2025 Biennial Groundwater Monitoring Report - Foxboro Green Well Field (FG1, FG2A, FG4)

The Region of Waterloo

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The Region of Waterloo

R.J. Burnside & Associates Limited
292 Speedvale Avenue West Unit 20
Guelph ON N1H 1C4 CANADA

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R.J. Burnside & Associates Limited

Report Prepared By:

Stephanie Charity, P.Geo.
Hydrogeologist
SC:js

Report Reviewed By:

Dave Hopkins, P.Geo.
Senior Hydrogeologist
DH:js

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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) for the Foxboro Green Well Field (2544-BBHP4S) 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 of the PTTW for 2024 and 2025. A copy of the PTTW is included in Appendix A.

The location of the Foxboro Green Well Field is shown on Figure 1 and the production wells in Wilmot are shown on Figure 2 with the monitoring network for FG1, FG2A and FG4 shown on 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 but are also located in known aquifer recharge areas. 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 Foxboro Green Well Field in accordance with PTTW 2544-BBHP4S which consists of the following activities:

- Measuring the daily volume pumped from the FG1, FG2A and FG4 production wells (Condition 4.1 of the PTTW);
- Measuring the water levels in monitoring well WT-FG-OW01-09-A (Condition 4.2 of the PTTW); and
- Review of precipitation data from the nearest GRCA/Environment Canada weather station; 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 Foxboro Green Well Field is in the western portion of Wilmot Township. Wells FG1, FG2A and FG4 are located south of Erb's Road in the Foxboro Green development about 800 m east of the Nith River (Figure 3). The closest municipal well field is Baden, located about 4.5 km to the southeast (Figure 2). The closest surface water feature is a storm water management pond that drains into the Nith River located between FG4 and FG1 / FG2A (Figure 3).

2.1.1 Pumping Wells

The Foxboro Green Well Field consists of production wells FG1, FG2A and FG4. The Foxboro Green Well Field production wells obtain water from the dolostone bedrock aquifer. Well records for the production wells are found in Appendix B. The locations of the production wells are shown on Figure 3. 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
FG1	1979	150	150	48.8 – 67.1	Dolostone Bedrock – Salina Formation
FG2A	2011	200	200	49.7 – 67.1	Dolostone Bedrock – Salina Formation
FG4	1998	150	150	45.4 – 55.5	Dolostone Bedrock – Salina Formation

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

Table 2: Annual Water Taking 2024 / 2025

Well	PTTW	2024			2025		
	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)
FG1	718.56	41	134	15,090	28	134	10,380
FG2A	718.56	29	128	10,743	32	141	11,849
FG4	718.56	33	134	11,927	35	137	12,746
Total	718.56	103	147	37,761	96	151	34,975

Condition 3.3 of the PTTW specifies that the maximum combined total daily water taking from the well field must not exceed 718.560 m^3/day. As shown in Table 2, this requirement was met in both 2024 and 2025.

The Region of Waterloo's SCADA system records total daily water taking volumes including the dates and times of water takings, the rates of pumping, and calculations of the total amounts of water pumped per day for each supply well, which complies with condition 4.1 of the PTTW.

The pumping volumes are presented in Appendix C as total monthly volumes. Pumping volumes from the well field ranged from 2,562 m^3/month to 3,628 m^3/month in 2024, and from 2,557 m^3/month to 3,350 m^3/month in 2025. In total, 37,761 m^3 was produced at this well field in 2024 and 34,975 m^3 was produced in 2025. These volumes are within the range of total volumes in the last five years and are below the permitted volume of 262,274 m^3 per year (Table C-1).

2.1.2 Monitoring Wells

The Region recently updated their well naming protocol and as a result, the well names in EQuIS may vary from the names listed on the PTTW. On the PTTW, the monitoring well is listed as WT-FG-OW1A-09. The Region's updated name WT-FG-OW01-09-A will be used throughout this report. Construction and location details for monitoring well WT-FG-OW01-09-A are described in Table 3 below and a well record is provided in Appendix B.

Table 3: Monitoring Well Construction Details

Monitoring Well ID	Year Built	Screened Depth (mbgs)	Screened Formation	Distance to FG1 / FG2A (m)	Distance to FG4 (m)
WT-FG-OW01-09-A	2009	45.72 – 48.77	Dolostone Bedrock – Salina Formation	120	242

2.2 Regional Geology and Hydrostratigraphy

The following sections provide a brief overview of the regional geology and hydrogeology of the Foxboro Green Well Field. The surficial geology based on regional OGS mapping is provided on Figure 4. The Foxboro Green Well Field is located on the western flank of the Waterloo Moraine (Figure 5). Representative cross-sections showing the stratigraphy in the vicinity of the Foxboro Green Well Field (FG1, FG2A, FG4) are included as Figures 6 and 7. The cross-section locations are provided in Figure 3.

Note that the cross-sections are provided as a visual aid and do not necessarily contain all wells in the vicinity of the Foxboro Green Well Field. 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 and may not necessarily match layers identified through borehole log interpretation.

2.2.1 Surficial Geology and Conceptual Hydrostratigraphy

The surficial geology of the Study Area has been mapped and described by the Ontario Geological Survey (2003) and updated in Bajc and Shirota (2007). The surficial geology of the Foxboro Green Well Field is characterized primarily by ice contact sand and gravel deposits (Figure 4). Silty to clayey till sediments are mapped to the north and south of the well field. Modern alluvial deposits and glaciofluvial outwash deposits are present to the west along the Nith River.

The Quaternary units typically present in the Waterloo Moraine area are briefly described below, in order from youngest to oldest.

Aquitard ATB1 – Mornington / Maryhill Till

Aquitard 1 consists of low permeability, spatially discontinuous, surficial till units found predominantly along the flanks of the Waterloo Moraine. Along the western flank of the Moraine, Aquitard 1 corresponds to the Mornington, Stratford and Tavistock Tills;

whereas along the eastern flank of the Moraine this unit corresponds to the Upper Maryhill and Port Stanley Tills (Bajc and Shirota, 2007). In the area of Foxboro Green, Mornington Till (ATB1) was mapped at surface (Unit 5d on Figure 4) to the north with Maryhill Till (ATB1) identified at surface to the south.

Aquifer AFB1 / ATB2 / AFB2 – Upper Waterloo Moraine Stratified Sediments and Equivalents

Aquifer AFB1 / AFB2 represents the main water supply aquifer in the core areas of the Waterloo Moraine. These units are generally comprised of layered silt and fine sand to coarse sand and gravel. Throughout the core areas of the Moraine (Figure 5), the unit typically exceeds 45 m in thickness. In some areas, the Upper Waterloo Moraine is interpreted to be bisected by the middle Maryhill Till (ATB2), effectively separating the aquifer into two units, AFB1 and AFB2. This aquifer is the most prolific aquifer in the Waterloo Region due to its high hydraulic conductivity and transmissivity, lateral extent, and high recharge rate.

Aquitard ATB3 – Lower Maryhill Till

The Lower Maryhill Till is described as a clayey silt to silty clay till. This unit represents one of the primary regional aquitards due to its strong influence on the groundwater flow system within the Waterloo Moraine. This unit is extensive within the core area of the Waterloo Moraine, and along the eastern flank tends to be thin, discontinuous, or reworked and re-deposited as glaciofluvial sediments.

Aquitard ATC1/ATC2 – Catfish Creek Till

The Catfish Creek Till was deposited by a major glacial advance from the north to northeast that covered all of southern Ontario. It is a dense, stony, sandy silt to silty sand till with little clay content. The hydrogeologic properties of the Catfish Creek Till are variable, ranging from a good aquitard to a poor aquifer, depending on local lithology, degree of compaction, and the presence of overlying aquitard units. The Catfish Creek Till is typically thickest in the core area of the Waterloo Moraine, and thin or absent along the eastern flank.

Aquifer AFD1 – Pre-Catfish Creek Sand and Gravel

Pre-Catfish Creek Till aquifer corresponds to sands and gravel re-worked from Catfish Creek and Pre-Catfish Creek Tills and represents the main supply aquifer in several production wells in the Cities of Kitchener and Waterloo. This unit is spatially discontinuous throughout much of the core areas of the Waterloo Moraine and pinches out beneath Alder Creek.

Aquitard ATE1 – Canning Drift

The Canning Drift is comprised of till and associated fine-textured lake deposits. It is typically found at depths of greater than 70 mbgs in the Waterloo Moraine area and is identified to be discontinuous and limited in lateral extent and thickness. Where it is absent, a hydraulic connection is present between the deep overburden aquifers and the underlying bedrock.

Aquifer AFF1 – Pre-Canning Till

The Pre-Canning aquifer is characterized by coarse-grained sand and gravel sediments and is typically found within bedrock depressions. This unit is discontinuous throughout the Region, and where present is hydraulically connected with the upper weathered portion of the bedrock aquifer.

2.2.2 Bedrock Geology

The Paleozoic bedrock in the Foxboro Green area consists of the Salina Formation. The Salina formation consists of interbedded dolostone and shale with lenses of gypsum and anhydrite.

2.3 Local Geology

Figure 3 displays the Foxboro Green Well Field well plan and cross-section locations. Representative cross-sections are included as Figures 6 and 7 to visualize the stratigraphy described in this section. The units are described below, listed in order from youngest to oldest.

Mornington Till (ATB1) - This unit was mapped at surface (Unit 5d on Figure 4) to the north with Maryhill Till (ATB1) identified at surface to the south. ATB1 was encountered at surface at FG2A to a depth of 4.5 metres below ground surface (mbgs). The sediments were described as silty clay with sand.

Upper Waterloo Moraine (AFB1 / AFB2) – Foxboro Green is located on the western flanks of the Waterloo Moraine. Near surface deposits predominantly reflect ice contact stratified deposits of sand and gravel (Unit 6 on Figure 4), associated with the Waterloo Moraine (AFB1). The unit consists of silty fine sand to silt with occasional layers of coarse sand and gravel and silty clay till. AFB1 / AFB2 is encountered at FG2A from

4.5 m to 9.1 mbgs and is described as sand and silt and fine-grained sand. At FG4, sand and silt (AFB1/AFB2) is encountered at surface with a thickness of 3 m.

Lower Maryhill Till (ATB3) – This aquitard found beneath Aquifer AFB1 / AFB2) consists of clay till. At WT-FG-OW01-09 the clayey silt extended to a depth of about 21 mbgs. The total thickness of the silty clay to clay till ranges from 20 to 25 m in the area of Foxboro Green production wells.

Catfish Creek Till (ATC1 / ATC2) - Due to similar lithology with the underlying ATE1, it is difficult to distinguish the individual thickness of ATC1 / ATC2 from ATE1. The combined thickness of ATC1 / ATC2 and ATE1 was estimated to range from 15 m to 20 m (Stantec, 2017). At FG2A, silty sand to sandy silt interpreted to be ATC1 / ATC2 and ATE1 from 34 m to 48 m overlies the bedrock.

Canning Drift (ATE1) – This unit consisting of clay with gravel and stones was encountered at WT-FG-OW01-09 from 36.6 mbgs to 39.6 mbgs overlying dolostone bedrock.

Bedrock - The Foxboro Green Well Field production wells are installed within the bedrock aquifer of the Salina formation (Stantec, 2012). Top of bedrock was encountered at FG2A at 48.2 mbgs and at WT-FG-OW01-09 at 39.6 mbgs. According to Stantec (2012), significant bedrock fractures and cavernous features were noted within the Salina Formation at FG2A around 58 mbgs.

3.0 2024 / 2025 Results

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

3.1 Precipitation

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

Since variations in precipitation totals can occur throughout the Region due to localized events, monthly precipitation data from the GRCA or Environment Canada station located closest to the production wells are used. The closest GRCA weather station relative to the Foxboro Green well field is Laurel Creek station located 11.7 km from the well field. The closest Environment Canada station is the Roseville station (19.6 km southeast of 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. At all GRCA locations, the long-term average

was calculated from when measurements started until the end of 2025. The Roseville station has “Climate Normals” calculated by Environment Canada for 1971 to 2000.

Annual 2024 / 2025 precipitation data for the closest meteorological stations are presented in Table 4 below. In 2024 Roseville was missing 5 days of data and 20 days in 2025. As a result, the precipitation totals at these stations may be under reported.

Table 4: Summary of Precipitation Data

Station	2024 Precipitation (mm)	2024 Deviation (mm)	Long-Term Average (mm)	2025 Precipitation (mm)	2025 Deviation (mm)
Laurel Dam (2)	907	-31	938 (B)	894	-44
Roseville Station (1)	856	-63	919 (A)	786	-133

Sources: Environment Canada (1), GRCA (2),
A 1991 to 2020 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.

The Laurel Dam weather station is the closest station to the Foxboro Green Well Field. Monthly precipitation data for the past 10 years at Laurel Dam are shown on Figure D.1 in Appendix D. The total precipitation measured in 2024 at the Laurel Dam weather station was 907 mm, which is 31 mm below the long-term average. Precipitation was also below the long-term average trend at the Roseville station. The March 1 GRCA snow survey indicated a snowpack across the Region that was low compared to normal. In 2025, the total precipitation at the Laurel Dam weather station was 894 mm which is 44 mm below the long-term average. Similarly, the total precipitation at the Roseville station was 133 mm below the long-term average, indicating 2025 was a drier-than-average year. However, Roseville was missing 20 days of data in 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

In accordance with condition 4.2 of the PTTW, water levels were measured and recorded once per month at WT-FG-OW1-09-A. 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.

3.2.1 WT-FG-OW01-09-A

Monitoring well WT-FG-OW01-09-A is located between FG1 / FG2 and FG4 (Figure 3) and is screened in dolostone bedrock at a similar depth to the production wells. Water levels are collected by an electronic water level meter (datalogger) and also measured manually once a month. Water levels observed in 2024 / 2025 were consistent with historical water level data. Daily fluctuations in water levels measured in monitoring well WT-FG-OW1-09-A indicate that the well is influenced by pumping. Water level increases occurred during decreased pumping and water level decreases occurred during increased pumping. While daily and seasonal fluctuations in water levels were evident, no long-term trend because of municipal pumping is discernable.

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."

There are properties that are not municipally serviced for water supply within 500 m of the Foxboro Green Well Field. 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 FG1, FG2A and FG4 received in 2024 and 2025.

Other groundwater takings registered in the MECP PTTW database within 2 km of the well field are mapped on Figure 3 and summarized below in Table 5. There is one PTTW registered in the MECP's PTTW database in the vicinity of the well field. The PTTW belongs to Foxwood Golf Ltd. and is for use of a dug out pond for irrigation.

Table 5: PTTWs in Vicinity of Foxboro Green Well Field

Permit Number	Permit Holder	Purpose	Source - Max Liters per Day	Distance (km) from FG1 / FG2A and FG4 Supply Wells	Expiry Date
4447-BCDR7H	Foxwood Golf Ltd.	Golf Irrigation	Dugout Pond – 1,310,000	0.64 km – FG1/FG2A, 0.95 km – FG4	02/28/2029

4.2 Aquifer Response to Pumping and Precipitation

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

Water levels in the dolostone bedrock production aquifer were monitored at WT-FG-OW1-09-A. The monitoring shows short term impacts to water levels in the aquifer as a result of pumping. No long-term trends in the aquifer as a result of municipal pumping are discernable. Seasonal fluctuations in the aquifer are observed with the highest and lowest levels observed in spring and late summer / fall, respectively. The correlation of individual precipitation events with groundwater levels is difficult due to several reasons including but not limited to hydraulic conductivity, well depth, precipitation intensity and ground cover conditions.

5.0 Conclusions

Impacts from pumping the municipal wells at the Foxboro Green Well Field 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 2544-BBHP4S;
- 2024 and 2025 pumping volumes were within the permitted range;
- Water levels in WT-FG-OW01-09-A are influenced by production well pumping;

- There were no reported well interference complaints arising from water taking at the Foxboro Green well field; and
- There are no long-term changes in water levels in the bedrock aquifer (WT-FG-OW01-09-A) due to pumping.

6.0 References

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Stantec Consulting Ltd., 2017. Water Monitoring Program Foxboro Green Retirement Community, Regional Municipality of Waterloo.

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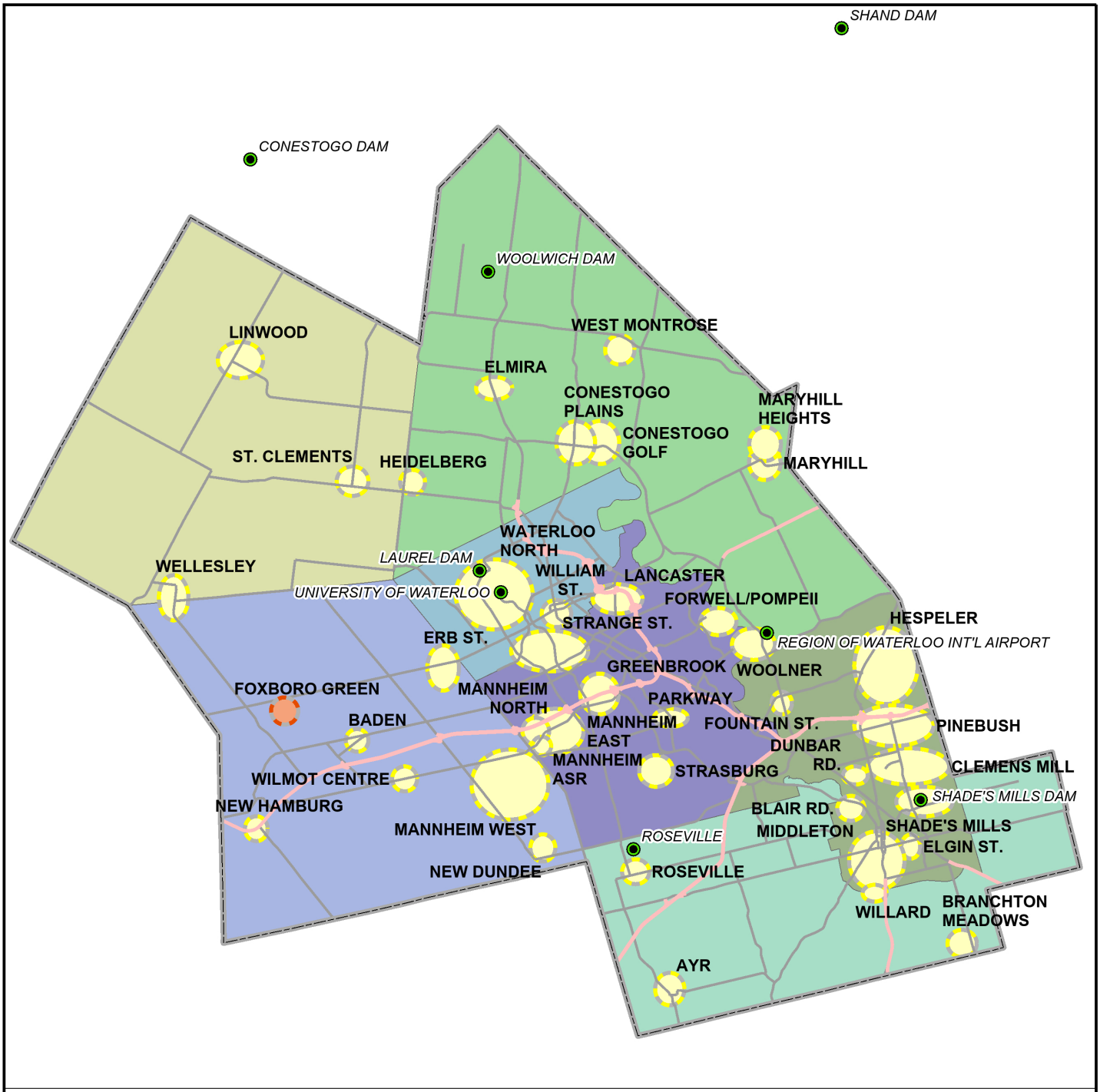
[THE DIFFERENCE IS OUR PEOPLE]

Figures



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Map Title

2025 GROUNDWATER MONITORING REPORT - FOXBORO GREEN WELL FIELD

WELL FIELD LOCATION MAP

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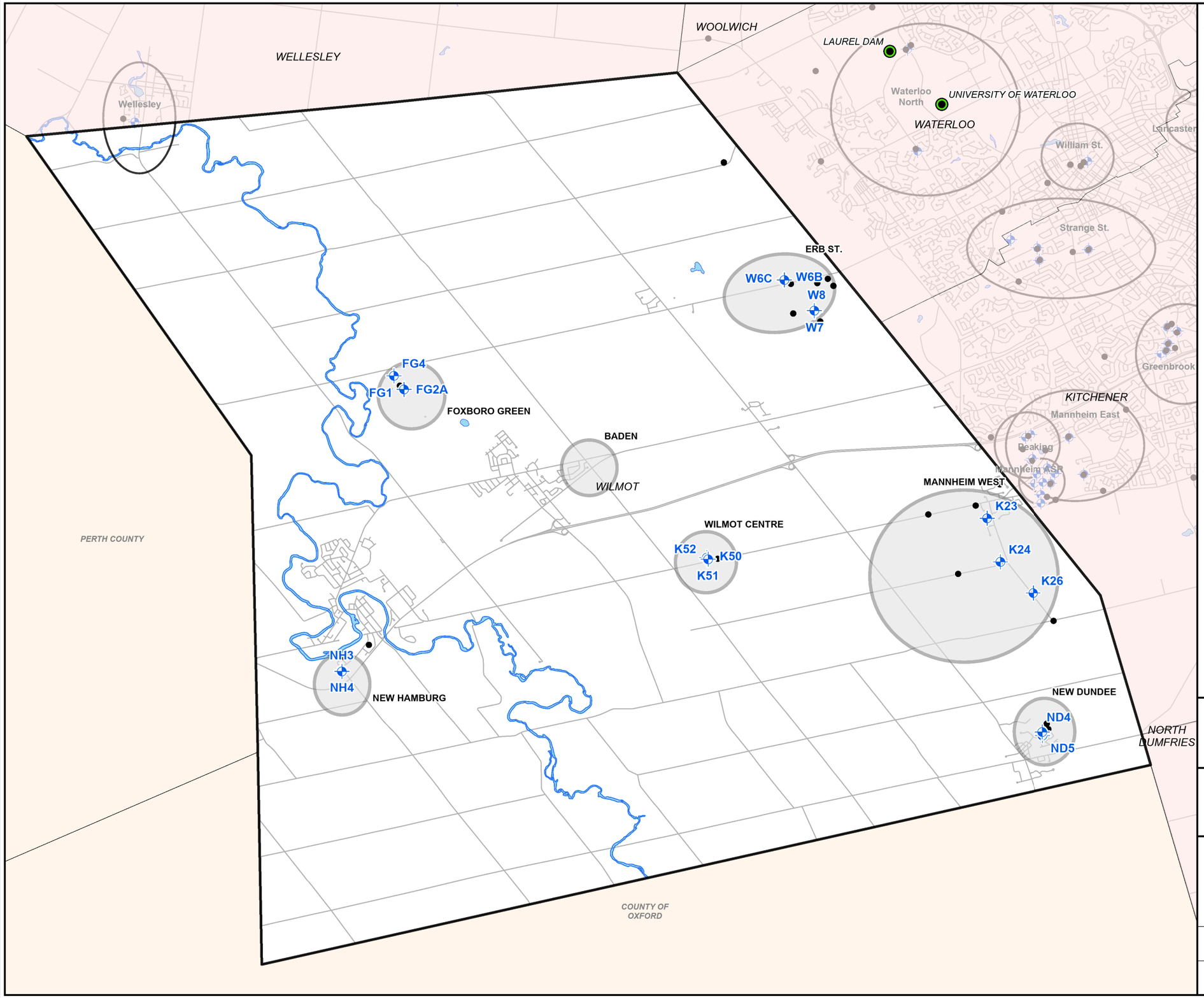

LEGEND

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

Sources:

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

Datum: North American 1983 CSRS

Coord. System: NAD 1983 CSRS UTM Zone 17N

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Kilometers

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Figure Title

2025 GROUNDWATER MONITORING REPORT - FOXBORO GREEN WELL FIELD

WILMOT WELL FIELDS AND MONITORING NETWORK

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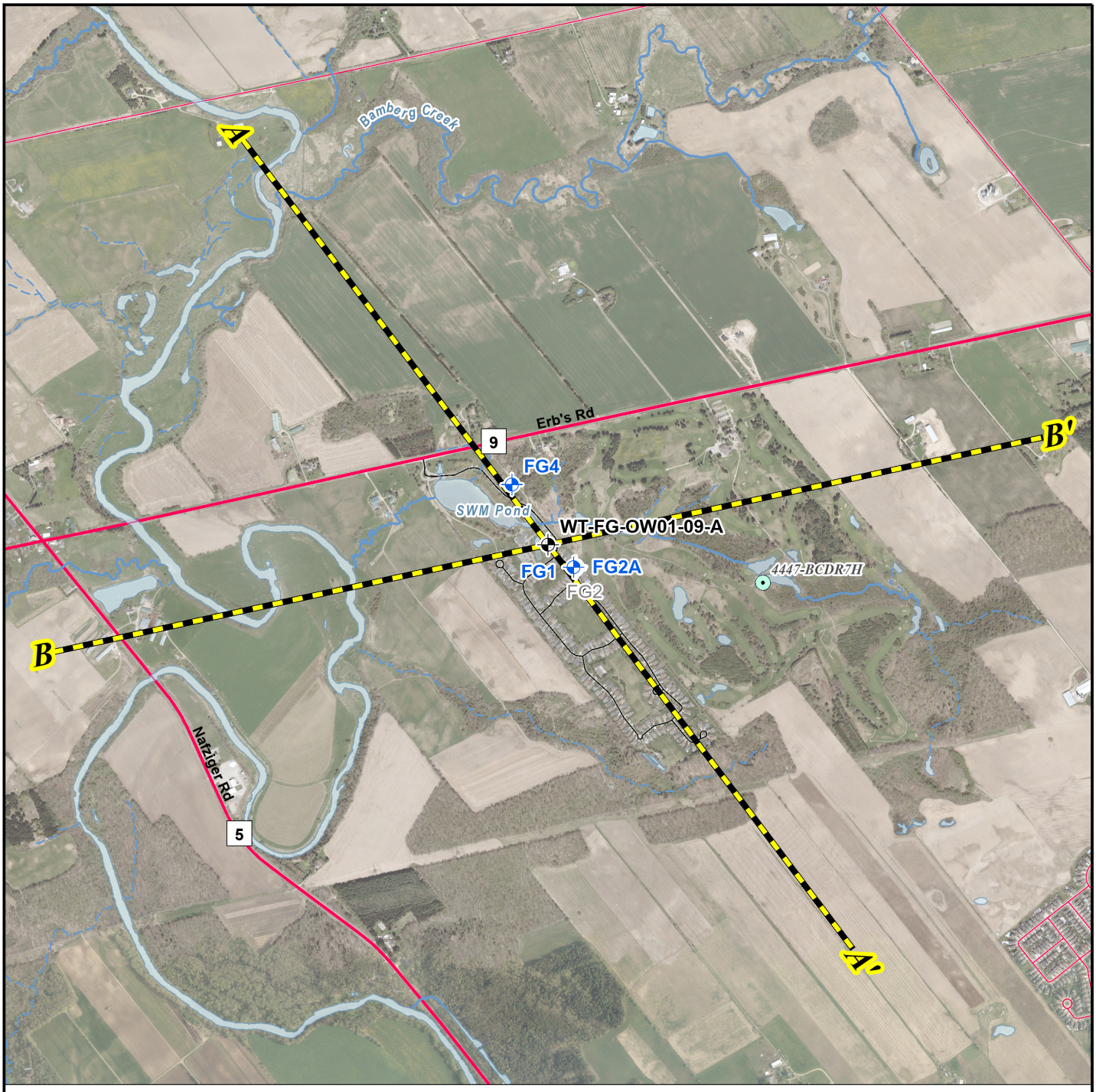

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Data Source:
Region of Waterloo GIS Data; Background 2020 Air Photo: ArcGIS Image Service Region of Waterloo; Ministry of Natural Resources, © Queen's Printer for Ontario; Natural Resources Canada © Her Majesty the Queen in Right of Canada.

0 150 300 450 600 750 900 1,050 1,200 1,350
Metres

Production Well Location
Decommissioned Production Well Location
Additional MECP PTTW Locations
Surface and Ground Water
Cross Section Orientation
Intermittent Creek
Creek
Waterbody
Regional Road
Local Road
Private / Other Road

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Map Title

2025 GROUNDWATER MONITORING REPORT - FOXBORO GREEN WELL FIELD

WELL LOCATION MAP

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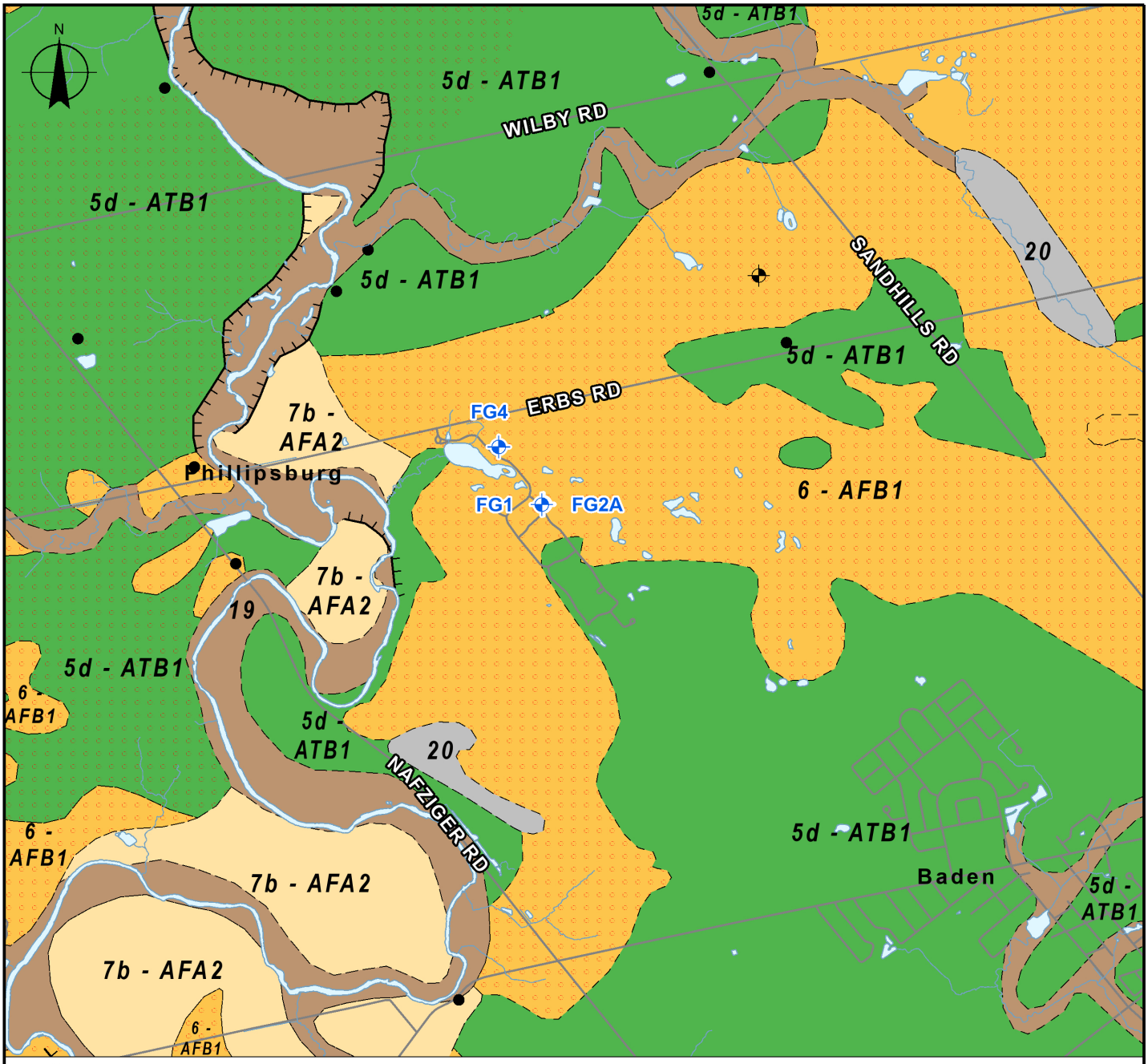

Data Source:
1. Ontario Geological Survey 2003. Surficial Geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128.
2. Region of Waterloo GIS

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Meters

- RMOW Supply Well
- Watercourse
- Waterbody

Surficial Geology

- 5d: Glaciolacustrine-derived silty to clayey till (ATB1 - Aquitard)
- 6: Ice-contact stratified deposits (AFB1 - Aquifer)
- 7b: Glaciofluvial deposits: Gravelly deposits (AFA2 - Aquifer)
- 19: Modern alluvial deposits
- 20: Organic deposits
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- Drill Hole
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- Unit Contact Boundary

BURNSIDE

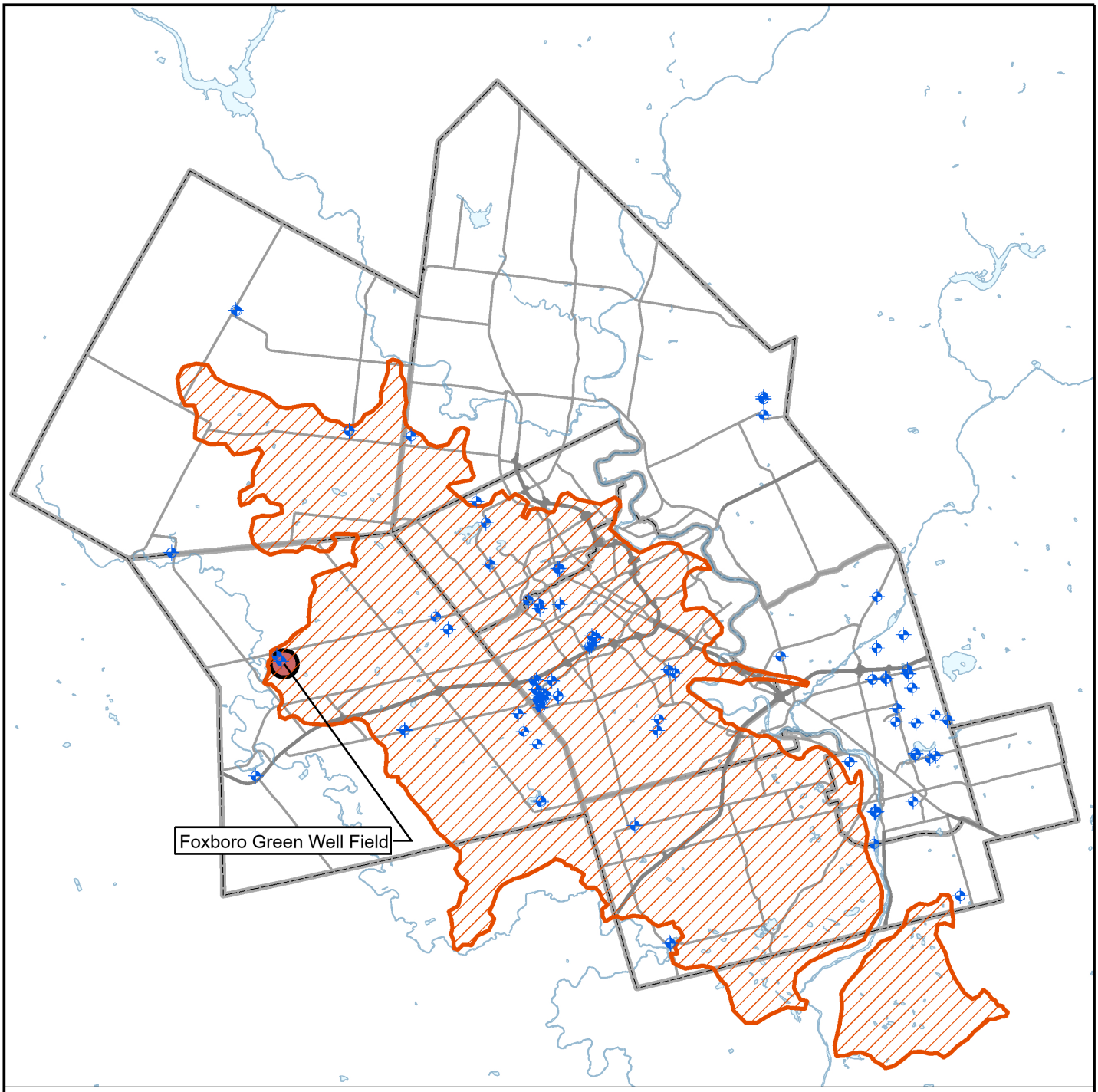
Map Title
2025 GROUNDWATER MONITORING REPORT - FOXBORO GREEN WELL FIELD

SURFICIAL GEOLOGY

Client
REGION OF WATERLOO

Drawn	Checked	Date	Figure No.
HN	SQ	February 2026	4
Scale		Project No.	
1:30,000		HA0464020	

File Path: \\elmo\gis\Project\H Jobs\HA 04 6402 (Waterloo)\Reporting\Groundwater Level Monitoring Program\2025 Groundwater Report Figures\New Dundee\Pro\New Dundee\New Dundee.aprx Print Date: 2026/02/05 Time: 03:16 PM



N

Data Source:
1. Andy F. Bajc, Hazen A.J. Russell and David R. Sharpe (2014) A three-dimensional hydrostratigraphic model of the Waterloo Moraine area, Southern Ontario, Canada, Canadian Water Resources Journal / Revue canadienne des ressources hydriques, 39:2, 95-119
2. Region of Waterloo; Includes material © 2019 of the Queen's Printer for Ontario. All rights reserved.

0 5 10 15 20 25
Kilometers

RMOW Supply Well
Waterloo Moraine (2014)
Foxboro Green Well Field
Waterbody
Regional Municipal Boundaries

BURNSIDE

Map Title

2025 GROUNDWATER MONITORING REPORT - FOXBORO GREEN WELL FIELD

LOCATION OF THE WATERLOO MORAINE

Client

REGION OF WATERLOO

Drawn	Checked	Date	Figure No.
CD	SQ	February 2026	5
Scale		Project No.	
1:300,000		HA0464020	

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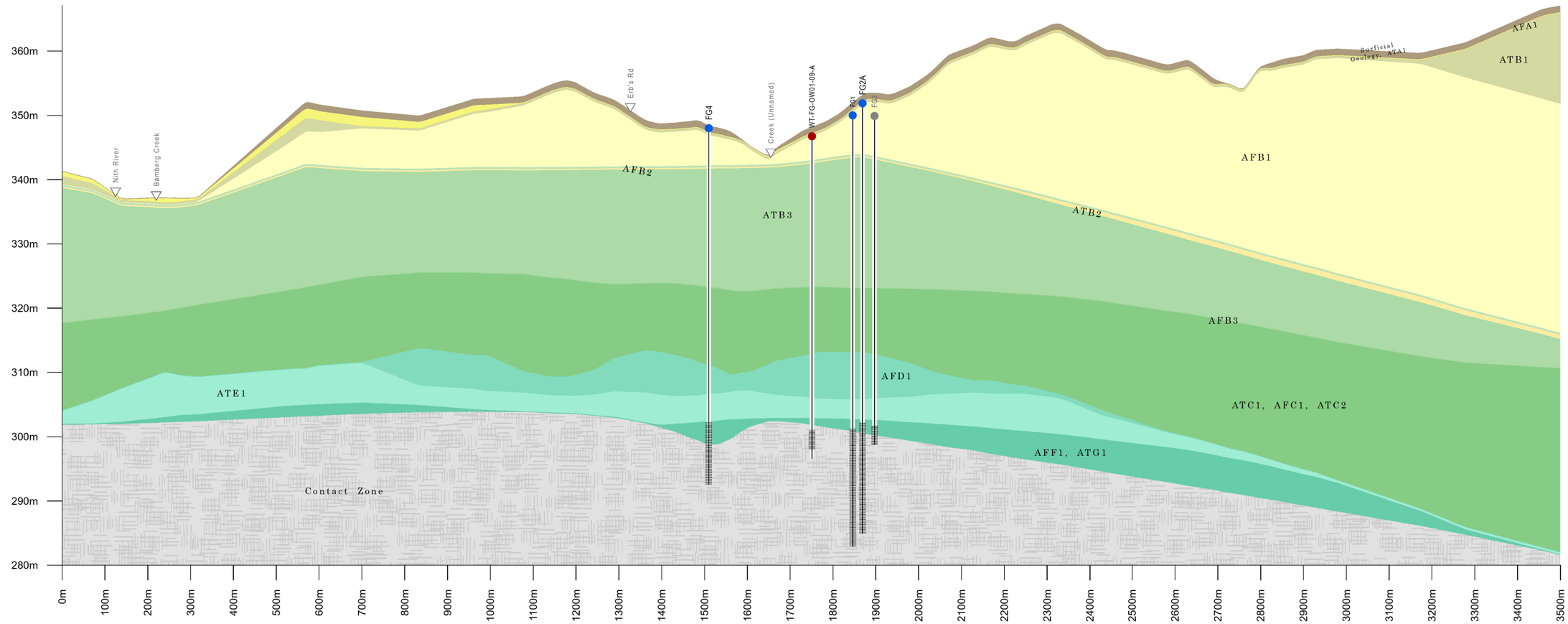

Wells

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

Moraine Model 2026

- Surficial Geology, Whittlesey Clay (ATA1)
- Whittlesey Sand (AFA1)
- Upper Maryhill, Port Stanley, Tavistock, Mornington, & Stratford Tills (ATB1)
- 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

Wellhead

Well

Screen or Open Hole

BURNSIDE

Client

REGION OF WATERLOO

Figure Title

GEOLOGIC CROSS SECTION
REGION OF WATERLOO
Foxboro
Cross Section A - A'

Drawn	Checked	Date	Figure No.
PS	DH	2026/06/01	6
Horizontal Scale 1:10,000		Project No.	
Vertical Ex.:15x		HA046402	

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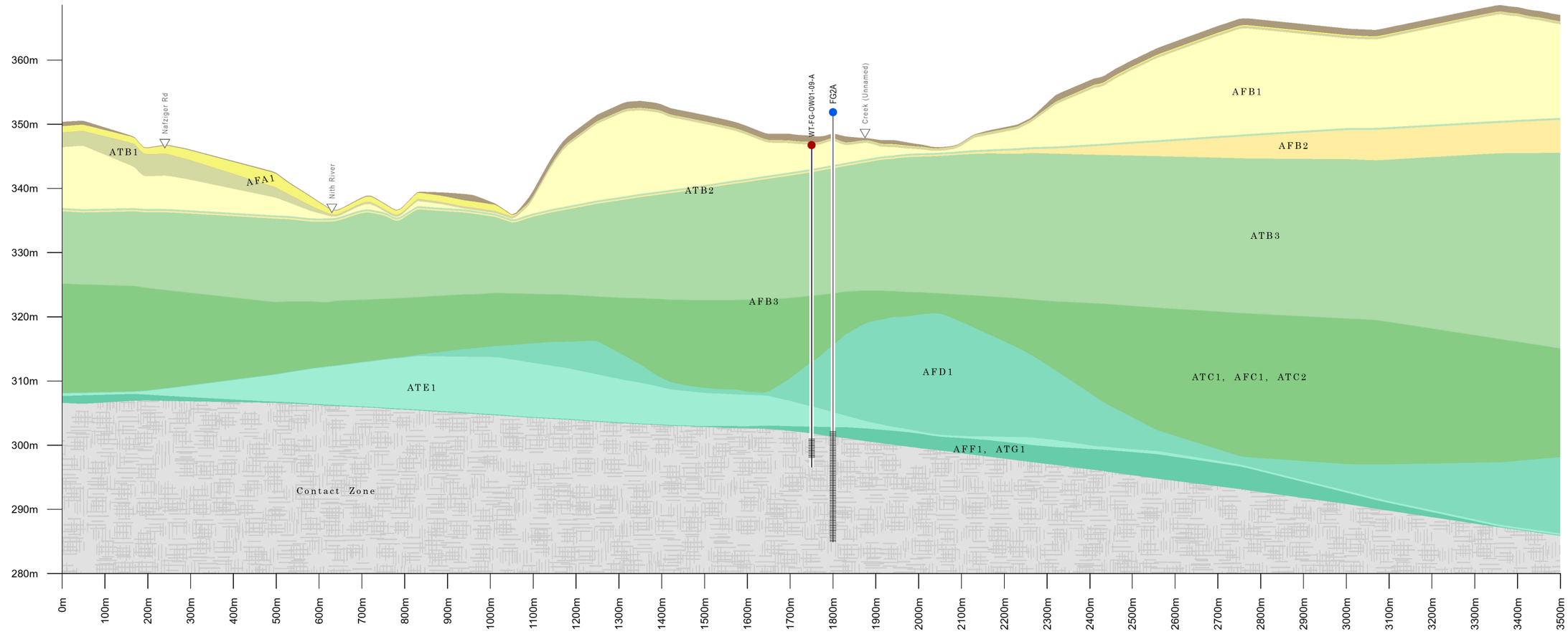

Wells

- Production Well (Active)
- Monitoring Well

Moraine Model 2026

- Surficial Geology, Whittlesey Clay (ATA1)
- Whittlesey Sand (AFA1)
- Upper Maryhill, Port Stanley, Tavistock, Mornington, & Stratford Tills (ATB1)
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- Middle Waterloo Moraine Stratified Sediments & Equivalents (AFB2)
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- 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

Wellhead

Well

Screen or Open Hole

BURNSIDE

Client

REGION OF WATERLOO

Figure Title

GEOLOGIC CROSS SECTION
REGION OF WATERLOO
Foxboro
Cross Section B - B'

Drawn	Checked	Date	Figure No.
PS	DH	2026/06/01	7
Horizontal Scale 1:10,000		Project No.	
Vertical Ex.:15x		HA046402	

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BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix A

Permit To Take Water

PERMIT TO TAKE WATER
Ground Water
NUMBER 2544-BBHP4S

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

For the water taking from: Three wells (FG1, FG2A and FG4)

Located at: Lot 16, Concession German Block South of Erbs Road, Geographic Township of Wilmot
Wilmot, 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. 2544-BBHP4S 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 January 30, 2019 and signed by Richard Wootton, 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 **April 30, 2029**. 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	FG1	Well Drilled	Municipal	Water Supply	499	24	718,560	365	17 524490 4807493
2	FG2A	Well Drilled	Municipal	Water Supply	499	24	718,560	365	17 524497 4807495
3	FG4	Well Drilled	Municipal	Water Supply	499	24	718,560	365	17 524278 4807779
						Total Taking:	718,560		

3.3 Notwithstanding Table A, the maximum combined rate and maximum combined total daily amount taken for all sources: Well FG1, Well FG2A and Well FG4 shall be 499 L/min and 718,560 L/day.

4. Monitoring

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

4.2 The Permit Holder shall measure and record water levels once a month in the following monitoring well: WT-FG-OW01-09.

4.3 The Permit Holder shall prepare and submit an electronic copy of a report every two years by June 30. The report shall present the results of the well field water level monitoring for the two preceding calendar years, assess changes in water levels in the supply aquifer(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 to the District Office in accordance with Condition 5.1 and the manner in which the Permit Holder has dealt with the complaint. Any application for an amendment or renewal shall be accompanied by the most recent biennial report.

5. Impacts of the Water Taking

5.1 Notification

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

5.2 For Groundwater Takings

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

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

6. Director May Amend Permit

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

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

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

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

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

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

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

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

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

This notice must be served upon:

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

AND

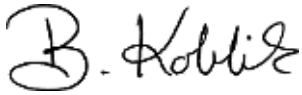
The Director, Section 34.1,
Ministry of the Environment, Conservation and Parks
12th Floor
119 King St W
Hamilton ON L8P 4Y7
Fax: (905) 521-7820

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

by Telephone at	by Fax at	by e-mail at
(416) 212-6349	(416) 326-5370	www.ert.gov.on.ca
Toll Free 1(866) 448-2248	Toll Free 1(844) 213-3474	

This Permit cancels and replaces Permit Number 2055-9C5PEU, issued on 2013/10/11.

Dated at Hamilton this 24th day of April, 2019.



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

Schedule A

This Schedule “A” forms part of Permit To Take Water 2544-BBHP4S, dated April 24, 2019.

BURNSIDE

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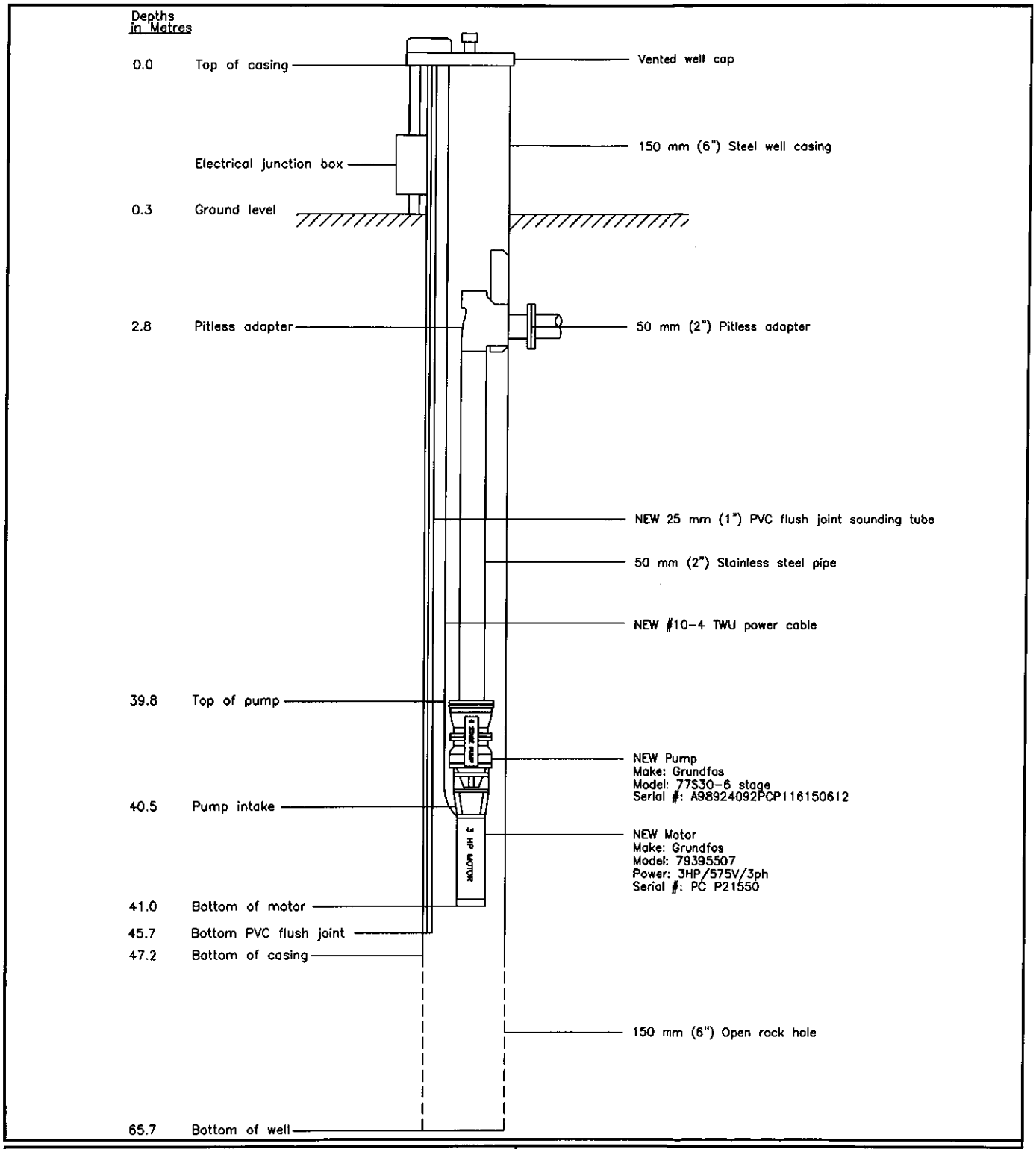
Appendix B

Well Records

FG1



Lotowater
TECHNICAL SERVICES INC.

CLIENT
Regional Municipality of Waterloo

TITLE
Well FG1
Pump Installation Drawing

PROJECT No. 006-385			G:\Lotowater Projects\006 Region of Waterloo\385 Well FG1\Pump Install.dwg		FIGURE 2
DESIGN			REVISION No. 2016-12-21	SCALE N.T.S.	
DRAWN	EH	2016-12-21			
CHECKED					

Test Well: WT-FG-TW1-11 (FG2A)

FG2A

Project: 2011 Municipal Well Construction and Testing
Client: Region of Waterloo
Location: Foxboro Green Well Field
Number: 160900651

Field Investigator: R. Dong / A. Vandenhoff
Contractor: Gerrits Well Drilling
Drilling method: Truck mount, DR 24, air rotary
Date started/completed: 07-Oct-2011 / 21-Oct-2011

Ground surface elevation: 351.88 m AMSL
Top of casing elevation: 352.38 m AMSL
Easting: 524497
Northing: 4807495

SUBSURFACE PROFILE

Lithologic Description	Elevation (m AMSL) / Depth (m BGS)
Ground Surface	352.79 / 351.88
SILTY CLAY sand, trace to little fine gravel, brown (10 Yr 4/3) becoming lighter brown (10 Yr 5/3) at 1.52 m BGS trace to little fine and coarse gravel beginning at 3.05 m BGS	0.00 347.31
SAND and SILT trace to little gravel, brown (10 Yr 5/3)	4.57 345.78
SAND fine grained, trace to little gravel, brown (10 Yr 5/3)	6.10 342.73
CLAY trace gravel, grey (10 Yr 5/1) trace to little sand and gravel beginning at 10.67 m BGS	9.14 325.36
SAND and GRAVEL some silt, light brownish grey (10 Yr 6/2), poorly sorted trace fine and medium sand, coarse and fine gravel, trace silt beginning at 28.93 m BGS	26.52 321.40
SAND fine grained, some silt, trace fine gravel, light brownish grey (10 Yr 6/2)	30.48 319.87
SAND and GRAVEL coarse grained sand, fine gravel, little silt	32.00 318.35
SILTY SAND fine, trace to little coarse grained sand, trace fine gravel, light brownish grey (10 Yr 6/2) fine, trace medium grained sand at 36.58 m BGS	33.53 313.78
SILTY SAND to SANDY SILT fine, trace medium and coarse grained sand, light brownish grey (10 Yr 6/2) becoming finer with depth some clay beginning at 41.16 m BGS becoming coarser with depth trace coarse sand beginning at 42.68 m BGS trace to little medium and coarse grained sand beginning at 45.72 m BGS	38.10 303.72
BEDROCK - SALINA FORMATION brown, interbedded dolostone and shale	48.16 300.37
dark brown shale	51.51 298.23
brown, laminated dolostone	53.64 293.66
brown, interbedded shale and dolostone	58.22 290.31
grey green, shale	61.57 284.82
End of Borehole	67.06

HYDROGEOLOGY

Hydro Stratigraphic Unit	Description
ATB1	Upper Maryhill Till/Port Stanley Till
AFB1/ AFB2	Upper and Lower Moraine Stratified Sediments and Equivalents
ATB3	Lower Maryhill Till
AFB3	Potentially Lower Moraine Stratified Sediments
ATC1/ ATC2	Upper/Main Catfish Creek Till
ATE1	Pre-Catfish Creek Sand and Gravel
Bedrock	Salina Formation

SAMPLE DETAILS

Sample Number	Sample Type
1	GB
2	GB
3	GB
4	GB
5	GB
6	GB
7	GB
8	GB
9	GB
10	GB
11	GB
12	GB
13	GB
14	GB
15	GB
16	GB
17	GB
18	GB
19	GB
20	GB
21	GB
22	GB
23	GB
24	GB
25	GB
26	GB

GEOPHYSIC DETAILS

Caliper (cm) 10 15 20 25 30
Gamma (cps) 20 40 60 80
Resistivity (Ohm.m) 600 1200 1800 2400

WELL DETAILS

- Stick-up = 0.50 m
- Cement grout (0 to 6.0 m BGS)
- 445 mm diameter borehole (0 to 6.0 m BGS)
- 221 mm and 322 mm diameter steel casings with annular space between casings sealed with cement grout (0 to 49.7 m BGS)
- 203 mm diameter open borehole (49.7 to 67.0 m BGS)

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

n/a - not available/applicable

Drawn By/Checked By: EH / LV

Stantec

Sheet 1 of 1

STANTEC BOREHOLE AND WELL - MASTER 17X11 160900651_BOREHOLES_110909.GPJ STANTEC - DATA TEMPLATE.GDT 9/5/12 MJFRASER

Ontario Ministry of the Environment

Well Tag No. (Place Sticker and/or Print Below): A112247

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Measurements recorded in: ☒ Metric ☐ Imperial

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Region of Waterloo		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
150 Frederick Street	Kitchener	ON	N2G4J3	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
	Wilmot	16	SER

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

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	521450	4810741		

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
Black	Topsoil			0	0.30
Brown	Clay			0.30	3.35
Brown	Sand	Clay, Stones		3.35	9.75
Gray	Clay			9.75	28.96
Brown	Clay	Sand		28.96	35.97
	Sand	Gravel, Clay		35.97	48.16
Grey	Limestone			48.16	61.87
Blue	Shale			61.87	67.06

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	49.68	Cement	1.73

Results of Well Yield Testing

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

If pumping discontinued, give reason:

Pump intake set at (m/ft): 48

Pumping rate (l/min / GPM): 454

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 44.92

If flowing give rate (l/min / GPM):

Recommended pump depth (m/ft): 48

Recommended pump rate (l/min / GPM): 454

Well production (l/min / GPM): ok

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	~~30.32~~		13.41
1	26.14	1	32.49
2	27.46	2	24.80
3	28.99	3	21.16
4	29.67	4	19.25
5	30.14	5	18.28
10	30.86	10	16.58
15	31.15	15	16.41
20	31.34	20	
25	31.43	25	
30	31.56	30	
40	43.38	40	
50	44.17	50	
60	44.92	60	

Method of Construction

☐ Cable Tool ☐ Diamond
☒ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, specify

Well Use

☒ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
20.3	Steel	0.889	+0.508	49.68
30.48	Steel	0.889	0	48.16
20.3	Open		49.68	67.06

Status of Well

☒ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

Construction Record - Screen

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

Water Details

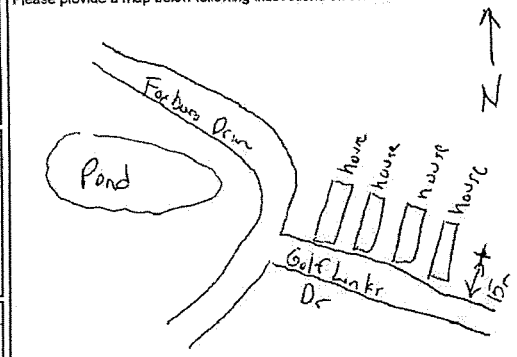
Water found at Depth (m/ft)	Kind of Water	
51.8	☐ Fresh ☒ Untested ☐ Gas ☐ Other, specify	
54.86	☐ Fresh ☒ Untested ☐ Gas ☐ Other, specify	
50.52	☐ Fresh ☒ Untested ☐ Gas ☐ Other, specify	

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	48.16	32.39
48.16	44.68	29.21
44.68	67.06	20.32

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor: Gerrits Drilling & Engineering Ltd.

Well Contractor's Licence No.: 3 4 0 1 6

Business Address (Street Number/Name): 215154 10th Line R.R. #1

Municipality:

Province: Grand Valley, Ontario

Postal Code: L0N 1G0

Business E-mail Address:

Bus. Telephone No. (inc. area code):

Name of Well Technician (Last Name, First Name): Aaron Bast

Well Technician's Licence No.: 3 4 1 4 3

Signature of Technician and/or Contractor:

Date Submitted: 2010 11 16

Well owner's information package delivered: ☒ Yes ☐ No

Date Package Delivered: 2010 11 16

Date Work Completed: 2010 11 16

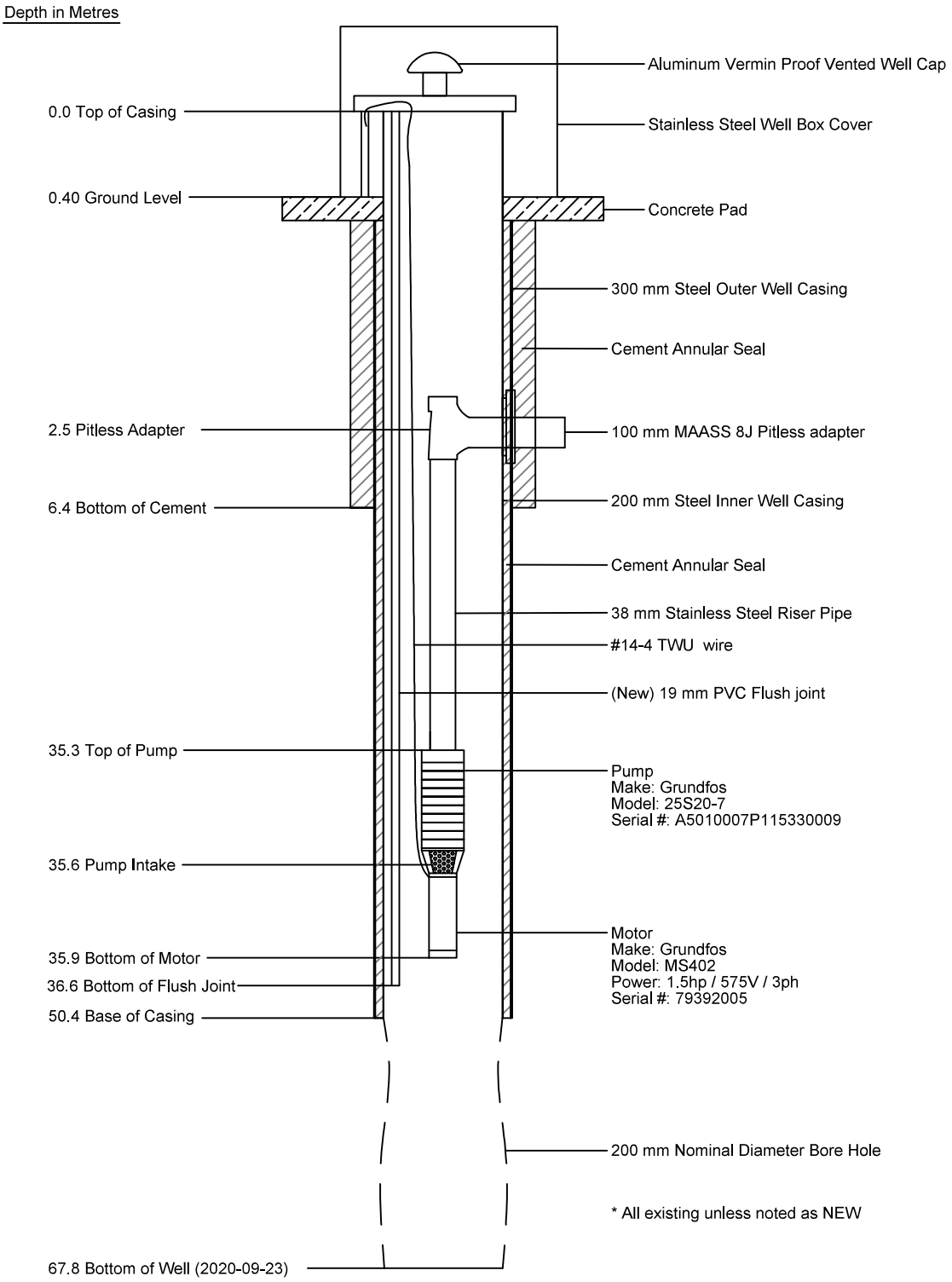
Ministry Use Only

Audit No.: Z 127272

Received

WT-FG-TWI-11 (FG 2A)

FG2A



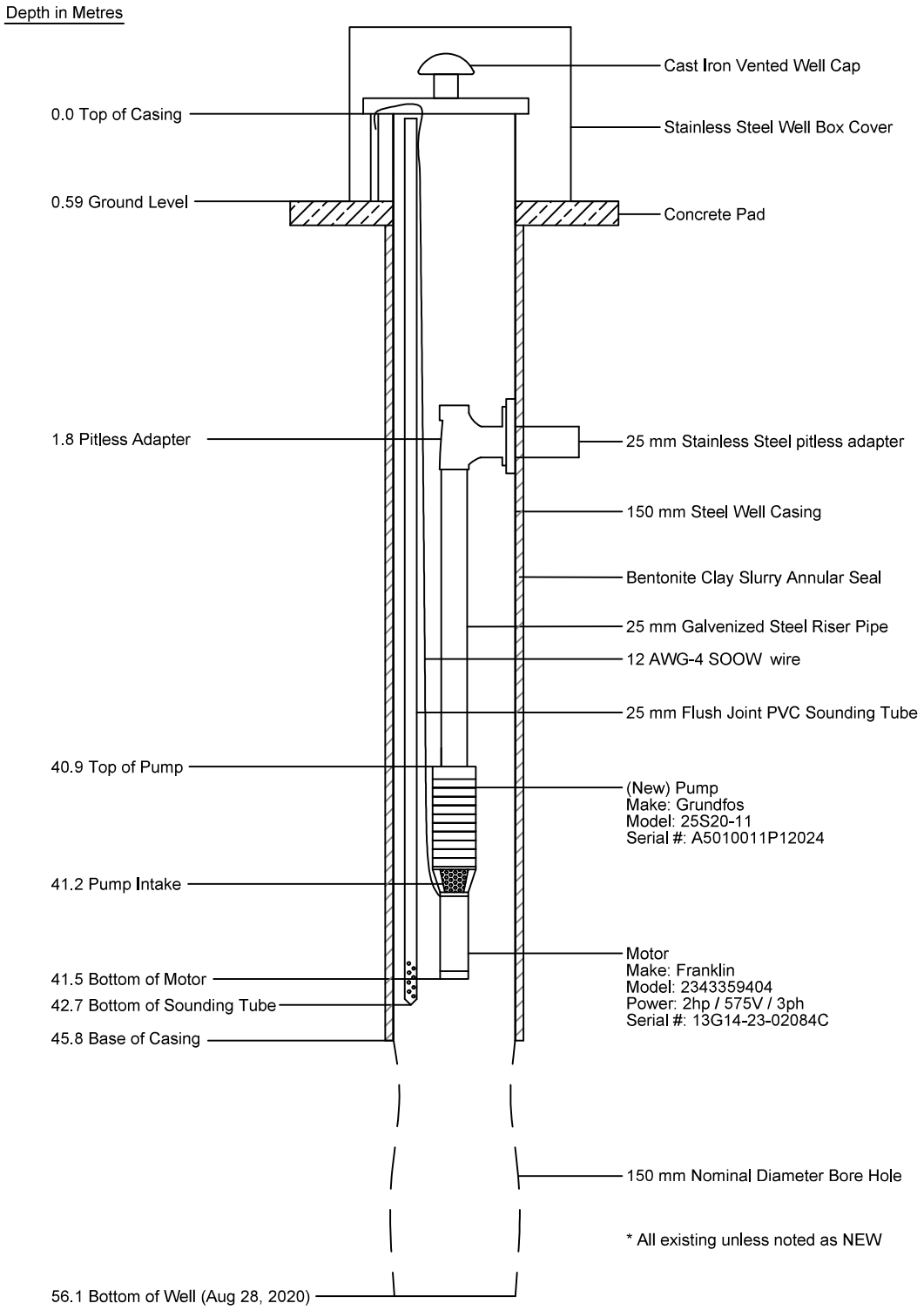
Lotowater TECHNICAL SERVICES INC.

CLIENT
REGIONAL MUNICIPALITY OF WATERLOO

TITLE
WELL FG2A
PUMP INSTALLATION DRAWING

PROJECT #:		006-487	L:\Lotowater Projects\006 Region of Waterloo\487 FG2A Service 2020\7. Technical		
DESIGN			REVISION No.	SCALE	FIGURE
DRAWN	EH	2020/09/28	2020-09-28	N.T.S	3
CHECKED	BP	2020/09/30			

FG4



Lotowater TECHNICAL SERVICES INC.

CLIENT
REGIONAL MUNICIPALITY OF WATERLOO

TITLE
WELL FG4
PUMP INSTALLATION DRAWING

PROJECT #:		006-484	L:\Lotowater Projects\006 Region of Waterloo\484 FG4 Service 2020\7. Technical		
DESIGN			REVISION No.	SCALE	FIGURE
DRAWN	EH	2013/12/16	2020-09-15	N.T.S	3
CHECKED	BP	2020/09/15			

PROJECT: 08-1112-0150

BOREHOLE LOG OF: WT-FG-OW01-09

SHEET 1 OF 3

LOCATION: N 4807571.0 ;E 524402.0

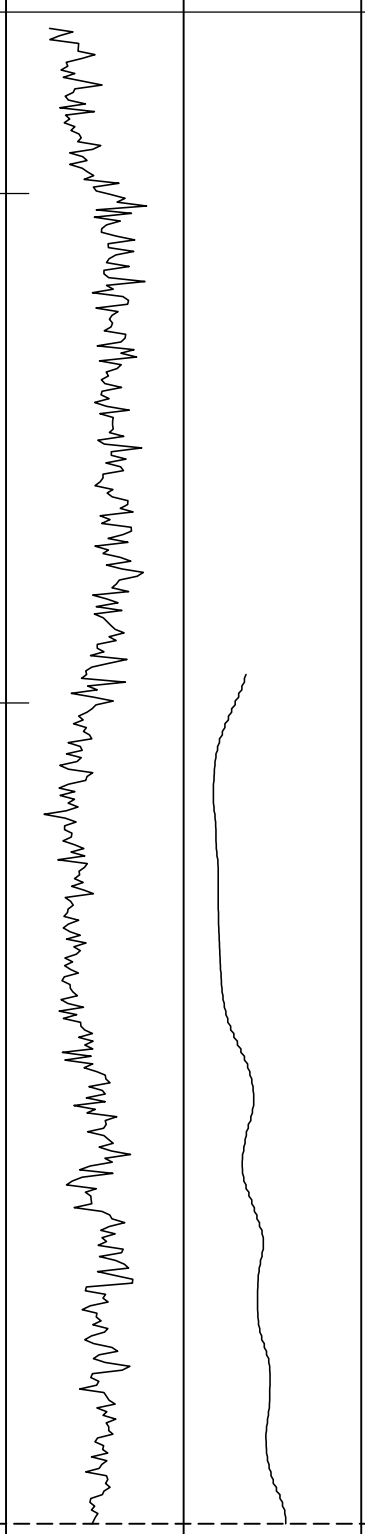
DRILLING DATE: September 1-2, 2009

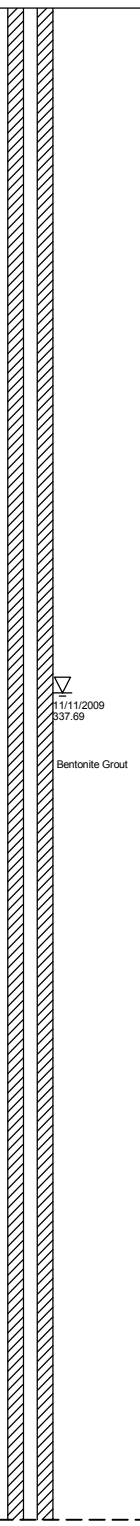
DATUM: NAD83

DRILL RIG: Mud Rotary

DRILLING CONTRACTOR: Davidson Well Drilling

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	OGS CODE
	GROUND SURFACE	346.75	
0	Light grey, CLAYEY SILT, with sand, some gravel	0.00	ATB1
2		344.35	
	Light grey, SILTY CLAY, trace sand, trace gravel	2.40	ATB2
4			
6			
8		337.61	
	Light grey, SILTY CLAY, trace coarse sand	9.14	ATB3
10			
12	(SA1 12.8 m)		
14			
16			
18			
20	*CONTINUED NEXT PAGE*		





DEPTH SCALE

1 : 100

Golder Associates

LOGGED: BH

CHECKED: DN

PROJECT: 08-1112-0150

BOREHOLE LOG OF: WT-FG-OW01-09

LOCATION: N 4807571.0 ;E 524402.0

DRILLING DATE: September 1-2, 2009

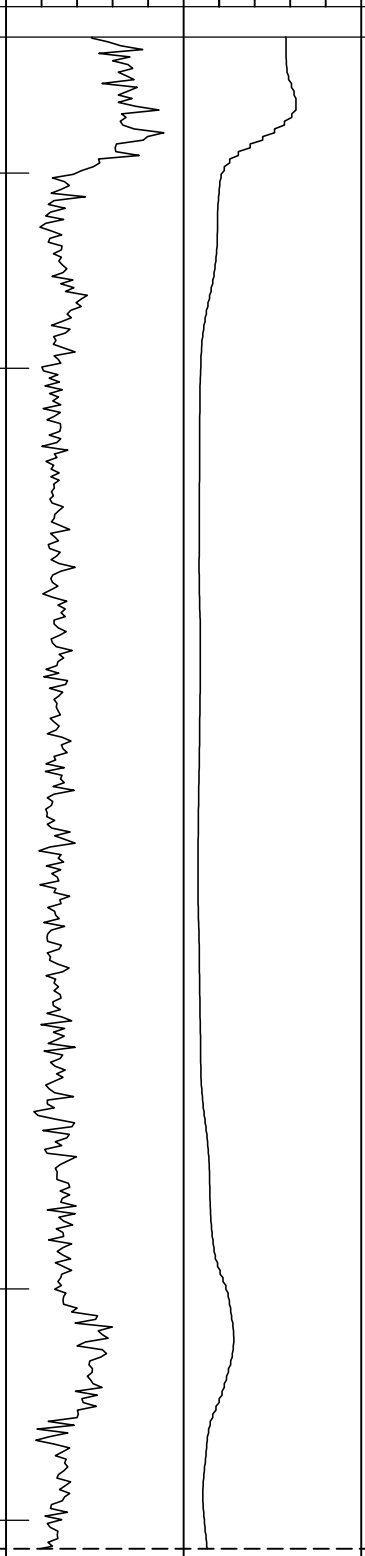
DATUM: NAD83

DRILL RIG: Mud Rotary

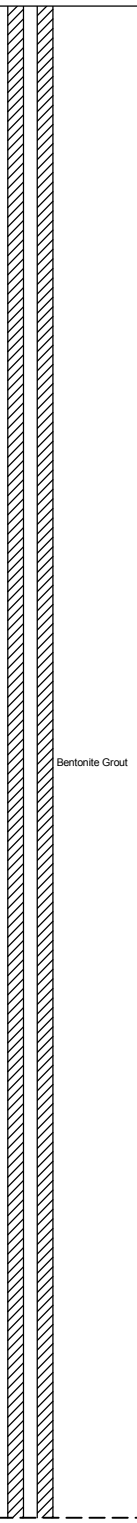
DRILLING CONTRACTOR: Davidson Well Drilling

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	OGS CODE
	--- CONTINUED FROM PREVIOUS PAGE ---		
20	Light grey, SILTY CLAY, trace coarse sand	324.95	ATB3
22	Light grey, GRAVEL and SAND, some silt	21.80 / 322.37	ATC1
24	Light grey, GRAVEL, some coarse sand, trace silt	24.38 / 310.17	ATC2
36	Light grey, SILTY CLAY, some gravel, trace coarse sand (SA2 36.9-38.7 m)	36.58 / 307.13	ATE1
38	Grey brown, DOLOSTONE	39.62	
40	*CONTINUED NEXT PAGE*		

GEOPHYSICAL RECORD



PIEZOMETER OR STANDPIPE INSTALLATION



DEPTH SCALE

1 : 100

Golder Associates

LOGGED: BH

CHECKED: DN

PROJECT: 08-1112-0150

BOREHOLE LOG OF: WT-FG-OW01-09

LOCATION: N 4807571.0 ;E 524402.0

DRILLING DATE: September 1-2, 2009

DATUM: NAD83

DRILL RIG: Mud Rotary

DRILLING CONTRACTOR: Davidson Well Drilling

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	OGS CODE	GEOPHYSICAL RECORD: GAMMA (cps) 25 50 75 100	GEOPHYSICAL RECORD: CONDUCTIVITY (mS/m) 10 20 30 40	PIEZOMETER OR STANDPIPE INSTALLATION
	--- CONTINUED FROM PREVIOUS PAGE ---						
40	Grey brown, DOLOSTONE						Bentonite Grout
42							Hole Plug
44							Filter Sand
46							*301.03*
48							Screen
			297.98				*297.98*
	END OF BOREHOLE		48.77				
50							
52							
54							
56							
58							
60							

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: BH

CHECKED: DN

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Appendix C

Monitoring Data
(Pumped Volumes and Hydrographs)

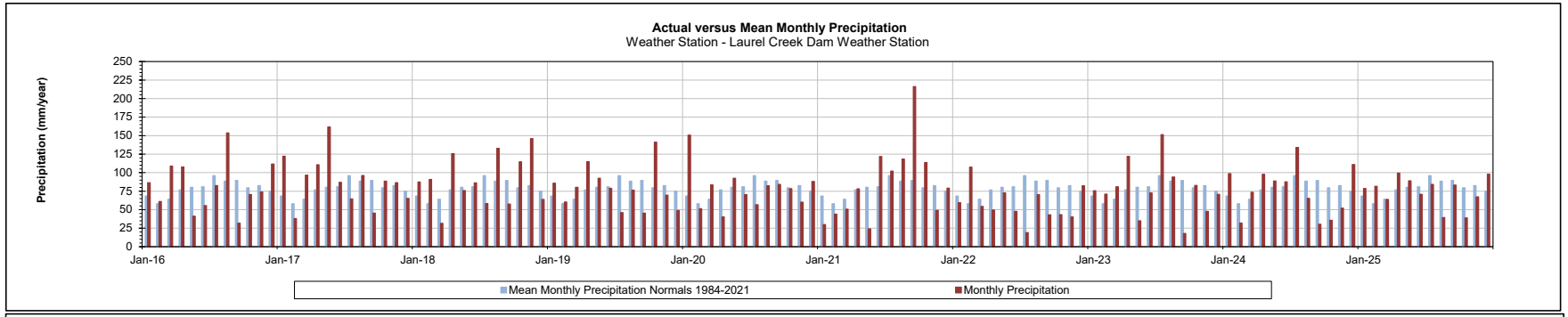
TABLE C-1
WELL FIELD WATER PRODUCTION SUMMARY
REGION OF WATERLOO - 2025 GROUNDWATER MONITORING REPORT

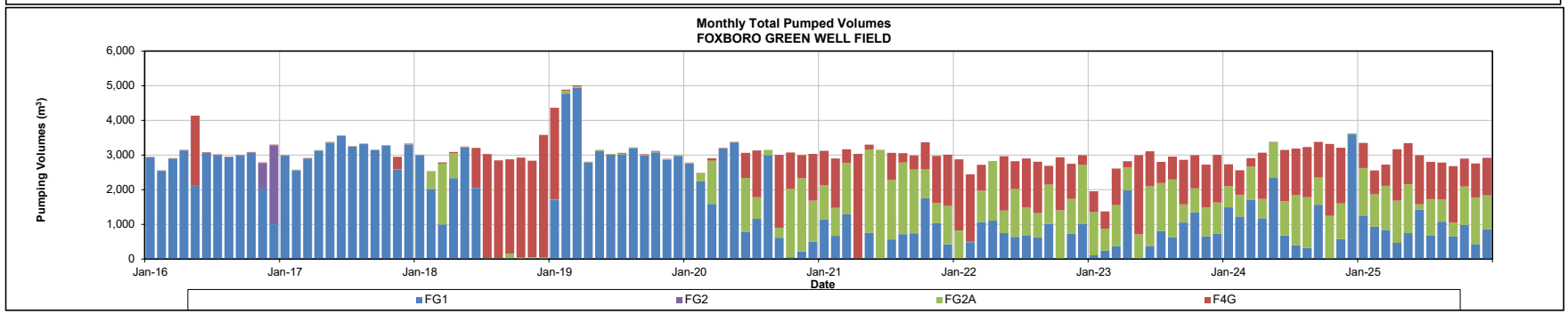
Well Field	Major or Minor Supply	Production Well Name	Status	Permit to Take Water Details			2021 Production Summary			2022 Production Summary			2023 Production Summary			2024 Production Summary			2025 Production Summary		
				MOE Permit Number[1]	Permitted Capacity (total m^3/year)*	Permitted Rate (L/s)*	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)
Foxboro Green	Minor	FG1	Supply	2544-BBHP4S			9,105	25	0.3	8,148	22	0.3	8,329	23	0.3	15,090	41	0.5	10,380	28	0.3
		FG2A	Supply	2544-BBHP4S	2544-BBHP4S		16,999	47	0.5	12,195	33	0.4	12,129	33	0.4	10,743	29	0.3	11,849	32	0.4
		FG4	Supply	2544-BBHP4S	262,274	8.3	11,027	30	0.3	13,384	37	0.4	11,760	32	0.4	11,927	33	0.4	12,746	35	0.4
				Well Field Total	***262,274***	***8.3***	***37,131***	***102***	***1.2***	***33,727***	***92***	***1.1***	***32,218***	***88***	***1.0***	***37,761***	***103***	***1.2***	***34,975***	***96***	***1.1***

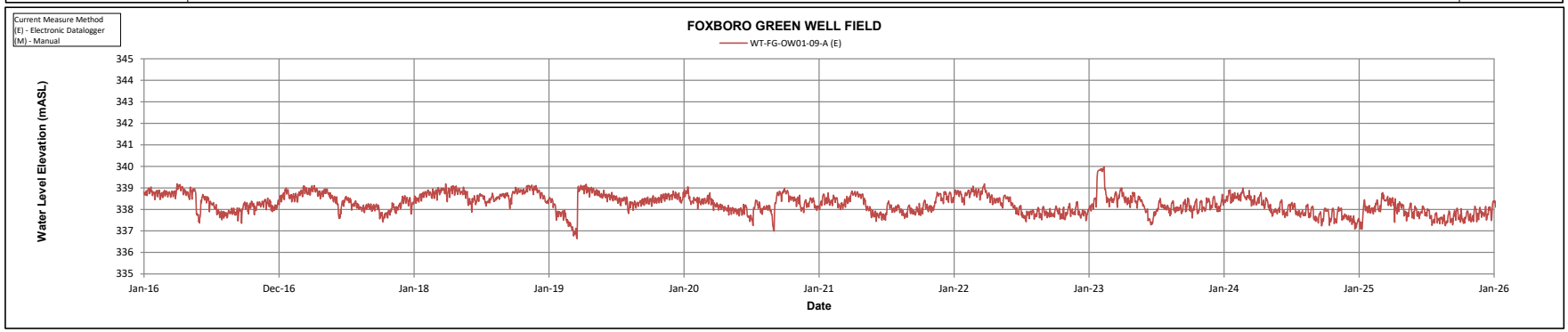
* Maximum combined rate and total daily amount taken for all wells shall not exceed 499L/min and 718,560L/day, respectively

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 -
FOXBORO GREEN







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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**

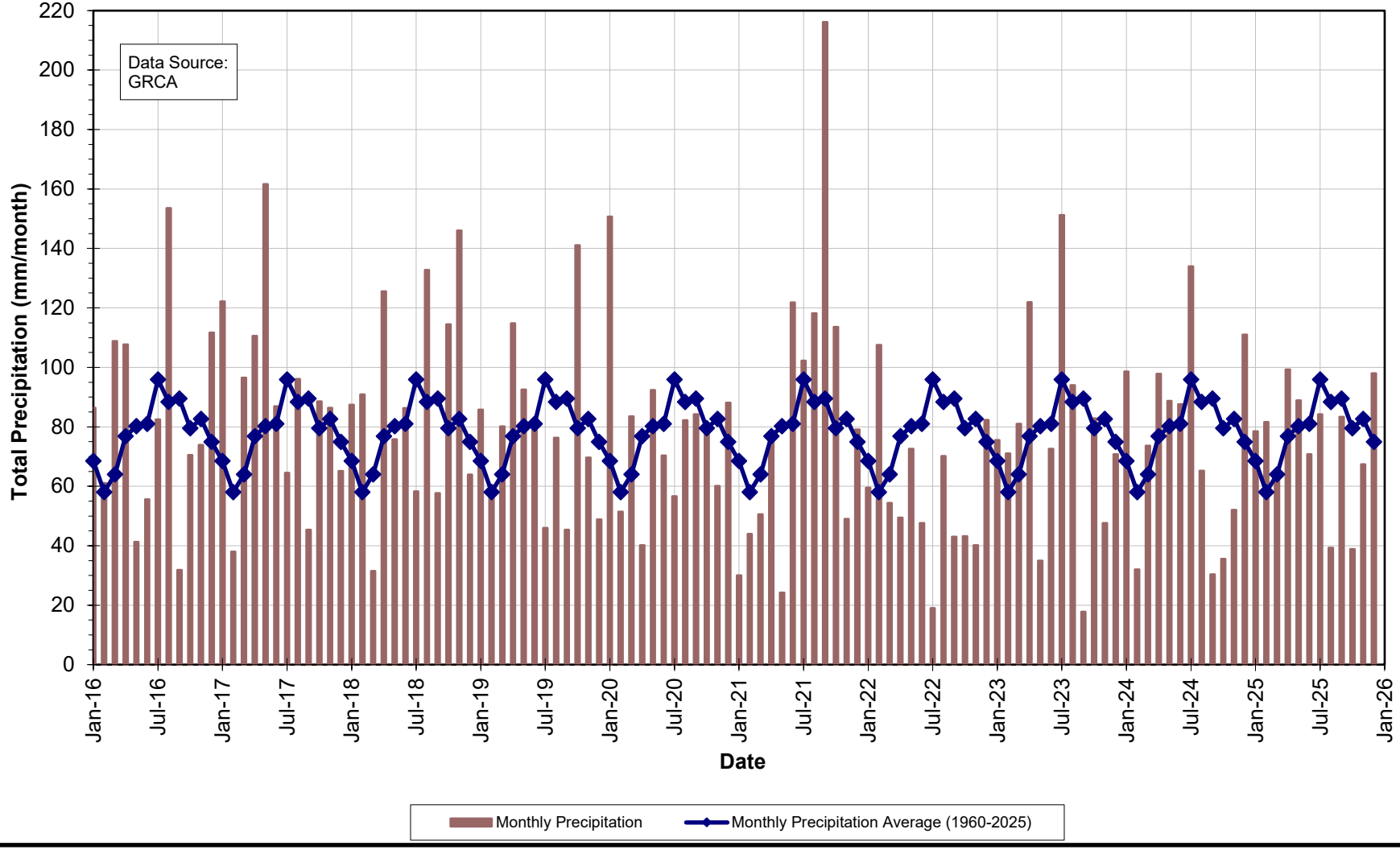
Year	Laurel Dam Established 1960		
	Annual Precipitation (mm)	Average Precipitation 1960-2025 (mm)	Difference (mm)
2016	985	938	**47**
2017	1062	938	**124**
2018	1071	938	**133**
2019	940	938	**2**
2020	938	938	**0**
2021	1027	938	**89**
2022	689	938	**-249**
2023	921	938	**-17**
2024	907	938	**-31**
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.

Figure D.1
Laurel Creek Dam
Monthly Precipitation



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Prepared By: C.D.
Printed On: 2/13/2026
File: Appendix D Precipitation Data/Monthly Laurel Creek

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

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

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

- 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.

R.J. Burnside & Associates Limited