2025 Biennial Groundwater Monitoring Report – St. Clements Well Field (SC2, SC3, SC4)

The Region of Waterloo

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The Region of Waterloo

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R.J. Burnside & Associates Limited

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June 26, 2026
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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 P-300-5118893858) for the St. Clements Well Field 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 conditions of the PTTW for 2024 and 2025. A copy of the PTTW is included in Appendix A.

The location of the St. Clements Well Field (SC2, SC3 and SC4) is shown in Figure 1 and the production wells are shown in Figure 2 with the monitoring network 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 and 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 St. Clements Well Field in accordance with PTTW P-300-5118893858 which consists of the following activities:

- Measuring the daily volume pumped from the SC2, SC3 and SC4 production wells (Condition 4.1 of the PTTW)
- Measuring the water levels in monitoring wells WY-SC-OW01-09-A and WY-SC-OW1-12-ABC (Condition 4.2 of the PTTW)
- Review of precipitation data from the nearest GRCA / Environment Canada weather station (Condition 4.3 of the PTTW)
- Completion of a biennial report (every two 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 St. Clements Well Field is located in the eastern portion of Wellesley Township. Wells SC2, SC3 and SC4 are located on Expo Drive which is in a subdivision northwest of the intersection of Lobsinger Line and Hergott Road. The closest municipal well field is the Heidelberg Well Field, located about 3 km to the east. The Linwood Well Field is also located about 8 km to the northwest and Wellesley located about 11 km to the southwest (Figure 2). The closest surface water feature to the SC2, SC3 and SC4 site is a tributary to Boomer Creek located 350 m to the northwest. Boomer Creek discharges into the Conestogo River near Hawksville. A small watercourse called Martin Creek (GRCA) flows generally east/west approximately 900 m south of the Well Field (Figure 3).

2.1.1 Pumping Wells

Well records for the production wells are found in Appendix B. Production well SC2 was drilled in 1981 to a depth of 20.1 metres below ground surface (mbgs) and screened in the Aquifer 1 (AFB1).

Production well SC3 was constructed in 1995 to a depth of 18.9 mbgs and also completed in Aquifer 1 (AFB1).

Production well SC4 was constructed in 2012 adjacent to SC2 and SC3 (Stantec, 2013), and is screened deeper (36.6 mbgs) in the production aquifer (AFB1 / AFB2).

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)	Screen Diameter (mm)	Screen interval (mbgs)	Aquifer
SC2	1981	203	203	16.8-20.1	AFB1
SC3	1995	254	254	15.8-18.9	AFB1

Well Name	Year Built	Casing Diameter (mm)	Screen Diameter (mm)	Screen interval (mbgs)	Aquifer
SC4	2012	219	191	30.5-36.6	AFB1

The water taking volumes for the St. Clements 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)
SC2	1,771*	109	524	39,786	147	855	53,765
SC3	1,771*	48	480	17,394	103	652	37,460
SC4	1,771*	101	519	36,778	154	584	56,267
Combined	1,771*	257	524[1]	93,958	404	855[2]	147,492

Note: *the Max Taken per Day of 1,771 m^3/day is based on a combined Max taken per minute of 1,230 (L)
[1] Daily maximum water taking in 2024 of 524 m^3 was recorded on December 21
[2] Daily maximum water taking in 2025 of 855 m^3 was recorded on August 11

Production wells 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. Pumping volumes from the well field ranged from 5,943 m^3/month to 12,144 m^3/month in 2024, and from 9,876 m^3/month to 15,598 m^3/month in 2025. In total, 93,958 m^3 was produced at this well field in 2024 and 147,492 m^3 was produced in 2025. These volumes are within the historical range and below the permitted volume of 646,488 m^3 per year (Table C-1).

As of late 2024, the Heidelberg water supply system was modified so that the St. Clements Well Field supplies potable water to Heidelberg via a dedicated watermain connection.

2.1.2 Monitoring Wells

The Region updated their well naming protocol and as a result, the well names in EQuIS may vary from the names listed on the PTTW. The well names on the PTTW are shown below along with the updated name that is used by the Region. The updated Region names will be used throughout this report.

Table 3: Well Nomenclature

Monitoring well names as they appear on the PTTW	Revised well names consistent with Region nomenclature
WY-SC-OW01-09	WY-SC-OW01-09-A
WY-SC-OW1A-12	WY-SC-OW1-12-A
WY-SC-OW1B-12	WY-SC-OW1-12-B
WY-SC-OW1C-12	WY-SC-OW1-12-C

WY-SC-OW1-12-ABC is a multi-level overburden well located adjacent to wells SC2, SC3 and SC4 while WY-SC-OW01-09-A is an overburden well located approximatley 340 m to the northwest of the production well site (Figure 3).

Construction and monitoring details of WY-SC-OW01-09-A and WY-SC-OW1-12-ABC are described in the table below. Well records for the monitoring wells are provided in Appendix B.

Table 4: Monitoring Well Construction Details

Monitoring Well ID	Year Built	Screened Depth (mbgs)	Screened Formation	Distance to SC2 (m)	Distance to SC3 (m)	Distance to SC4 (m)
WY-SC-OW01-09-A	2009	16.7-19.8	AFB1	329	344	339
WY-SC-OW1-12-A	2012	65.5-68.6	AFD1/AFF1	17.6	5.7	5.5
WY-SC-OW1-12-B	2012	32.9-36.0	AFB1	17.6	5.7	5.5
WY-SC-OW1-12-C	2012	10.7-13.7	AFB1	17.6	5.7	5.5

2.2 Regional Geology and Hydrostratigraphy

The following sections provide a brief overview of the regional geology and hydrogeology of the St. Clements Well Field. The surficial geology based on regional OGS mapping is provided in Figure 4. The St. Clements Well Field is located in the core of the Waterloo Moraine (Figure 5). Representative cross-sections showing the stratigraphy in the vicinity of the St. Clements Well Field are included as Figure 6 and Figure 7. The cross-section locations are provided in Figure 3. The recently completed Tier Three Assessment Update Project (Aqua Insight et al, 2023) has revised the

previous (Matrix 2015) stratigraphic interpretation of the lithology around the St. Clements Wellfield. The lithological layers were updated in accordance with documentation provided in the Numerical Model Surface Transfer memorandum (Aqua Insight Inc, 2026).

Aqua Insight Inc. and S.S. Papadopulos & Associates, Inc. (2024) indicated that St. Clements well SC4 was drilled and tested during the same period as the earlier Tier Three Study and, as a result, was not incorporated into the original groundwater flow model. The hydrostratigraphic and hydrogeologic data collected from SC4 and associated observation wells led to a revised understanding of local conditions, prompting updates to the aquifer characterization in the St. Clements Well Field. These revisions improved representation of the Upper Waterloo Moraine Sands Aquifer (AFB1).

The St. Clements production wells are completed within the shallow, unconfined AFB1 unit. Available well logs indicate that fine-grained materials are largely absent above the production zone. Among the wells, SC4 contains the deepest screened interval, extending from approximately 335.5 to 341.6 m asl.

To better reflect these findings, the AFB1 unit was locally thickened to include SC4, and both the upper and lower aquifer boundaries were smoothed south of the well field to improve continuity. The Lower Waterloo Moraine Sand Aquifer (AFB3) was also adjusted, with smoothing and improved continuity applied eastward toward Heidelberg.

The upper surface of ATC1, AFC1 and ATC2 was smoothed which resulted in overlying AFB3 becoming thinner and more laterally extensive. In addition, the upper surface of the bedrock was smoothed out.

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 St. Clements Well Field is characterized primarily by silty to sandy till sediments and ice contact sand and gravel (Figure 4). In addition, the deposition of the Waterloo Moraine in this area resulted in fine to coarse-grained sand and gravel deposits at surface.

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

Aquitard ATA1 – Whittlesey Clay

This silt and clay unit is present at surface across the section and corresponds to glaciolacustrine Whittlesey clay (Bajc and Shirota, 2007). This unit forms a laterally extensive, low-permeability aquitard that restricts infiltration and provides partial confinement to the underlying aquifer.

Aquifer AFA1 - Whittlesey Sand

This very fine to coarse sand unit is interpreted as glaciolacustrine Whittlesey sand (Bajc and Shirota, 2007) and is encountered immediately below ATA1 across the section. AFA1 is continuous aquifer that facilitates groundwater flow within the upper overburden sequence.

Aquitard ATB1 – Tavistock Till and Mornington Till

In various areas of the Region, Bajc and Shirota (2007) have used unit ATB1 to represent the Port Stanley, Tavistock, Mornington and Upper Maryhill Tills.

The Tavistock Till is a clayey silt till, with occasional stony texture, whereas the Mornington Till is a sandy silt to silty sand till, with occasional stony texture. These units are predominantly found along the flanks of the Waterloo Moraine. These units are considered an aquitard and, where present, act to restrict recharge to the lower aquifers. Surficial geology mapping indicates that ATB1 is not present near the St. Clements Well Field but is found to the south and west ATB1 (Figure 4).

Aquifer AFB1 – Upper Waterloo Moraine Stratified Sediments and Equivalents

Aquifer AFB1 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, 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. AFB1 is present at surface within the St. Clements Well Field (Figure 4), to an average depth of 39 m.

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 re-worked and re-deposited as glaciofluvial sediments.

Aquifer AFB3 – Lower Waterloo Moraine Stratified Sediments

The Lower Waterloo Moraine Stratified Sediments is present below the Lower Maryhill Till, mainly along the eastern flank of the Moraine. This unit consists of stratified gravels, sands, or silts and is of very limited extent but is present in the St. Clements well field.

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.

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 / ATG1 – 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 and Conceptual Hydrostratigraphy

The Paleozoic bedrock in the area consists of the Salina which consists of interbedded grey and brown dolostone, green to red shale units, and gypsum. Groundwater extracted from this unit tends to be of poor quality due to the presence of sulphates (Johnston et al., 1992).

2.3 Local Geology

The following description of local geology is based on lithological descriptions in the well records for SC4 and monitoring well WY-SC-OW1-12-ABC (Stantec, 2013). Borehole logs are included in Appendix B.

Aquifer AFB1 – Upper Waterloo Moraine Stratified Sediments and Equivalents: This unit was identified at ground surface at all the well locations. AFB1 is 39 m thick at SC4 and 38 m thick at WY-SC-OW1-12-ABC.

Aquitard ATB3 – Lower Maryhill Till: This unit was identified underlying AFB1 at SC4 and WY-SC-OW1-12-ABC. It was 4 m thick at SC4 and 5 m thick at WY-SC-OW1-12-ABC.

AFB3 – Lower Waterloo Moraine Stratified Sediments: This unit was absent at SC4 and WY-SC-OW1-12-ABC.

Aquitard ATC1 / ATC2 – Catfish Creek Till: This unit was identified in SC4 and WY-SC-OW1-12-ABC with a thickness of 15 m and 17 m respectively.

Aquifer AFD1 – Pre-Catfish Creek Sand and Gravel: This unit was absent at SC4 and WY-SC-OW1-12-ABC.

ATE1– Canning Drift: This unit was 2 m thick at SC4 and 3 m thick at WY-SC-OW1-12-ABC.

Aquifer AFF1 / ATG1 – Pre-Canning Till: AFF1 was encountered at 59 mbgs at SC4 and 62 mbgs at SC-OW1-12-ABC. AFF1 was 14 m thick at SC-OW1-12-ABC. WY-SC-TW1-12 (which became SC4) (Appendix B) was driled partway through AFF1 but did not reach the bottom so its total thickness is not known.

Bedrock: The grey and brown bedrock of the Salina formation was encountered at 76.2 m bgs at WY-SC-OW1-12-ABC.

3.0 2024 / 2025 Results

In accordance with conditions 4.2 of the PTTW, water levels were measured in monitoring wells WY-SC-OW1-12-ABC and WY-SC-OW01-09-A.

The following sections summarize groundwater levels in the 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 and Environment Canada station located closest to the production wells are used. The closest GRCA weather station to the St. Clements well field is the Laurel Dam station located 8.5 km to the southeast. The closest Environment Canada station is the Waterloo International Airport (WIA) located 23 km to the southeast. The locations of the meteorological stations are shown in Figure 1.

Annual precipitation data from the past ten years for all stations are compared with long term averages in Table D.1, Appendix D. At Laurel Dam, the long-term average was calculated from when measurements started until the end of 2025. The WIA have "Climate Normals" calculated by Environment Canada for 1991 to 2020.

Annual 2024 / 2025 precipitation data for all the meteorological stations closest to the St. Clements well field are presented in Table 5 below. WIA was missing six days of data in 2024 and six days in 2025. As a result, the precipitation totals at this station may be under reported.

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
Laurel Dam (2)	907	-31	938[B]	894	-44

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 2024 total precipitation at Laurel Dam station was 907 mm, which is 31 mm below the long-term average. In contrast, 2024 precipitation was above the Normal at the WIA station. The March 1 GRCA snow survey indicated a snowpack across the Region that was low compared to normal. In 2025, the total precipitation was 894 mm, which is 44 mm below the long-term average. The 2025 total precipitation at the WIA station was 128 mm below the Normal, 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 ten 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.

WY-SC-OW1-09-A

Well WY-SC-OW01-09-A is located about 340 m northwest from the production wells with monitoring started in 2009. WY-SC-OW01-09-A is screened within the Upper Waterloo Moraine stratified sediments and equivalents (AFB1). Water level monitoring was completed using an electronic data logger. WY-SC-OW01-09-A had no measurable drawdown during testing of SC4 at 45 L/s (Stantec, 2013)

Water levels at this well reflect seasonal trends and do not appear to be influenced by pumping. Water levels observed in 2024 / 2025 were consistent with historical values.

WY-SC-OW1-12-ABC

Well cluster WY-SC-OW1-12-ABC is located adjacent to the production wells. Monthly manual water levels have been obtained from these wells since January 2013.

The A screen monitors the Pre-Catfish Creek (AFD1) and Pre-Canning till (AFF1), which is separated from the production well aquifer by the Catfish Creek Till, and the Lower Maryhill Till aquitard units (Section 2.3). The A screen had no measurable drawdown during testing of SC4 at 45 L/s (Stantec, 2013).

The B (AFB1) and C (AFB1) screens are completed in the upper Waterloo Moraine Stratified Sediments and Equivalents unit. The B screen had 1.03 m of drawdown

during testing of SC4 at 45 L/s while the C screen had 0.49 m of drawdown (Stantec, 2013).

Historically the water levels in all three screens have followed a similar seasonal pattern with no apparent response to pumping. In 2024 / 2025, the B and C screens have similar water levels. The summer decline was noticeably steeper in 2024 and 2025 in the A-screen, with water levels dropping to elevations lower than those observed in the preceding years. Water levels typically show a moderate seasonal recession; however, both 2024 and 2025 display sharper and more sustained summer drawdowns. As indicated above, there was no response to pumping seen in the A screen during long term testing of SC4 (Stantec, 2013) and WY-SC-OW1-12-A screened in the AFF1 aquifer, located approximately 40 below the production aquifer (AFB1).

Deeper water level declines at WY-SC-OW1-12-A in May 2024 do not correspond in timing with periods of increased groundwater production; however, the lowest levels in August 2025 do occur during peak monthly pumping. Similar monthly pumping of only SC3 in February 2020 did not result in any response in the A screen.

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 within 500 m of the St. Clements Well Field that are not serviced with municipal water supply. There are no other PTTWs within 2 km of the wellfield.

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 SC2, SC3 and SC4 received in 2024 and 2025.

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 commencing June 30, 2020, that presents the results of the well field water level monitoring for the two preceding calendar years, assesses changes in water levels in the supply aquifer(s) in relation to precipitation and water taking from the aquifer(s)".

Water levels in the deeper aquifer, AFF1, have historically followed seasonal trends, as shown in the hydrograph for WY-SC-OW1-12-A. This is to be expected due to the presence of approximately 40 m of fine-grained sediments separating AFF1 from the production aquifer (AFB1). However, water levels in 2024 / 2025 are lower than typically seen during a period when combined pumping of the three production wells was increased. Currently water levels are measured monthly which does not allow for the correlation of water levels with changes in pumping. Equipping the well with an automatic water level recorder would assist in assessing water level responses to changes in pumping.

There was no measurable water level response in the aquifer AFB1 during routine well field operations, as shown in the hydrographs for WY-SC-OW01-09-A, WY-SC-OW1-12-B and WY-SC-OW1-12-C. The 2024 / 2025 precipitation data from the nearest weather station did not correlate with any specific water level response.

5.0 Conclusions

Impacts from pumping the municipal wells at the St. Clements Well Field are 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-300-5118893858;
- 2024 and 2025 pumping volumes were within the permitted range;
- There were no reported well interference complaints arising from water taking at the St. Clements well field;
- Water levels in AFB1/AFB2 do not show a measurable response to pumping of the St. Clements wells;
- Water levels in AFB1/AFB2 and AFF1 follow seasonal trends, and
- An automatic water level recorder should be installed in WY-SC-OW1-12-A.

6.0 References

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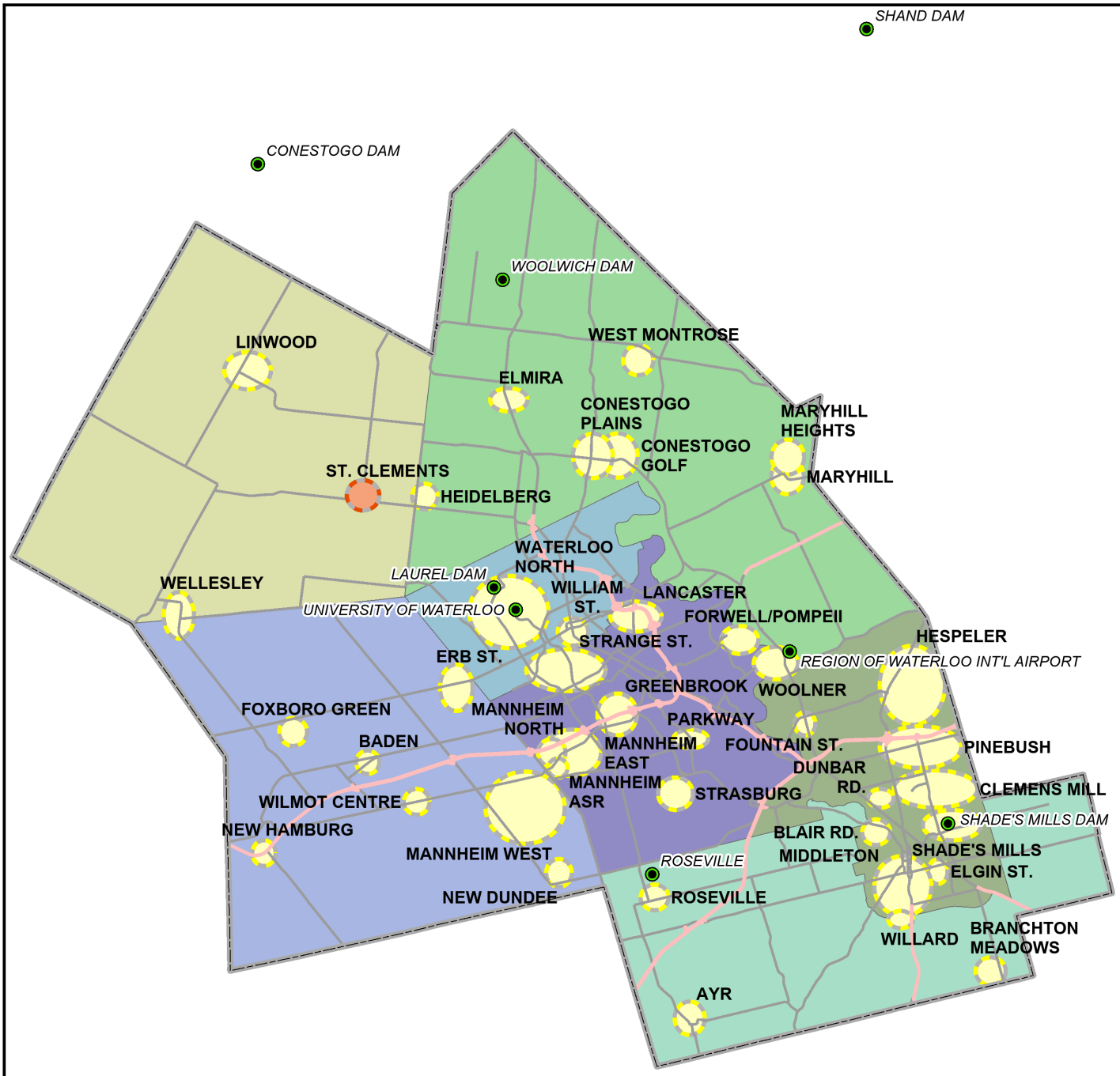
BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Figures



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0 5 10 15 20
Kilometers

- Well Field Location
- Well Fields
- Regional Municipal Boundaries
- City of Cambridge
- City of Kitchener
- City of Waterloo
- Township of North Dumfries
- Township of Wellesley
- Township of Wilmot
- Township of Woolwich
- Meteorological Monitoring Locations

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Map Title

2025 GROUNDWATER MONITORING REPORT - ST. CLEMENTS WELL FIELD

WELL FIELD LOCATION MAP

Client

REGION OF WATERLOO

Drawn	Checked	Date	Figure No.
HN	SQ	February 2026	1
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CONESTOGO DAM

WELLINGTON COUNTY

WELLINGTON COUNTY

WOOLWICH DAM

LINWOOD

L1A

L2

PERTH COUNTY

WOOLWICH

Elmira

WELLESLEY

ST. CLEMENTS

SC2

SC3

SC4

Heidelberg

WELLESLEY

WY6

WY1

WY5

WILMOT

LAUREL DAM

UNIVERSITY OF WATERLOO

Waterloo North

WATERLOO

William St.

Strange St.

KITCHENER

LEGEND

- Production Well Location
- Monitoring Well Location
- Wellesley 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.

Datum: North American 1983 CSRS

Coord. System: NAD 1983 CSRS UTM Zone 17N

N

0 1 2 3 4 5 6 7 8

Kilometers

BURNSIDE

Client

REGION OF WATERLOO

Figure Title

2025 GROUNDWATER MONITORING REPORT - ST. CLEMENTS WELL FIELD

WELLESLEY WELL FIELDS AND MONITORING NETWORK

Drawn	Checked	Date	Figure No.
HN	SQ	March 2026	2
Scale		Project No.	
1:100,000		HA0464020	

File Path: \\elmo\gis\Project\H Jobs\HA 04 6402 (Waterloo)\Reporting\Groundwater Level Monitoring Program\2025 Groundwater Report Figures\St. Clements\Pro\St\St.aprx Print Date: 2026/03/14 Time: 12:09 PM

N

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

Metres

PTTW Monitoring Well Location
Cross Section Orientation
Intermittent Creek
Creek
Provincially Significant Wetland (MNR)
Regional Road
Local Road

BURNSIDE

Map Title

2025 GROUNDWATER MONITORING REPORT - ST. CLEMENTS WELL FIELD

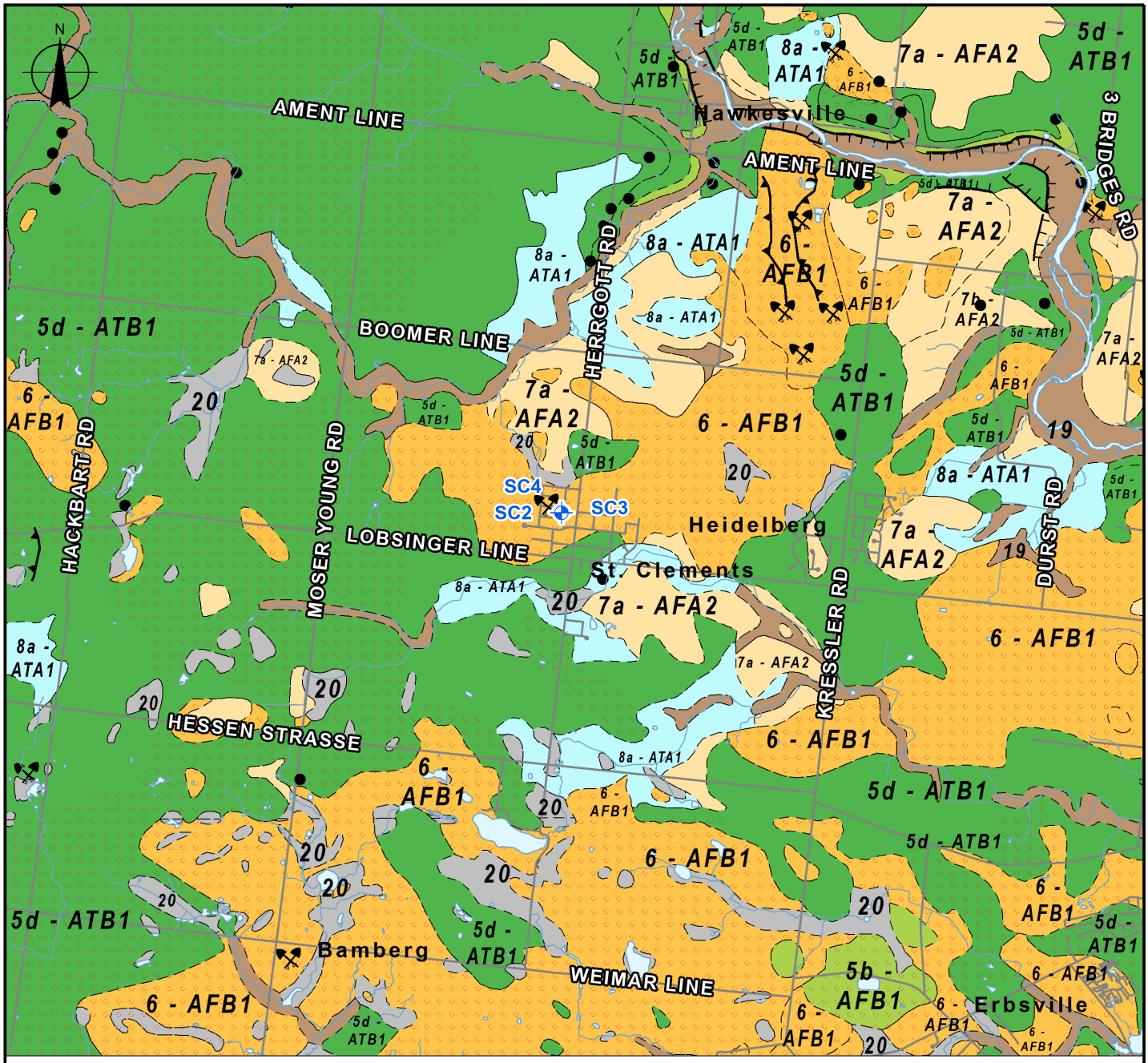
WELL LOCATION MAP

Client

REGION OF WATERLOO

Drawn	Checked	Date	Figure No.
HN	SQ	March 2026	3
Scale		Project No.	
1:17,500		HA0464020	

File Path: \\elmo\gis\Project\H Jobs\HA 04 6402 (Waterloo)\Reporting\Groundwater Level Monitoring Program\2025 Groundwater Report Figures\St. Clements\Pro\StSt.aprx Print Date: 2026/03/14 Time: 12:24 PM



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

0 1,000 2,000 3,000 4,000 5,000
Meters

- RMOW Supply Well
- Watercourse
- Waterbody

Surficial Geology

- 5b: Stone-poor, carbonate-derived silty to sandy till (ATA2/ATB1 - Aquitard)
- 5d: Glaciolacustrine-derived silty to clayey till (ATB1 - Aquitard)
- 6: Ice-contact stratified deposits (AFB1 - Aquifer)
- 7a: Glaciofluvial deposits: Sandy deposits (AFA2 - Aquifer)
- 7b: Glaciofluvial deposits: Gravelly deposits (AFA2 - Aquifer)
- 8a: Fine-textured glaciolacustrine deposits: Massive-well laminated (ATA1)
- 19: Modern alluvial deposits
- 20: Organic deposits
- Sand and Gravel Pit
- Esker: Direction of Flow Known
- Ice-Contact Slope
- Terrace
- Sample Location
- Hummocky Topography
- Unit Contact Boundary

BURNSIDE

Map Title

2025 GROUNDWATER MONITORING REPORT - ST. CLEMENTS WELL FIELD

SURFICIAL GEOLOGY

Client

REGION OF WATERLOO

Drawn	Checked	Date	Figure No.
HN	SQ	February 2026	4
Scale		Project No.	
1:60,000		HA0464020	

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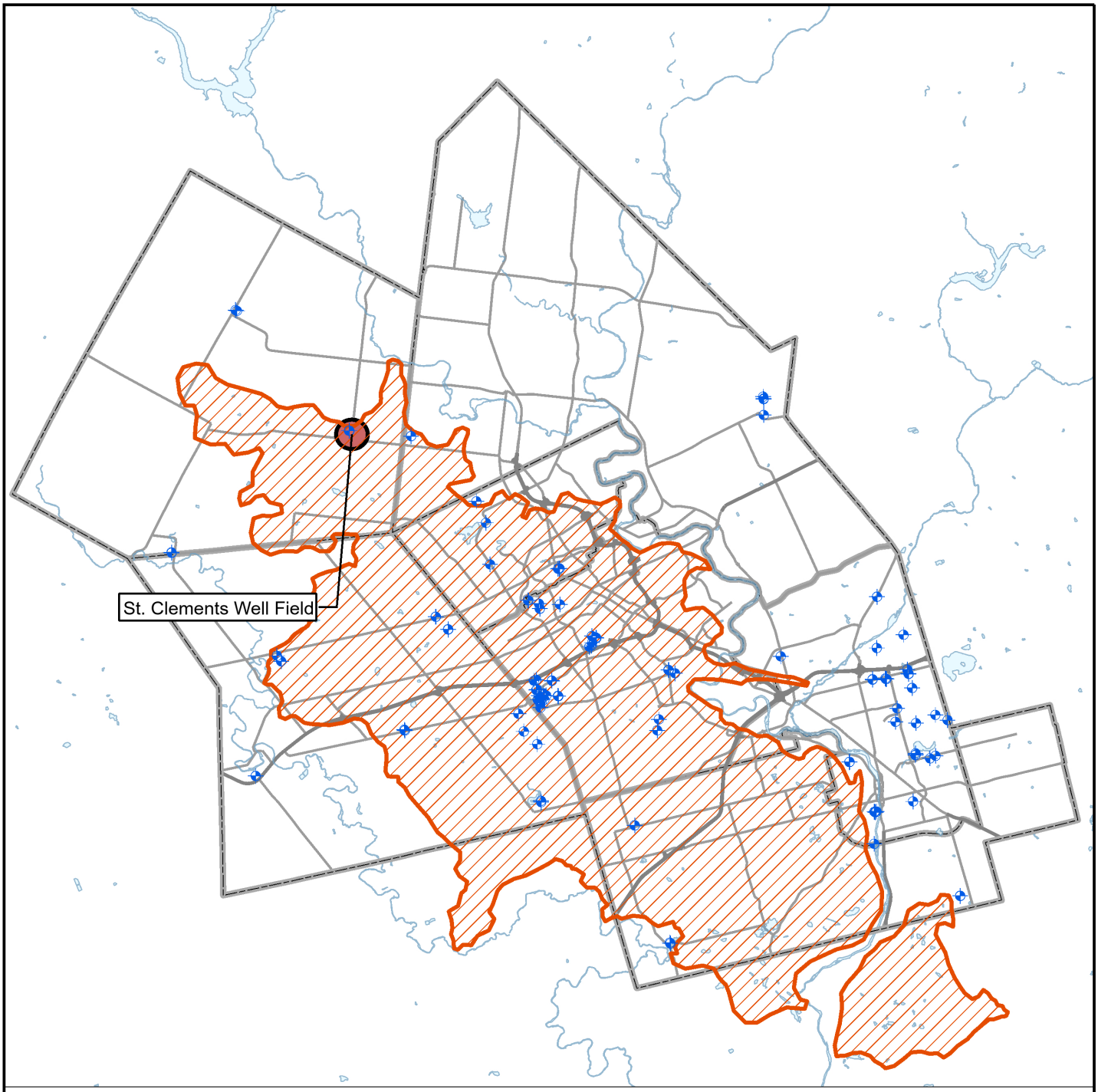


N

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)
St. Clements Well Field
Waterbody
Regional Municipal Boundaries

BURNSIDE

Map Title

2025 GROUNDWATER MONITORING REPORT - ST. CLEMENTS WELL FIELD

LOCATION OF THE WATERLOO MORAINE

Client

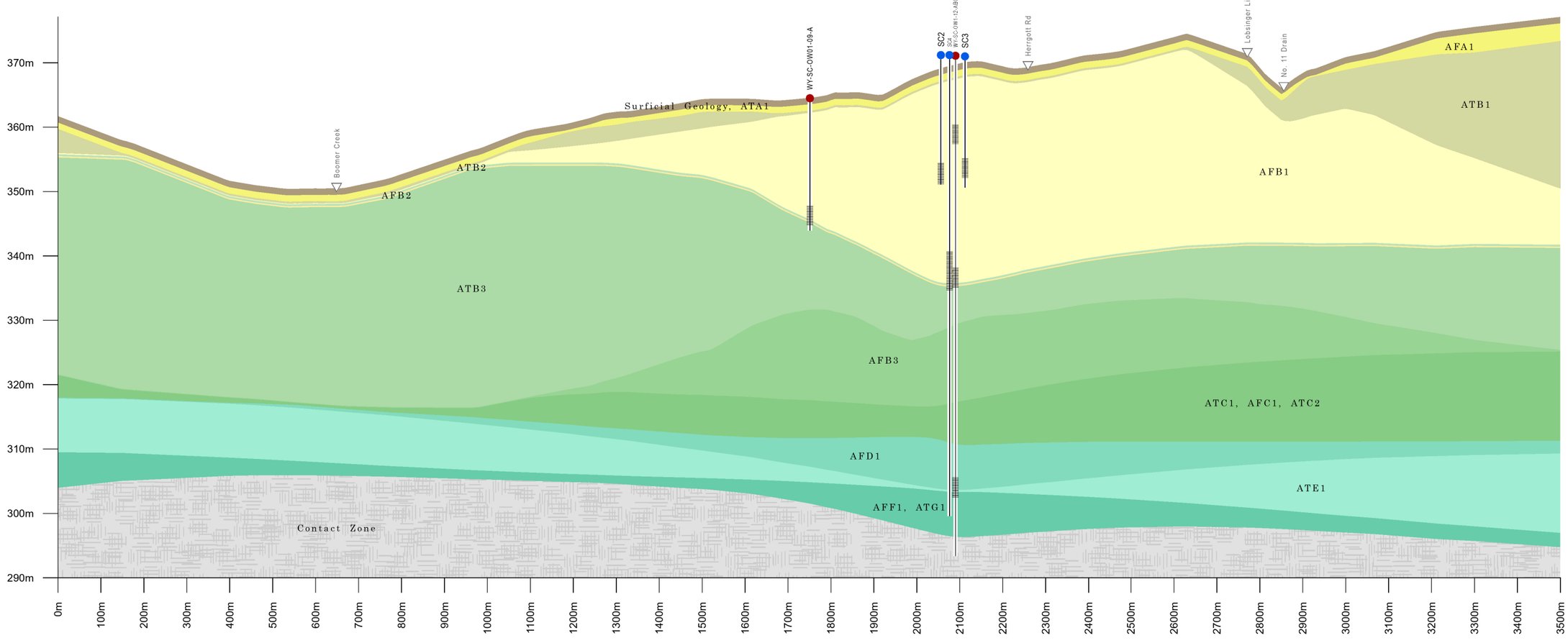
REGION OF WATERLOO

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

File Path: \\elmo\gis\Project\H Jobs\HA 04 6402 (Waterloo)\Reporting\Groundwater Level Monitoring Program\2025 Groundwater Report Figures\St. Clements\Pro\StSt.aprx Print Date: 2026/03/14 Time: 12:27 PM

A

A'



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)
- 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

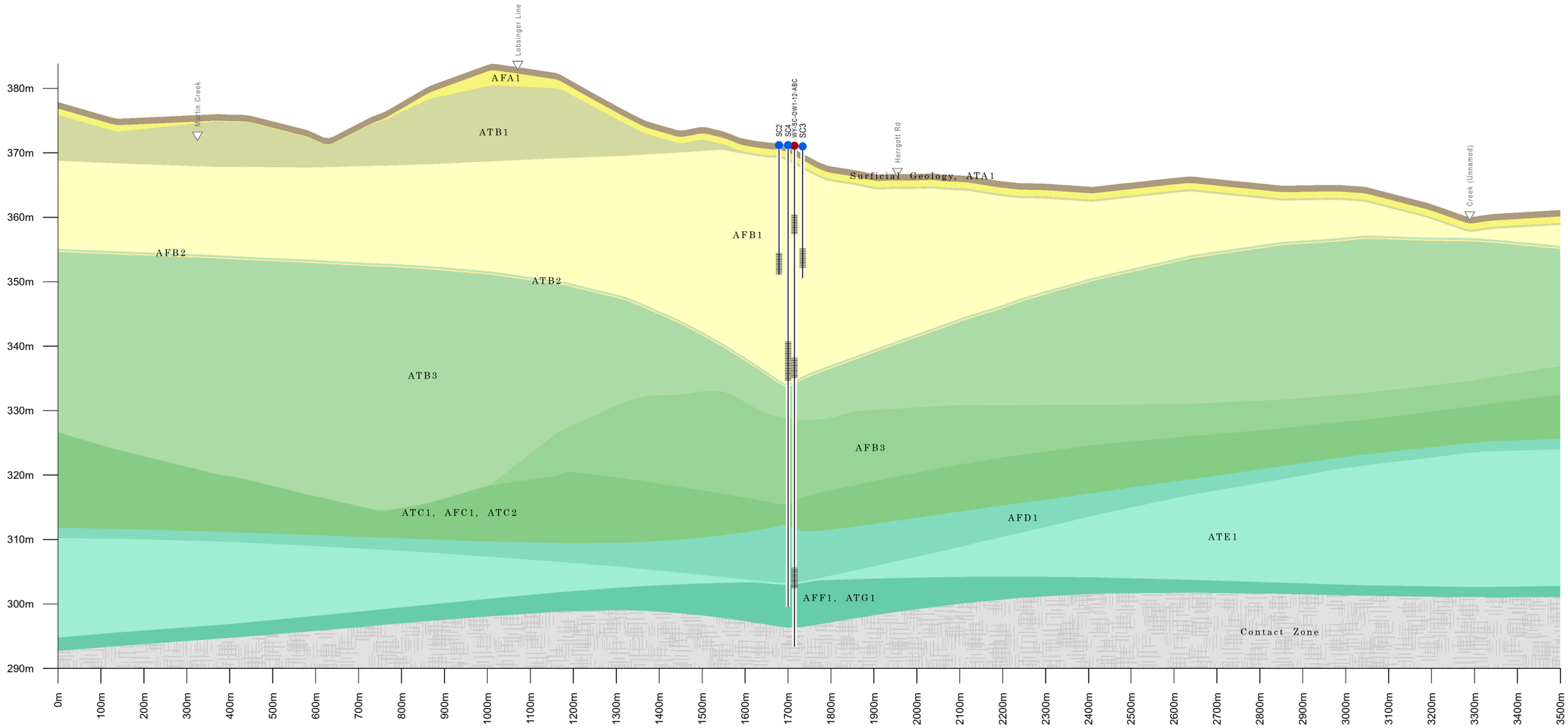
St Clements
Cross Section A - A'

Drawn	Checked	Date	Figure No.
PS	DH	2026/05/28	6
Horizontal Scale 1:10,000		Project No.	
Vertical Ex.:15x		HA046402	

File Path: F:\GIS Working\Projects\ROW_Cross_Sections\ROW_Cross_Sections.aprx Print Date: 2026/05/28 Time: 02:01 PM

B

B'



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)
- 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

St Clements
Cross Section B - B'

Drawn	Checked	Date	Figure No.
PS	DH	2026/05/28	7
Horizontal Scale 1:10,000		Project No.	
Vertical Ex.:15x		HA046402	

File Path: F:\GIS Working\Projects\ROW_Cross_Sections\ROW_Cross_Sections.aprx Print Date: 2026/05/28 Time: 12:01 PM

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix A

Permit To Take Water

PERMIT TO TAKE WATER
Ground Water
NUMBER P-300-5118893858
Version: 1.0
Effective Date: June 15, 2021
Expiry Date: May 31, 2031

Pursuant to Section 34.1 of the Ontario Water Resources Act, 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

SC2

SC4

SC3

Located at:

14 EXPO Drive , ST CLEMENTS, WELLESLEY, ONTARIO,
CANADA, N0B 2M0

This Permit cancels and replaces Permit Number 0152-998JPE, issued on July 15, 2013.

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-300-5118893858 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 Karl Belan, on February 25, 2021, 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, 2031. 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	Max. Taken per minute	Max. No. of Hrs Taken per day	Max. volume per Day	Max. days in a year	Zone / Easting / Northing
1	SC2 (SC2)	Well	Public administration	Municipal Supply	Water Supply	1230	24	1771200	365	17 / 527999 / 4819425
2	SC3 (SC3)	Well	Public administration	Municipal Supply	Water Supply	1230	24	1771200	365	17 / 528026 / 4819420
3	SC4 (SC4)	Well	Public administration	Municipal Supply	Water Supply	1230	24	1771200	365	17 / 528015 / 4819419
Total Taking								**1771200**		

4. **Monitoring**

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

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

WY-SC-OW01-09
WY-SC-OW1A-12
WY-SC-OW1B-12
WY-SC-OW1C-12

4.3. The Permit Holder shall prepare and submit a report to the Director every two years by June 30 commencing June 30, 2023, 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, the Environmental Review Tribunal and the Minister of the Environment, Conservation and Parks, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Minister of the Environment, Conservation and Parks will place notice of your appeal on the Environmental Registry. Section 101 of the Ontario Water Resources Act, as amended, provides that the Notice requiring a hearing shall state:

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

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

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*	*Minister of the Environment, Conservation and Parks* *777 Bay Street, 5th Floor* *Toronto, ON* *M7A 2J3*	*AND*	*The Director, Section 34.1,* *Ministry of the Environment, Conservation and Parks* *135 St.Clair Avenue West, 1st Floor* *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 instrument is subject to Section 38 of the ***Environmental Bill of Rights*** *that allows residents of Ontario to seek leave to appeal the decision on this instrument. Residents of Ontario may seek to appeal for 15 days from the date this decision is placed on the Environmental Registry. By accessing the Environmental Registry, you can determine when the leave to appeal period ends.*

Dated at Toronto this 14th day of June, 2021

Gregory Meek

Director, Section 34.1

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

c: Karl Belan, Regional Municipality of Waterloo

SCHEDULE 1

This Schedule "A" forms part of Permit To Take Water P-300-5118893858 Version Number 1.0, dated June 14, 2021.

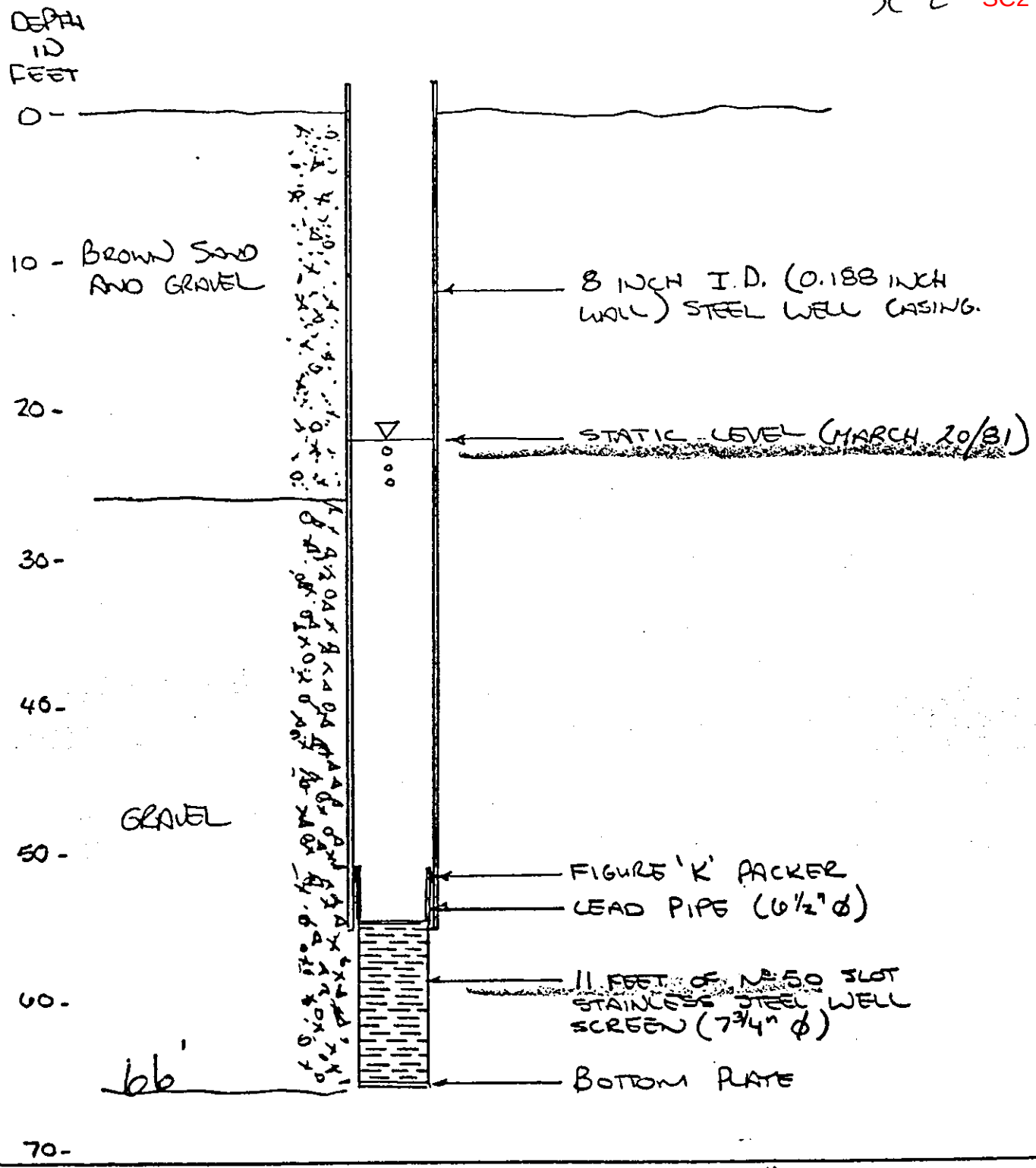
BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix B

Well Records

SC-2 SC2



-ST. CLEMENTS - WELL #2 VII-6011

VERTICAL SCALE: 1" = 10 FEET

DATE OF WELL CONSTRUCTION COMPLETION - MARCH 20, 1981.

PROJECT № 5-275

FIGURE 4

AS-CONSTRUCTED DETAILS.

PW2-81

SC2

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

County or District	Township, Borough, City, Town, Village	Con. or Block, Tract, Survey, etc.	Lot
Waterloo	Wellesley E.S.	Con. 8	3

Owner (Surname First)	Address	Date Completed
HERGOTT, Pat	St. Clements, Ontario.	20 Mar 81

LOG OF OVERBURDEN AND BEDROCK MATERIALS (See Instructions)

General Colour	Most Common Material	Other Materials	General Description	Depth - Feet From	Depth - Feet To
Brown	Sand	Gravel		0	26
	Gravel			26	66

WATER RECORD

Water Found at Feet	Kind of Water
54-66	Fresh

CASING & OPEN HOLE RECORD

Inside Diam.	Material	Wall Thickness	Depth - Feet From	Depth - Feet To
8	Steel	.188	0	55-2
6¼	Steel	.234	51	54-4

SCREEN

Make	Diameter	Length
#50	7-3/4	11
Material and Type: Stainless Steel Telescope	Setting	55

PLUGGING & SEALING RECORD

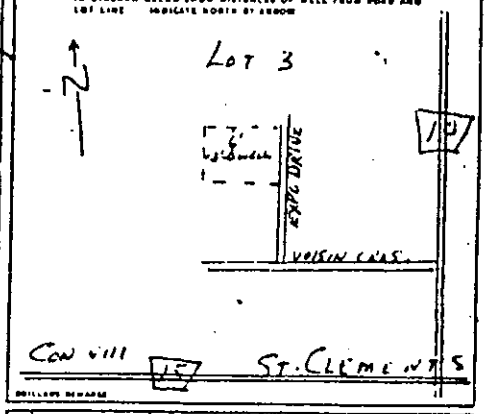
Depth Set at - Feet From	To	Material and Type	Amount

PUMPING TEST

Static Level	Water Level End of Pumping	Pumping Rate	Duration of Pumping
22 Feet		Pumping Test by others	

LOCATION OF WELL

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



Final Status of Well	Water Supply
Water Use	Public Supply
Method of Drilling	

CONTRACTOR

Name of Well Contractor	Well Contractor's Licence No.
Davidson Well Drilling Limited	1737

Address	Name of Driller or Borer	Licence No.
Box 486, Wingham, Ontario.	G. Reavie	

Signature of Contractor — Date: 2 Apr. 81

CONTRACTOR'S COPY

OFFICE USE ONLY

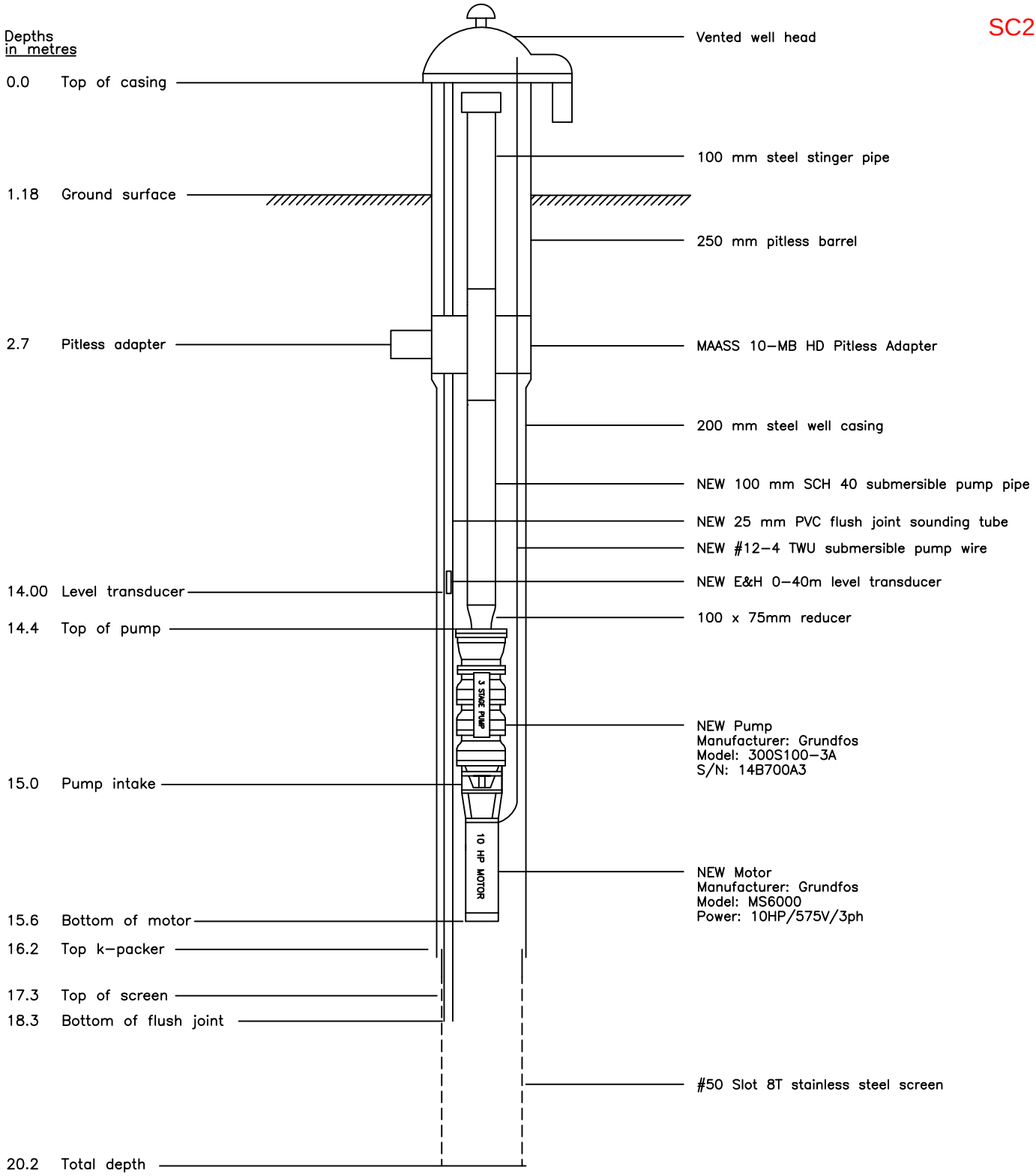
FORM 16

FIGURE 5

WATER WELL RECORD

PW 2-81

SC2



Lotowater TECHNICAL SERVICES INC.

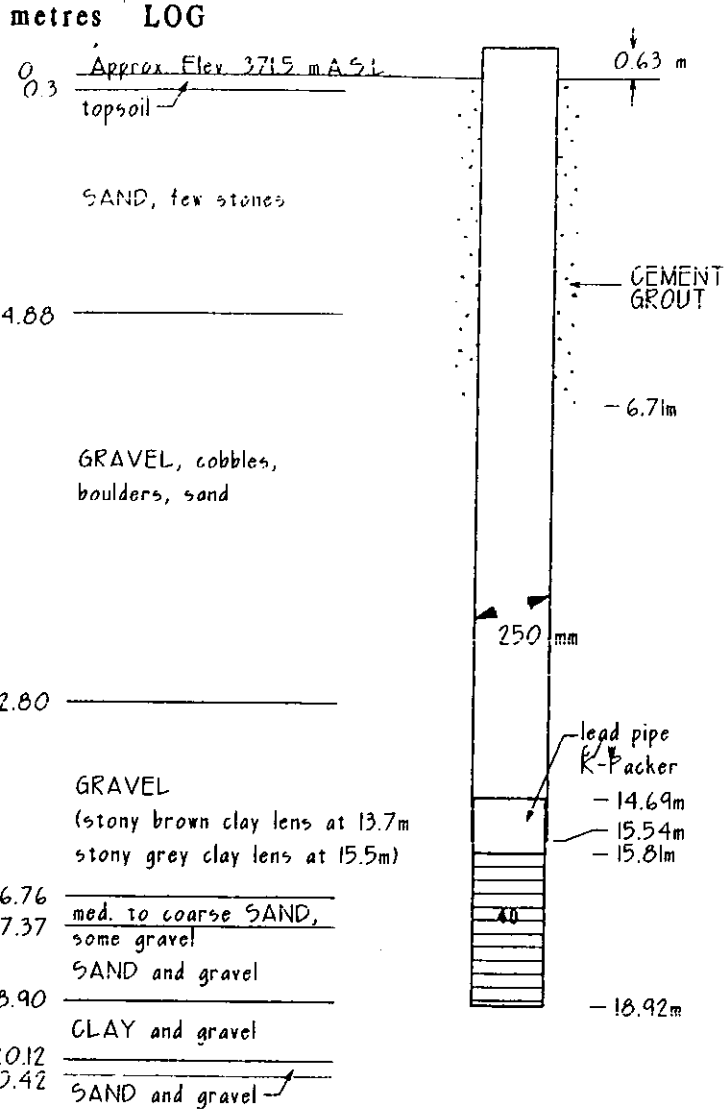
CLIENT
Regional Municipality of Waterloo

TITLE
Well SC2
Pump Installation Drawing

PROJECT No. **006-405**			G:\Lotowater Projects\006 Region of Waterloo\405 Well SC2 Service\Pump Install.dwg		FIGURE **3**
DESIGN			REVISION No. 2017-08-30	SCALE **N.T.S.**	
DRAWN	**EH**	**2017/08/11**			
CHECKED	**BP**	**2017/08/30**			

SC3

metres LOG



WELL MATERIAL

Outer Casing: 250 mm dia. 9.27 mm Wall Thk. Mat'l Steel
Cemented from 0.3 m to 6.71 m
Inner Casing: ____ mm dia. ____ mm Wall Thk. Mat'l ____
Screen: Make: Tate 240 mm dia. Opening & Mat'l: 40 slot SS
Plug: Type: Plate Mat'l SS Other ____
Gravel: Type: ____ Size: ____ Quantity: ____

AQUIFER TEST DATA

Date: Dec 21/95 By: A. Grimster
Static Level 6.56 m below M.P. 0.63 m A.G.L.
Pumping Rate L/s : 7.6, 15.1, 22.7
Pumping Duration: 3 hrs. 0 min.
Pumping Level at Test End: 8.05 m
Performance Plots: dd-t Dwg. ____
dd-r Dwg. ____
Step Test L95252

EQUIPPED WELL DATA

Date: ____ By: ____
Rated Well Capacity L/s ____
Pumping Rate L/s ____ Static Level ____ m
Pumping Level ____ m at ____ hrs. ____ min.
Pump Pressure: ____ kPa Main Pressure ____ kPa
Shut Off: AGH ____ kPa W.L. ____ m
Clear Well Depth from B.P ____ m Air Line ____ m

PUMP & MOTOR DATA

Pump Make: ____ Rating: ____ L/s @ ____ m T.H
Head: Type: ____ S.N. ____
Column: ____ m X ____ mm X ____ mm X ____ mm Shaft Mat'l ____
Bowl: ____ Stage: ____ Curve: ____
Suction: ____ mm dia. ____ m Long
Special: Zinc Sleeves ____ Taped Oil Line ____
Other ____
Motor Make: ____ Frame: ____ S.N. ____
____ kW ____ phase ____ hz ____ rpm ____ Volts
Bearing No. Upper ____
Lower ____

Special Equipment

WELL REVISIONS AND REHABILITATION

DATE	WORK DONE	BY

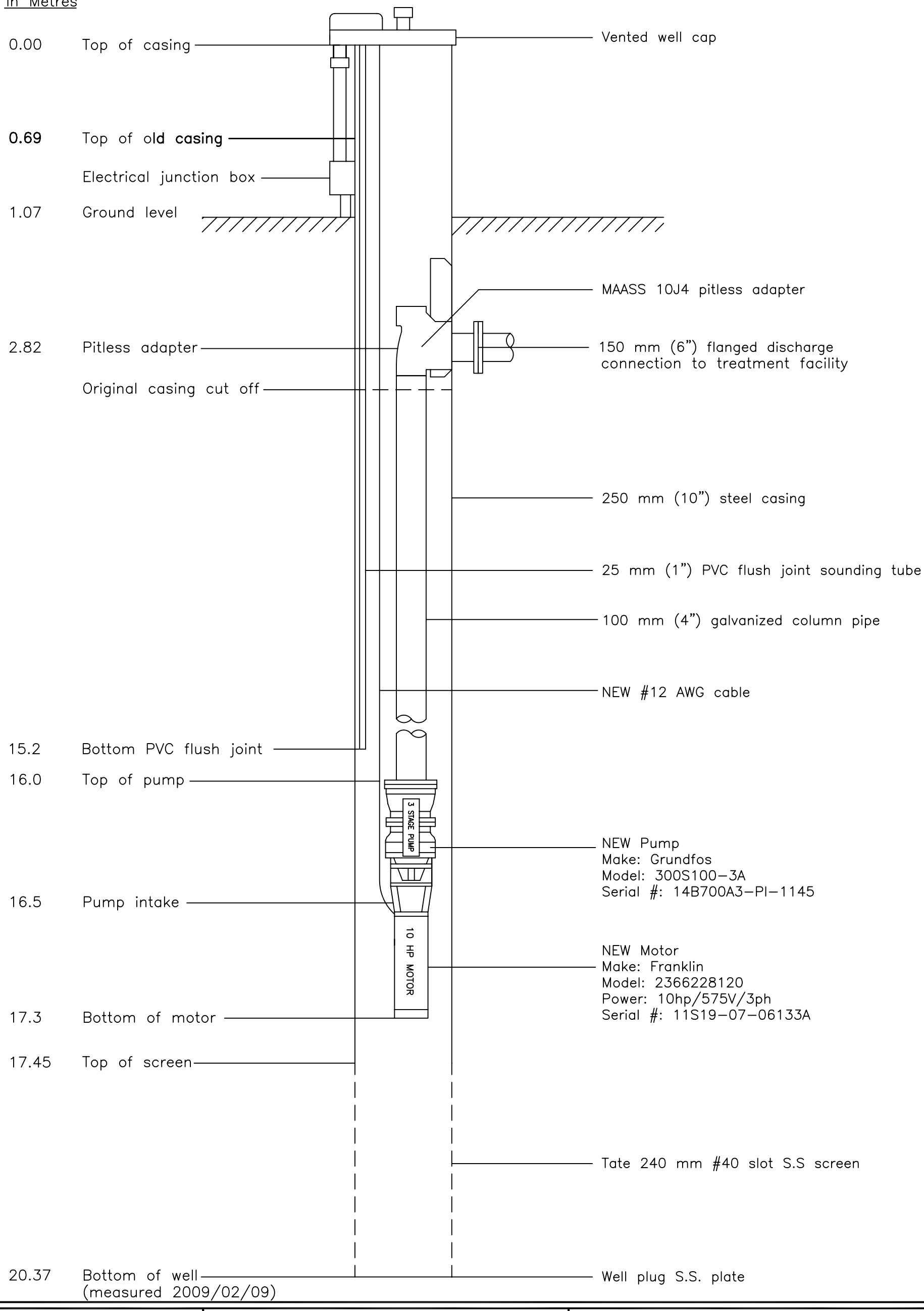
International Water Supply Ltd.

MONTREAL - BARRIE - SASKATOON

CLIENT: REGIONAL MUNICIPALITY OF WATERLOO
WELL No: ST. CLEMENTS 3

DRILLED BY: A. GRIMSTER	DATE: DEC/95	DRAWN: T. Brown	
INSTALLED BY:	DATE:	DATE: Jan. 12/95	

SC3



NOTES

(1) All measurements below new top of casing which is 1.07 m above grade as of 2009/03/27.

(2) Regions backup pump and motor for SC2 used here

(3) Static water level = 6.92 m below top of casing

(4) All existing components, unless otherwise specified.

Lotowater TECHNICAL SERVICES INC.

CLIENT: **Regional Municipality of Waterloo**

TITLE: **St. Clements Well 3 (SC-3) Pump Installation Details**

PROJECT No. 006-274			G:\Lotowater Projects\006 Region of Waterloo\274 SC3 Leak Repair\Pump installation drawing (SC-3)		
DESIGN			REVISION No. 1	SCALE N.T.S.	FIGURE 2
DRAWN	EH	2013/04/04			
CHECKED					

Test Well: WY-SC-TW1-12

SC4

Project: 2012 Construction and Testing of Municipal Wells
Client: Regional Municipality of Waterloo
Location: St. Clements Well Field
Number: 160900679

Field Investigator: E. Hayman
Contractor: Gerrits Well Drilling Inc.
Drilling method: DR24, truckmount, air rotary
Date started/completed: 06-May-2012 / 16-Jul-2012

Ground surface elevation: 372.10 m AMSL
Top of casing elevation: 372.63 m AMSL
Easting: 528015
Northing: 4819419

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS		GEOPHYSIC DETAILS	WELL DETAILS
Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Static Flow (L/min) 0.1 0.2 0.3 0.4	
		Ground Surface	372.63 372.10						Above Ground Casing Stick-Up = 0.53 m
0 – 0		SAND medium grained sand, trace gravel, light brown	0.00						
20 – 6			366.00 6.10						Neat Cement 0 to 22.9 m BGS
25 – 8		SAND and GRAVEL well graded, brown to greyish-brown, wet							
40 – 12									219 mm OD Steel Casing
45 – 14						N/A	N/A		
50 – 16									
60 – 18		coarse grained sand and gravel from 18.29 m BGS to 27.43 m BGS		AFB1/ AFB2	Aquifer 1 / Stratified Sediments				349 mm Diameter Borehole 0 to 36.6 m BGS
65 – 20									
70 – 22									
75 – 24									
80 – 24									
85 – 26									Bentonite Chips 22.9 to 28.9 m BGS
90 – 28		medium to coarse, little fine grained sand, fine to coarse gravel, subrounded to subangular, well graded from 27.43 m BGS to 36.58 m BGS				1	GB		
95 – 30		trace silt from 28.97 m BGS to 33.53 m BGS				2	GB		Native Cave 28.9 to 36.6 m BGS
100 – 30						3	GB		
105 – 32						4	GB		
110 – 34						5	GB		191 mm OD No. 30 slot Stainless Steel Telescopic Screen With K-Packer 30.5 to 36.6 m BGS
115 – 36						6	GB		
120 – 36		fine to medium grained sand, fine and coarse gravel, trace silt from 36.58 m BGS to 38.10 m BGS				7	GB		
125 – 38			333.39						
130 – 40		SILT and CLAY grey, wet	38.71	ATB3	Aquitard 2 / Maryhill Till	N/A	N/A		Clean Stone 36.6 to 42.7 m BGS
135 – 42			329.43						155 mm Diameter Borehole 36.6 m to 71.6 m BGS
140 – 42		SILT, SAND, and GRAVEL well graded, grey, wet	42.67						
145 – 44									

Screen Interval: 65.20 - 66.40; 30.50 - 36.60 m BGS
Sand Pack Interval: 56.99 - 71.63 m BGS
Well Seal Interval: 0.00 - 28.90 m BGS

Drawn By/Checked By: EH / MF

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

Stantec

0.6

Test Well: WY-SC-TW1-12

Project: 2012 Construction and Testing of Municipal Wells
Client: Regional Municipality of Waterloo
Location: St. Clements Well Field
Number: 160900679

Field Investigator: E. Hayman
Contractor: Gerrits Well Drilling Inc.
Drilling method: DR24, truckmount, air rotary
Date started/completed: 06-May-2012 / 16-Jul-2012

Ground surface elevation: 372.10 m AMSL
Top of casing elevation: 372.63 m AMSL
Easting: 528015
Northing: 4819419

Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Static Flow (L/min) 0.1 0.2 0.3 0.4	WELL DETAILS
150	46		SILT, SAND, and GRAVEL well graded, grey, wet		ATC1/ ATC2	Aquitard 3 / Catfish Creek Till	8	GB		Bentonite Chips 42.7 to 57.0 m BGS
155	48									
160	50									
165	50									
170	52									
175	54						9	GB		
180	56			317.24						
185	56		SILTY SAND little clay, little fine grained sand, trace fine gravel, grey, wet	54.86			10	GB		
190	58			314.19						
195	60		CLAY little silt, trace fine grained gravel, wet	57.91 312.66	ATE1	Aquitard 4 / Pre-Catfish Creek Till	11	GB		
200	62		SAND trace silt, medium grained sand, some gravel, wet	59.44			12	GB		Clean Stone 57.0 to 71.6 m BGS
205	62			309.62			13	GB		
210	64		SAND and GRAVEL trace silt, medium grained sand, well graded gravel, wet	62.48			14	GB		
215	66		increasing coarse grained gravel at 64.01 m BGS		AFF1	Aquifer 4 / Pre-Catfish Creek Till	15	GB		
220	68			305.04			16	GB		Abandoned 143 mm ID No. 20 Slot Stainless Steel Telescopic Screen 65.2 to 66.4 m BGS
225	70		SAND fine to medium grained sand, trace coarse grained gravel, wet	67.06			17	GB		
230	70		increasing fine grained sand at 68.58 m BGS to 70.10 m BGS				18	GB		
235	72			300.47			19	GB		
240	74		End of Borehole	71.63						
245	76									
250	76									
255	78									
260	80									
265	80									
270	82									
275	84									
280	86									
285	88									
290	88									
295	90									

Screen Interval: 65.20 - 66.40; 30.50 - 36.60 m BGS
Sand Pack Interval: 56.99 - 71.63 m BGS
Well Seal Interval: 0.00 - 28.90 m BGS

Drawn By/Checked By: EH / MF

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

Stantec

0.6

WY-SC-OW01-09-A

PROJECT: 08-1112-0150

BOREHOLE LOG OF: WY-SC-OW01-09

SHEET 1 OF 1

LOCATION: N 4819705.0 ;E 527834.0

DRILLING DATE: September 16-17, 2009

DRILL RIG: PQ Coring

DRILLING CONTRACTOR: Davison Well Drilling

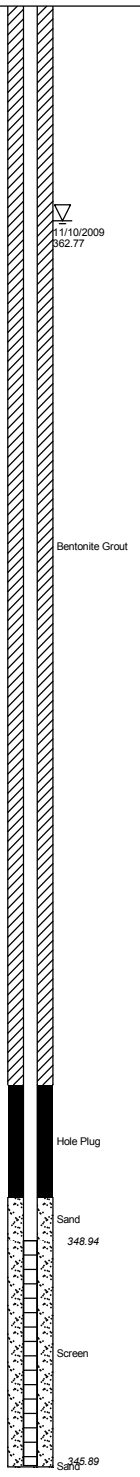
DATUM: NAD83

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	OGS CODE
	GROUND SURFACE	365.68	
0	Brown, SAND with TOPSOIL	0.00 / 365.18	
	Medium brown, SAND, trace gravel (FILL)	0.50 / 363.28	FILL
2	Dark brown/black, PEAT, organics	2.40 / 362.48	
	Moist, medium brown, silty SAND	3.20 / 361.08	
4	Brown, silty SAND, little to some gravel	4.60 / 359.68	
6	Medium brown, silty SAND, trace gravel	6.00 / 355.58	
8			
10	Moist, brown, sandy SILT	10.10 / 353.78	AFB1
12	Silty SAND, trace gravel	11.90 / 351.61	
14	SAND and GRAVEL, some silt	14.07 / 351.25	
	Silty SAND, trace gravel	14.43	
	SAND and GRAVEL, some silt	14.78 / 350.44	
	Coarse GRAVEL, some sand, some cobbles, trace silt	15.24 / 348.53	
16	Fine GRAVEL, some sand, trace silt	17.15 / 348.00	
	Coarse GRAVEL, some sand, trace silt	17.68 / 345.88	
18			
20	END OF BOREHOLE	19.80	

GEOPHYSICAL RECORD

GAMMA (cps) 25 50 75 100

CONDUCTIVITY (mS/m) 10 20 30 40



PIEZOMETER OR STANDPIPE INSTALLATION

MIS-HYD 009 08-1112-0150.GPJ GAL-MISS.GDT 2/7/11 RJ

DEPTH SCALE

1 : 102.5

Golder Associates

LOGGED: SC

CHECKED: DN

Monitoring Well: WY-SC-OW1ABC-12

WY-SC-OW1-12-(A-B-C)

Project: 2012 Construction and Testing of Municipal Wells
Client: Regional Municipality of Waterloo
Location: St. Clements Well Field
Number: 160900679

Field Investigator: E. Hayman and A. MacKay
Contractor: Gerrits Well Drilling Inc. / Aardvark Drilling Inc.
Drilling method: DR12, truckmount, air rotary / CME75, trackmount
Date started/completed: 27-Feb-2012 / 05-Apr-2012

Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery
				372.77					
0	0		Ground Surface	371.99					
			SAND fine to medium grained, light brown (7.5 YR 6/4), moist	0.00			1	GB	n/a
10	2								
			wet at 3.05 m BGS				2	GB	n/a
15	4								
				366.20					
20	6		SAND and GRAVEL medium to coarse grained sand, fine to coarse grained gravel, light brown sand (7.5 YR 6/4), wet, subangular to subrounded gravel	5.79					
25	8						3	GB	n/a
30	10		trace oxidation staining from 9.14 m BGS to 12.19 m BGS				4	GB	n/a
40	12								
45	14						5	GB	n/a
50	16		greyish brown at 15.24 m BGS						
55	18						6	GB	n/a
60	18				AFB1/ AFB2	Aquifer 1 / Stratified Sediments			
65	20						7	GB	n/a
70	22						8	GB	n/a
75	24								
80	24						9	GB	n/a
85	26								
90	28		silty clay lense at 27.4 m BGS				10	GB	n/a
95	30								
100	30						11	GB	n/a
105	32								
110	34						12	GB	n/a
115	36								
120	36			335.11					
			SANDY SILT with CLAY grey, well graded, wet	36.88			13	GB	n/a
125	38								
130	40			331.61	ATB3	Aquitard 2 / Maryhill Till	14	GB	n/a
			CLAY little silt, grey, stiff, wet, no odour	40.39			15	GB	n/a
135	42						16	GB	n/a
				329.63			17	GB	n/a
140	44		SAND and GRAVEL little silt, grey, sand and gravel grain sizes grading in and out with depth, wet	42.37			18	GB	n/a
145							19	GB	n/a

Gamma (cps) 20 40 60 80

WELL DETAILS

	SC-OW1A-12	SC-OW1B-12	SC-OW1C-12
WRAS No:	9205822	9205823	9205824
GS Elev:	371.99 m AMSL	372.09 m AMSL	371.80 m AMSL
TOC Elev:	372.76 m AMSL	372.98 m AMSL	372.58 m AMSL
Easting:	528020.470	528018.703	528022.239
Northing:	4819419.490	4819419.339	4819419.321
Stick-up:	0.77 m	0.90 m	0.78 m

- Above Ground Casing
- Concrete
- 254 mm Diameter Borehole 0 to 6.1 m BGS
- 152 mm Diameter Borehole 6.1 to 77.7 m BGS
- 152 mm O.D. Steel Casing 0 to 61.0 m BGS
- Bentonite Grout
- 51 mm Diameter Schedule 80 PVC Riser
- Bentonite Chips
- Top of Sand 32.0 m BGS
- No.2 Silica Sand
- No.10 Slot Schedule 40 PVC Screen 51 mm Diameter 32.9 to 36.0 m BGS
- Bottom of Sand 37.5 m BGS

- Above Ground Casing
- Concrete
- Bentonite Grout
- 152 mm Diameter Borehole
- 51 mm Diameter Schedule 40 PVC Riser
- Bentonite Chips

- Above Ground Casing
- Concrete
- 51 mm Diameter Schedule 40 PVC Riser
- Bentonite Chips
- 123 mm Diameter Borehole
- Top of Sand 10.1 m BGS
- No.2 Silica Sand
- No.10 Slot Schedule 40 PVC Screen 51 mm Diameter 10.7 to 13.7 m BGS
- Bottom of Sand 13.7 m BGS

Screen Interval: 10.67 - 13.72; 32.92 - 35.97; 65.53 - 68.58 m BGS
Sand Pack Interval: 68.58 - 70.10 m BGS
Well Seal Interval: 0.30 - 64.01 m BGS

Drawn By/Checked By: EH / MF

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

Stantec

Monitoring Well: WY-SC-OW1ABC-12

Project: 2012 Construction and Testing of Municipal Wells
Client: Regional Municipality of Waterloo
Location: St. Clements Well Field
Number: 160900679

Field Investigator: E. Hayman and A. MacKay
Contractor: Gerrits Well Drilling Inc. / Aardvark Drilling Inc.
Drilling method: DR12, truckmount, air rotary / CME75, trackmount
Date started/completed: 27-Feb-2012 / 05-Apr-2012

Depth (ft)	Depth (m)	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery
150	46	SAND and GRAVEL little silt, grey, sand and gravel grain sizes grading in and out with depth, wet		ATC1/ ATC2	Aquitard 3 / Catfish Creek Till	20	GB	n/a
						21	GB	n/a
155	48					22	GB	n/a
						23	GB	n/a
160						24	GB	n/a
	50					25	GB	n/a
165						26	GB	n/a
						27	GB	n/a
170	52					28	GB	n/a
						29	GB	n/a
175			317.74			30	GB	n/a
	54	SAND and SILT fine grained sand, trace clay, brown-grey, wet	54.25			31	GB	n/a
180						32	GB	n/a
						33	GB	n/a
185	56	medium grained sand and fine to medium grained gravel from 57.00 m BGS to 59.74 m BGS				34	GB	n/a
						35	GB	n/a
190	58					36	GB	n/a
			312.25			37	GB	n/a
195	60	CLAY, SAND and GRAVEL some silt, well graded, brown, wet	59.74	ATE1	Aquitard 4 / Pre-Catfish Creek Till	38	GB	n/a
						39	GB	n/a
200	62		309.97			40	GB	n/a
		SAND fine to medium grained sand, brown, wet	62.03			41	GB	n/a
205						42	GB	n/a
	64		307.99			43	GB	n/a
210		SAND and GRAVEL fine to coarse grained sand and gravel, brown, wet	64.01			44	GB	n/a
						45	GB	n/a
215	66					46	GB	n/a
						47	GB	n/a
220						48	GB	n/a
	68					49	GB	n/a
225			303.11			50	GB	n/a
		SAND trace silt, medium grained sand, brown, wet	68.88	AFF1	Aquifer 4 / Pre-Catfish Creek Till	51	GB	n/a
230	70					52	GB	n/a
						53	GB	n/a
235						54	GB	n/a
	72		299.45			55	GB	n/a
240		SAND trace to little silt, fine grained sand, brown, wet	72.54			56	GB	n/a
245	74	little gravel at 74.37 m BGS						
250		little medium to coarse grained sand at 75.29 m BGS	295.79					
	76	BEDROCK grey and brown	76.20		Bedrock			
255			294.27					
	78	End of Borehole	77.72					
260								
	80							
265								
270	82							
275	84							
280								
	86							
285								
290	88							
295	90							

GEOPHYSIC DETAILS

Gamma (cps)
20 40 60 80

WELL DETAILS

SC-OW1A-12	SC-OW1B-12	SC-OW1C-12
WRAS No: 9205822	WRAS No: 9205823	WRAS No: 9205824
GS Elev: 371.99 m AMSL	GS Elev: 372.09 m AMSL	GS Elev: 371.80 m AMSL
TOC Elev: 372.76 m AMSL	TOC Elev: 372.98 m AMSL	TOC Elev: 372.58 m AMSL
Easting: 528020.470	Easting: 528018.703	Easting: 528022.239
Northing: 4819419.490	Northing: 4819419.339	Northing: 4819419.321
Stick-up: 0.77 m	Stick-up: 0.90 m	Stick-up: 0.78 m

Base of 152 O.D. Steel Casing 61.0 m BGS
Bentonite Chips
Top of Sand 64.0 m BGS
No.2 Silica Sand
No.10 Slot Schedule 80 PVC Screen 51 mm Diameter 65.5 to 68.6 m BGS
Bottom of Sand 70.1 m BGS
Gravel and Bentonite Chips

Screen Interval: 10.67 - 13.72; 32.92 - 35.97; 65.53 - 68.58 m BGS
Sand Pack Interval: 68.58 - 70.10 m BGS
Well Seal Interval: 0.30 - 64.01 m BGS

Drawn By/Checked By: EH / MF

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

Stantec

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix C

Monitoring Data
(Pumped Volumes and Hydrographs)

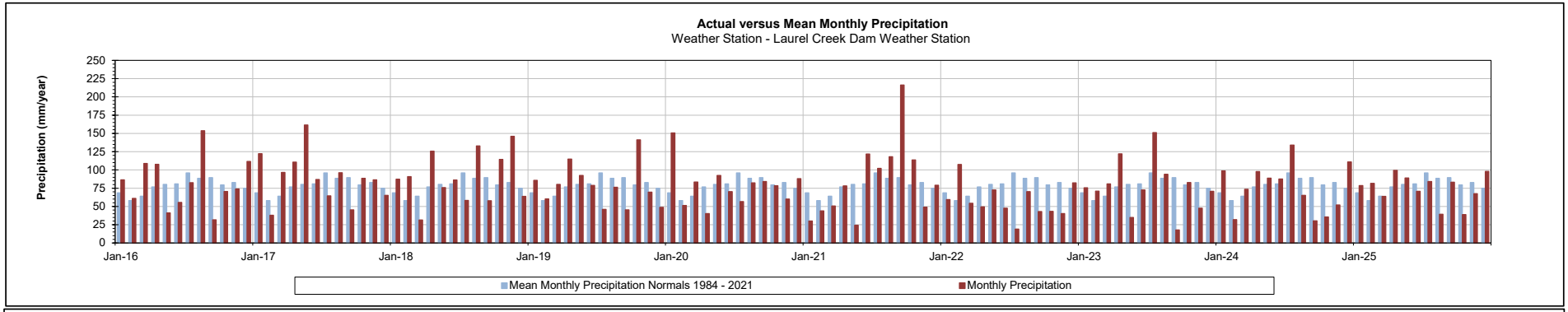
Region of Waterloo

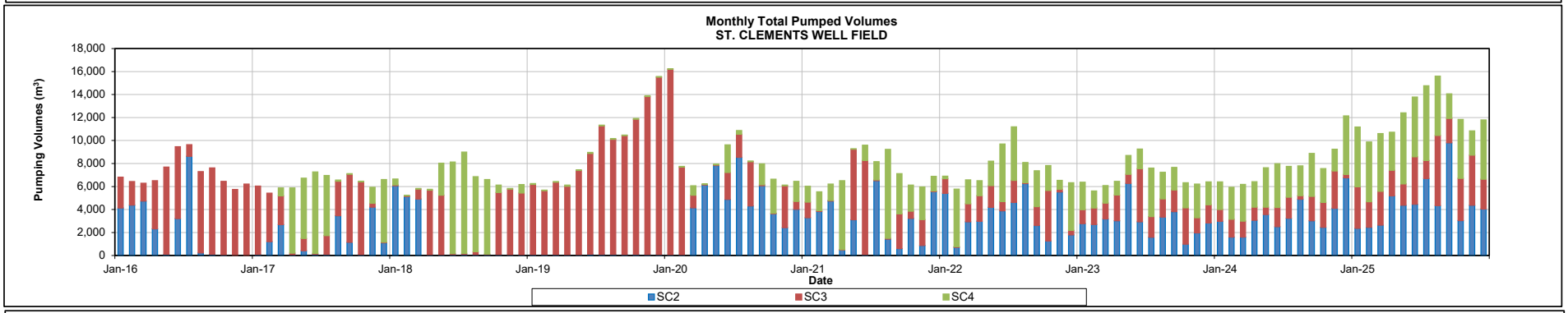
TABLE C-1
WELL FIELD WATER PRODUCTION SUMMARY
REGION OF WATERLOO - 2025 GROUNDWATER MONITORING REPORT

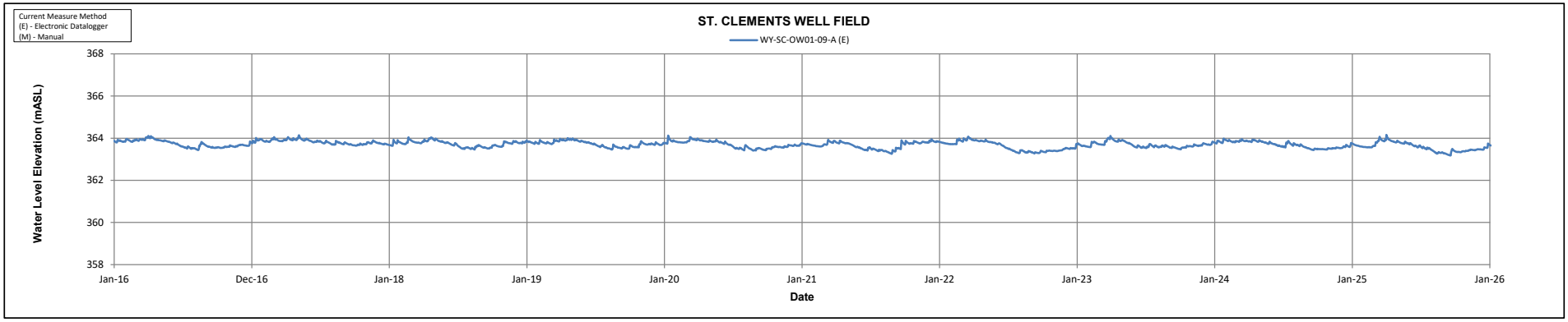
BURNSIDE

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)*
St. Clements	Minor	SC2	Supply	P-3000-5118893858	646,488	20.5	33,695	92	1.1	42,180	116	1.3	35,411	97	1.1	39,786	109	1.3	53,765	147	1.7
		SC3	Supply	P-3000-5118893858	646,488	20.5	21,990	60	0.7	16,471	45	0.5	23,010	63	0.7	17,394	48	0.6	37,460	103	1.2
		SC4	Supply	P-3000-5118893858	646,488	20.5	30,965	85	1.0	32,346	89	1.0	25,511	70	0.8	36,778	101	1.2	56,267	154	1.8
				Well Field Total	***646,488***	***20.5***	***86,650***	***237***	***2.7***	***90,997***	***249***	***2.9***	***83,932***	***230***	***2.7***	***93,958***	***257***	***3.0***	***147,492***	***404***	***4.7***
				Maximum taking is 1,230L/min at each well and combined taking shall not exceed 1,771,200 L/day																	

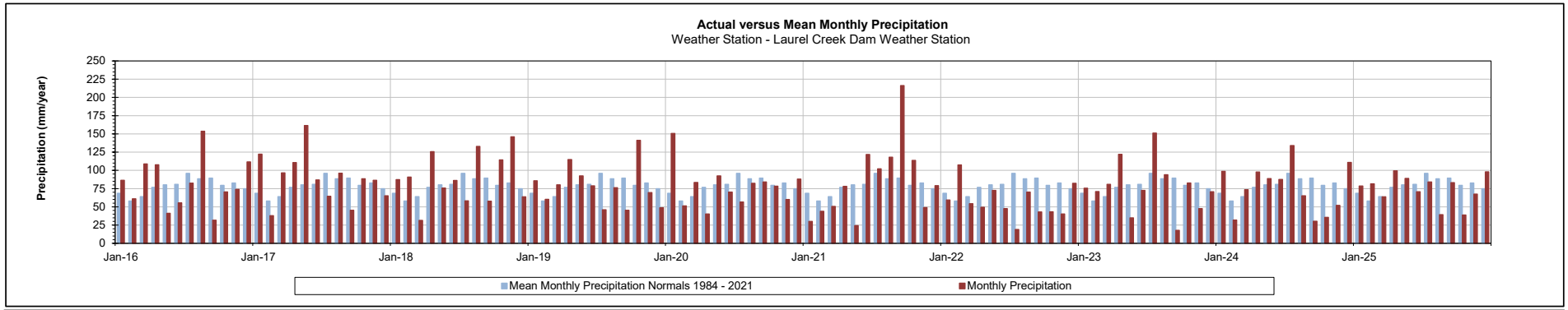
Notes:
- = no applicable data
n/a = data not available
*** = rates and volumes based on permitted L/day**
[1] = Current Permit

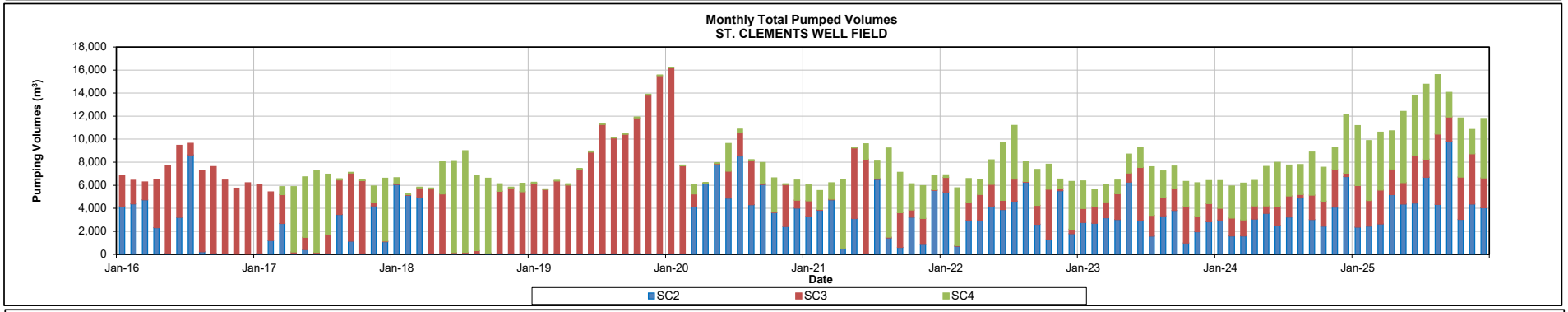

Actual versus Mean Monthly Precipitation
Weather Station - Laurel Creek Dam Weather Station
Precipitation (mm/year)
250
225
200
175
150
125
100
75
50
25
0
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Mean Monthly Precipitation Normals 1984 - 2021
Monthly Precipitation

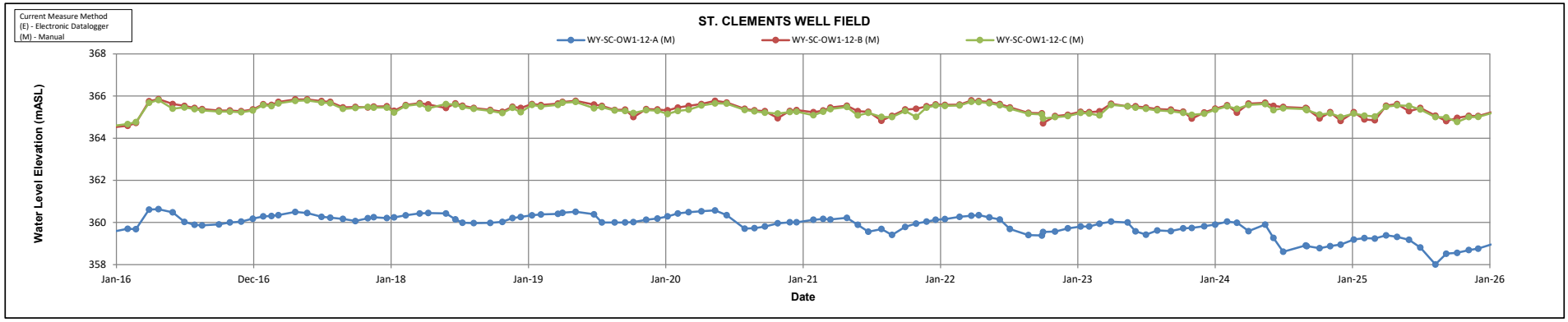

Monthly Total Pumped Volumes
ST. CLEMENTS WELL FIELD
Pumping Volumes (m³)
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Date
SC2
SC3
SC4


Current Measure Method
(E) - Electronic Datalogger
(M) - Manual
ST. CLEMENTS WELL FIELD
WY-SC-OW01-09-A (E)
Water Level Elevation (mASL)
368
366
364
362
360
358
Jan-16
Dec-16
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Jan-26
Date

REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
ST. CLEMENTS







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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

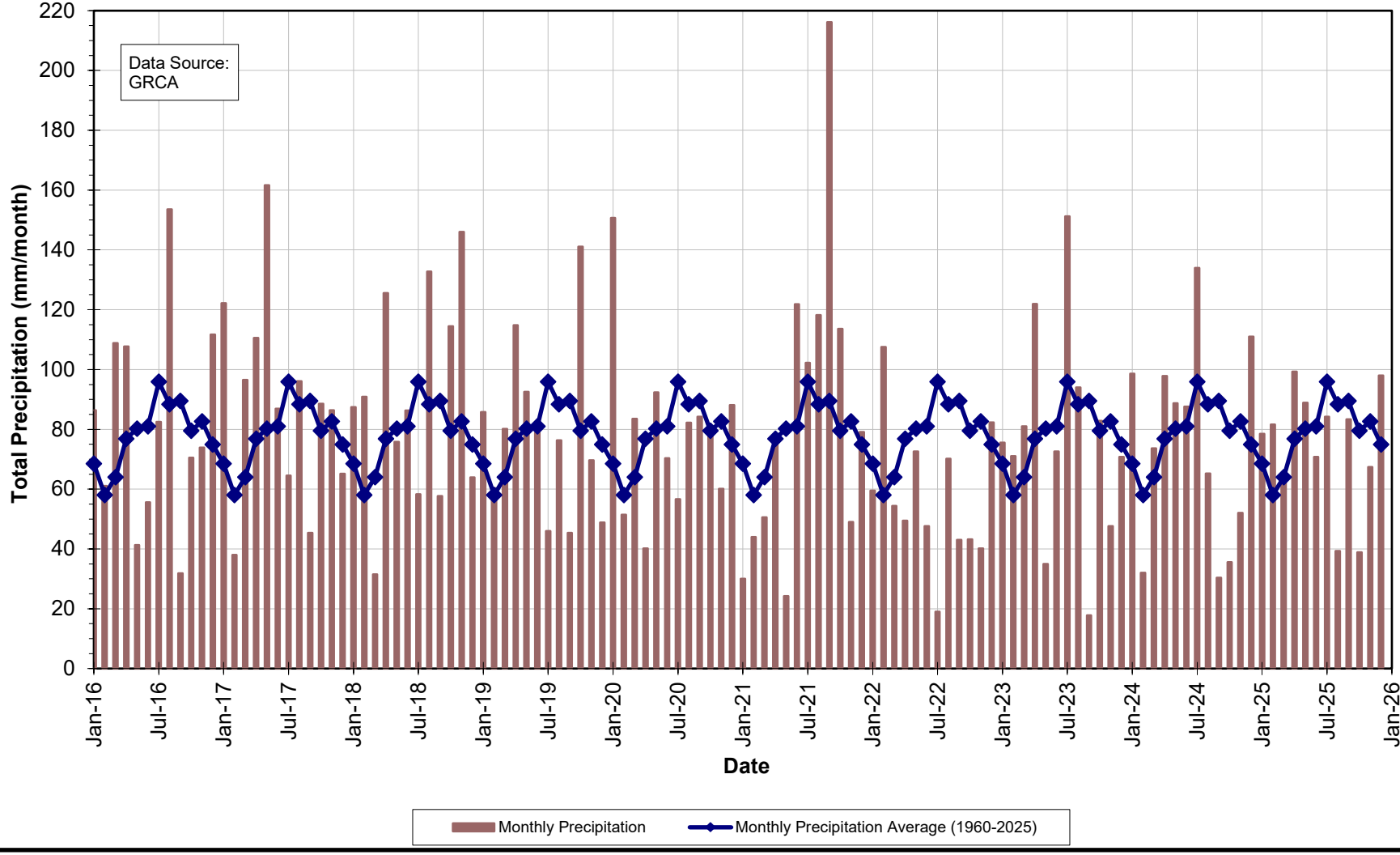
Year	Laurel Dam Established 1960		
	Annual Precipitation (mm)	Average Precipitation 1960-2025 (mm)	Difference (mm)
2016	985	938	47
2017	1062	938	124
2018	1071	938	133
2019	940	938	2
2020	938	938	0
2021	1027	938	89
2022	689	938	-249
2023	921	938	-17
2024	907	938	-31
2025	894	938	-44

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