in accordance with PTTW P-300-2229080479 which consists of the following activities:

- Measuring the daily volume pumped from the G4 and G4A production wells (Condition 4.1 of the PTTW);
- Measuring the water levels in monitoring wells C-BR-OW1-09-ABC, C-BR-OW1-08-D, and C-BR-OW5-95-ABCDEF (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.

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 Blair Well Field production wells are located on Dianne Crescent in the Southwest portion of the City of Cambridge, formerly the Town of Blair. The closest municipal well fields are the Dunbar Road Well Field located approximately 1.8 km to the north, and the Shade's Mills Well Field located approximately 2.5 km to the east (Figure 2). The closest surface water feature to the G4 and G4A site is Devil's Creek, a small tributary to the Grand River located 25 m to the east (Figure 3). The Grand River is located 430 m north of G4A. (Figure 3).

2.1.1 Pumping Wells

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

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
G4	1954	230	250	31.4-60.9	Middle Guelph / Lower Guelph/ Eramosa
G4A	2009	300	300	52.7-83.4	Lower Guelph / Eramosa / Goat Island

The water taking volumes for the Blair G4 and G4A 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

	PTTW Details	2024			2025		
Well	Permitted Max. Daily Water Taking (m ³)	Avg. Daily Water Taking (m ³)	Max Taken per Day (m ³)	Total Volume Pumped (m ³)	Avg. Daily Water Taking (m ³)	Max Taken per Day (m ³)	Total Volume Pumped (m ³)
G4	1,900.8	0.1	21	21	324	1,428	118,086

	PTTW Details	2024			2025		
G4A	4,579.2	1,347	1,477	491,813	418	1,384	152,426
Combined	4,579.2	1,347	1,477	491,834	741	1,428	270,512

The total combined water taking from Wells G4 and G4AA may not exceed an annualized average of 3,701.4 m³/day, which corresponds to a long-term rate of 2,570.4 L/min, as specified in Condition 3.3 of the PTTW. As shown in Table 2, this requirement was met in both 2024 and 2025.

Production wells G4 and G4A are pumped in alternation. 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. Rehabilitation of G4A was conducted in 2025, during which time the well field was taken offline between April 22 and October 2. Pumping volumes from the well field ranged from 37,881 m³/month to 42,812 m³/month in 2024, and from 0 m³/month to 42,698 m³/month in 2025. In total, 491,834 m³ was produced at this well field in 2024 and 270,512 m³ was produced in 2025. These volumes are within the historical range and below the permitted volume of 1,351,002 m³ per year (Table C-1). The annualized average for the combined taking from G4 and G4A was 1,347 m³/day in 2024 and 741 m³/day in 2025. These were below the annualized average of 3,701.4 m³/day allowed under Condition 3.3 of the PTTW.

2.1.2 Monitoring Wells

Observation wells C-BR-OW1-09-ABC and C-BR-OW1-08-D are located adjacent to wells G4 and G4A and C-BR-OW5-95-ABCDEF is located approximately 610 m west from the production well site (Figure 3). C-BR-OW1-09-ABC is a multi-level bedrock well that was originally drilled as one of the exploration holes on the site and was subsequently converted to a monitoring well nest. C-BR-OW1-08-D is an overburden well that was constructed to monitor water levels during the long-term test of G4A (May 2009).

Construction and monitoring details of C-BR-OW1-09-ABC, C-BR-OW1-08-D and C-BR-OW5-95-ABCDEF are described in the table below. Well records for the monitoring wells are provided in Appendix B.

Table 3: Monitoring Well Construction Details

Monitoring Well ID	Year Built	Screened Depth (mbgs)	Screened Formation	Distance to G4 (m)	Distance to G4A (m)
C-BR-OW1-09-A	2009	96.9-100.0	Middle Gasport	24	14
C-BR-OW1-09-B	2009	67.8-73.9	Eramosa	24	14
C-BR-OW1-09-C	2009	24.9-28.0	Middle Guelph	24	14
C-BR-OW1-08-D	2008	3.4-4.6	Overburden (AFD1)	25	15
C-BR-OW5-95-A	1995	140.2-143.3	Lower Gasport / Cabot Head	605	616
C-BR-OW5-95-B	1995	102.1-109.7	Upper Gasport	605	616
C-BR-OW5-95-C	1995	54.9-61.0	Eramosa	605	616
C-BR-OW5-95-D	1995	20.7-23.8	Guelph-Overburden Contact	605	616
C-BR-OW5-95-E	1995	20.4-22.0	Guelph-Overburden Contact	605	616
C-BR-OW5-95-F	1995	6.1-7.6	Overburden (AFA2)	605	616

2.2 Regional Geology and Hydrostratigraphy

The following sections provide a brief overview of the regional geology and hydrogeology of the Blair 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 Blair Well Field (G4 and G4A) are included as Figures 5 and 6 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 Blair Well Field. It should be noted that the deep A series wells were not included in the modelling. The layers displayed were generated from results of the Hydrogeological Characterization and Conceptual Model Tier 3 Assessment Update Project (Aqua Insight et al, 2023) and associated hydrogeological modelling work.). At the Blair Road Well Field, the hydrostratigraphic interpretation developed by Golder was based on drilling and testing completed in 2016 and 2017 (Golder, 2020). Results from the new boreholes indicated

that the Guelph Formation is approximately 10 to 15 m thinner than previously interpreted at Well G4A.

Differentiation between the Reformatory Quarry Member and the Goat Island Formation remained uncertain, and it was suggested that a transitional or hybrid unit between these formations may be present at the Blair Road Well Field. In addition, the top elevations of both the Reformatory Quarry Member and Goat Island Formation were interpreted to be approximately 10 to 15 m higher than shown in the earlier conceptual model. The Vinemount Member was not observed in any of the new boreholes. The interpreted areal extent of the Vinemount Member was updated. No new geological picks have been identified to further refine the hydrostratigraphic interpretation at this location.

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 range from approximately 5 to 10 m in areas of outwash deposits, however, 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 Shade's Mills, 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 overburden west of the Grand River consists largely of kame and outwash sands and gravels with steep terraces on the western edge of the river. Overburden thickness west of the Grand River is variable with deposits of up to 60 m in thickness (Stantec 2011).

The Quaternary Geology of the Cambridge area (Lotowater 1997, Karrow 1987 and Bajo and Shirota, 2007) typically includes the units described below:

Aquitard ATA1 / AFA1 / 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 AFA1 - Whittlesey Sand

This very fine to coarse sand unit is interpreted as glaciolacustrine Whittlesey sand (Bajc and Shiota, 2007) and is encountered at surface across the section. AFA1 is non-continuous.

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 Shiota (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 / ATB2 / AFB2 - Upper Waterloo Moraine Stratified Sediments and Equivalents

Areas of significant thicknesses of aquifer AFB1 are interpreted to occur southeast of the Speed River and west of Puslinch Lake and generally correspond 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 / AFB3 / ATC1 / AFC1 / ATC2 - 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 (approximately 6.5 km northwest of the Blair Rd Well Field), 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.

Aquifer AFD1 / ATE1 / AFF1 / ATG1 - Pre-Catfish Sand and Gravel

The Pre-Catfish sand and gravel aquifer is present below the Ice-Contact Stratified Deposits in the Willard Well Field but is not a significant unit elsewhere in the Cambridge area (approximately 4.5 southeast of the Blair Rd Well Field). This unit is the main municipal aquifer for the Fountain Street Well Field. The Pre-Catfish Sand and Gravel is found directly overlying bedrock in the Willard and Fountain Street Well Field area and is hydraulically connected with the upper weathered portion of the bedrock aquifer. Aquifer AFD1 corresponds to sands and gravel reworked 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) 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 G4 and G4A are shown on the cross sections in Figures 5 and 6.

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 Blair Well Field well plan and cross-section locations. Representative cross-sections are included as Figures 5 and 6 to visualize the stratigraphy described in this section.

The overburden at the Blair Road Well Field consists of layers of coarse - grained sand and gravel as well as finer grained till deposits. Based on the borehole results of a continuously cored overburden borehole (C-BR-OW1-08-D), the overburden at the well field is approximately 4.6 m thick and includes gravelly sand from 1.2 m to 2.1 m and sandy gravel from 2.1 m to 4.6 m below grade (AFD1).

2.3.1 Bedrock Geology

Based on the results of drilling investigations at the site, the bedrock surface is encountered at approximately 4.6 mbgs (Appendix B).

Table 4 is a summary of the formations encountered during drilling of G4A and C-BR-OW1-09-ABC.

Table 4: Summary of Bedrock Formations at Blair Well Field (G4 and G4A)

Formation	Description	Thickness (m)	G4A Water Production (m bgs)
Guelph	Dolostone – grey, moderately porous, some large voids.	55.4	-
Eramosa	Dolostone – dark grey, slightly to very porous with some large voids.	16.2	65, 76
Goat Island	Dolostone – grey, slightly porous with some large voids.	7.3	80
Ancaster	Dolostone – black with some white, slightly porous	8.9	-
Gasport	Dolostone - grey, fine crystalline, slightly to very porous, moderately to richly fossiliferous, mottled, few vugs.	24.6	-
Rochester	Dolostone - grey horizontal layers, no crystals, not porous.	0.4	-
Irondequoit	Dolostone - dark grey, slightly porous, fine crystalline.	2.1	-
Rockway-Merriton	Dolostone - dark grey, slightly porous, finely crystalline.	2.3	-
Cabot Head	Shale – grey and red layered	> 3.2	-

3.0 2024 / 2025 Results

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 Blair well field is the Shade's Mills Dam station located about 3.8 km east from the well field. The closest Environment Canada station is Waterloo International Airport (WIA) located about 10.5 km north from the well field. The locations of the meteorological stations are shown on 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. Monthly precipitation data for the past 10 years at Shade's Mills Dam are

shown on Figure D.1, Appendix D. At the Shade's Mills Dam station, the long-term average was calculated from when measurements started until the end of 2025. The Roseville and Region of Waterloo International Airport (WIA) has "Climate Normals" calculated by Environment Canada for 1981 to 2010.

Annual 2024 / 2025 precipitation data for the GRCA and Environment Canada meteorological station closest to the Shade's Mills well field are presented in Table 5 below. WIA was missing 6 days of data in 2024 and 6 days in 2025. As a result, the precipitation totals may be under reported at this location.

Table 5: Summary of Precipitation Data

Station	2024 Precipitation (mm)	2024 Deviation (mm)	Long- Term Average (mm)	2025 Precipitation (mm)	2025 Deviation (mm)
Region of Waterloo International Airport ⁽¹⁾	874	+23	851 ^(A)	723	-128
Shade's Mills Dam ⁽²⁾	976	+67	909 ^(B)	895	-14
Sources: Environment Canada (1), GRCA (2), ^A 1981 to 2010 Normal ^B 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.

In 2024, the total precipitation at Shade's 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, 2024 GRCA snow survey indicated a snowpack across the Region that was low compared to normal.

In 2025, the total precipitation at Shade's Mills station was 895 mm, which is 14 mm below the long-term average. Similarly, the 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 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-BR-OW5-95-ABCDEF

C-BR-OW5-95 is located approximately 600 m west of G4 and G4A. Monthly manual water level monitoring began in November 2001 at C-BR-OW5-95-ABCDEF until May 2022 when electronic data loggers were installed in screens A through E. Water levels observed in 2024 / 2025 were consistent with historical values.

Screen A measures water levels in the Lower Gasport / Cabot Head Formation. Well sampling in October 2008 drew down water levels in the monitoring well by 35 m. The water levels in the well are slowly recovering and at the end of 2025 were approximately 1.7 m below the 2008 static water level. This slow recovery is indicative of the extremely low permeability of the bedrock at this location. The well does not respond to pumping or seasonal variations.

Screen B is completed within the Upper Gasport Formation, while Screen C is completed within the Eramosa Formation. Groundwater levels in Screens B and C generally range from approximately 264 to 266 masl and exhibit similar trends. In 2025, water levels in both screens fluctuated by about 1.5 m, with the greatest responses observed between May and September during periods of no well field pumping.

Screens D, E and F are in the overburden and do not typically respond to pumping, however water levels rise about 1.4 m when pumping ceases between May and October 2025. Water levels in Screens D, E and F typically follow seasonal variations.

C-BR-OW1-09-ABC and C-BR-OW1-08-D

C-BR-OW1-09 and C-BR-OW1-08 is located adjacent to G4 / G4A and monitoring at the well nest started in December 2010. Water level monitoring was completed using electronic data loggers at C-BR-OW1-09-ABC and C-BR-OW1-08-D. Water levels observed in 2024 / 2025 were consistent with historical values.

Screen A is completed in the Middle Gasport Formation. Water level fluctuations in screen A are attributable to drawdown from pumping. The response to pumping of either G4 or G4A is similar in the A screen. Water levels in the A screen rose approximately 1.5 m when the well field was off-line from May to September 2025.

Screen B is completed in the Eramosa Formation and screen C is completed in the Middle Guelph Formation. The water levels in the two wells show a similar pattern. Water levels in the B screen respond up to 7 m to pumping and water levels in C screen

fluctuate by 2 to 3 m on a daily basis as a result of cyclic pumping at G4A production well. Water levels in the B screen respond more to G4A while the C screen water levels respond more to the pumping of G4. Water levels in the B and C screens are also impacted by seasonal variations. Water levels in both screens rose when the well field was off-line from May to September 2025.

An electronic data logger was added to measure hourly water levels in the overburden at C-BR-OW1-08-D in March 2022. Prior to this, water level monitoring of the D screen was completed monthly. Water levels show a similar pattern to that seen at C-BR-OW5-95-DEF with seasonal trends. This well had detectable drawdown during the pumping test of G4A in May 2009 (Burnside, 2010). Water levels in 2024 / 2025 do not respond to pumping.

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 G4 and G4A received in 2024 and 2025.

Other non-municipal groundwater and surface water takings registered in the MECP's Permit to Take Water (PTTW) database within 2 km of the well field are shown on Figure 3 and summarized in Table 6. The only PTTW identified within this radius is associated with the Galt Country Club, which withdraws surface water from the Grand River. No groundwater takings are registered within 2 km of the well field, and no impacts to groundwater levels at the production wells are expected as a result of the surface water taking.

Table 6: PTTWs in Vicinity of Blair Well Field

Permit Number	Permit Holder	Purpose	Max Liters per Day	Distance (km) from G4 and G4A Supply Wells	Expiry Date
2318-D46H6C*	Galt Country Club Limited	Commercial	2,272,000	650 m	2/28/2034

Note: * Galt Country Club PTTW source is the Grand River.

4.1 Aquifer Response 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)".

The Guelph Formation shows a response to pumping (up to approximately 3 m of drawdown) as well as some seasonal variability.

In the Eramosa Formation, drawdown of up to 7 m indicates a strong hydraulic connection to the pumping well. Seasonal fluctuations are observed; however, groundwater levels do not show a clear response to precipitation.

The Upper Gasport Formation shows a response to pumping (up to approximately 1.5 m of drawdown). Seasonal variability is not evident, although groundwater levels respond to major precipitation events.

The Middle Gasport Formation and Lower Gasport / Cabot Head Formation do not exhibit a measurable response to pumping at G4A. Groundwater levels in these units also do not show seasonal trends or a correlation with precipitation events.

Groundwater levels in the overburden aquifer exhibit clear seasonal variability and respond to precipitation events, but do not respond to typical daily pumping.

5.0 Conclusions

Impacts from pumping the municipal wells at the Blair Well Field (G4 and G4A) 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 P-300-2229080479;
- 2024 and 2025 pumping volumes were within the permitted range;
- There were no reported well interference complaints arising from water taking at the Blair well field;
- Water levels in wells screened in the Upper Gasport, Guelph and Eramosa Formations show a measurable response to pumping; and
- Water levels in overburden wells C-BR-OW1-08-D and C-BR-OW5-95-DEF follow seasonal trends, and do not respond to pumping.

6.0 References

Aqua Insight Inc., Technical Memorandum Numerical Model Surface Transfer, March 2026.

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Characterization Study.

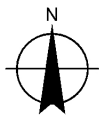
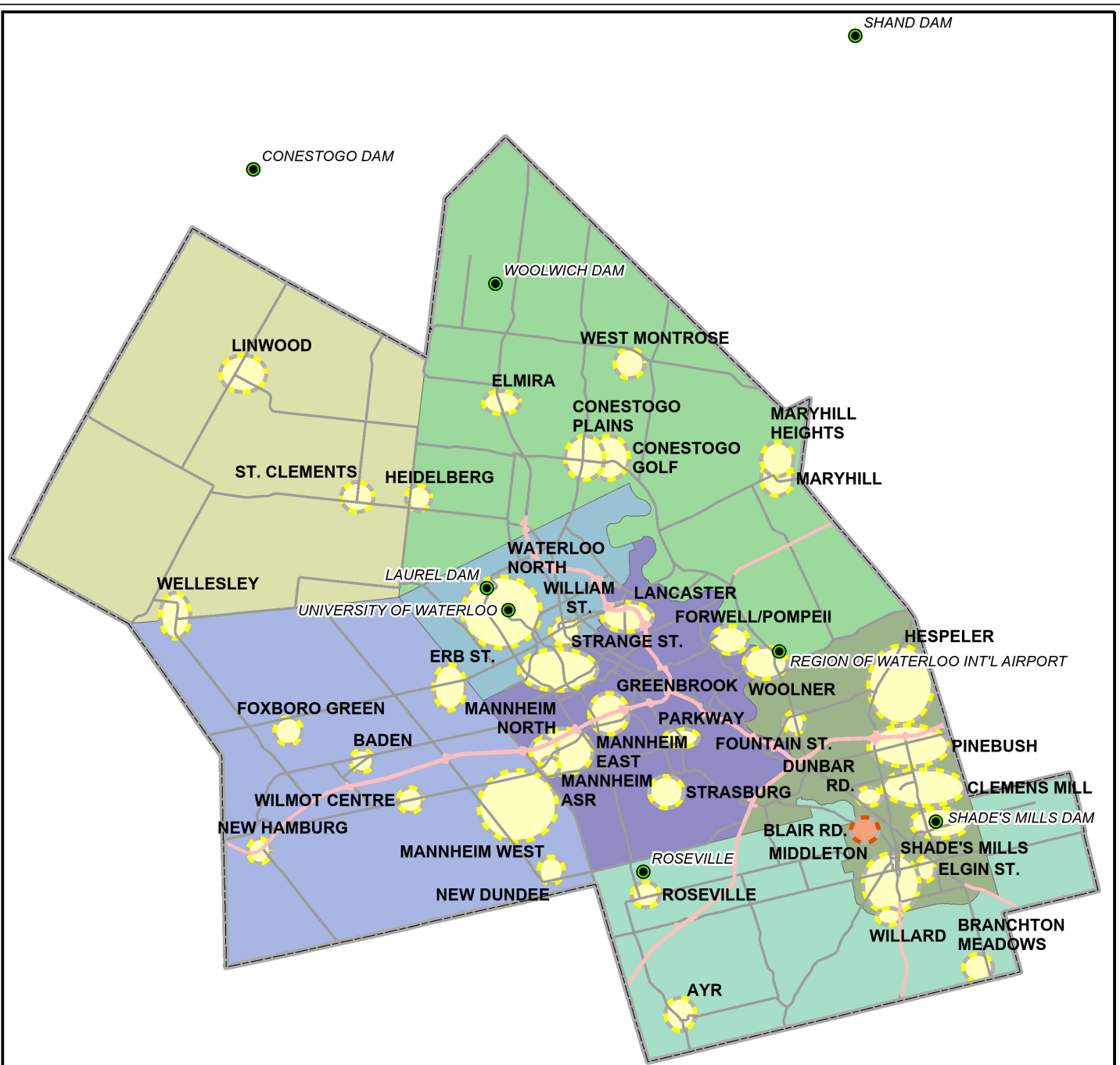


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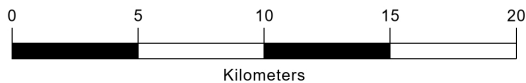
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Figures



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



Map Title

2025 GROUNDWATER MONITORING REPORT - BLAIR ROAD WELL FIELD

WELL FIELD LOCATION MAP

Client

REGION OF WATERLOO

Drawn

HN

Scale

1:300,000

Checked

SQ

Date

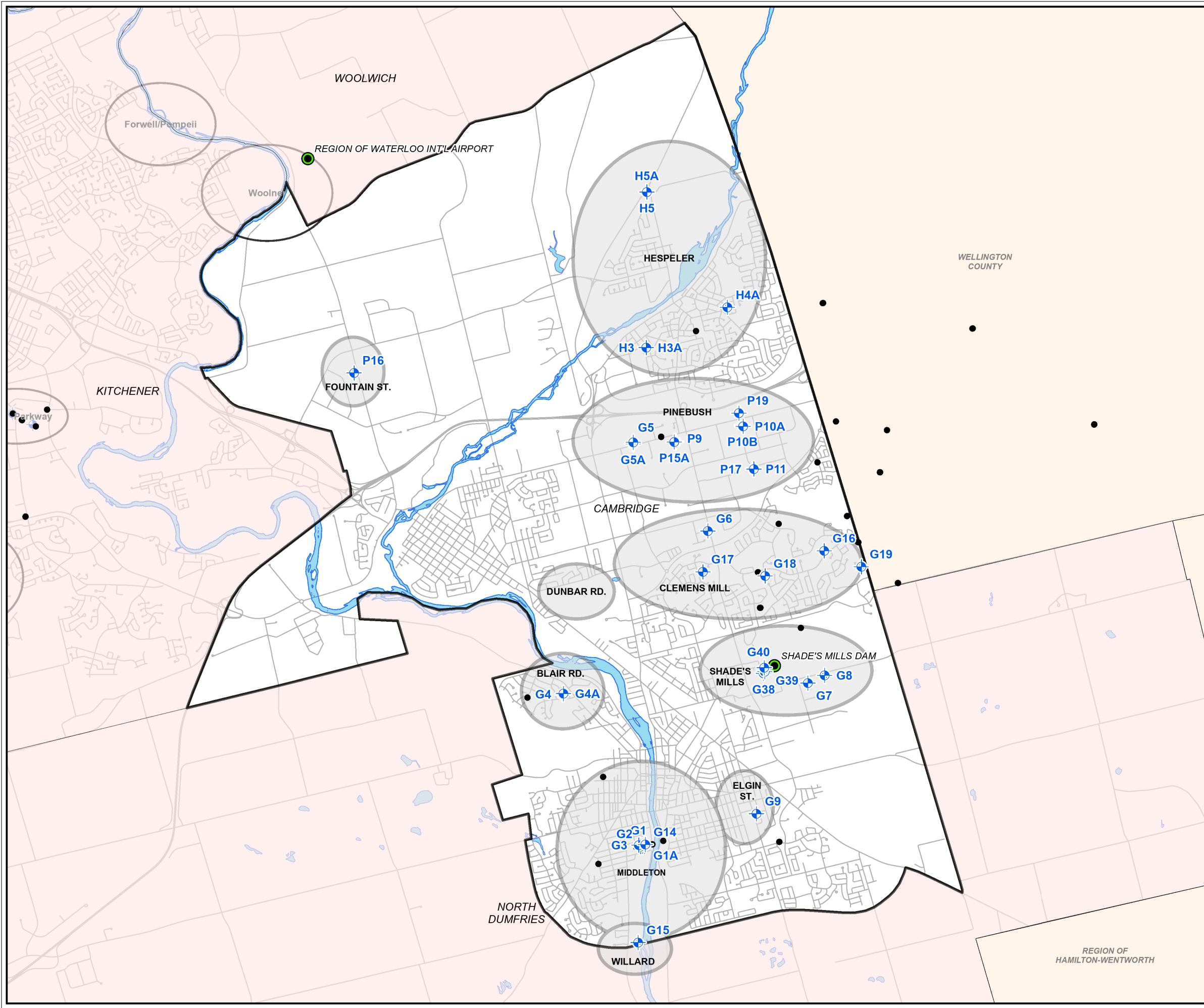
February 2026

Project No.

HA0464020

Figure No.

1



LEGEND

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

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

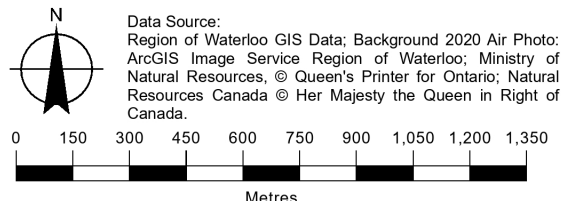
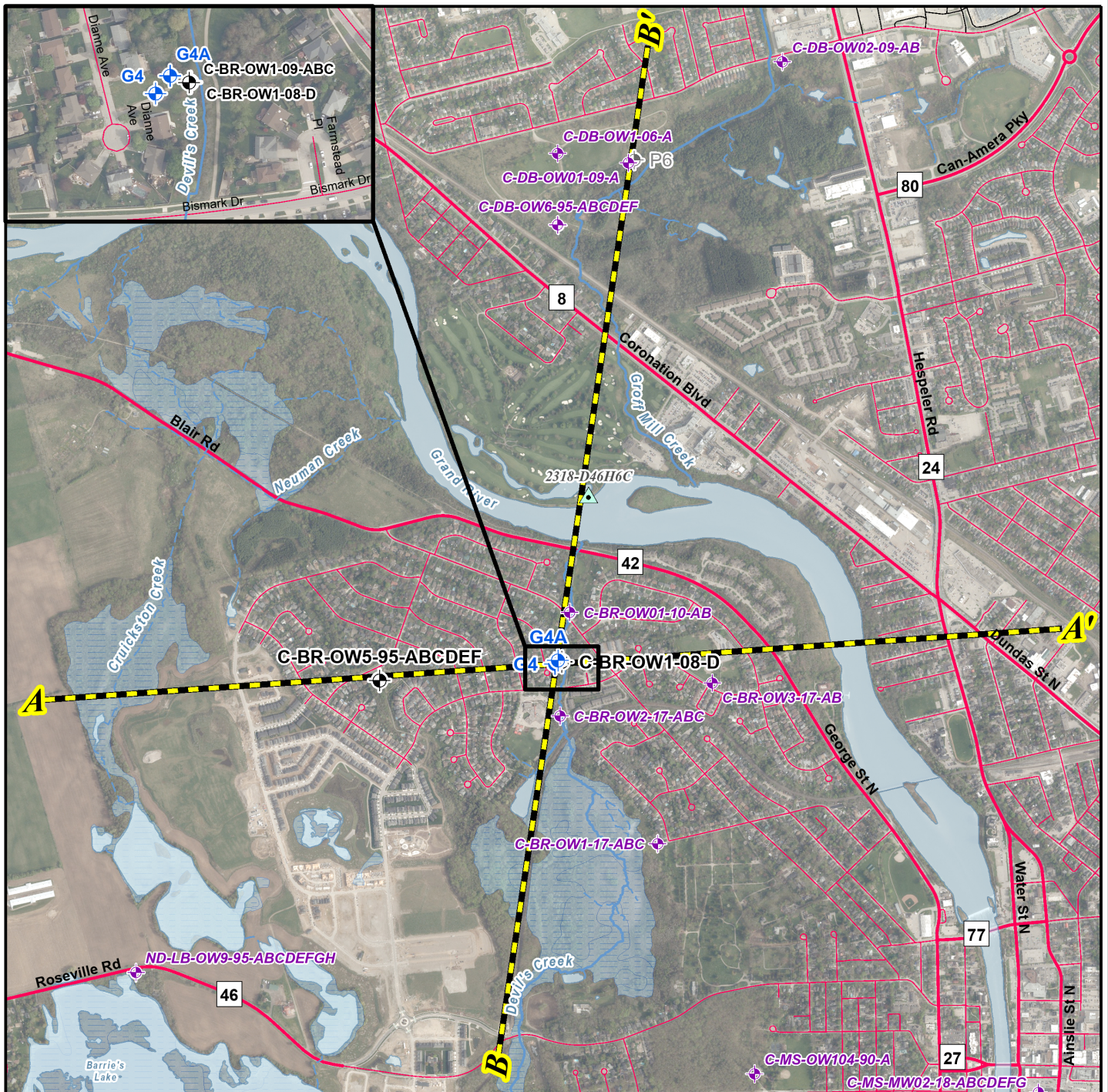
REGION OF WATERLOO

Figure Title

**2025 GROUNDWATER MONITORING
REPORT - BLAIR ROAD WELL FIELD**
**CAMBRIDGE WELL FIELDS AND
MONITORING NETWORK**

Drawn	Checked	Date	Figure No.
HN	SQ	March 2026	
Scale		Project No.	
1:65,000		HA0464020	

2

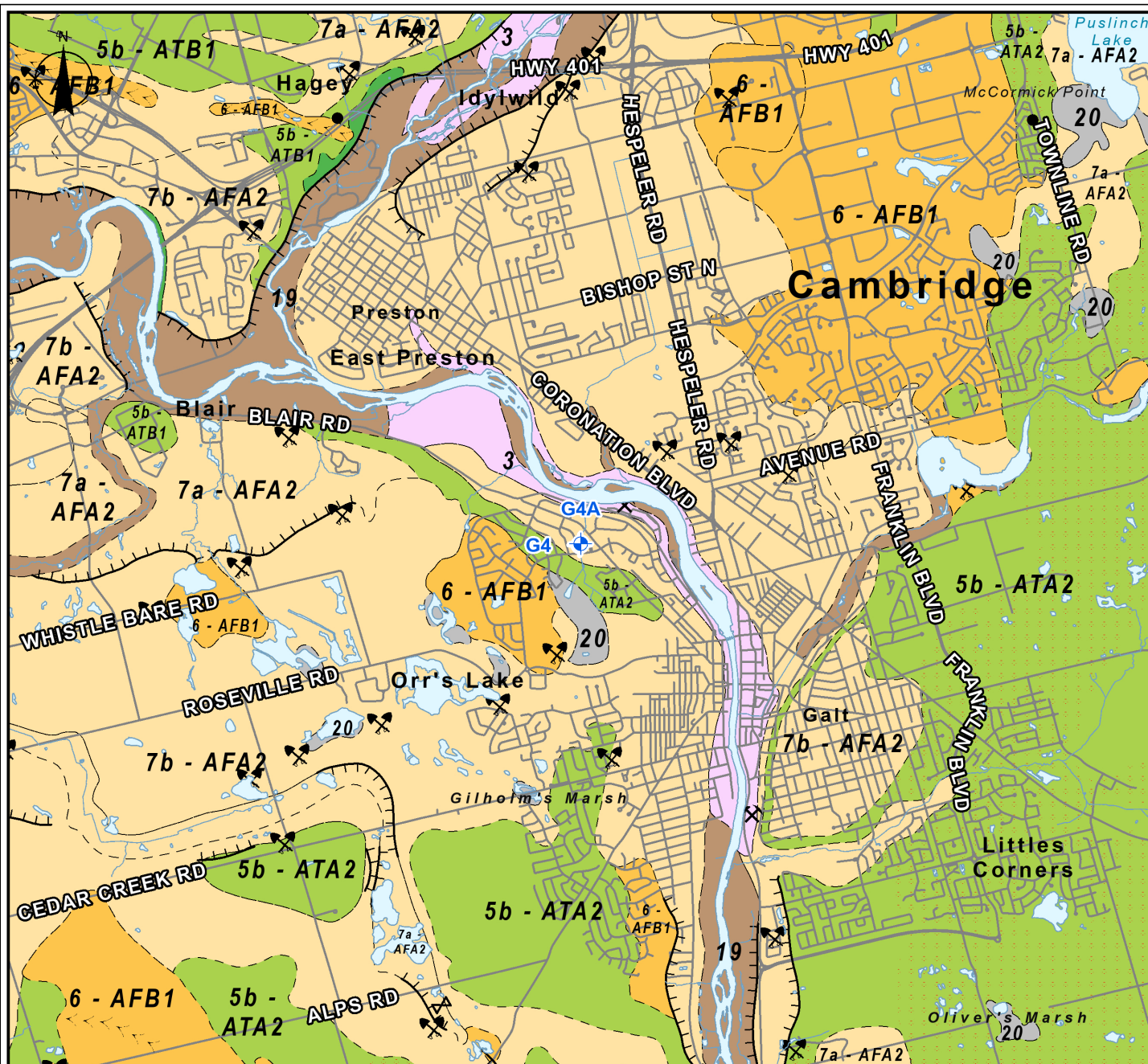


Data Source:
Region of Waterloo GIS Data; Background 2020 Air Photo;
ArcGIS Image Service Region of Waterloo; Ministry of
Natural Resources, © Queen's Printer for Ontario; Natural
Resources Canada © Her Majesty the Queen in Right of
Canada.

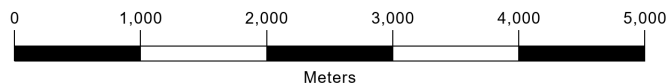
- PTTW Monitoring Well Location
- Nearby Monitoring Well Location
- Decommissioned Production Well Location
- Additional MECP PTTW Locations
- Surface Water
- Cross Section Orientation
- Intermittent Creek
- Creek
- Waterbody
- Provincially Significant Wetland (MNR)
- Regional Road
- Local Road
- Private / Other Road



Map Title			
2025 GROUNDWATER MONITORING REPORT - BLAIR ROAD WELL FIELD			
WELL LOCATION MAP			
Client	Drawn	Checked	Date
REGION OF WATERLOO	HN	SQ	March 2026
	Scale	Project No.	
	1:20,000	HA0464020	
Figure No.			3



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



- | | | | | | |
|--|---|--|--|---|--|
| <ul style="list-style-type: none"> RMOW Supply Well Watercourse Waterbody | <ul style="list-style-type: none"> 5b: Stone-poor, carbonate-derived silty to sandy till (ATA2/ATB1 - Aquitard) 5d: Glaciolacustrine-derived silty to clayey till (ATB1 - Aquitard) | <ul style="list-style-type: none"> 6: Ice-contact stratified deposits (AFB1 - Aquifer) 7a: Glaciofluvial deposits: Sandy deposits (AFA2 - Aquifer) | <ul style="list-style-type: none"> 7b: Glaciofluvial deposits: Gravelly deposits (AFA2 - Aquifer) 19: Modern alluvial deposits 20: Organic deposits | <ul style="list-style-type: none"> Quarry (Point) Sand and Gravel Pit Esker: Direction of Flow Known Terrace Delta, glaciolacustrine | <ul style="list-style-type: none"> Drumlin or drumlinoid ridges (point) Sample Location Hummocky Topography Unit Contact Boundary |
|--|---|--|--|---|--|



Map Title
**2025 GROUNDWATER MONITORING
 REPORT - BLAIR ROAD WELL FIELD**

SURFICIAL GEOLOGY

Client

REGION OF WATERLOO

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Date

February 2026

Project No.

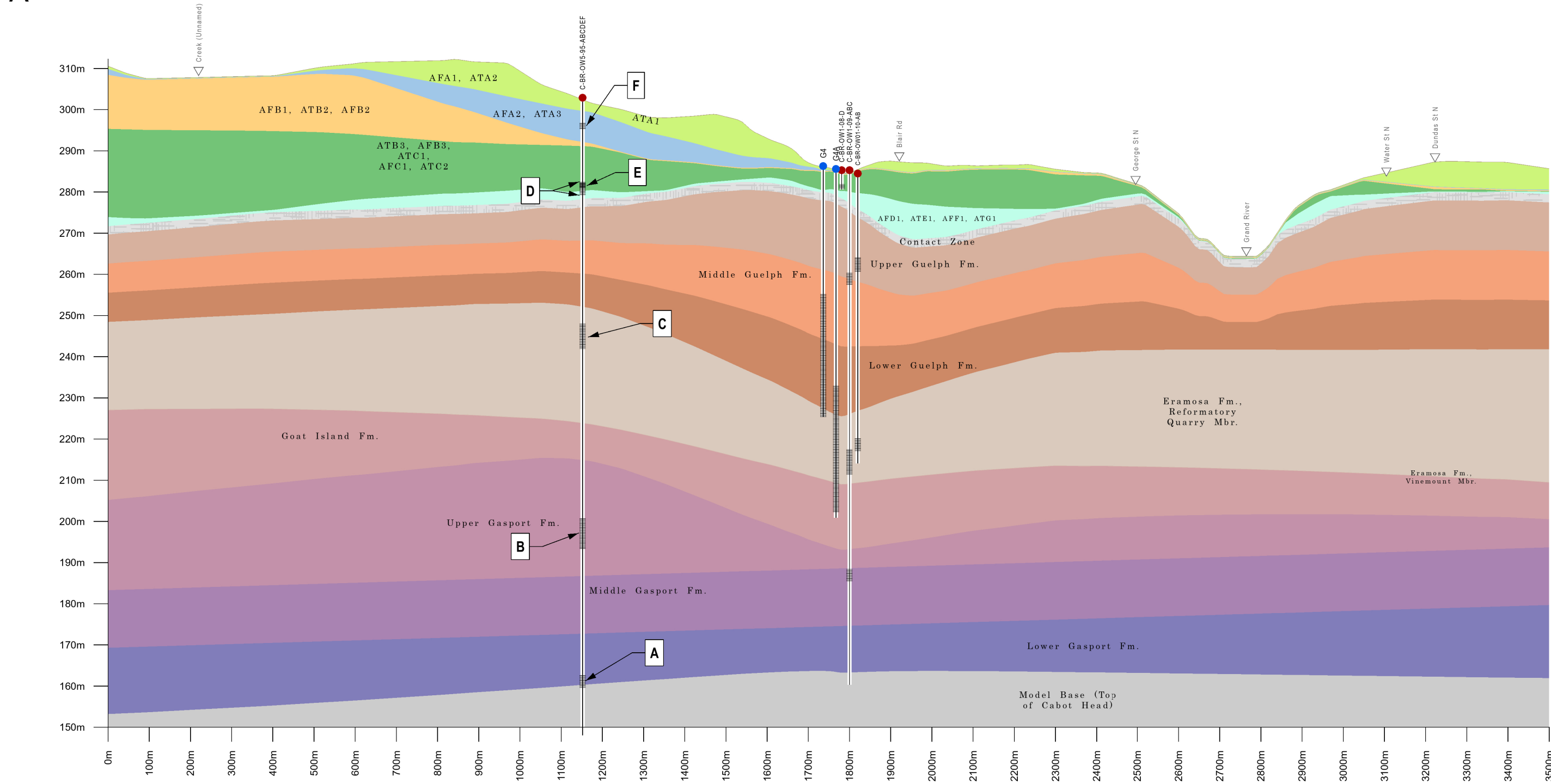
HA0464020

Figure No.

4

A

A'

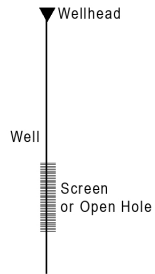


Wells

● Production Well (Active) ● 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), Wentworth 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.	





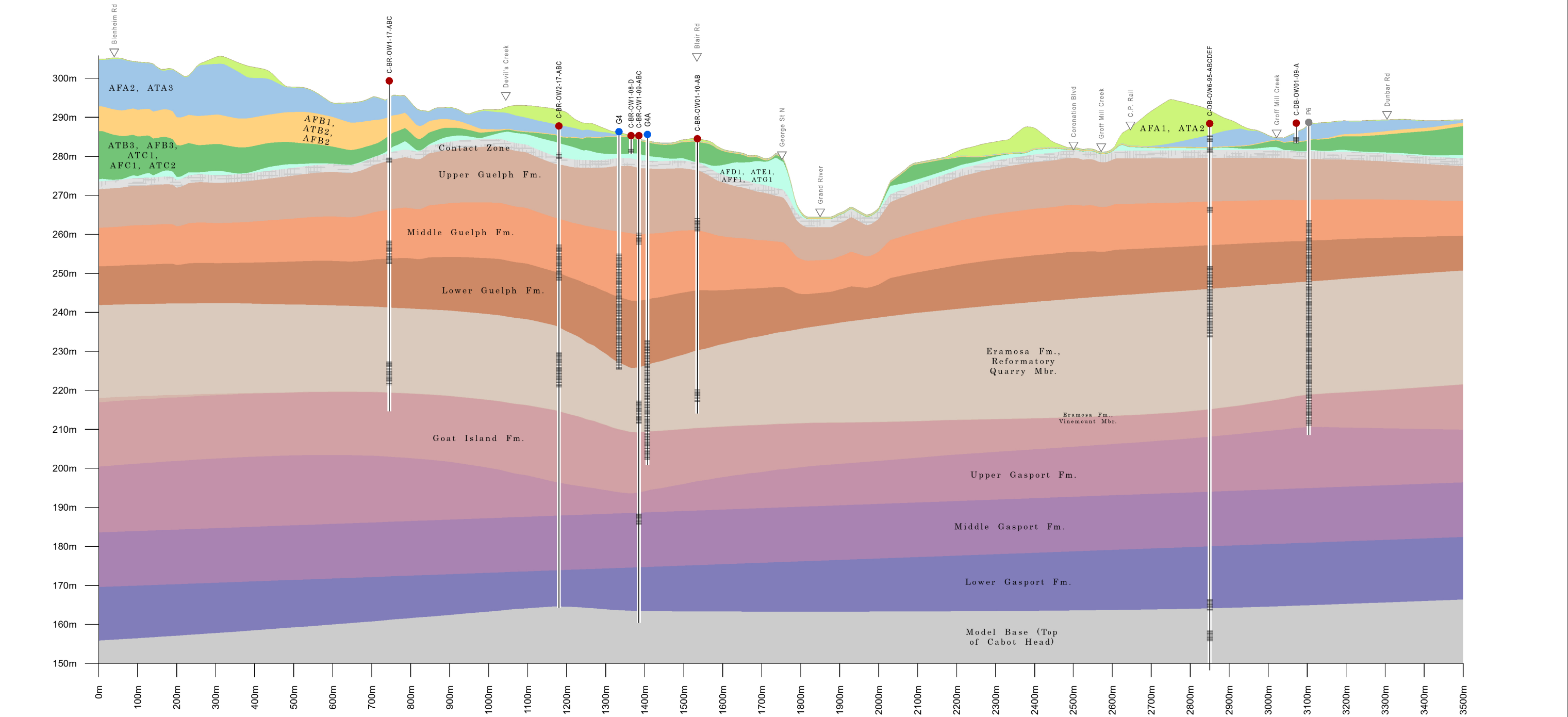
Client

REGION OF WATERLOO

Figure Title			
GEOLOGIC CROSS SECTION REGION OF WATERLOO Blair Road Cross Section A - A'			
Drawn	Checked	Date	Figure No.
PS	DH	2026/06/18	
Horizontal Scale 1:10,000		Project No.	
Vertical Ex.:10x		HA046402	

B

B'



Wells

● Production Well (Active) ● Production Well (Decommissioned) ● Monitoring Well

Cambridge Model 2026

Surficial Geology, Whittlesey Clay (ATA1) Whittlesey Sand (AFA1), Wentworth Till (ATA2) Grand River Valley Outwash Deposits (AFA2), Fine Grain Deposits in the Grand River Valley (ATA3)	Upper Waterloo Moraine Stratified Sediments & Equivalents (AFB1), Middle Maryhill Till & Equivalents (ATB2), Middle Waterloo Moraine Stratified Sediments & Equivalents (AFB2) 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)	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) Weathered Bedrock	Bedrock: Upper Guelph Fm. Bedrock: Middle Guelph Fm. Bedrock: Lower Guelph Fm. Bedrock: Eramosa Fm., Reformatory Quarry Mbr.	Bedrock: Eramosa Fm., Vinemount Mbr. Bedrock: Goat Island Fm. Bedrock: Lower Gasport Fm. Bedrock: Upper Gasport Fm.	Bedrock: Middle Gasport Fm. Model Base (Top of Cabot Head)	Wellhead Well Screen or Open Hole	 Client REGION OF WATERLOO	Figure Title GEOLOGIC CROSS SECTION REGION OF WATERLOO Blair Road Cross Section B - B'	<table border="1"><tr><td>Drawn</td><td>Checked</td><td>Date</td><td rowspan="3">Figure No.</td></tr><tr><td>PS</td><td>DH</td><td>2026/06/22</td></tr><tr><td colspan="2">Horizontal Scale 1:10,000</td><td>Project No.</td></tr><tr><td colspan="2">Vertical Ex.:10x</td><td>HA046402</td><td></td></tr></table>	Drawn	Checked	Date	Figure No.	PS	DH	2026/06/22	Horizontal Scale 1:10,000		Project No.	Vertical Ex.:10x		HA046402		6
Drawn	Checked	Date	Figure No.																					
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Horizontal Scale 1:10,000		Project No.																						
Vertical Ex.:10x		HA046402																						



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Appendix A

Permit To Take Water



PERMIT TO TAKE WATER

Ground Water

NUMBER P-300-2229080479

Version: 2.0

Effective Date: March 28, 2024

Expiry Date: May 31, 2030

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

REGIONAL MUNICIPALITY OF WATERLOO

150 Frederick Street
6th Floor
KITCHENER
ONTARIO
Canada
N2G 4J3

For the water taking from

G4

G4A

Located at:

35 DIANNE Avenue (AVE) , CAMBRIDGE, CAMBRIDGE, ONTARIO, CANADA, N1S 3J4

This Permit cancels and replaces Permit Number P-300-2229080479 Version 1.0, issued on February 27, 2024.

DEFINITIONS

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

- 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 of the 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 the ministry of the government of Ontario responsible for the administration of the OWRA, currently named the Ministry of the Environment, Conservation and Parks.
- d. "District Office" means the Guelph District Office of the Ministry.
- e. "Permit" or "PTTW" means this Permit to Take Water No. P-300-2229080479 including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA, as may amended.
- f. "Permit Holder" means REGIONAL MUNICIPALITY OF WATERLOO.
- g. "OWRA" means the *Ontario Water Resources Act*, R.S.O. 1990, c. O. 40.

TERMS AND CONDITIONS

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

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, attested to by Frank Kosa, on July 10, 2023, 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 without the Director's written consent.
- 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.

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 (litres)

	Source Name / Description	Source Type	Purpose Category	Specific Purpose	Activity	Maximum Taken per minute	Maximum Number of Hours Taken per day	Maximum volume per Day	Maximum days in a year	Zone / Easting / Northing
1	G4 (G4)	Well	Public administration	Municipal Supply	Water Supply	1320	24	1900800	365	17 / 553888 / 4802282
2	G4A (G4A)	Well	Public administration	Municipal Supply	Water Supply	3180	24	4579200	365	17 / 553898 / 4802291
Total Taking								4579200		

3.3. Notwithstanding Table A, the combined taking from wells G4 and G4A may not exceed an annualized average of 3,701,376 litres per day, equivalent to a long-term rate of 42.84 litres per second and 2,570.4 litres per minute.

4. Monitoring

4.1. The Permit Holder shall maintain a record of all water takings. 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.

This record shall include the dates and times of water takings, the rates of pumping, and an estimated calculation of the total amounts of water pumped per day for each day that water is taken under the authorization of this Permit. A separate record shall be maintained for each source. The Permit Holder shall keep all required records up to date and available at or near the site of the taking and shall produce the records immediately for inspection by a Provincial Officer upon his or her request. The Permit Holder, unless otherwise required by the Director, shall submit, on or before March 31st in every year, the records required by this condition to the Ministry's Regulatory Self Reporting System.

4.2. The Permit Holder shall measure and record water levels once a month in the following monitoring wells:

C-BR-OW1-09-A
C-BR-OW1-09-B
C-BR-OW1-09-C
C-BR-OW1-08-D
C-BR-OW5-95-A
C-BR-OW5-95-B
C-BR-OW5-95-C
C-BR-OW5-95-D
C-BR-OW5-95-E
C-BR-OW5-95-F

4.3. The Permit Holder shall prepare and submit a report every two years by June 30 commencing June 30, 2024, 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), and provides a summary for all interference complaints received by the Permit Holder related to this Permit and reported in the District Office in accordance with Condition 5.1 and the manner in which the Permit Holder has dealt with the complaint.

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. Impacts for Water Situation Type

For Surface-Water Takings

The taking of water (including the taking of water into storage and the subsequent or simultaneous withdrawal from storage) shall be carried out in such a manner that streamflow is not stopped and is not reduced to a rate that will cause interference with downstream uses of water or with the natural functions of the stream.

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

6.1. 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).

REASONS

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.

APPEAL PROVISIONS

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 Ontario Land 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 ("the Notice") 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:

Registrar*		The Director, Section 34.1,
Ontario Land Tribunal		Ministry of the Environment, Conservation and Parks
655 Bay Street, Suite 1500	and	5775 Yonge Street, 8 th Floor
Toronto ON		Toronto, ON
M5G 1E5		M2M 4J1
OLT.Registrar@ontario.ca		Fax: (416) 325-6347

*** Further information on the Ontario Land Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349 or 1 (866) 448-2248, or www.olt.gov.on.ca**

Dated at Hamilton this 27th day of March, 2024



Neil Taylor

Director, Section 34.1

Ontario Water Resources Act, R.S.O. 1990

c: Frank Kosa
Karl Belan, REGIONAL MUNICIPALITY OF WATERLOO

SCHEDULE 1

This Schedule "A" forms part of Permit To Take Water P-300-2229080479 Version Number 2.0, dated March 27, 2024.

AMENDED PERMIT TO TAKE WATER

Ground Water
NUMBER 5134-BW6LJX

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
150 Frederick St
Kitchener, Ontario, N2G 4J3
Canada

For the water taking from: Two Wells (G4 and G4A)

Located at: Lot 2 West of Grand River, Concession 12, Geographic Township of Dumfries
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. 5134-BW6LJX 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 February 26, 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	G4	Well Drilled	Municipal	Water Supply	1,320	24	1,900,800	365	17 553888 4802282
2	G4A	Well Drilled	Municipal	Water Supply	1,320	24	1,900,800	365	17 553898 4802292
						Total Taking:	1,900,800		

3.3 Notwithstanding the Maximum Taken per Day specified in Table A, the combined taking from wells G4 and G4A shall not exceed 1,900,800 L/day with the maximum rate not to exceed 1,320 L/min.

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 measure and record water levels once a month in the following monitoring wells:

C-BR-OW1-09-A
C-BR-OW1-09-B
C-BR-OW1-09-C
C-BR-OW1-08-D
C-BR-OW5-95-A
C-BR-OW5-95-B
C-BR-OW5-95-C
C-BR-OW5-95-D
C-BR-OW5-95-E
C-BR-OW5-95-F

4.3 The Permit Holder shall prepare and submit a report every two years by June 30 commencing June 30, 2022, 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), and provides a summary for all interference complaints received by the Permit Holder related to this Permit and reported in the District Office in accordance with Condition 5.1 and the manner in which the Permit Holder has dealt with the complaint.

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
Email: 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

This Permit cancels and replaces Permit Number 7812-BQVJL6, issued on 2020/06/26.

Dated at Toronto this 10th day of December, 2020.



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 5134-BW6LJX, dated December 10, 2020.



BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix B

Well Records

G-4

Well Material

Outer Casing 12" x (19'2") 36' ±
 Inner Casing None
 Screen "
 Plug "
 Gravel "

Pump

No. 33160 Setting BP-MB 100'
 No. Stages 9 Length Bowl 6'2"
 Bowl 8" RKHC Size & Lgth. Suction 10' x 6"
 Head TF 613 Size Column 6" x 2"

Materials or setting details other than standard:

Impellers: Trim

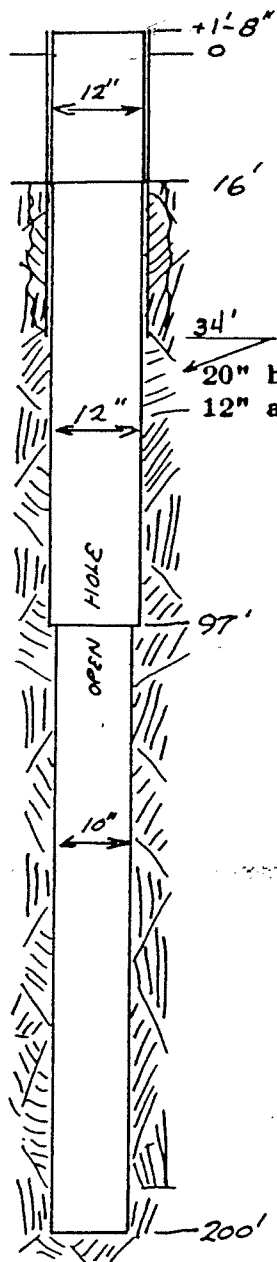
20" hole cemented between
 12" and 20" hole to 34'

Motor

Make USEM Phase 3
 H. P. 30 Cycles 60
 R. P. M. 1750 Volts 550
 Type CFU Amps.
 Frame 365P Serial 2470824
 Bearing Nos. Upper - 7220.M
 Lower - 6212

Special Equipment

DIRTY SAND & GRAVEL	0
SAND & GRAVEL	4'
DIRTY SAND & GRAVEL	7'
	16'
BROWN LIMESTONE	
	133'
GRAY LIMESTONE	
	149'
BR. N LIMESTONE	
	178'
WHITE LIMESTONE	
	200'

Well No. 6 (Blair Road)

B. P. referred to original ground level.....
 Clear depth below B. P. 203'7"
 Started March 18/54 Final Test Aug. '56
 Preliminary Test Apr. 3 Static Level 57'8"
 Final Test Pumping Level 83'
 Guarantee None 1 G P M Capacity 605 1 G P M
 Contract Pressure # Pressure Pump #
 Length Air Line 109' Main #

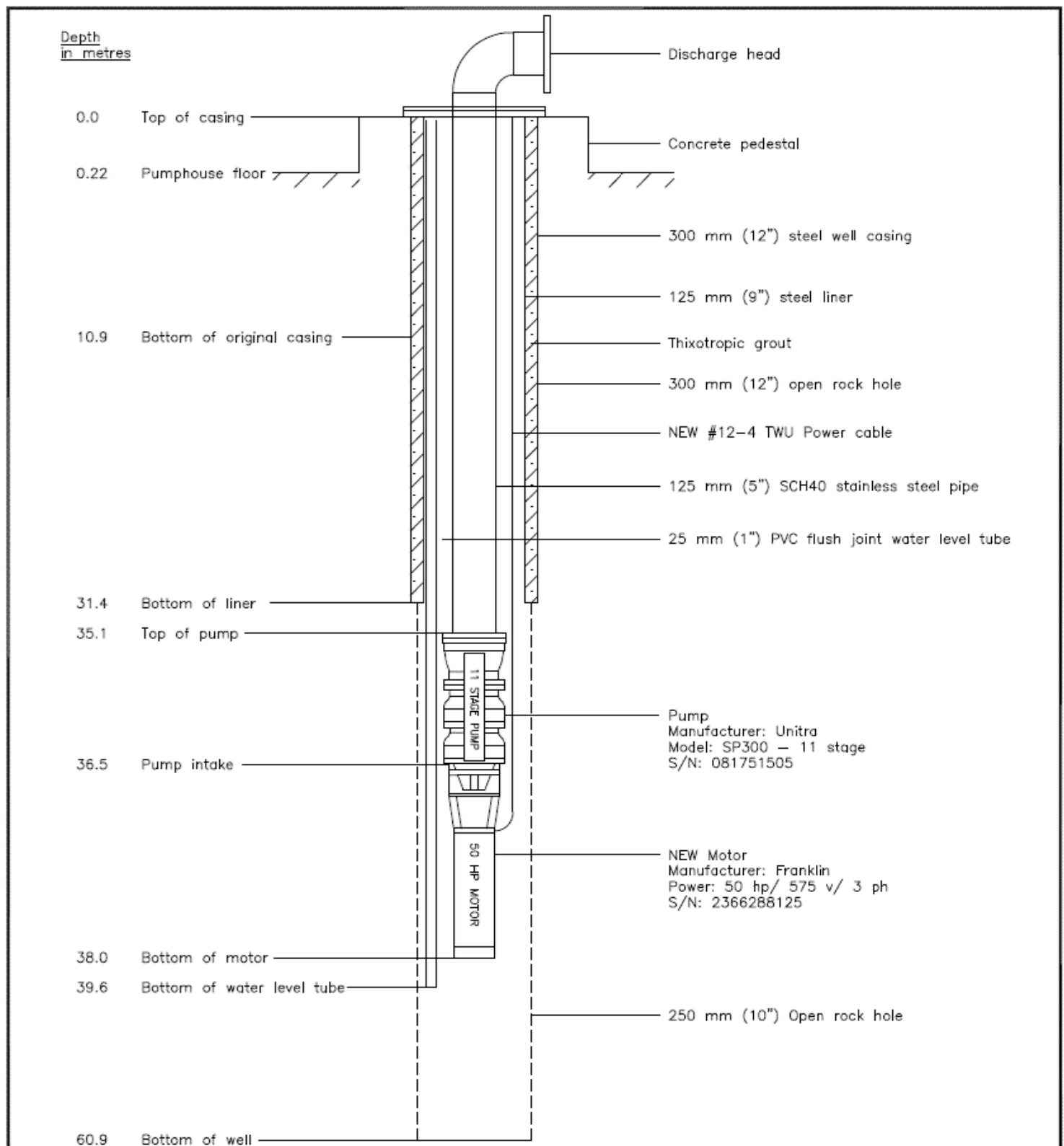
INTERNATIONAL WATER SUPPLY LTD.

MONTREAL LONDON, CANADA SASKATOON
 OAKVILLE WATER SUPPLY CONTRACTORS VANCOUVER

PUBLIC UTILITIES COMMISSION

GALT, ONTARIO

DRILLED BY R. Stroh DRAWN BY
 INSTALLED BY J. Hartman APPROVED BY



CLIENT

Regional Municipality of Waterloo

TITLE

Well G4
Pump Installation Drawing

PROJECT No. 006—396			G:\Lotowater Projects\006 Region of Waterloo\396 Well G4\Pump Install Drawing.dwg		FIGURE 1
DESIGN			REVISION No. 2017/05/24	SCALE N.T.S.	
DRAWN	EH	2017/05/24			
CHECKED					

LOG OF DRILLING OPERATIONS

G4-TW2-08

Page 1 of 5



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

Client: Region of Waterloo	Project Name: Cambridge Well Optimization	Logged by: S. Quinlan
Project No.: MTA14155.0	Location: Cambridge, ON	Ground (m amsl):
Drilling Co.: Davidson Drilling Limited	Date Started: 10/27/2008	Static Water Level (m amsl):
Drilling Method: Solid Stem Auger	Date Completed: 10/30/2008	Sand Pack (m amsl):

Depth Scale (ft) (m)	Stratigraphic Description	Strat. Plot	Depth (m)		SAMPLE				Depth Scale (ft) (m)
					Num.	Type	Int.	%Recov.	
1.0	TOPSOIL - Dark brown, moist.								1.0
5.0	GRAVELLY SAND - brown, dry.		1.22						5.0
2.0									2.0
10.0	SANDY GRAVEL - brown, some boulders, wet to saturated.		2.13						10.0
3.0									3.0
4.0									4.0
15.0	GUELPH FORMATION - DOLOSTONE - grey, moderately porous, some large voids.		4.57						15.0
5.0									5.0
20.0				steel casing	0	NR		0	20.0
8.0									7.0
25.0									25.0
8.0									8.0
30.0									30.0
9.0									9.0
35.0									35.0
9.0									10.0
40.0									35.0
12.0									40.0
13.0									45.0
14.0					1	GRAB	G	100	45.0
15.0									50.0
16.0									16.0
55.0				open hole bedrock	2	GRAB	G	100	55.0
17.0									17.0
18.0									18.0
60.0									60.0
19.0									19.0
65.0					3	GRAB	G	100	65.0
20.0									20.0
21.0									21.0
70.0	GUELPH FORMATION - DOLOSTONE - light		21.34				G		70.0

Prepared By: **S. Quinlan**Checked By: **J. Baxter**Date Prepared: **11/25/2008**

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.

LEGEND

- Water found @ time of drilling
 Static Water Level -

MONITORING WELL DATA

Pipe: **20.3 cm dia. steel**
 Screen: **15.6 cm dia. open hole**

SAMPLE TYPE

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

LOG OF DRILLING OPERATIONS



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

G4-TW2-08

Page 2 of 5

Client: Region of Waterloo	Project Name: Cambridge Well Optimization	Logged by: S. Quinlan
Project No.: MTA14155.0	Location: Cambridge, ON	Ground (m amsl):
Drilling Co.: Davidson Drilling Limited	Date Started: 10/27/2008	Static Water Level (m amsl):
Drilling Method: Solid Stem Auger	Date Completed: 10/30/2008	Sand Pack (m amsl):

Depth Scale (ft) (m)	Stratigraphic Description	Strat. Plot	Depth (m)		SAMPLE				Depth Scale (ft) (m)
					Num.	Type	Int.	%Recov.	
75.0 23.0	grey, very porous, voids.				4	GRAB	G	100	75.0 23.0
80.0 24.0									80.0 24.0
85.0 25.0					5	GRAB	G	100	85.0 25.0
90.0 26.0									90.0 26.0
95.0 27.0					6	GRAB	G	100	95.0 27.0
100.0 28.0									100.0 28.0
105.0 29.0					7	GRAB	G	100	105.0 29.0
110.0 30.0									110.0 30.0
115.0 31.0					8	GRAB	G	100	115.0 31.0
120.0 32.0									120.0 32.0
125.0 33.0			33.53	open hole bedrock					125.0 33.0
130.0 34.0	GUELPH FORMATION - DOLOSTONE - grey, slightly porous.								130.0 34.0
135.0 35.0					9	GRAB	G	100	135.0 35.0
140.0 36.0									140.0 36.0
145.0 37.0					10	GRAB	G	100	145.0 37.0
150.0 38.0									150.0 38.0
155.0 39.0									155.0 39.0
160.0 40.0									160.0 40.0
165.0 41.0									165.0 41.0
170.0 42.0									170.0 42.0
175.0 43.0									175.0 43.0

Prepared By: **S. Quinlan**Checked By: **J. Baxter**Date Prepared: **11/25/2008**

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.

LEGEND

- Water found @ time of drilling
 Static Water Level -

MONITORING WELL DATA

Pipe: **20.3 cm dia. steel**
 Screen: **15.6 cm dia. open hole**

SAMPLE TYPE

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

B:\LOG ORANGEVILLE P:\GINT\PROJECTS\MMTA14155\G4 TW1A & TW2.GPJ TEMPLATE.GDT 8/4/10

Client: Region of Waterloo	Project Name: Cambridge Well Optimization	Logged by: S. Quinlan
Project No.: MTA14155.0	Location: Cambridge, ON	Ground (m amsl):
Drilling Co.: Davidson Drilling Limited	Date Started: 10/27/2008	Static Water Level (m amsl):
Drilling Method: Solid Stem Auger	Date Completed: 10/30/2008	Sand Pack (m amsl):

[illegible]

Prepared By: **S. Quinlan**

Checked By: **J. Baxter**

Date Prepared: 11/25/2008

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.

LEGEND		MONITORING WELL DATA		SAMPLE TYPE					
	Water found @ time of drilling	Pipe:	20.3 cm dia. steel	AC		Auger Cutting	SS		Split Spoon
	Static Water Level -	Screen:	15.6 cm dia. open hole	CS		Continuous	AR		Air Rotary
				RC		Rock Core	WC		Wash Cuttings

LOG OF DRILLING OPERATIONS



BURNSIDE

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

G4-TW2-08

Page 4 of 5

Client: Region of Waterloo	Project Name: Cambridge Well Optimization	Logged by: S. Quinlan
Project No.: MTA14155.0	Location: Cambridge, ON	Ground (m amsl):
Drilling Co.: Davidson Drilling Limited	Date Started: 10/27/2008	Static Water Level (m amsl):
Drilling Method: Solid Stem Auger	Date Completed: 10/30/2008	Sand Pack (m amsl):

Depth Scale (ft) (m)	Stratigraphic Description	Strat. Plot	Depth (m)		SAMPLE				Depth Scale (ft) (m)
					Num.	Type	Int.	%Recov.	
220.0 67.0	ERAMOSA FORMATION - DOLOSTONE - brown, very porous, large voids, fracture at 74 m.		69.00				G		220.0 67.0
225.0 68.0					19	GRAB	G	100	225.0 68.0
230.0 69.0									230.0 69.0
235.0 70.0									235.0 70.0
240.0 71.0	GOAT ISLAND FORMATION - DOLOSTONE - grey, slightly porous, fracture at 80 m & 84.		78.20	open hole bedrock	20	GRAB	G	100	240.0 71.0
245.0 72.0									245.0 72.0
250.0 73.0					21	GRAB	G	100	250.0 73.0
255.0 74.0									255.0 74.0
260.0 75.0	ANCASTER FORMATION - DOLOSTONE - black-grey mottled, moderately porous.		83.50		22	GRAB	G	100	260.0 75.0
265.0 76.0									265.0 76.0
270.0 77.0					23	GRAB	G	100	270.0 77.0
275.0 78.0									275.0 78.0
280.0 79.0	ANCASTER FORMATION - DOLOSTONE - black with some white, slightly porous.		85.34		24	GRAB	G	100	280.0 79.0
285.0 80.0									285.0 80.0
290.0 81.0					25	GRAB	G	100	290.0 81.0
295.0 82.0									295.0 82.0

Prepared By: **S. Quinlan**Checked By: **J. Baxter**Date Prepared: **11/25/2008**

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.

LEGEND

Water found @ time of drilling
Static Water Level -

MONITORING WELL DATA

Pipe: **20.3 cm dia. steel**
Screen: **15.6 cm dia. open hole**

SAMPLE TYPE AC



Auger Cutting



Continuous



Rock Core



Split Spoon



Air Rotary



Wash Cuttings



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

G4-TW2-08

Page 5 of 5

Client: Region of Waterloo	Project Name: Cambridge Well Optimization	Logged by: S. Quinlan
Project No.: MTA14155.0	Location: Cambridge, ON	Ground (m amsl):
Drilling Co.: Davidson Drilling Limited	Date Started: 10/27/2008	Static Water Level (m amsl):
Drilling Method: Solid Stem Auger	Date Completed: 10/30/2008	Sand Pack (m amsl):

Depth Scale (ft) (m)		Stratigraphic Description	Strat. Plot	Depth (m)		SAMPLE				Depth Scale (ft) (m)			
						Num.	Type	Int.	%Recov.				
290.0		ANCASTER FORMATION - DOLOSTONE - dark brown, slightly porous		88.39				G		290.0			
89.0										89.0			
295.0	90.0							26	GRAB	G	100	295.0	90.0
91.0												91.0	
300.0				91.44	91.44					300.0			

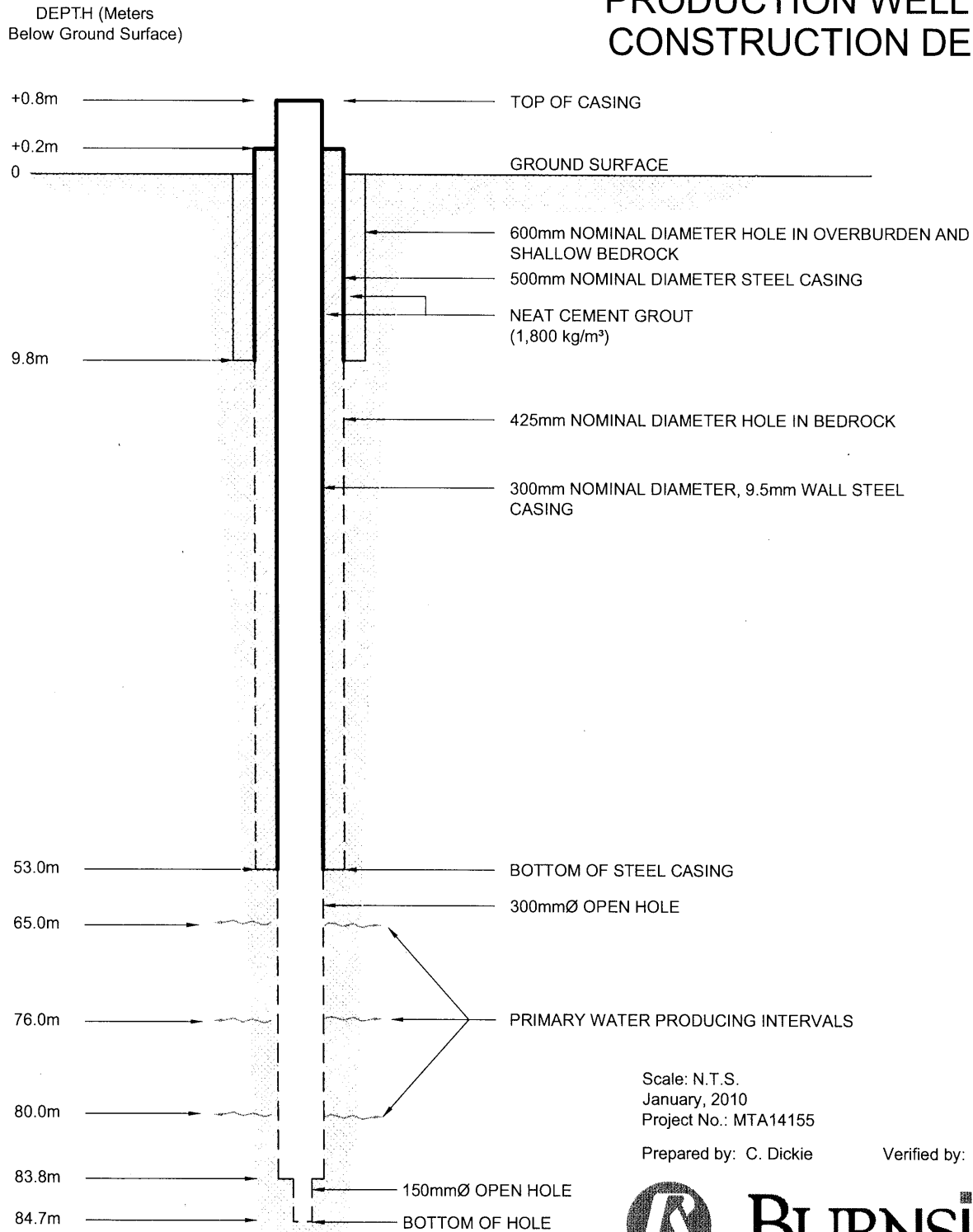
\\BHLOG ORANGEVILLE P:\GINT\PROJECTS\MMTA14155\G4 TW1A & TW2.GPJ TEMPLATE.GDT 8/4/10

Prepared By: S. Quinlan		Checked By: J. Baxter		Date Prepared: 11/25/2008	
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.					
LEGEND		MONITORING WELL DATA		SAMPLE TYPE	
 Water found @ time of drilling	Pipe: 20.3 cm dia. steel	AC  Auger Cutting	SS  Split Spoon		
 Static Water Level -	Screen: 15.6 cm dia. open hole	CS  Continuous	AR  Air Rotary		
		RC  Rock Core	WC  Wash Cuttings		

FIGURE 8

REGION OF WATERLOO
CITY OF CAMBRIDGE

WELL G4A CONSTRUCTION & TESTING REPORT

PRODUCTION WELL G4A
CONSTRUCTION DETAIL

Scale: N.T.S.
January, 2010
Project No.: MTA14155

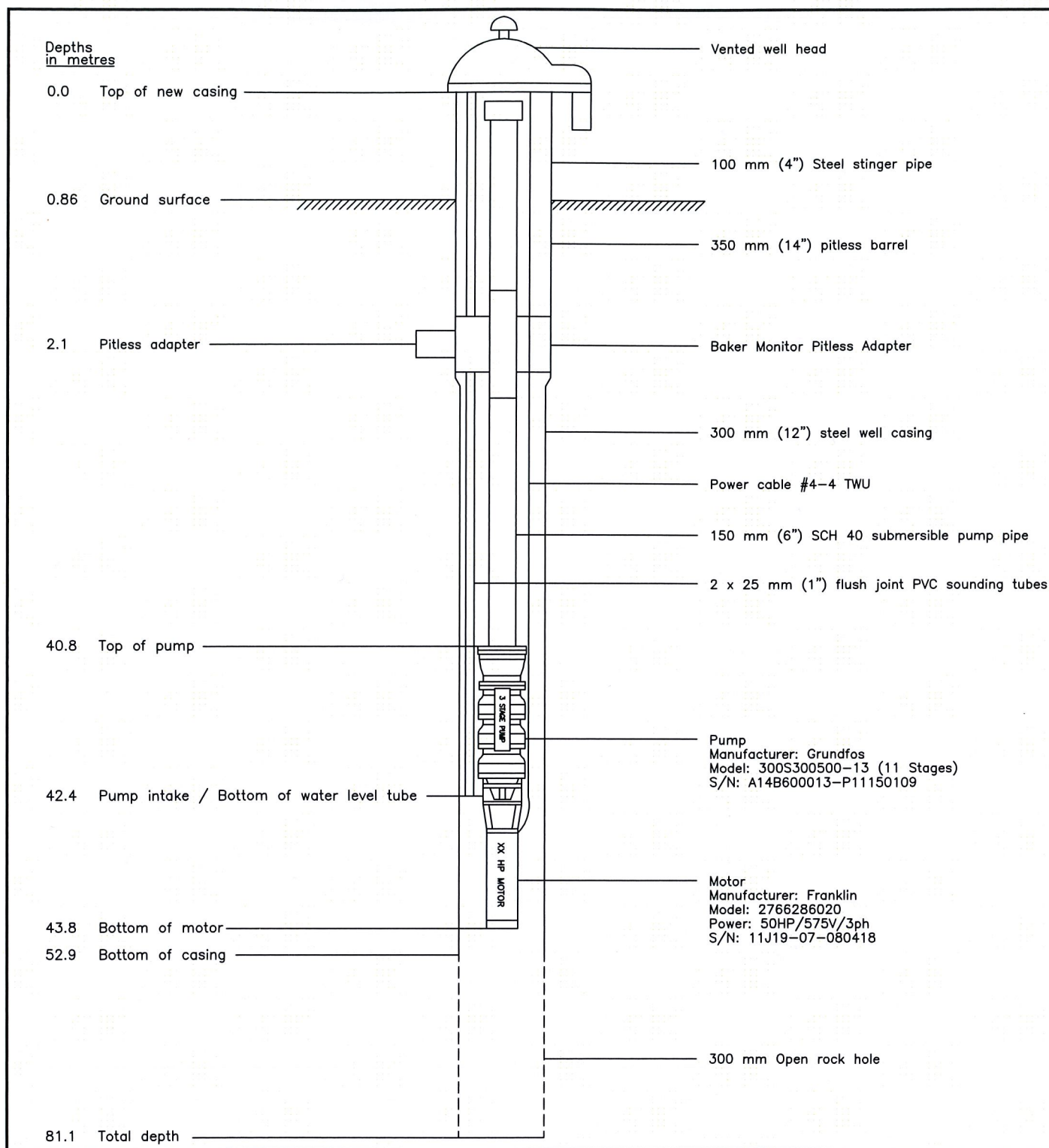
Prepared by: C. Dickie

Verified by: J. Baxter



BURNSIDE

14155 G4 WELL CONSTRUCTION DETAIL.dwg



CLIENT

Regional Municipality of Waterloo

TITLE

Well G4A
Pump Installation Drawing

PROJECT No.006—372			G:\Lotowater Projects\006 Region of Waterloo\372 G4A\G4A Pump Installation.dwg		FIGURE 2
DESIGN			REVISION No. 2016/07/27	SCALE N.T.S.	
DRAWN	EH	2016/07/27			
CHECKED					

Test well completed
to 2 MW

LOG OF DRILLING OPERATIONS



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

C-BR-QW1-09-(A-B-C)

G4-TW1A-08

obj # 9205740

Client: Region of Waterloo	Project Name: Cambridge Well Optimization	Logged by: S. Quinlan
Project No.: MTA14155.0	Location: Cambridge, ON	Ground (m amsl):
Drilling Co.: Davidson Drilling Limited	Date Started: 9/24/2008	Static Water Level (m amsl):
Drilling Method: PQ Coring	Date Completed: 10/16/2008	Sand Pack (m amsl):

Depth Scale (ft) (m)	Stratigraphic Description	Strat. Plot	Depth (m)		SAMPLE				Depth Scale (ft) (m)
					Num.	Type	Int.	%Recov.	
1.0	TOPSOIL - Dark brown, moist.								1.0
5.0	GRAVELLY SAND - brown, dry.		1.22						5.0
2.0	SANDY GRAVEL - brown, some boulders, wet to saturated.		2.13						2.0
10.0				steel casing	0	NR		0	10.0
3.0									3.0
4.0									4.0
15.0	GUELPH FORMATION - DOLOSTONE - grey, moderately porous, vuggy, fine crystalline		4.57						15.0
5.0					1	CORE		100	5.0
20.0									20.0
6.0	GUELPH FORMATION - DOLOSTONE - grey brown, slightly porous, limited vugs		6.55						6.0
7.0					2	CORE		100	7.0
25.0	GUELPH FORMATION - DOLOSTONE - grey, moderately porous, extensive vugs		7.82						25.0
8.0					3	CORE		95	8.0
30.0	GUELPH FORMATION - DOLOSTONE - grey to light grey, slightly porous, slightly vuggy		8.23						30.0
9.0					4	CORE		100	9.0
10.0									10.0
35.0	GUELPH FORMATION - DOLOSTONE - grey, moderately porous, extensive vugs, fine crystalline		8.91						35.0
11.0			10.19		5	CORE		100	11.0
40.0	GUELPH FORMATION - DOLOSTONE - grey-yellow, slightly porous, fine to medium crystalline		10.67						40.0
12.0					6	CORE		100	12.0
13.0	GUELPH FORMATION - DOLOSTONE - light grey, slightly porous, vugs, fine crystalline		12.19						13.0
14.0				open hole bedrock	8	CORE		90	14.0
45.0	GUELPH FORMATION - DOLOSTONE - grey, slightly porous, ribbed large vugs, medium crystalline, possible fossils		15.24						45.0
15.0					7	CORE		70	15.0
60.0	GUELPH FORMATION - DOLOSTONE - light grey, slightly porous, few vugs, fine crystalline		16.46						60.0
16.0					8	CORE		100	16.0
55.0	GUELPH FORMATION - DOLOSTONE - light grey, slightly porous, large vugs, fine crystalline		17.68						55.0
17.0					9	CORE		95	17.0
18.0	GUELPH FORMATION - DOLOSTONE - grey, slightly porous, few vugs, medium crystalline		18.28						18.0
19.0					10	CORE		100	19.0
65.0	GUELPH FORMATION - DOLOSTONE - grey, moderately porous, vuggy, fine crystalline		21.34						65.0
20.0					11	CORE		95	20.0
70.0	GUELPH FORMATION - DOLOSTONE - white								70.0

Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **11/25/2008**

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.

LEGEND	MONITORING WELL DATA	SAMPLE TYPE	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 -	Screen: 15.6 cm dia. open hole	RC	Rock Core	WC	Wash Cuttings	

BHLOG ORANGEVILLE PROJECTS\PROJECTS\MTA14155\G4 TW1A & TW2.GPJ TEMPLATE.GDT 8/4/10



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LOG OF DRILLING OPERATIONS

G4-TW1A-08

Page 2 of 6

Client: Region of Waterloo	Project Name: Cambridge Well Optimization	Logged by: S. Quinlan
Project No.: MTA14155.0	Location: Cambridge, ON	Ground (m amsl):
Drilling Co.: Davidson Drilling Limited	Date Started: 9/24/2008	Static Water Level (m amsl):
Drilling Method: PQ Coring	Date Completed: 10/16/2008	Sand Pack (m amsl):

Depth Scale (ft) (m)	Stratigraphic Description	Strat. Plot	Depth (m)		SAMPLE				Depth Scale (ft) (m)
					Num.	Type	Int.	%Recov.	
75.0 - 23.0	grey, moderately porous, vuggy, medium crystalline				12	CORE		100	75.0 - 23.0
80.0 - 24.0					13	CORE		90	80.0 - 24.0
85.0 - 25.0					14	CORE		95	85.0 - 25.0
85.0 - 26.0	GUELPH FORMATION - DOLOSTONE - dark grey, moderately porous, vuggy, fine crystalline, mottled		25.30		15	CORE		95	85.0 - 26.0
90.0 - 27.0					16	CORE		100	90.0 - 27.0
95.0 - 28.0					17	CORE		90	95.0 - 28.0
100.0 - 29.0					18	CORE		100	100.0 - 29.0
100.0 - 30.0	GUELPH FORMATION - DOLOSTONE - dark grey-black, not porous, coarse crystalline		29.87		19	CORE		100	100.0 - 30.0
105.0 - 31.0	GUELPH FORMATION - DOLOSTONE - dark grey, moderately porous, extensive vugs, fine crystalline, trace fossils		30.10		20	CORE		100	105.0 - 31.0
105.0 - 32.0					21	CORE		100	105.0 - 32.0
110.0 - 33.0	GUELPH FORMATION - DOLOSTONE - grey-brown, slightly porous, coarse crystalline, richly fossiliferous, mottled		31.76		22	CORE		100	110.0 - 33.0
110.0 - 34.0					23	CORE		100	110.0 - 34.0
115.0 - 35.0	GUELPH FORMATION - DOLOSTONE - medium to dark grey, slightly porous, few vugs, fine crystalline		32.76		24	CORE		100	115.0 - 35.0
120.0 - 36.0					25	CORE		100	120.0 - 36.0
120.0 - 37.0					26	CORE		100	120.0 - 37.0
125.0 - 38.0	GUELPH FORMATION - DOLOSTONE - grey, slightly porous, slightly vuggy, fine crystalline, mottled		37.39		27	CORE		90	125.0 - 38.0
130.0 - 39.0					28	CORE		100	130.0 - 39.0
135.0 - 40.0					29	CORE		100	135.0 - 40.0
135.0 - 41.0					30	CORE		100	135.0 - 41.0
140.0 - 42.0	GUELPH FORMATION - DOLOSTONE - dark grey, slightly porous, fine crystalline, trace fossils, mottled		41.15		31	CORE		100	140.0 - 42.0
140.0 - 43.0					32	CORE		100	140.0 - 43.0

open hole bedrock

Prepared By: **S. Quinlan**

Checked By: **J. Baxter**

Date Prepared: **11/25/2008**

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LEGEND

- Water found @ time of drilling
- Static Water Level -

MONITORING WELL DATA

Pipe: **20.3 cm dia. steel**
Screen: **15.6 cm dia. open hole**

SAMPLE TYPE AC

- Auger Cutting
- Continuous
- Rock Core
- Split Spoon
- Air Rotary
- Wash Cuttings



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LOG OF DRILLING OPERATIONS

G4-TW1A-08

Page 3 of 6

Client: Region of Waterloo	Project Name: Cambridge Well Optimization	Logged by: S. Quinlan
Project No.: MTA14155.0	Location: Cambridge, ON	Ground (m amsl):
Drilling Co.: Davidson Drilling Limited	Date Started: 9/24/2008	Static Water Level (m amsl):
Drilling Method: PQ Coring	Date Completed: 10/16/2008	Sand Pack (m amsl):

Depth Scale (ft) (m)	Stratigraphic Description	Strat. Plot	Depth (m)	SAMPLE				Depth Scale (ft) (m)
				Num.	Type	Int.	% Recov.	
145.0	GUELPH FORMATION - DOLOSTONE - light grey-white, moderately porous, extensive vugs, fine crystalline, trace fossils		47.85	27	CORE		100	145.0
45.0				28	CORE		100	45.0
150.0				29	CORE		100	150.0
48.0				30	CORE		100	48.0
155.0				31	CORE		100	155.0
47.0				32	CORE		100	47.0
160.0				33	CORE		65	160.0
49.0				34	CORE		100	49.0
165.0				35	CORE		100	165.0
50.0				36	CORE		100	50.0
170.0	ERAMOSA FORMATION - DOLOSTONE - light grey-white, moderately porous, extensive vugs, fine crystalline, trace fossils		60.00	37	CORE		100	170.0
52.0				38	CORE		100	52.0
175.0				39	CORE		95	175.0
53.0				40	CORE		100	53.0
180.0	ERAMOSA FORMATION - DOLOSTONE - light grey, moderately porous, extensive vugs, medium crystalline		64.10					180.0
54.0								54.0
185.0	ERAMOSA FORMATION - DOLOSTONE -		66.50					185.0
55.0								55.0
190.0								190.0
56.0								56.0
195.0								195.0
57.0								57.0
200.0								200.0
58.0								58.0
205.0								205.0
59.0								59.0
210.0								210.0
60.0								60.0
215.0								215.0

Prepared By: S. Quinlan	Checked By: J. Baxter	Date Prepared: 11/25/2008
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.		

LEGEND	MONITORING WELL DATA	SAMPLE TYPE 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 -	Screen: 15.6 cm dia. open hole	RC	Rock Core	WC	Wash Cuttings

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LOG OF DRILLING OPERATIONS

G4-TW1A-08

Page 4 of 6

Client: Region of Waterloo	Project Name: Cambridge Well Optimization	Logged by: S. Quinlan
Project No.: MTA14155.0	Location: Cambridge, ON	Ground (m amsl):
Drilling Co.: Davidson Drilling Limited	Date Started: 9/24/2008	Static Water Level (m amsl):
Drilling Method: PQ Coring	Date Completed: 10/16/2008	Sand Pack (m amsl):

Depth Scale (ft) (m)	Stratigraphic Description	Strat. Plot	Depth (m)	SAMPLE				Depth Scale (ft) (m)
				Num.	Type	Int.	%Recov.	
220.0 - 67.0	dark grey, very porous, extensive vugs, coarse crystalline. 2" layer of opaque gypsum at 67 m			41	CORE		65	220.0 - 67.0
225.0 - 68.0				42	CORE		100	225.0 - 68.0
230.0 - 69.0				43	CORE		75	230.0 - 69.0
235.0 - 70.0				44	CORE		100	235.0 - 70.0
240.0 - 71.0				45	CORE		75	240.0 - 71.0
245.0 - 72.0				46	CORE		100	245.0 - 72.0
250.0 - 73.0				47	CORE		75	250.0 - 73.0
255.0 - 74.0				48	CORE		100	255.0 - 74.0
260.0 - 75.0				49	CORE		95	260.0 - 75.0
265.0 - 76.0				50	CORE		100	265.0 - 76.0
270.0 - 77.0				51	CORE		100	270.0 - 77.0
275.0 - 78.0				52	CORE		100	275.0 - 78.0
280.0 - 79.0				53	CORE		100	280.0 - 79.0
285.0 - 80.0				54	CORE		100	285.0 - 80.0
290.0 - 81.0				55	CORE		100	290.0 - 81.0
295.0 - 82.0								295.0 - 82.0
300.0 - 83.0								300.0 - 83.0
305.0 - 84.0								305.0 - 84.0
310.0 - 85.0								310.0 - 85.0
315.0 - 86.0								315.0 - 86.0
320.0 - 87.0								320.0 - 87.0
	GOAT ISLAND - DOLOSTONE - dark grey, not porous, few vugs, fine crystalline, few fractures		76.20	48	CORE		100	76.20
	ANCASTER FORMATION - DOLOSTONE - dark grey-black, slightly porous, slightly vuggy, coarse crystalline, some layers, mottled		83.50					83.50

Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **11/25/2008**

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LEGEND	MONITORING WELL DATA	SAMPLE TYPE	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 -	Screen: 15.6 cm dia. open hole	RC	Rock Core	WC	Wash Cuttings	

B:\LOG ORANGEVILLE PROJECTS\MTA14155\G4 TW1A & TW2.GPJ TEMPLATE.GDT 8/4/10



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LOG OF DRILLING OPERATIONS

G4-TW1A-08

Page 5 of 6

Client: Region of Waterloo	Project Name: Cambridge Well Optimization	Logged by: S. Quinlan
Project No.: MTA14155.0	Location: Cambridge, ON	Ground (m amsl):
Drilling Co.: Davidson Drilling Limited	Date Started: 9/24/2008	Static Water Level (m amsl):
Drilling Method: PQ Coring	Date Completed: 10/16/2008	Sand Pack (m amsl):

Depth Scale (ft) (m)	Stratigraphic Description	Strat. Plot	Depth (m)	SAMPLE				Depth Scale (ft) (m)
				Num.	Type	Int.	%Recov.	
290.0				56	CORE		100	290.0
295.0				57	CORE		100	295.0
300.0				58	CORE		100	300.0
305.0	GASPORT FORMATION - DOLOSTONE - dark grey - black, very porous, fine crystalline, mottled		302.37	59	CORE		100	305.0
310.0				60	CORE		100	310.0
315.0				61	CORE		85	315.0
320.0				62	CORE		100	320.0
325.0				63	CORE		20	325.0
330.0				64	CORE		75	330.0
335.0	GASPORT FORMATION - DOLOSTONE - grey, slightly porous, fine crystalline, few fractures		102.11	65	CORE		100	335.0
340.0	GASPORT FORMATION - DOLOSTONE - grey-black, moderately porous, fine crystalline		103.83	66	CORE		100	340.0
345.0				67	CORE		100	345.0
350.0	GASPORT FORMATION - DOLOSTONE - grey-black, not porous, richly fossiliferous, mottled		106.68	68	CORE		100	350.0
355.0				69	CORE		100	355.0
360.0								360.0

Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **11/25/2008**

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LEGEND	MONITORING WELL DATA	SAMPLE TYPE	AC	Auger Cutting	SS	Split Spoon
Water found @ time of drilling	Pipe: 20.3 cm dia. steel	CS		Continuous	AR	
Static Water Level -	Screen: 15.6 cm dia. open hole	RC		Rock Core	WC	

BHLOS ORANGEVILLE P:\GINT\PROJECTS\MTA14155\G4 TW1A & TW2.GPJ TEMPLATE.GDT 8/4/10



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LOG OF DRILLING OPERATIONS

G4-TW1A-08

Test well
converted to 3MW
Page 6 of 6

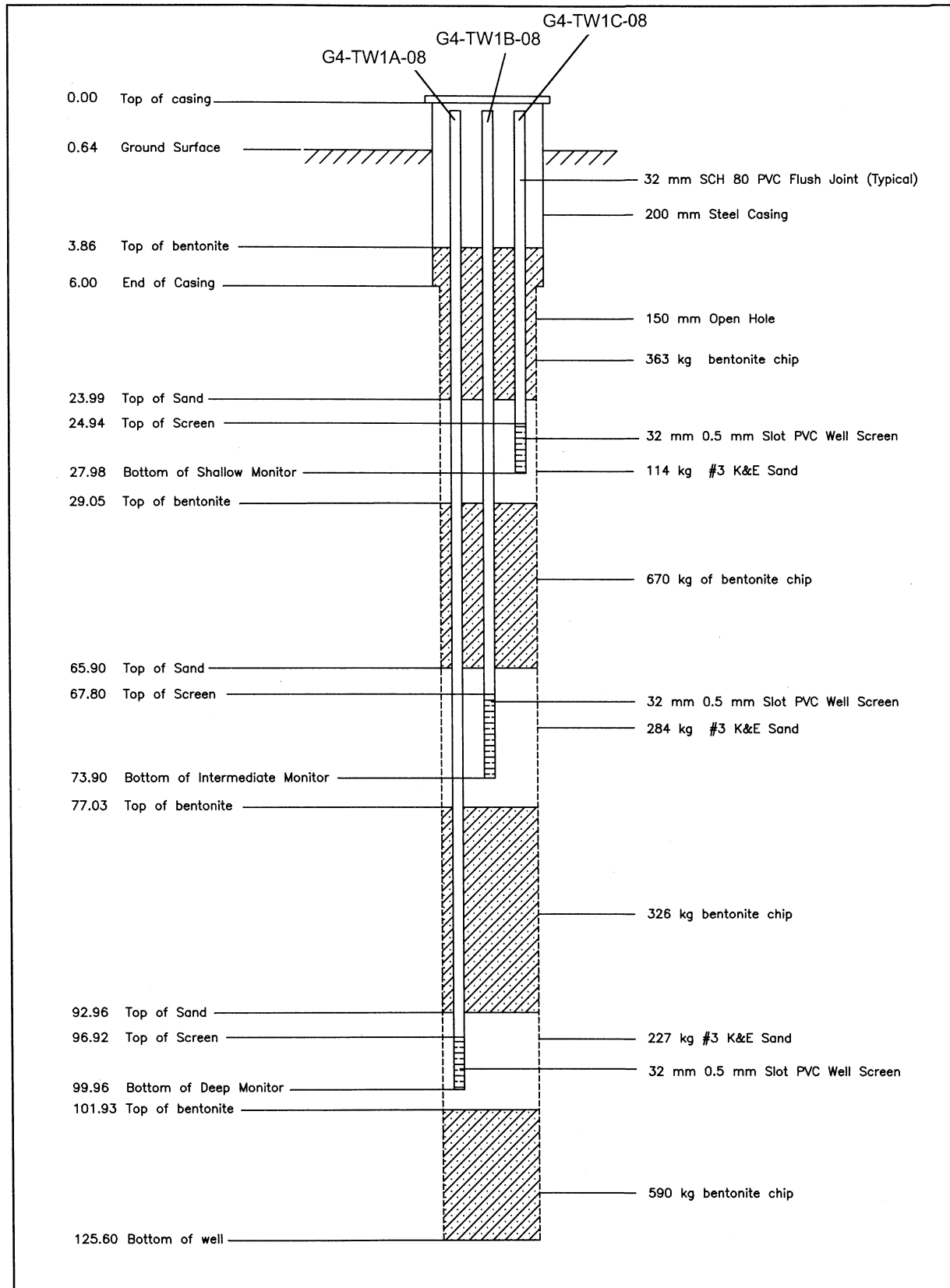
Client: Region of Waterloo	Project Name: Cambridge Well Optimization	Logged by: S. Quinlan
Project No.: MTA14155.0	Location: Cambridge, ON	Ground (m amsl):
Drilling Co.: Davidson Drilling Limited	Date Started: 9/24/2008	Static Water Level (m amsl):
Drilling Method: PQ Coring	Date Completed: 10/16/2008	Sand Pack (m amsl):

Depth Scale (ft) (m)	Stratigraphic Description	Strat. Plot	Depth (m)		SAMPLE				Depth Scale (ft) (m)
					Num.	Type	Int.	%Recov.	
365.0 - 111.0	ROCHESTER FORMATION - DOLOSTONE - grey-black, not porous, richly fossiliferous, mottled IRONDEQUOIT FORMATION - DOLOSTONE - grey-black, not porous, richly fossiliferous, mottled ROCKWAY FORMATION - DOLOSTONE - dark grey, not porous, no fossils MERRITTON FORMATION - DOLOSTONE - dark grey, not porous, no fossils CABOT HEAD FORMATION - SHALE - dark black, soft, horizontal layering		117.00	open hole bedrock	70	CORE		75	365.0 - 111.0
370.0 - 112.0			117.38		71	CORE		55	366.0 - 112.0
375.0 - 113.0			119.50		72	CORE		100	370.0 - 113.0
380.0 - 114.0			120.96		73	CORE		100	375.0 - 114.0
385.0 - 115.0			121.79		74	CORE		100	380.0 - 115.0
390.0 - 116.0					75	CORE		55	385.0 - 116.0
395.0 - 117.0					76	CORE		100	390.0 - 117.0
400.0 - 118.0					77	CORE		80	400.0 - 118.0
405.0 - 119.0					78	CORE		100	405.0 - 119.0
410.0 - 120.0			124.97		79	CORE		100	410.0 - 120.0

Prepared By: **S. Quinlan** Checked By: **J. Baxter** Date Prepared: **11/25/2008**

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.

LEGEND	MONITORING WELL DATA	SAMPLE TYPE	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 -	Screen: 15.6 cm dia. open hole	RC		Rock Core	WC	 Wash Cuttings

**NOTES**

- (1) All measurements referenced to top of casing.
 (2) Well drilled Fall 2008, Monitor constructed April 6&7, 2009



CLIENT

Region of Waterloo

TITLE

G4-TW1-08
As Constructed

PROJECT No. 006-110

G:\Lotowater Projects\006 Region of Waterloo\110 G4-TW1-08\Monitor Well Construction.dwg

DESIGN

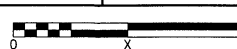
REVISION No. 1

SCALE N.T.S.

DRAWN EH

2009/04/07

SCALE (m)



CHECKED



FIGURE

1

LOG OF DRILLING OPERATIONS



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G4-TW2B-08

Page 1 of 1

Client: Region of Waterloo	Project Name: Well Optimization	Logged by: S. Quinlan
Project No.: MTA14155.0	Location: Cambridge	Ground (m amsl):
Drilling Co.: Geoenergy Solutions Inc.	Date Started: 30/04/2008	Static Water Level (m amsl):
Drilling Method: Sonic Drilling	Date Completed: 30/04/2008	Sand Pack (m amsl): 2.74 - 4.57

Depth Scale (ft) (m)	Stratigraphic Description	Strat. Plot	Depth (m)		SAMPLE				Depth Scale (ft) (m)
					Num.	Type	Int.	%Recov.	
	TOPSOIL - Dark brown, moist.								
1.0				silica sand pack		CS		100	1.0
5.0	GRAVELLY SAND - brown, dry.		1.22						5.0
2.0				bentonite seal					2.0
	SANDY GRAVEL - brown, some boulders, wet to saturated.		2.13			CS		100	
3.0									3.0
10.0									10.0
4.0				silica sand pack		CS		100	4.0
15.0	BEDROCK - LIMESTONE, white, dry.		4.57	cave					15.0
			4.72						

Prepared By: **S. Quinlan**Checked By: **J. Baxter**Date Prepared: **05/05/2008**

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LEGEND

- ▼ Water found @ time of drilling
 ▽ Static Water Level - 06/04/2008

MONITORING WELL DATA

Pipe: **51 mm dia. PVC**
 Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE

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

93320 (100022)

TEST HOLE/MONITORING WELL OW5/95 PRINCESS STREET

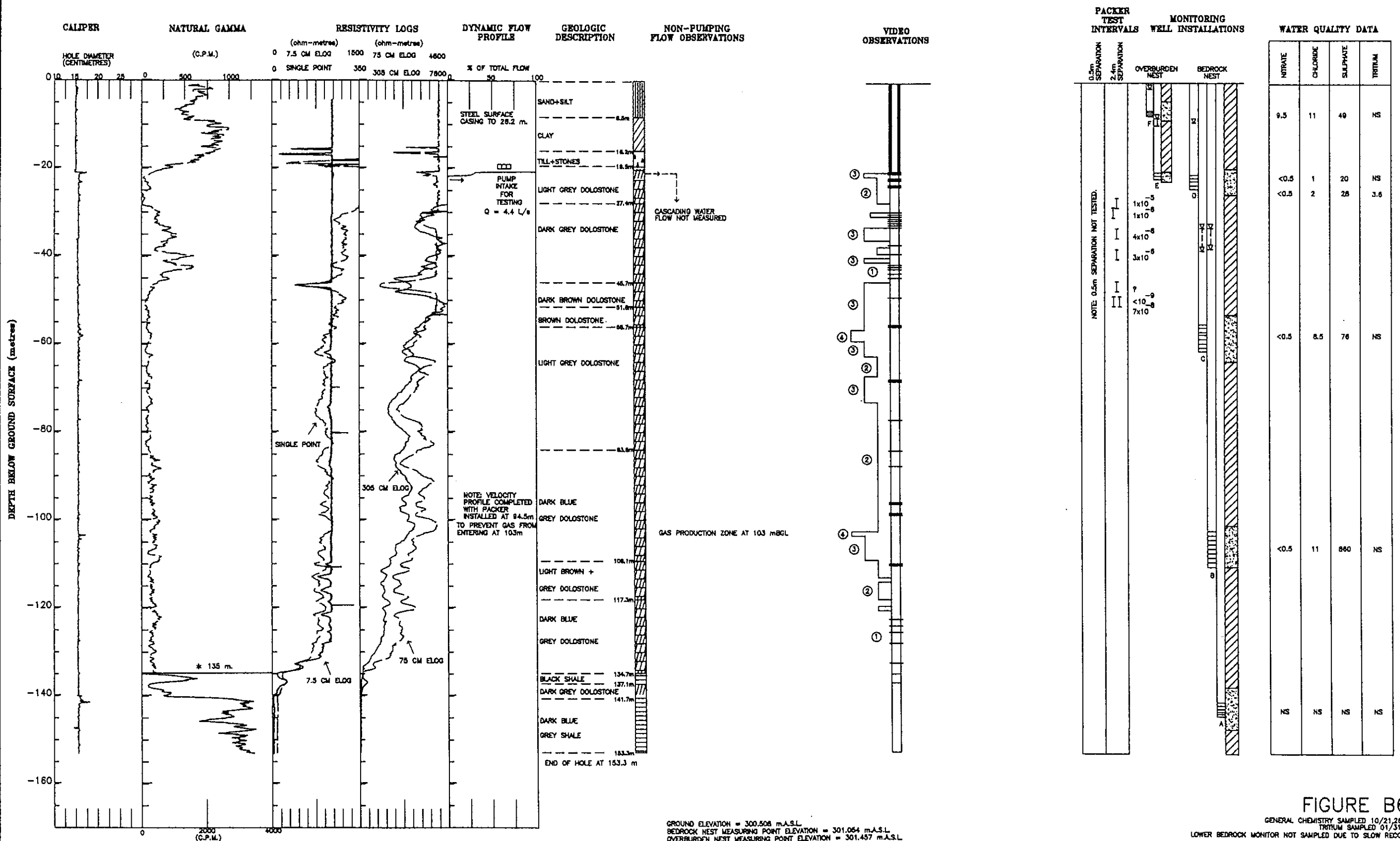


FIGURE B6

GENERAL CHEMISTRY SAMPLED 10/21/95
TRITIUM SAMPLED 01/31/96
LOWER BEDROCK MONITOR NOT SAMPLED DUE TO SLOW RECOVERY



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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

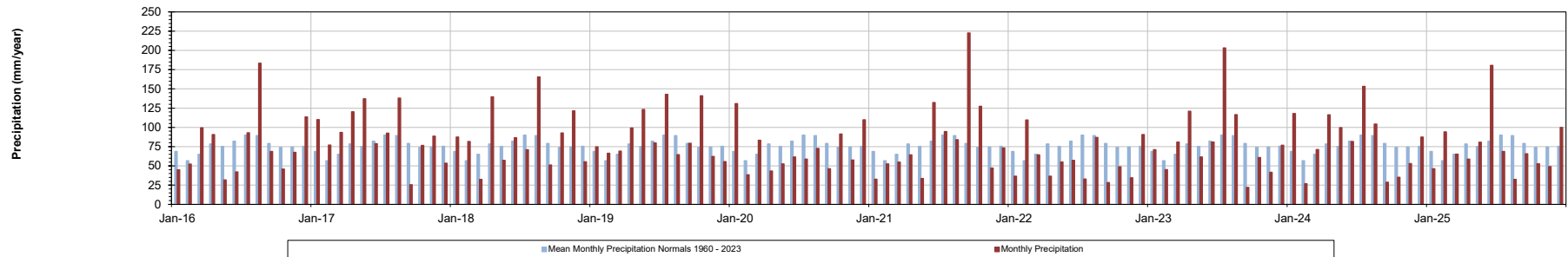


Well Field	Major or Minor Supply	Production Well Name	Status	Permit to Take Water Details			2021 Production Summary			2022 Production Summary			2023 Production Summary			2024 Production Summary			2025 Production Summary		
				MOE Permit Number ¹	Permitted Capacity (total m ³ /year)*	Permitted Rate (L/s)*	Total Production Well Volume (total m ³ /year)	Average Daily Rate (m ³ /day)	Average Rate (L/s)	Total Production Well Volume (total m ³ /year)	Average Daily Rate (m ³ /day)	Average Rate (L/s)	Total Production Well Volume (total m ³ /year)	Average Daily Rate (m ³ /day)	Average Rate (L/s)	Total Production Well Volume (total m ³ /year)	Average Daily Rate (m ³ /day)	Average Rate (L/s)	Total Production Well Volume (total m ³ /year)	Average Daily Rate (m ³ /day)	Average Rate (L/s)
Blair Road	Minor	G4 G4A	Supply Supply	PTTW 300-2229080479	693,792 1,351,002	22.0 53.0	66,595 413,088	182 1,132	2.1 13.1	152,140 274,937	417 753	4.8 8.7	221,330 277,642	606 761	7.0 8.8	21 491,813	0.1 1,347	0.0 15.6	118,086 152,426	324 418	3.7 4.8
				Well Field Total	1,351,002	53.0	479,683	1,314	15.2	427,077	1,167	13.5	498,972	1,367	15.8	491,834	1,344	15.6	270,512	741	8.6
				* G4 and G4A many not exceed an annualized average of 3.701,376 litres per day, equivalent to a long-term rate of 2,570.4 litres per minute.																	

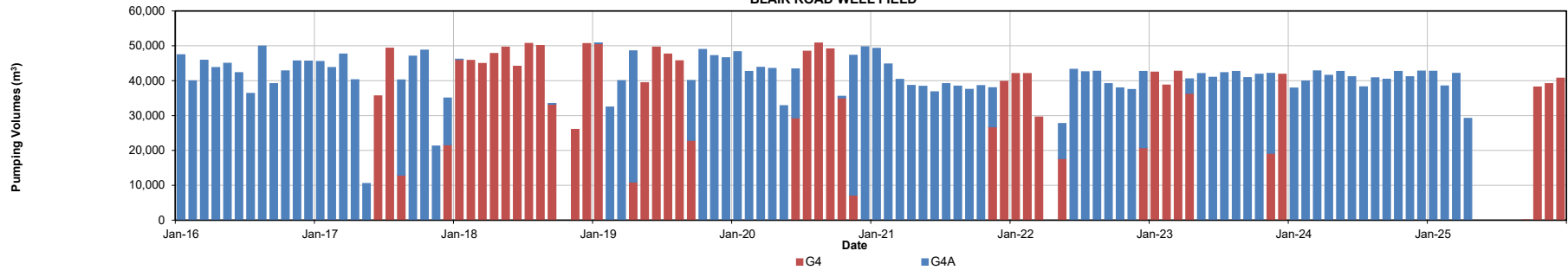
Notes:
- = no applicable data
n/a = data not available
* = rates and volumes based on permitted L/day
¹ = Current Permit

REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
BLAIR ROAD

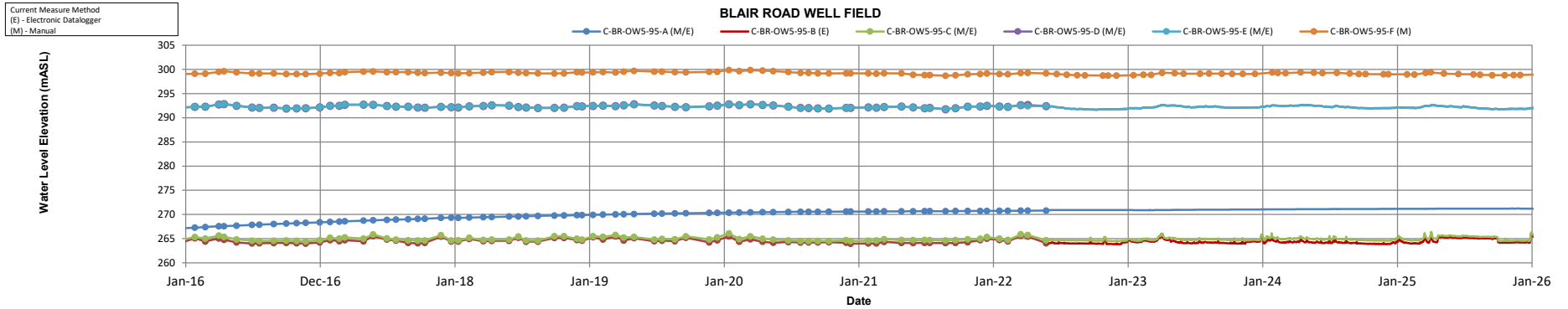
Actual versus Mean Monthly Precipitation
Weather Station - Shades Mills Dam Weather Station



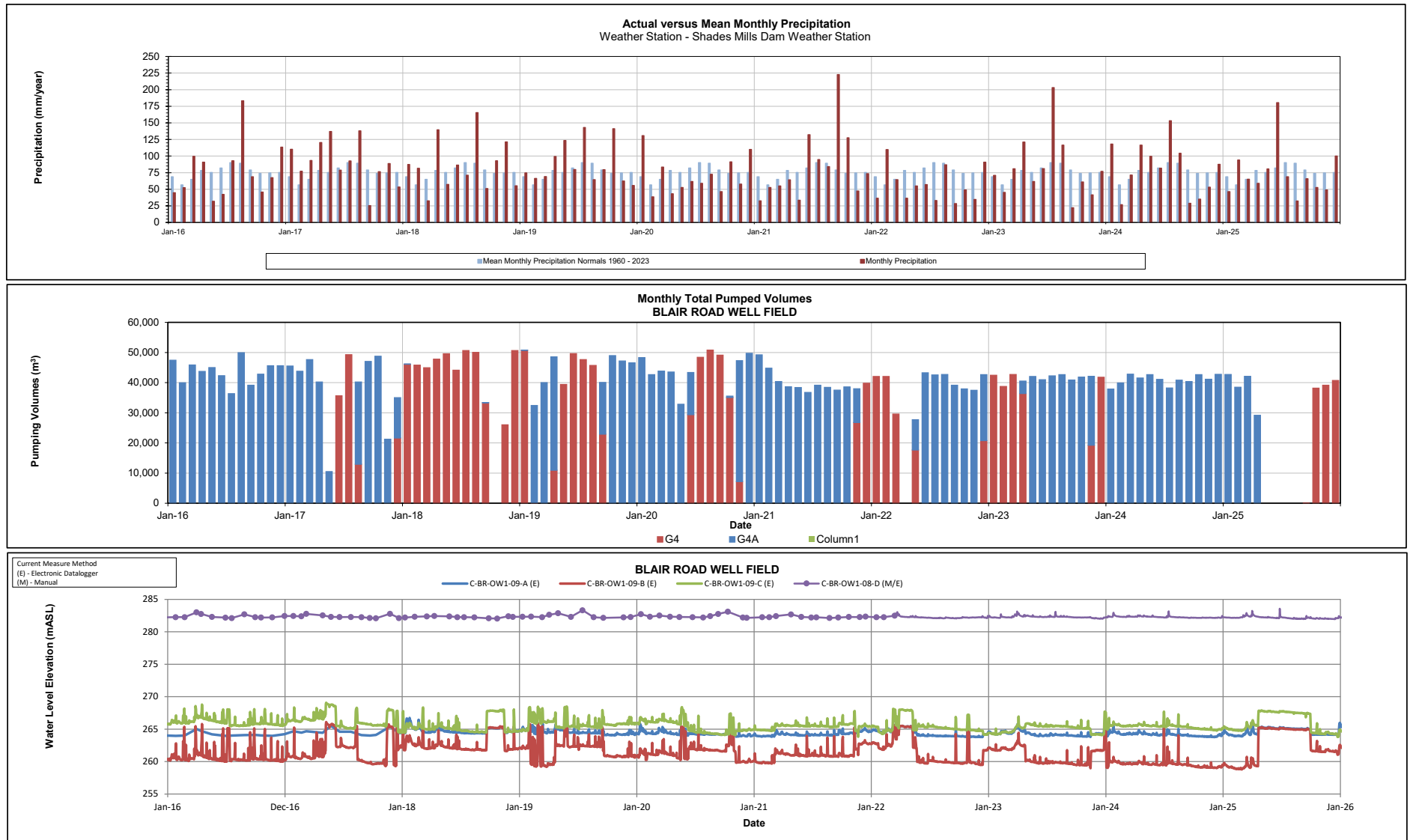
Monthly Total Pumped Volumes
BLAIR ROAD WELL FIELD



BLAIR ROAD WELL FIELD



REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
BLAIR ROAD





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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 Established 1966		
	Annual Precipitation (mm)	30-yr NORMAL Precipitation 1981-2010 (mm)	Difference (mm)
2016	748	851	-103
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 Established 1988		
	Annual Precipitation (mm)	Average Precipitation 1998-2024 (mm)	Difference (mm)
2016	891	871	20
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 Established 1939		
	Annual Precipitation (mm)	Average Precipitation 1940-2025 (mm)	Difference (mm)
2016	976	926	50
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 Established 1961		
	Annual Precipitation (mm)	Average Precipitation 1961-2025 (mm)	Difference (mm)
2016	983	990	-7
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 Established 1960		
	Annual Precipitation (mm)	Average Precipitation 1960-2025 (mm)	Difference (mm)
2016	844	835	9
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 Established 1960		
	Annual Precipitation (mm)	Average Precipitation 1960-2025 (mm)	Difference (mm)
2016	934	909	24
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 Established 1960		
	Annual Precipitation (mm)	Average Precipitation 1960-2025 (mm)	Difference (mm)
2016	985	938	47
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

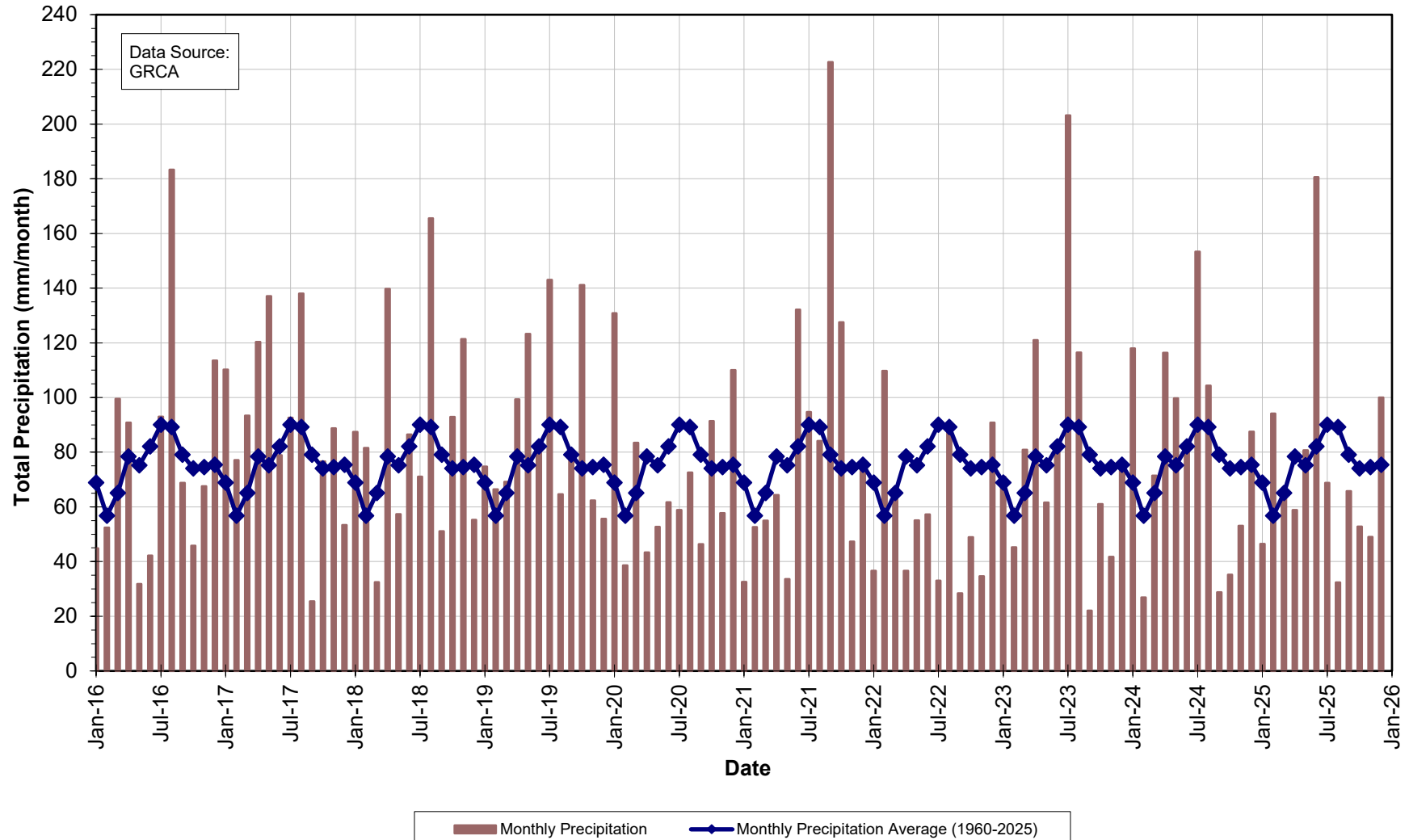
Year	Roseville Weather Station Established 1972		
	Annual Precipitation (mm)	30-yr NORMAL Precipitation 1981-2010 (mm)	Difference (mm)
2016	899	919	-20
2017	882	919	-37
2018	905	919	-14
2019	957	919	38
2020	817	919	-102
2021	832	919	-87
2022	637	919	-282
2023	945	919	26
2024	856	919	-63
2025	786	919	-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.

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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*® Leveloggers®

- 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 disconnected 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.

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- 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.

