



BURNSIDE

**2025 Biennial Groundwater Monitoring
Report - Strange Street Well Field
(K10A, K11A, K13B, K18, K19)**

The Region of Waterloo



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Table of Contents

1.0	Introduction.....	1
1.1	Scope of Work.....	1
2.0	Site Setting.....	2
2.1	Well Field Description.....	2
2.1.1	Pumping Wells.....	2
2.1.2	Monitoring Wells.....	4
2.2	Regional Geology and Hydrostratigraphy.....	4
2.2.1	Surficial Geology and Conceptual Hydrostratigraphy.....	5
2.2.2	Bedrock Geology.....	7
2.3	Local Geology.....	7
3.0	2024 / 2025 Results.....	8
3.1	Precipitation.....	8
3.2	Monitoring Results.....	9
4.0	Impact Assessment.....	11
4.1	Well Interference.....	11
4.2	Aquifer Response to Pumping and Precipitation.....	12
5.0	Conclusions.....	13
6.0	References.....	14

Tables

Table 1: Production Well Construction Details.....	2
Table 2: Annual Water Taking 2024 / 2025.....	3
Table 3: Monitoring Well Construction Details.....	4
Table 4: Summary of Precipitation Data.....	8
Table 5: PTTWs in Vicinity of the Strange Street Well Field.....	12

Figures

Figure 1: Well Field Location Map
Figure 2: Kitchener Well Fields and Monitoring Network
Figure 3: Well Location Map
Figure 4: Surficial Geology
Figure 5: Location of the Waterloo Moraine
Figure 6: Strange Street Well Field Cross Section A – A'
Figure 7: Strange Street Well Field Cross Section B – B'
Figure 8: Strange Street Well Field Cross Section C – C'

Appendices

Appendix A Permit To Take Water
Appendix B Well Records
Appendix C Monitoring Data (Pumped Volumes and Hydrographs)
Appendix D Precipitation Data
Appendix E Monitoring Program Overview

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 Strange Street 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 condition of the PTTW for 2024 and 2025.

PTTW P-300-6221899077 was issued to the Region of Waterloo on June 29, 2023, for water takings from the Strange Street Well Field consisting of wells K10A, K11A, K13B, K18 and K19. A copy of the applicable PTTW for 2024 and 2025 is provided in Appendix A.

The location of the Strange Street Well Field is shown on Figure 1 and the production wells in Kitchener are shown on Figure 2 with the monitoring network for K10A, K11A, K13B, K18 and K19 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 requirements of their Permits to Take Water 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 Strange Street Well Field in accordance with PTTW Number P-300-6221899077 which consists of the following activities:

- Measuring the daily volume pumped from production wells K10A, K11A, , K13B, K18 and K19 (Condition 4.1 of the PTTW);
- Measuring the water levels in monitoring wells K-SS-STOW2-07-A, K-SS-SS11-99-A, K-SS-OW1-82-A, K-SS-SS13-99-A, K-SS-SS08-99-A, K-SS-OW1-13-A and K-SS-OW1-14-B (Condition 4.2 of the PTTW);
- 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 Strange Street Well Field is located in the northeast portion of Kitchener. Wells K11A, K13B, K18 and K19 are located in a predominantly residential area near the Westmount Golf Course (Figure 3). K10A is situated to the east in an area with mixed residential / industrial / commercial uses. The closest municipal well field is William Street, located approximately 1.5 km to the northeast. The Erb Street well field is approximately 4 km west, the Greenbrook well field is approximately 2 km southeast and the Mannheim Well Fields are approximately 3 km south (Figure 2). The closest surface water feature to the Strange Street Well Field site is the Henry Sturm Creek located 500 m south of K13B and Schneider Creek located 400 m east of K10A (Figure 3).

2.1.1 Pumping Wells

The Strange Street Well Field consists of wells K10A, K11, K13B, K18 and K19. 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 / Screen Diameter (mm)	Screened Interval (mbgs)	Aquifer
K10A	1982	200 / 250	17.5 – 20.5	AFB2
K11A	2007	300 / 270	29.0 – 34.7	AFB2
K13B	2022	305 / 286	28.3 – 33.0	AFB2
K18	1975	300	29.3 – 37.2	AFB2

Well Name	Year Built	Casing / Screen Diameter (mm)	Screened Interval (mbgs)	Aquifer
K19	2005	350	30.5 – 38.1	AFB2

The water taking volumes for the Strange Street 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)
K13B	16,512	1,415	1,901	516,322	858	1,225	313,233
K11A	16,512	2,672	3,498	975,118	2,523	3,270	921,052
K18	16,512	1,628	2,287	594,291	1,250	1,998	456,408
K19	16,512	792	1,735	289,084	1,006	1,584	367,309
K10A	16,512	1,099	1,308	401,278	759	1,177	277,216
Combined	16,512	7,606	9,284	2,776,093	6,398	8,669	2,335,218

Condition 3.3 of the PTTW specifies that the combined total taking from the well field must not exceed an annual daily average of 10,575 m³/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 155,546 m³/month to 271,718 m³/month in 2024, and from 136,073 m³/month to 251,528 m³/month in 2025. In total, 2,776,093 m³ was produced at this well field in 2024 and 2,335,218 m³ was produced in 2025. These volumes are similar to 2022 and 2023. The volumes are below the permitted volume of 3,859,875 m³ per year (Table C-1). In 2024 and 2025, about 37% of the total volume pumped was provided by K11A, 21% of the volume was from K18, 16% of the volume was from K13B and K19 and K10A providing 13% each. K19 was not pumped in January and February 2024.

2.1.2 Monitoring Wells

Water level monitoring is completed at observation wells K-SS-STOW2-07-A, K-SS-SS11-99-A, K-SS-OW1-82-A, K-SS-SS13-99-A, K-SS-SS08-99-A, K-SS-OW1-13-A and K-SS-OW1-14-B (Figure 3). Construction and monitoring well location details for the observation wells are described in the table below. Well records for the monitoring wells are provided in Appendix B.

Table 3: Monitoring Well Construction Details

Monitoring Well ID	Year Built	Screened Depth (mbgs)	Screened Formation	Closest Pumping Well (Distance to Well)
K-SS-STOW2-07-A	2007	29.6 – 34.1	AFB2	K11A (adjacent)
K-SS-SS11-99-A	1999	39.0 – 42.1	AFB2	K11A (800 m)
K-SS-OW1-82-A	1982	13.3 – 19.4	AFB2	K10A (adjacent)
K-SS-SS13-99-A	1999	17.4 – 20.4	AFB2	K10A (300 m)
K-SS-SS08-99-A	1999	17.6 – 20.7	AFB2	K19 (600 m)
K-SS-OW1-13-A	2013	30.5 – 32.0	AFB2	K11A (250 m)
K-SS-OW1-14-B	2014	11.6 – 13.1	AFB1	K11A (250 m)

2.2 Regional Geology and Hydrostratigraphy

The following sections provide a brief overview of the regional geology and hydrogeology of the Strange Street Well Field.

The surficial geology based on regional OGS mapping is provided in Figure 4. The Strange Street Well Field is in the core of the Waterloo Moraine (Figure 5). Representative cross-sections showing the stratigraphy in the vicinity of the Strange Street Well Field are included as Figures 6, 7 and 8. The cross-section locations are provided on Figure 3.

The cross-sections are provided as a visual aid and do not necessarily contain all wells in the monitoring program for the Strange Street Well Field. 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 Strange Street Well Field.

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

Refinements (Aqua Insight et al, 2023) along the cross-sections (Figures 6, 7 and 8) include the following:

- At K10 A, AFB2 is slightly thicker, while ATB3 is slightly thinner;
- A thicker ATB2 and thinner AFB1 at K18 and K19;
- AFA1 is mapped at surface north of K11A instead of ATB1

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 in the Strange Street Well Field area consists of predominantly ice-contact stratified deposits of sand and gravel with occasional pockets of clay to silt textured tills (Maryhill Till-AFB1) and stone poor sandy silt to silty sand till (Port Stanley Till-ATB1), and modern alluvial and organic deposits (Figure 4). To the west of the Strange Street Well Field area, the surficial geology is comprised of clay to silt-textured till that is interpreted by Karrow (1993) as the Maryhill Till (ATB1).

The Quaternary units typically present associated with 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 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). AFA1 is a continuous aquifer that facilitates groundwater flow within the upper overburden sequence.

Aquitard ATB1 – Port Stanley Till

The Port Stanley Till is a sandy silt to silty sand till, with occasional stony texture, that is predominantly found along the flanks of the Waterloo Moraine. The Port Stanley Till was deposited by ice advancing from the Erie-Ontario ice lobe. In other parts of the Region, Bajc and Shirota (2007) have also used unit ATB1 to represent Tavistock, Mornington and Upper Maryhill Tills. This unit is considered an aquitard and, where present, acts to restrict recharge to the lower aquifers. ATB1 is interpreted to be thin or absent to the east of Fischer Hallman Road (Stantec, 2009) and correlates well with the surficial regional geology mapping (Figure 4).

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, including the Strange Street Well Field production wells (Figure 5). 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 re-worked 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 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 interpreted to occur at elevations between 270 masl and 290 masl in the Strange Street Well Field area.

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 interpreted to be thin (<5 m) and discontinuous in the Strange Street Well Field Area. 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 area consists of the Salina and Guelph Formations.

2.3 Local Geology

The following description of local geology is based on information provided in the Strange Street Characterization Study (Stantec, 2009) and borehole logs for the Strange Street Well Field production wells and monitoring wells. Borehole logs are included in Appendix B.

Upper Waterloo Moraine (AFB1 / ATB2 / AFB2) – Aquifer 1 (AFB1 / ATB2 / AFB2) is the water supply aquifer at the Strange Street Well Field. The lithology of the unit was found to be a range of fine to medium sands, with some gravel, and the vertical extent of AFB1 was no thicker than 30 m under the refined interpretation. Based on logs for the production wells, AFB1 has a thickness ranging from 2 m to 15 m in the area of the Strange Street Well Field. AFB1 is not continuous and is most prominent at higher elevations. Therefore, when the ground surface elevation drops off to the east of the Strange Street Well Field, this aquifer unit was observed to thin out or pinch out. ATB2 is a discontinuous, silty to clayey till unit. ATB2 was found to be thicker toward the core area of the Waterloo Moraine (i.e., to the west of Fischer-Hallman Road), and was either thin or not present to the east of Fischer Hallman Road. Based on the drillers' logs at the Strange Street Well Field, ATB2 was found to be between 1 m and 14 m thick. Where present, ATB2 typically bisects Aquifer 1, separating AFB1 from AFB2. The presence of ATB2 may locally impact the vertical movement of groundwater through Aquifer 1, wherever present; however, at a well field scale, Aquifer 1 is interpreted to behave as a single system.

Lower Maryhill Till (ATB3) – This unit which consists of clayey silt to silty clay till was identified in the area of the Strange Street Well Field with a thickness ranging from 5 to 25 m and an average thickness of 10 m. At K13A, the unit was encountered at a depth of 32.5 m and at monitoring well K-SS-SS08-99-A the unit was encountered from 21.2 m bgs to 26.1 m bgs.

Catfish Creek Till (ATC1 / ATC2) - This unit is interpreted to be continuous across the Strange Street Well Field Areas with thicknesses ranging from 5 m to 25 m. The unit was identified at K-SS-SS08-99 at a depth of 26.1 m bgs and at K-SS-SS11-99 at a depth of 55 m.

Bedrock Geology - The Paleozoic bedrock geology beneath the Strange Street Well Field consists of the Salina and Guelph Formations. The contact between the Salina and Guelph Formations is interpreted to be present in the eastern portion of the Strange Street Well Field area. In the Strange Street Well Field area, bedrock is found at depths of approximately 80 m to 100 m bgs.

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 and Environment Canada station located closest to the production wells are used. The closest GRCA weather station relative to the Strange Street well field is the University of Waterloo weather station located 4.4 km northwest from the well field. The closest Environment Canada station is Roseville located about 11 km southeast from the well field. The locations of the meteorological stations are shown on Figure 1. Annual precipitation data from the past 10 years for all stations are compared with long term averages in Table D.1, Appendix D. Monthly precipitation data for the past 10 years at the University of Waterloo station and Roseville station are shown on Figures D.1 and D.2, Appendix D. At the University of Waterloo station, the long-term average was calculated from 1998 until the end of 2025. The Roseville station has “Climate Normals” calculated by Environment Canada for 1981 to 2010.

Annual 2024 / 2025 precipitation data for the closest weather station and closest Environment Canada meteorological station to the Strange Street well field 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 may be under reported at this location.

Table 4: Summary of Precipitation Data

Station	2024 Precipitation (mm)	2024 Deviation (mm)	Long- Term Average (mm)	2025 Precipitation (mm)	2025 Deviation (mm)
University of Waterloo ⁽²⁾	763	-108	871 ^(B)	943	+72

Station	2024 Precipitation (mm)	2024 Deviation (mm)	Long- Term Average (mm)	2025 Precipitation (mm)	2025 Deviation (mm)
Roseville Station ⁽¹⁾	856	-63	919 ^(A)	786	-133
Sources: Environment Canada (1), University of Waterloo (2) ^A 1981 to 2010 Normal ^B 1998-2025 data					

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 University of Waterloo station was 763 mm, which is 108 mm below the long-term average, indicating 2024 was a drier-than-average year at the well field. A similar below long-term average trend is noted 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 was 943 mm, which is 73 mm above the long-term average. Alternately, 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 25 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

In accordance with Condition 4.2 of the PTTW, water levels were measured and recorded once per month at monitoring wells listed in Table 3 (Figure 3). Hydrographs showing the results of water level monitoring at each monitoring well 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.

K-SS-STOW2-07-A

Monitoring well K-SS-STOW2-07-A is adjacent to K11A and is screened from 29 to 34 m in the production aquifer, Aquifer 1 (AFB2). Manual monthly water level monitoring at the well began in 2011 and an electronic water level meter was installed in 2019.

Water levels over 2024 to 2025 are generally lower compared to previous years. Prior to the increase in pumping in 2022, water level elevations ranged from 333.7 to 339.8 masl. Over

2024 to 2025, water level elevations ranged from 327.4 to 333.3 masl, which shows an overall decline in levels. Water levels appear to have stabilized mid 2025 to the end of the year.

The decline in levels during 2022 correlates with increased pumping at the Strange Street Well Field. Prior to 2020, monthly pumping volumes at the well field were closer to 100,000 m³ with a high of 150,000m³. Since 2022, monthly pumping volumes have doubled and are closer to 200,000 m³, with a high of 250,000 m³.

K-SS-SS11-99-A

K-SS-SS11-99-A is located 600 m southwest of K13B and 800 m southwest of K11A. It is screened from 39.0 to 42.0 m below ground level in the production aquifer, Aquifer 1 (AFB2). Manual water levels are measured monthly. Over the past 10 years, water levels at SS11-99 have ranged from 337.3 masl to 342 masl. Water levels over 2024 to 2025 are generally lower compared to previous years.

A 4.5m decline in water levels is observed from November 2022 to the end of 2025. The decline corresponds to increased pumping at K13B, K11A and K18 however levels do not stabilize like other monitoring wells located closer to the pumping wells. This indicates that climate conditions may also be impacting the aquifer.

K-SS-OW1-82-A

Monitoring well K-SS-OW1-82-A is located adjacent to K10A and screened in the production aquifer, Aquifer 1 (AFB2). This monitoring well was installed in the K10 production well following its replacement with K10A due to poor well conditions. Monthly manual water levels in OW1-82-A respond to changes in pumping at K10A and generally range from 324.2 masl to 331 masl.

Water levels over 2024 to 2025 are generally lower compared to previous years. Water levels decreased by 7 m in 2022 with K10A going back online and the overall increase in well field pumping. Water levels increase 4.5 m in November and December 2025 when K10A is offline. Water levels appear to have stabilized between 2023 and 2025.

K-SS-SS13-99-A

K-SS-SS13-99-A is located between K10A and K11A and K13B and is screened from 17.4 to 20.4 m below ground level in the production aquifer (AFB2). Since 2016, monthly manual water levels at SS13-99 have ranged between 329.4 masl and 334.6 masl and show a response to pumping at K10A and K11A. Water levels over 2024 to 2025 are generally lower compared to previous years. Water levels appear to have stabilized by October 2025.

A 4 m declining trend in water levels observed from 2022 to 2025 corresponds to increased pumping volumes at K10A, K13B and K11A. Below normal precipitation may also be contributing to the decline in water levels.

K-SS-SS08-99-A

K-SS-SS08-99-A is located about 600 m north of the nearest supply wells K19 and K18. The well is screened from 17.8 to 20.6 m below ground level in AFB2. Water levels at SS08-99 have only varied by about 1.4 m between 2016 and 2022 with variations in water levels generally correspond to typical seasonal variations with the highest levels noted in the spring and decreasing levels through the summer. Beginning in 2022 there is a decreasing water level trend with water levels from July 2022 to December 2025 lower than the historical low of the past ten years. It is interpreted that seasonal changes in precipitation are the source of variation in water levels at SS08-99.

K-SS-OW1-13-A and K-SS-OW1-14-B

K-SS-OW1-13-A and K-SS-OW1-14-B are located about 250 m south of K11A and within 15 m of K13B. K-SS-OW1-13-A is screened from 30.5 to 32.0 m below ground level in Aquifer AFB2 and K-SS-OW1-14-B is screened from 11.6 to 13.1 m below ground level in Aquifer AFB1. Manual monthly water level monitoring at the wells began in 2015.

In both wells, water levels are very similar and vary within a 1 m range, mimicking typical seasonal trends. An increase of about 2 m beginning in October 2019 is observed when the Strange Street wells are off-line. Water levels collected in 2024 to 2025 are generally lower compared to historical levels. Water levels appear to have stabilized by July 2025. Water levels decline starting in October 2021 when K10A and K11A are back online and continue to decline in 2022 / 2023 as well field pumping increase. In September 2023 there is a 5 m decrease in water levels at OW1-13-A and a 2 m decrease at OW1-14-B, in response to K13B going online. Water levels at OW1-13-A continue to be below OW1-14-B in 2024 and 2025 while K13B is pumped.

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."

Municipal servicing is provided to areas within 500 m of the Strange Street Well Field; however, if 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 K10A, K11A, K13B, K18 and K19 received in 2024 and 2025.

Other groundwater takings registered in the MECP Permit to Take Water (PTTW) database within 2 km of the well field are mapped on Figure 3 and summarized below in .

Table 5: PTTWs in Vicinity of the Strange Street Well Field

Permit Number	Permit Holder	Purpose	Source (Max Liters per Day)	Distance from Supply Wells	Expiry Date
7300-BCPJ4Q	Region of Waterloo	Remediation	W14 (4,546,000)	1,820 m (K11A)	5/31/2029
6377-ACWRQF	ivari	Remediation	West RW-1 (72,000)	1,500 m (K19/K18)	8/31/2025
			West RW-2 (72,000)		8/31/2025

There are two long-term remediation PTTWs located in the vicinity of the Strange Street Well Field (Figure 3). There is no evidence that the water takings associated with the PTTWs have impacted water levels in the production aquifer.

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)".

Monitoring wells screened within AFB2 have water level declines during periods of pumping of the production wells and recover during periods of shutdown. 2024 and 2025 water levels are lower than historical levels in all of the monitoring wells. Lower water levels in 2024 and 2025 can be attributed to increased pumping at the well field but appear to have stabilized in wells directly influenced by pumping. Climate conditions may also be contributing to decreasing trends in water levels as a decreasing trend in the aquifer is observed at K-SS-SS08-99-A and at K-SS-SS11-99-A that is not attributed to pumping.

Seasonal fluctuations in the aquifer are observed at K-SS-SS08-99-A 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 Strange Street 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 P-300-6221899077.
- Pumping at the Strange Street Well Field in 2024 and 2025 did not exceed the maximum volumes outlined in PTTW P-300-6221899077.
- There were no reported well interference complaints arising from water taking at the Strange Street Well Field.
- There is no evidence of long-term adverse effects to groundwater levels from pumping at the Strange Street Well Field.

6.0 References

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

Aqua Insight Inc., et al. 2023. Hydrogeological Characterization and Conceptual Model Update Report, Region of Waterloo Tier Three Assessment Update Project, June 2023.

Aqua Insight Inc. 2023. Moraine Model Update and Recalibration Report. Region of Waterloo Tier Three Update Project. Final Report, June 2023.

Bajc, A.F. and Shirota J., 2007. Three-dimensional mapping of surficial deposits in the Regional Municipality of Waterloo, southwestern Ontario; report in Ontario Geological Survey, Groundwater Resources Study 3, p. 42.

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Stantec Consulting Ltd, June 2009. Tier 3 Water Budget and Water Quality Risk Assessment Strange Street Well Field Characterization Study.

Stantec, 2012. Hydrogeological Assessment Strange Street Water Supply Class EA Update, Regional Municipality of Waterloo, Stantec Consulting Ltd, March 2012.

Terraqua Investigations Ltd., 1995. The Study of the Hydrogeology of the Waterloo Moraine. Regional Municipality of Waterloo Water Services Division Report. (Four volumes: Executive Summary, Text, Figures, Appendices).

Waterloo Hydrogeologic Inc., 2000. Delineation of Well Field Capture Zones within the Waterloo Moraine, Regional Municipality of Waterloo Water Services Division Report, 77 pages.



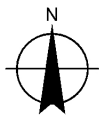
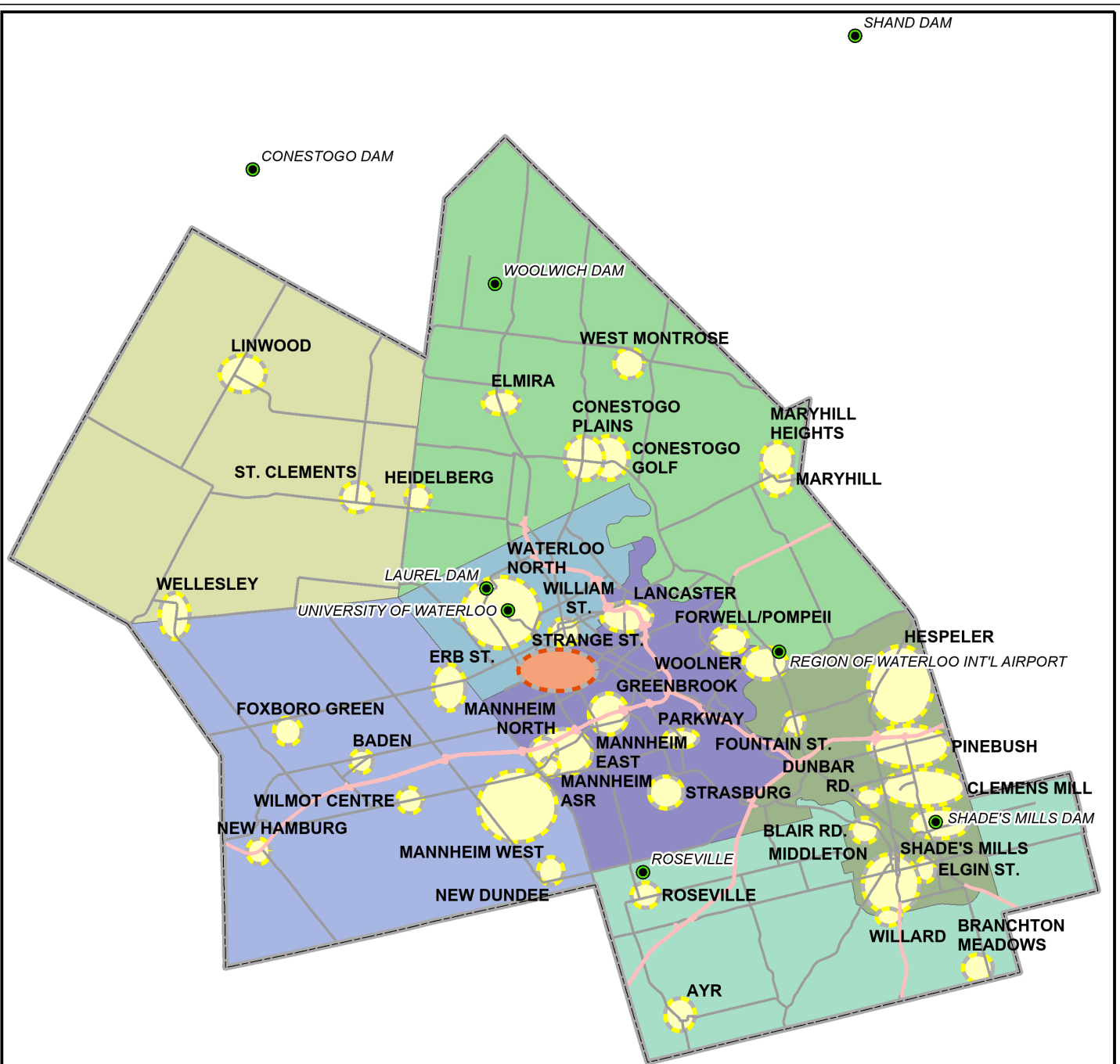
BURNSIDE

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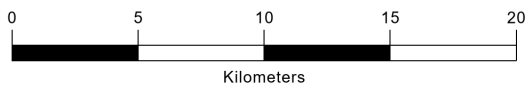


Figures

Figures



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



Map Title

2025 GROUNDWATER MONITORING REPORT - STRANGE STREET WELL FIELD

WELL FIELD LOCATION MAP

Client

REGION OF WATERLOO

Drawn

HN

Scale

1:300,000

Checked

SQ

Date

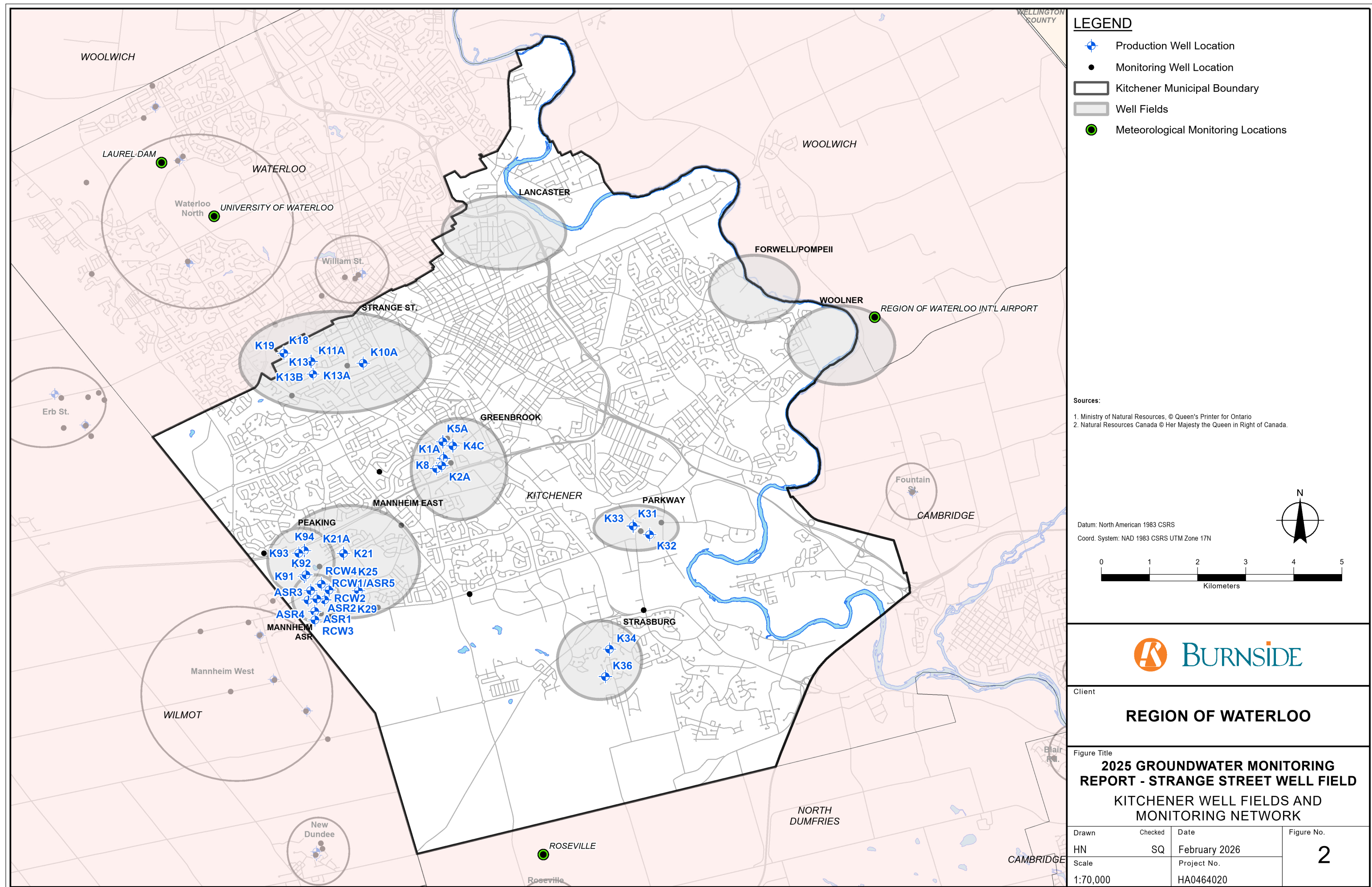
February 2026

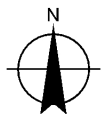
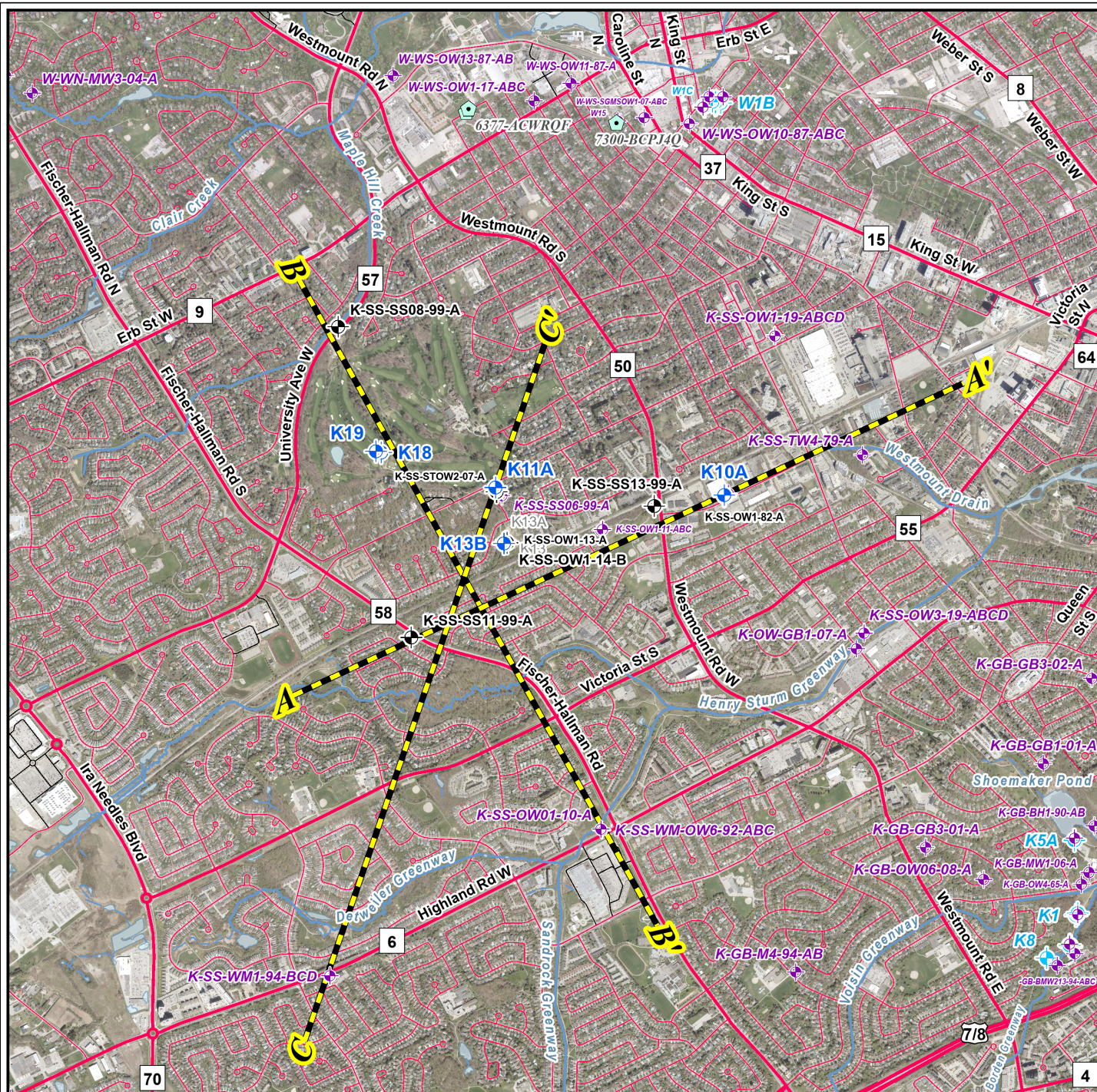
Project No.

HA0464020

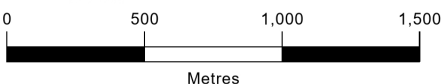
Figure No.

1





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



PTTW Monitoring Well
Location



Decommissioned
Production Well Location



Nearby Monitoring Well
Location



Nearby Production Well
Location

Additional MECP PTTW
Locations



Groundwater

— Cross Section Orientation

- - - Intermittent Creek

— Creek

— Provincial Highway

— Regional Road

— Local Road

— Private / Other Road



Map Title

2025 GROUNDWATER MONITORING REPORT - STRANGE STREET WELL FIELD

WELL LOCATION MAP

Client

REGION OF WATERLOO

Drawn

HN

Scale
1:27,500

Checked

SQ

Date

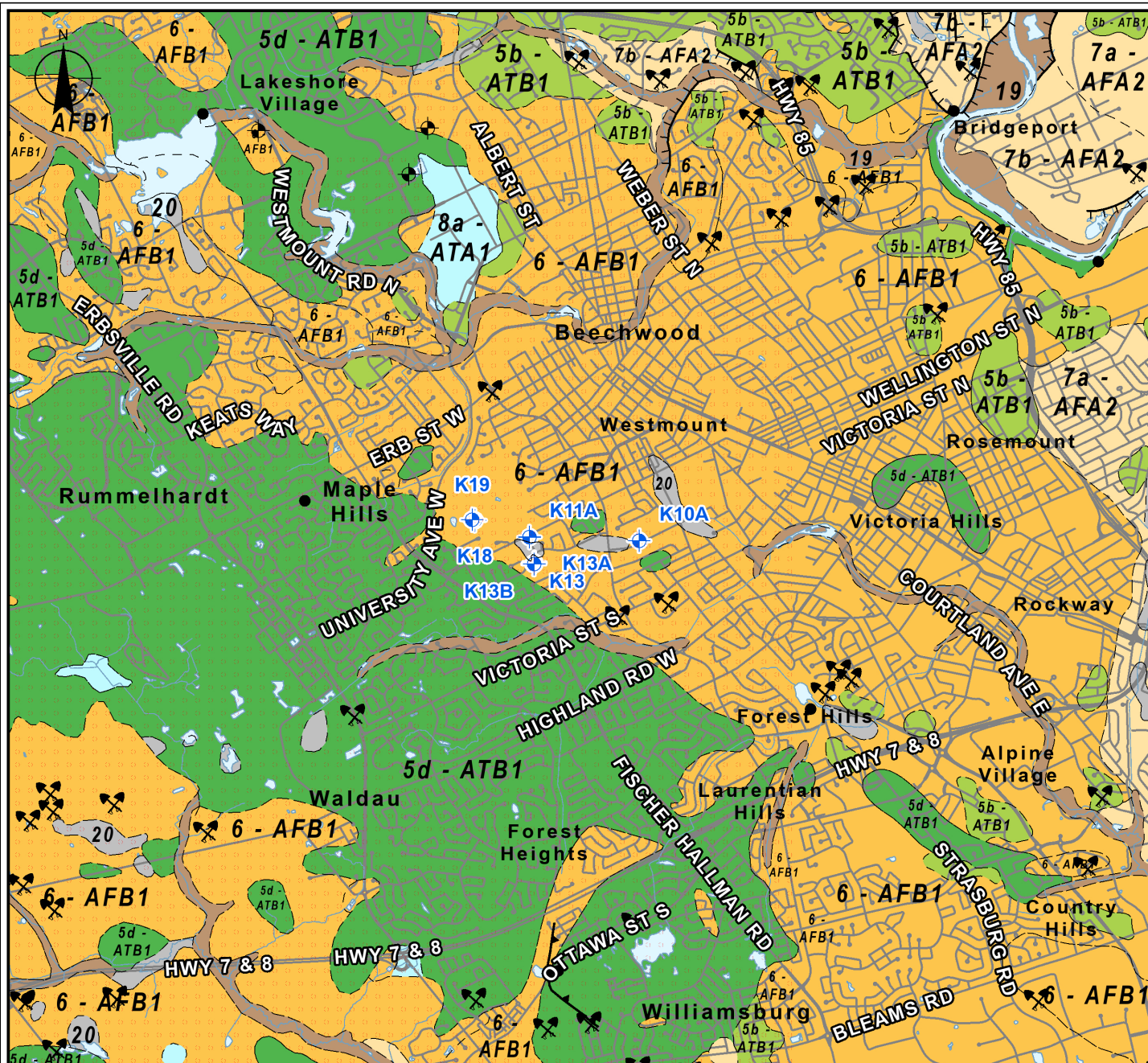
February 2026

Project No.

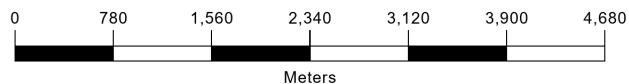
HA0464020

Figure No.

3



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



- RMOV 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
- Ice-Contact Slope
- Terrace
- Drill Hole
- Sample Location
- Hummocky Topography



2025 GROUNDWATER MONITORING REPORT - STRANGE STREET WELL FIELD

SURFICIAL GEOLOGY

Client

REGION OF WATERLOO

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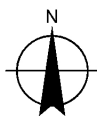
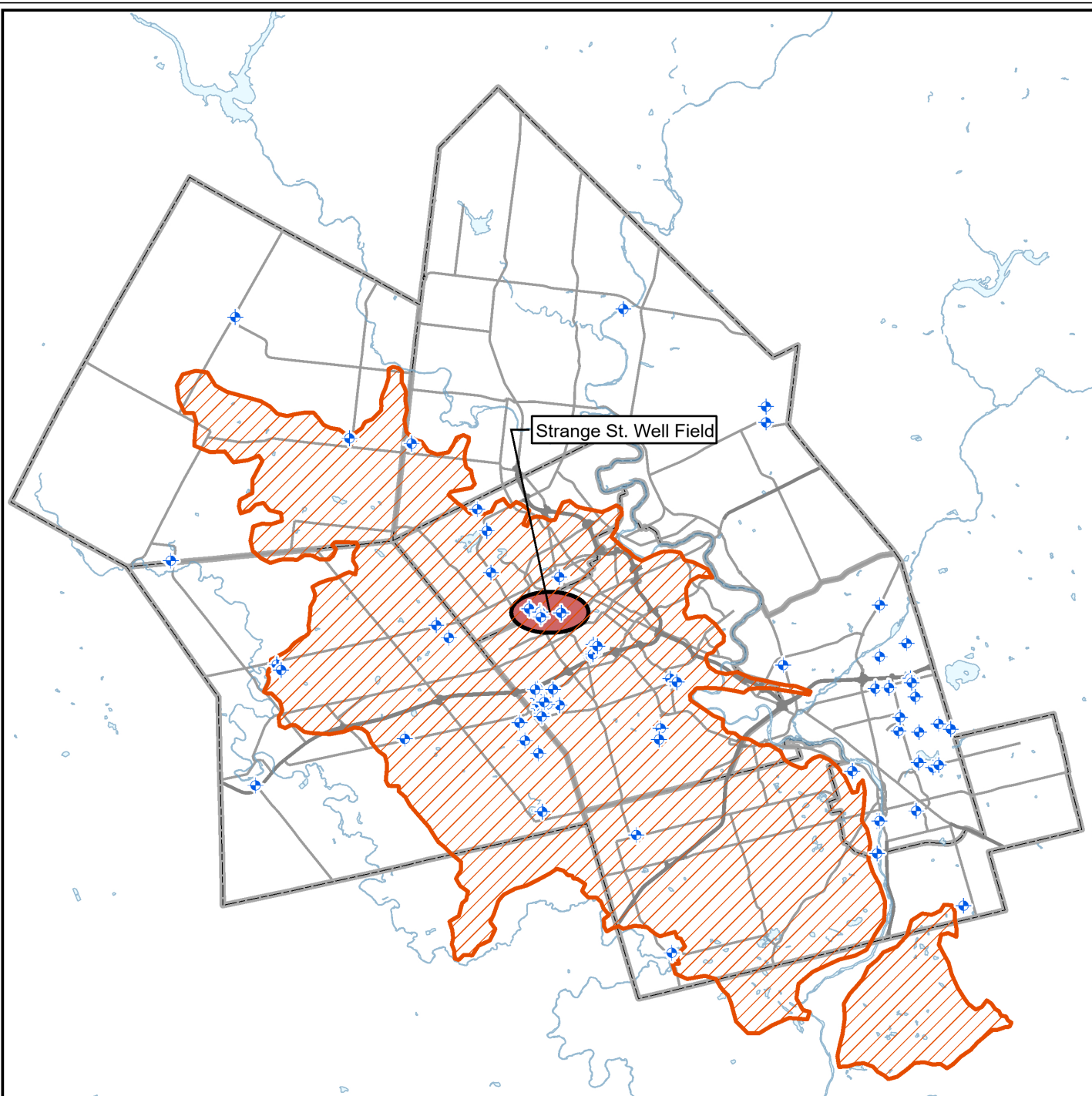
February 2026

Project No.

HA0464020

Figure No.

4



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.



- RMOW Supply Well
- Waterloo Moraine (2014)
- Strange Street Well Field
- Waterbody
- Regional Municipal Boundaries



Map Title

2025 GROUNDWATER MONITORING REPORT - STRANGE STREET WELL FIELD

LOCATION OF THE WATERLOO MORaine

Client

REGION OF WATERLOO

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Scale

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SQ

Date

February 2026

Project No.

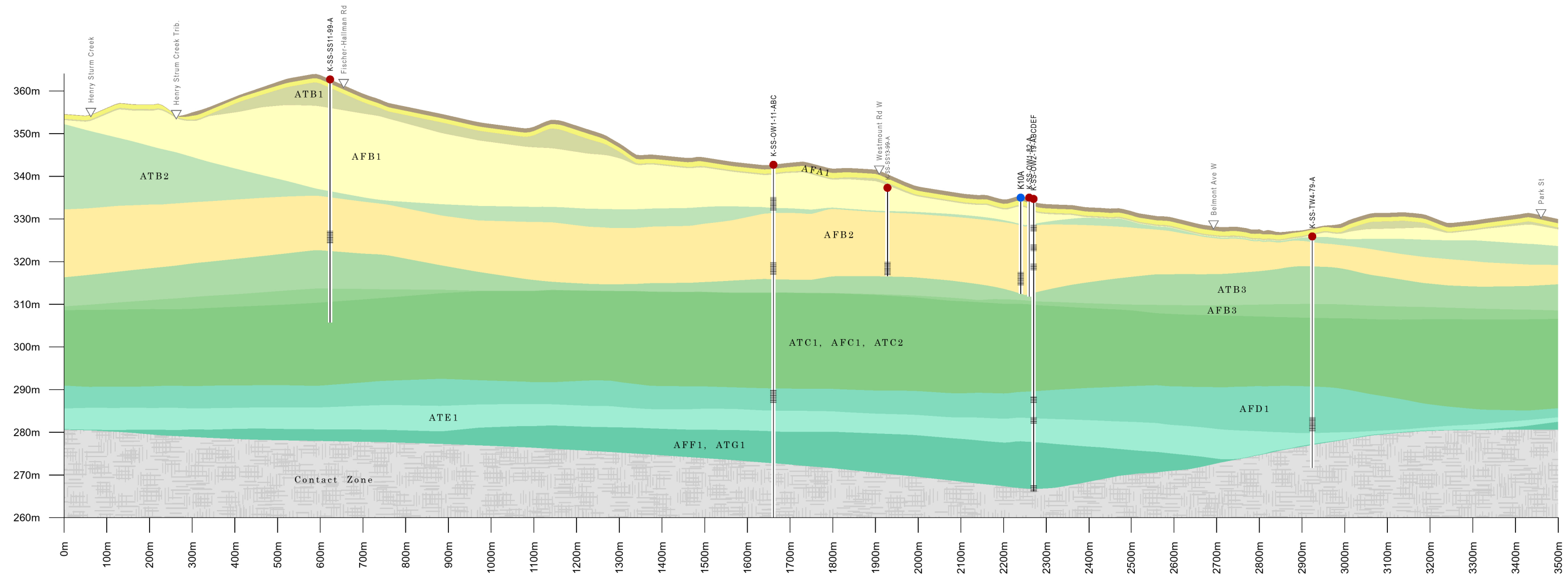
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Figure No.

5

A

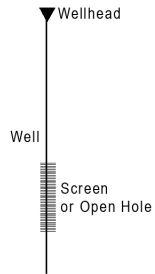
A'



Wells

- Production Well (Active) ● Monitoring Well

 Surficial Geology, Whittlesey Clay (ATA1)	 Upper Waterloo Moraine Stratified Sediments & Equivalents (AFB1)	 Lower Maryhill Till & Stratified Equivalents (ATB3)	 Pre-Catfish Creek Coarse-Grained Glaciofluvial/Lacustrine Deposits (AFD1)	 Weathered Bedrock
 Whittlesey Sand (AFA1)	 Middle Maryhill Till & Equivalents (ATB2)	 Lower Waterloo Moraine Stratified Sediments or Catfish Creek Till Outwash (AFB3)	 Canning Drift, Till & Fine Textured Glaciolacustrine Deposits (ATE1)	
 Upper Maryhill, Port Stanley, Tavistock, Mornington, & Stratford Tills (ATB1)	 Middle Waterloo Moraine Stratified Sediments & Equivalents (AFB2)	 Upper/Main Catfish Creek Till (ATC1), Middle Catfish Creek Stratified Deposits (AFC1), Lower Catfish Creek Till (ATC2)	 Pre-Canning Coarse Textured Glaciofluvial / Glaciolacustrine Deposits (AFF1), Pre-Canning Coarse Textured Till (ATG1)	



Client
REGION OF WATERLOO

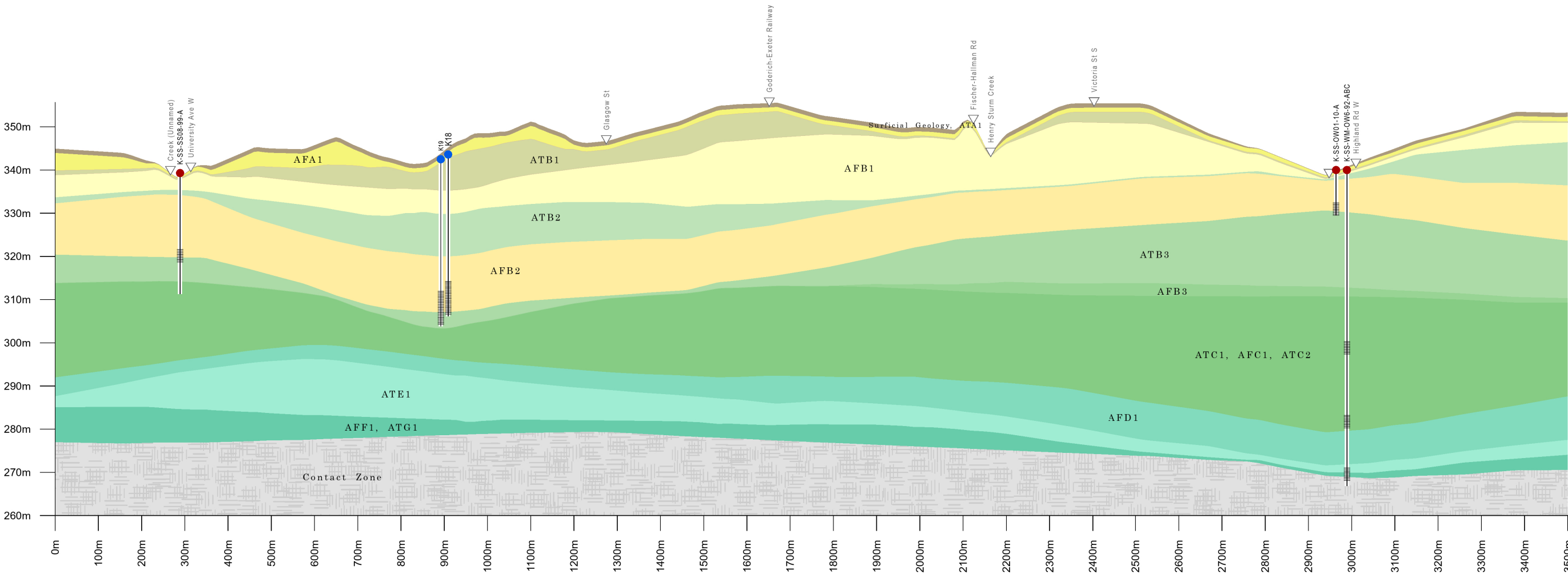
Figure Title
**GEOLOGIC CROSS SECTION
REGION OF WATERLOO**
Strange Street
Cross Section A - A'

Drawn PS	Checked DH	Date 2026/06/19	Figure No. 6
Horizontal Scale 1:10,000		Project No.	
Vertical Ex.:10x		HA046402	

Moraine Model 2026

B

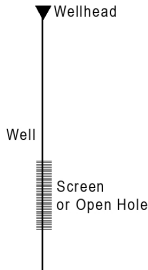
B'



Wells
● Production Well (Active) ● Monitoring Well

Moraine Model 2026

 Surficial Geology, Whittlesey Clay (ATA1)	 Upper Waterloo Moraine Stratified Sediments & Equivalents (AFB1)	 Lower Maryhill Till & Stratified Equivalents (ATB3)	 Pre-Catfish Creek Coarse-Grained Glaciofluvial/Lacustrine Deposits (AFD1)	 Weathered Bedrock
 Whittlesey Sand (AFA1)	 Middle Maryhill Till & Equivalents (ATB2)	 Lower Waterloo Moraine Stratified Sediments or Catfish Creek Till Outwash (AFB3)	 Canning Drift, Till & Fine Textured Glaciolacustrine Deposits (ATE1)	
 Upper Maryhill, Port Stanley, Tavistock, Mornington, & Stratford Tills (ATB1)	 Middle Waterloo Moraine Stratified Sediments & Equivalents (AFB2)	 Upper/Main Catfish Creek Till (ATC1), Middle Catfish Creek Stratified Deposits (AFC1), Lower Catfish Creek Till (ATC2)	 Pre-Canning Coarse Textured Glaciofluvial / Glaciolacustrine Deposits (AFF1), Pre-Canning Coarse Textured Till (ATG1)	



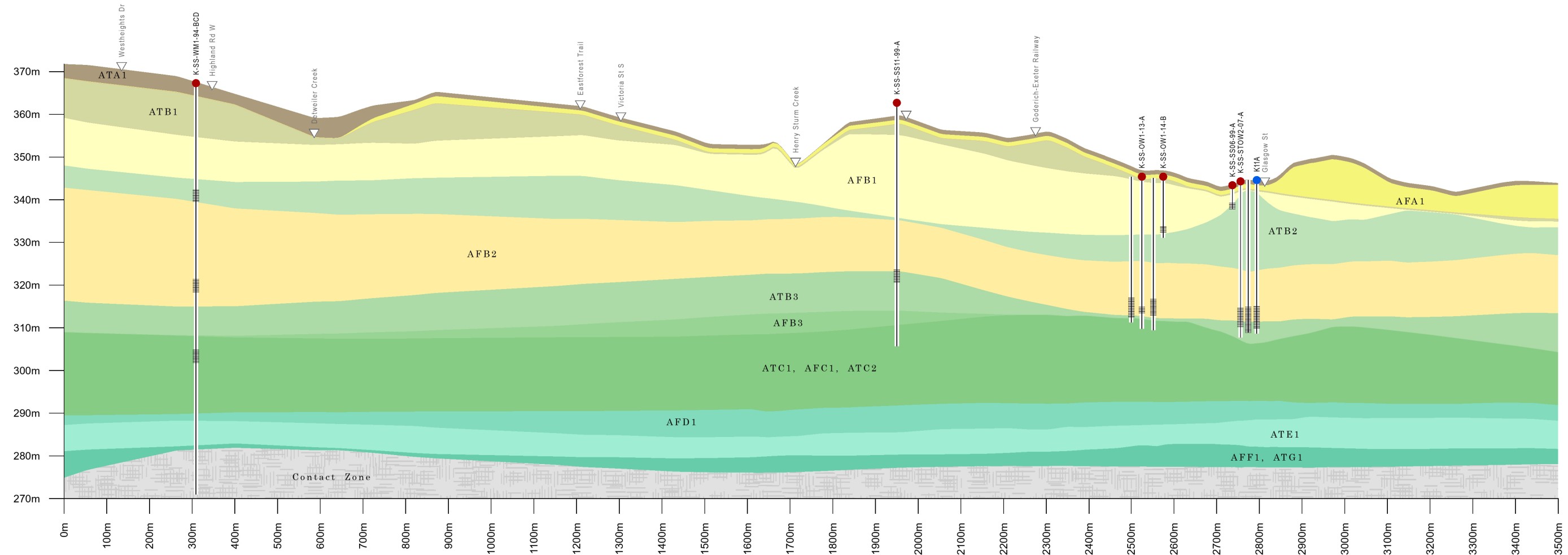


Client
REGION OF WATERLOO

Figure Title GEOLOGIC CROSS SECTION REGION OF WATERLOO Strange Street Cross Section B - B'			
Drawn PS	Checked DH	Date 2026/06/01	Figure No. 7
Horizontal Scale 1:10,000		Project No. HA046402	
Vertical Ex.:10x			

C

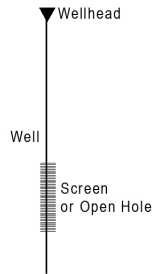
C'



Wells

- Production Well (Active) ● Monitoring Well

 Surficial Geology, Whittlesey Clay (ATA1)	 Upper Waterloo Moraine Stratified Sediments & Equivalents (AFB1)	 Lower Maryhill Till & Stratified Equivalents (ATB3)	 Pre-Catfish Creek Coarse-Grained Glaciofluvial/Lacustrine Deposits (AFD1)	 Weathered Bedrock
 Whittlesey Sand (AFA1)	 Middle Maryhill Till & Equivalents (ATB2)	 Lower Waterloo Moraine Stratified Sediments or Catfish Creek Till Outwash (AFB3)	 Canning Drift, Till & Fine Textured Glaciolacustrine Deposits (ATE1)	
 Upper Maryhill, Port Stanley, Tavistock, Mornington, & Stratford Tills (ATB1)	 Middle Waterloo Moraine Stratified Sediments & Equivalents (AFB2)	 Upper/Main Catfish Creek Till (ATC1), Middle Catfish Creek Stratified Deposits (AFC1), Lower Catfish Creek Till (ATC2)	 Pre-Canning Coarse Textured Glaciofluvial / Glaciolacustrine Deposits (AFF1), Pre-Canning Coarse Textured Till (ATG1)	



Client
REGION OF WATERLOO

Figure Title
**GEOLOGIC CROSS SECTION
REGION OF WATERLOO**
Strange Street
Cross Section C - C'

Drawn PS	Checked DH	Date 2026/06/19	Figure No. 8
Horizontal Scale 1:10,000		Project No.	
Vertical Ex.:10x		HA046402	

Moraine Model 2026



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Appendix A

Permit To Take Water



PERMIT TO TAKE WATER

Ground Water

NUMBER P-300-6221899077

Version: 1.0

Effective Date: June 30, 2023

Expiry Date: June 29, 2033

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

REGIONAL MUNICIPALITY OF WATERLOO

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

For the water taking from

K11A

K13B

K18

K19

K10A

Located at:

500 Glasgow Street
175 Westwood Drive
660 Glasgow Street
325 Gage Ave
Kitchener, Waterloo, ON

This Permit cancels and replaces Permit Number 7163-A27HM3, issued on November 19, 2012.

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
Guelph District Office
Guelph District Office
Guelph District Office
of the Ministry.

e. "Permit" or "PTTW" means this Permit to Take Water No. P-300-6221899077 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 April 14, 2023, and all Schedules included in this Permit.
- 1.2. The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.
- 1.3. Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.
- 1.4. This Permit is not transferable to another person without the Director's written consent.
- 1.5. This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.
- 1.6. The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.
- 1.7. The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change.

2. General Conditions and Interpretation

2.1. Inspections

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

2.2. Other Approvals

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

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

2.3. Information

The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person

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

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

2.4. Rights of Action

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

2.5. Severability

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

2.6. Conflicts

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

3. Water Takings Authorized by This Permit

3.1. Expiry

This Permit expires on June 29, 2033. No water shall be taken under authority of this Permit after the expiry date.

3.2. Amounts of Taking Permitted

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

Table A (litres)

	Source Name / Description	Source Type	Purpose Category	Specific Purpose	Activity	Maximum Taken per minute	Maximum Number of Hours Taken per day	Maximum volume per Day	Maximum days in a year	Zone / Easting / Northing
1	K13B (K13B)	Well	Public administration	Municipal Supply	Water Supply	11467	24	16512480	365	17 / 537868 / 4810209
2	K11A (K11A)	Well	Public administration	Municipal Supply	Water Supply	11467	24	16512480	365	17 / 537828 / 4810474
3	K18 (K18)	Well	Public administration	Municipal Supply	Water Supply	11467	24	16512480	365	17 / 537286 / 4810639
4	K19 (K19)	Well	Public administration	Municipal Supply	Water Supply	11467	24	16512480	365	17 / 537263 / 4810645
5	K10A (K10A)	Well	Public administration	Municipal Supply	Water Supply	11467	24	16512480	365	17 / 538909 / 4810439
Total Taking								16512480		

3.3. Notwithstanding the Maximum Volume per Day specified in the Table A of Condition 3.2, the total taking from the well field (in any combination of five listed wells) shall not exceed an annual daily average of 10,575,000 litres per day.

4. Monitoring

4.1. The Permit Holder shall maintain a record of all water takings. The daily volume of water taken shall be measured by a flow meter or calculated in accordance with the method described in the application for this Permit, or as otherwise accepted by the Director.

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

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

- K-SS-STOW2-07-A
- K-SS-SS11-99-A
- K-SS-OW1-82-A
- K-SS-SS13-99-A
- K-SS-SS08-99-A
- K-SS-OW1-13-A
- K-SS-OW1-14-B

4.3. The Permit Holder shall submit a report every two years by June 30th that presents the results of the water level monitoring conducted over the two preceding calendar years. The report shall assess changes in water levels in the supply aquifer in relation to precipitation and the water taken from the aquifer. The report shall also provide a summary for all interference complaints received by the Permit Holder and the manner in which the Region has dealt with the complaint. The first report shall be submitted to the Director by June 30th, 2024 and shall summarize the data collected for the years 2022 and 2023.

5. Impacts of the Water Taking

5.1. Notification

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

5.2. Impacts for Water Situation Type

For Surface-Water Takings

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

For Groundwater Takings

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

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

6. Director May Amend Permit

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

REASONS

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

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

APPEAL PROVISIONS

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

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

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

- a. The name of the appellant;
- b. The address of the appellant;
- c. The permit to take water number;
- d. The date of the permit to take water;
- e. The name of the Director;
- f. The municipality within which the works are located;

This Notice must be served upon:

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

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

Dated at Hamilton this 29th day of June, 2023



Adam Leus

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-300-6221899077 Version Number 1.0, dated June 29, 2023.



BURNSIDE

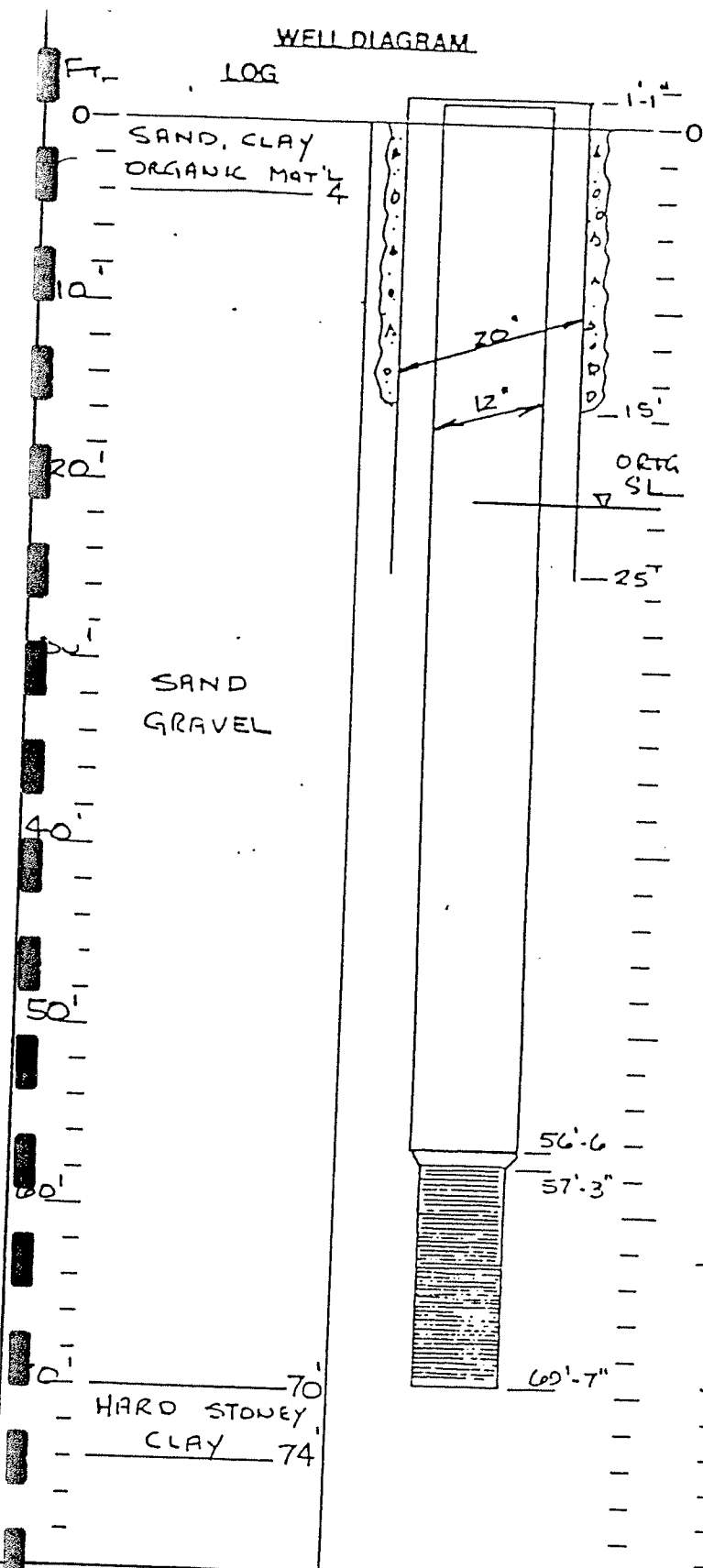
[THE DIFFERENCE IS OUR PEOPLE]

Appendix B

Well Records

WELL DIAGRAM

LOG



WELL MATERIAL

Outer Casing: 20" dia. 0.375" Wall Thk. Matl.: STL
 Cemented from 0" to 15"
 Inner Casing: 12" dia. 0.375" Wall Thk. Matl.: STL
 Screen: Make John 10" dia., Opening & Matl.: #5 SS
 Plug: Type PLATE Matl. SS Other: -
 Gravel: Type SILICA, Size 1/2" X 3/4" Quantity 10T

WELL TEST DATA

Preliminary Test Date: SEPT 20/02 by A.G.
 Static Level: 21.15" below M.P. ±1.5
 Pumping Rate IGM: 350 IGM
 Pumping Duration: 8 hrs. - min.
 Pumping Level at Test End: 39.25"
 Performance Plots: dd-t Dwg. A-82326-27
 dd-r Dwg. A-82328
 Step Test B-82286

Final Test: Date _____ by _____
 Rated Well Capacity IGM _____
 Pumping Rate IGM _____ Static level _____"
 Pumping level _____" at _____ hrs. _____ min.
 Pump pressure: _____ psi Main pressure _____ psi
 Shut off: AGH _____ psi W.L. _____"
 Clear Well Depth from B.P. _____" Air Line _____"

PUMP & MOTOR DATA

Pump Make _____ Rating _____ IGM @ _____' TH
 Head: Type _____ S.N. _____
 Column: _____' X _____" X _____": Shaft Mtl: _____
 Bowl: _____ Stage _____ Curve: _____
 Suction: _____" dia. _____' Long
 Special: Zinc Sleeves _____: Taped Oil Line _____
 Other _____
 Motor Make: _____ Frame: _____ S.N.: _____
 _____ HP, _____ ph, _____ hz, _____ rpm, _____ Volts
 Bearing No. Upper _____
 Lower _____

Special Equipment

WELL REVISIONS AND REHABILITATION

DATE	WORK DONE	BY
	<u>Work Copy</u>	

International Water Supply Limited
 SASKATOON - BARRIE - MONTREAL

CLIENT: REGION of WATERLOO
 WELL NO: K10A

DRILLED BY: A.G.

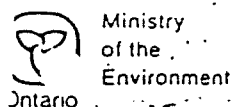
DATE:

DRAWN: /S

INSTALLED BY:

DATE:

DATE Sept 20/02



The Ontario Water Resources Act

Ontario

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

COUNTY OR DISTRICT WATERLOO		TOWNSHIP, CARRIAGE, CHURCH, VILLAGE KITCHENER		CON. BLOCK, TRACT, SURVEY ETC. —		LOT —
WHERE (SURNAME FIRST) REGION of WATERLOO		ADDRESS MARSLAND CENTRE - WATERLOO		DATE COMPLETED OCT 24 1984		BY Sgt. 02

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

[illegible]

WATER RECORD		
WATER FOUND AT - FEET	KIND OF WATER	
5-70	☒ FRESH	☐ SULPHUR
	☐ SALTY	☐ MINERAL
	☐ FRESH	☐ SULPHUR
	☐ SALTY	☐ MINERAL
	☐ FRESH	☐ SULPHUR
	☐ SALTY	☐ MINERAL
	☐ FRESH	☐ SULPHUR
	☐ SALTY	☐ MINERAL
	☐ FRESH	☐ SULPHUR
	☐ SALTY	☐ MINERAL

CASING & OPEN HOLE RECORD				
INSIDE DIA IN FEET	MATERIAL	WELL FACE - HOLE IN FEET	DEPTH - FEET	
			FROM	TO
12 1/4	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE	375		25
12	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE	375		56-9
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE			

SCREEN	WEIGHT OF OPENING SHEET NO. # 50	DIMETER .10	LENGTH .12	FEET
	MATERIAL AND TYPE S.S. WIRE WRAP		DEPTH TO TOP OF SECTION 57'-3	

PLUGGING & SEALING RECORD			
DEPTH SET AT - FEET		MATERIAL AND TYPE	PERCENT GROUT (LEAD PACKED, ETC.)
FROM	TO		
0	15	3" GROUT AROUND	
		20" CASING	

PUMPING TEST METHOD		PUMPING RATE		SECTION OF PUMPING	
☒ PUMP ☐ BAILER		350 gpm		8 HOURS -	
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING		☒ PUMPING ☐ RECOVERY	
21.15 FEET	39.25 FEET	15 MINUTES 36.52 FEET	30 MINUTES 36.89 FEET	45 MINUTES — FEET	60 MINUTES 37.18 FEET
15 GPM	PUMP INITIAL SET AT		WATER AT END OF TEST		
	6PM		☒ CLEAR ☐ CLOUDY		
RECOMMENDED PUMP TYPE		RECOMMENDED PUMP SETTING		RECOMMENDED PUMPING RATE	
☐ SHALLOW ☒ DEEP		50 FEET		gpm	

FINAL STATUS OF WELL	☒ WATER SUPPLY ☐ DEGRADATION WELL ☐ TEST HOLE ☐ RECHARGE WELL	☐ ABANDONED INSUFFICIENT SUPPLY ☐ ABANDONED FOUR QUALITIES ☐ UNFINISHED
WATER USE	☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER	☐ COMMERCIAL ☒ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED
METHOD NG	☐ CABLE TOOL ☒ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSES) ☐ ROTARY (AIR) ☐ AIR PERCUSSION	☐ BORING ☐ MANDRAM ☐ JETTING ☐ DRIVING

LOCATION OF WELL K10A

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

CNR

1500'

80'

K10A

GAGE ST.

BELMONT AVE

14VE

N.

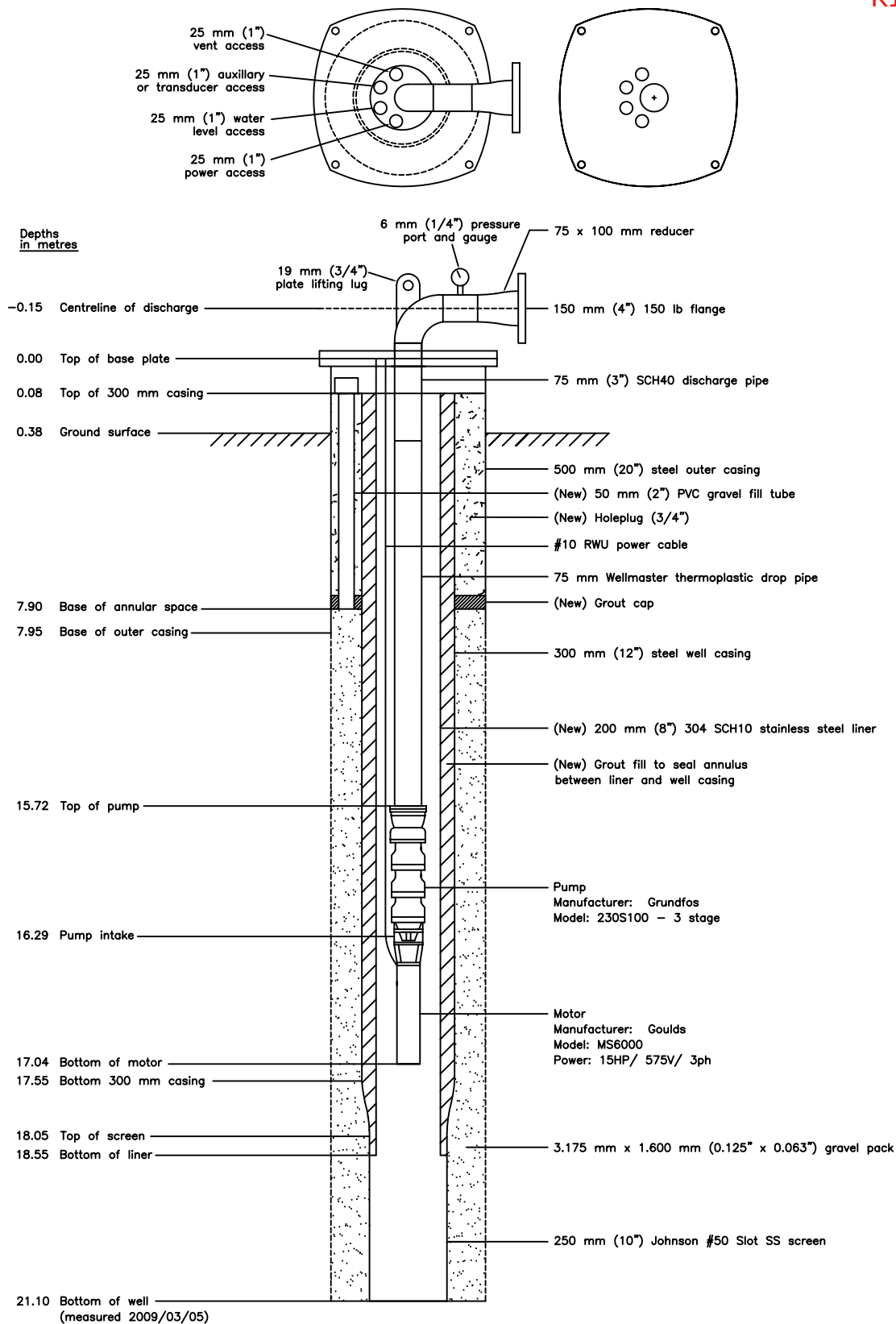
DRILLING REMARKS

NAME OF WELL CONTRACTOR		LICENCE NUMBER
International Water Supply Ltd		ZB01
ADDRESS		
42 Bayview Drive Barrie Ont		
NAME OF DRILLER OR BOILER		LICENCE NUMBER
A. GRIMSTER		
SIGNATURE OF CONTRACTOR		EXPIRATION DATE

ANCE USE ONLY

**SCH40 304 SS x 25 mm (1") thick base plate
(Adapted to existing Layne TP618 base plate)**

K10A



NOTES

- (1) All measurements referenced to top of base plate.
- (2) All existing components unless otherwise specified.
- (3) Static water level = 4.64 m measured 2009/03/12.
- (4) Existing pump, motor and PVC discharge hose installed 2006.



CLIENT

Regional Municipality of Waterloo

TITLE

**K10A Well
Liner and Pump Installation (As-Installed)**

PROJECT No. **006-121**

G:\Lotowater Projects\006 Region of Waterloo\121...Liner & Pump Installation (As-Installed) K10A.dwg

DESIGN
DRAWN
CHECKED

MO 2009/01/26

REVISION No. 1

SCALE **N.T.S.**

FIGURE
2

Client: Regional Municipality of Waterloo	Project Name: K11A	Logged by: D. Wilson
Project No.: MSO 09419	Location: Glasgow Street, Kitchener	Ground (m amsl): 346
Drilling Co.: Davidson Well Drilling	Date Started: 2/20/2007	Static Water Level (m amsl):
Drilling Method: Mud Rotary	Date Completed: 2/23/2007	Sand Pack (m amsl):

Depth Scale (ft) (m)	Stratigraphic Description	Strat. Plot	Depth (m)		SAMPLE			Depth Scale (ft) (m)
					Num.	Type	Int.	
	Surface Elevation (m): 346.00							
1.0 5.0 2.0 10.0 3.0 4.0 15.0 5.0 20.0 6.0 7.0 25.0 8.0 30.0 9.0 35.0 11.0 40.0 12.0 45.0 13.0 50.0 14.0 55.0 15.0 60.0 16.0 65.0 17.0 70.0 18.0 75.0 19.0 80.0 20.0 85.0 21.0 90.0 22.0 95.0 23.0 100.0 24.0 105.0 25.0 110.0 26.0 31.0 32.0 33.0 34.0	Light brown sandy clay TILL.							1.0 5.0 2.0 10.0 3.0 4.0 15.0 5.0 20.0 6.0 7.0 25.0 8.0 30.0 9.0 35.0 11.0 40.0 12.0 45.0 13.0 50.0 14.0 55.0 15.0 60.0 16.0 65.0 17.0 70.0 18.0 75.0 19.0 80.0 20.0 85.0 21.0 90.0 22.0 95.0 23.0 100.0 24.0 105.0 25.0 110.0 26.0 31.0 32.0 33.0 34.0
	Light grey silty clay TILL.		5.18					
				cement				
	Light grey medium SAND with silt deposits.		22.55					
	Grey medium to fine SAND.		24.69					
	Light brownish grey coarse SAND with gravel.		26.20					
				native granular material				
	Grey dense CLAY.		34.14					
			34.75					
	UTM: E537828.381 N4810474.847							

Prepared By: **D. Wilson** Checked By: **J. Baxter** Date Prepared: **8/13/2007**

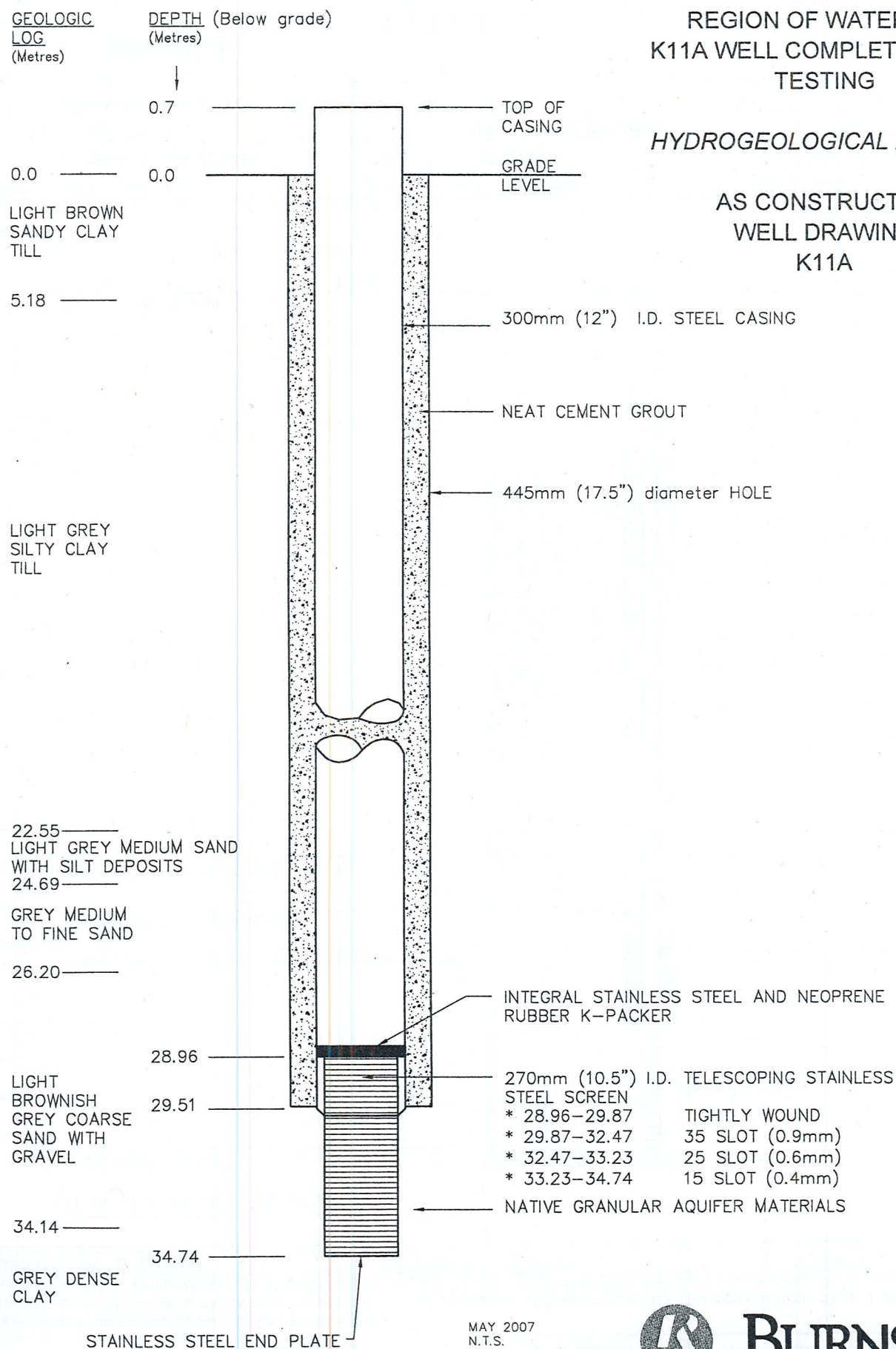
This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND	MONITORING WELL DATA	SAMPLE TYPE	AC	Auger Cutting	SS	Split Spoon
Water found @ time of drilling	Pipe: 300 mm Steel	CS	Continuous	AR	Air Rotary	
Static Water Level - 3/21/2007	Screen: 270 mm Stainless Steel	RC	Rock Core	WC	Wash Cuttings	

FIGURE 6
REGION OF WATERLOO
K11A WELL COMPLETION AND
TESTING

HYDROGEOLOGICAL REPORT

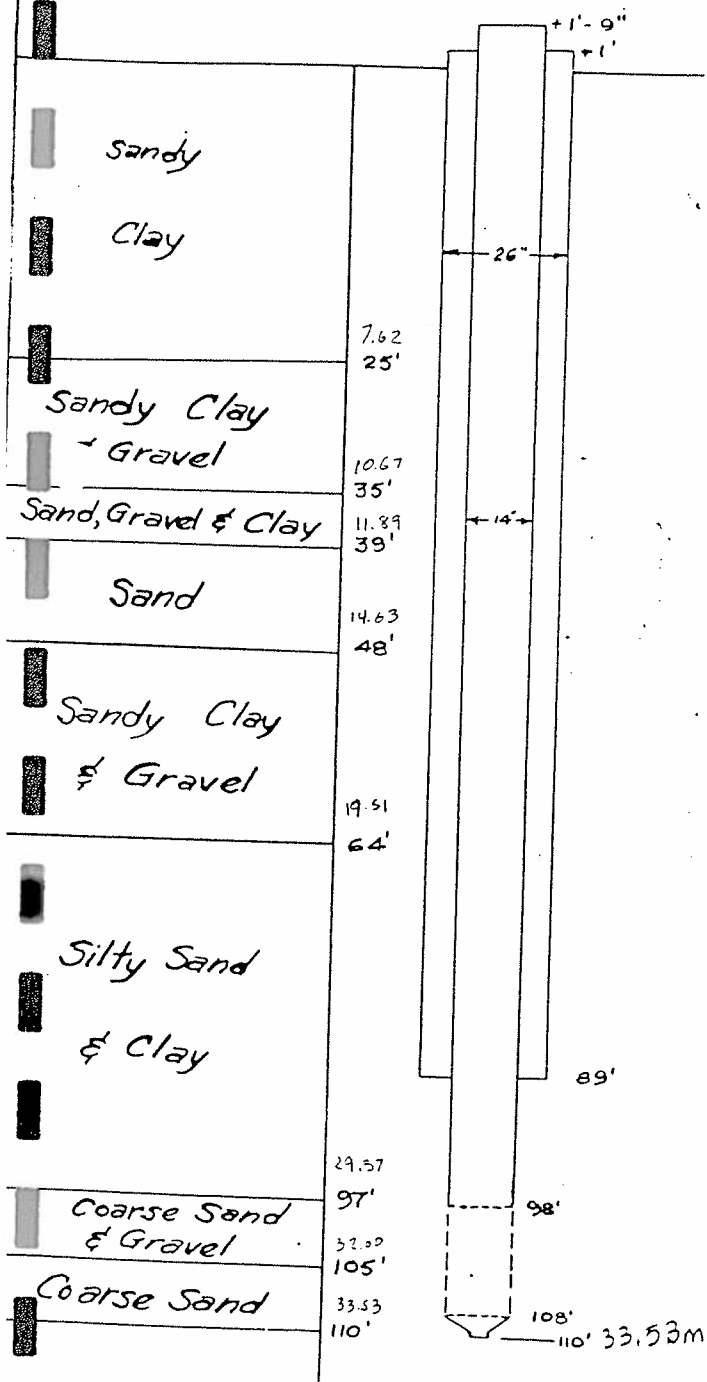
AS CONSTRUCTED
WELL DRAWING
K11A



MAY 2007
N.T.S.
FILE NO.: MSO 09419



BURNSIDE

Material

Pit: 90' ft. of 26" welded
100 ft. of 14" welded

Screen: 10' of 14" Everdur, #6

Plug: W.O.

Pump

Type WMC

Setting 90'

Suction 10' of 8"

Basket

Discharge 8"

Tubing 2 1/2"

Shafting 1 1/2"

Shop No. 16936

Size 12"

Stages (4) 3(-)

Impellers Bronze

Head TF 818

Press. B. P.

Length Air Line 106'-1'

Motor

Make GE

Volts 550

Phase 3

H. P. 40

Frame 445P

Model

Type K

Cycle (25) 60

Amp. 45.5

R. P. M. (1450) 1750

Form

Serial OF 6749098

Well

Started Sept. 13/46

First Test Nov. 22/46

Final "

Accepted

Clear Depth 110'

Static Level 26'-6"

Production 633 GPM

Pumping Level

Guarantee

Press.

Driller: L. Oliver

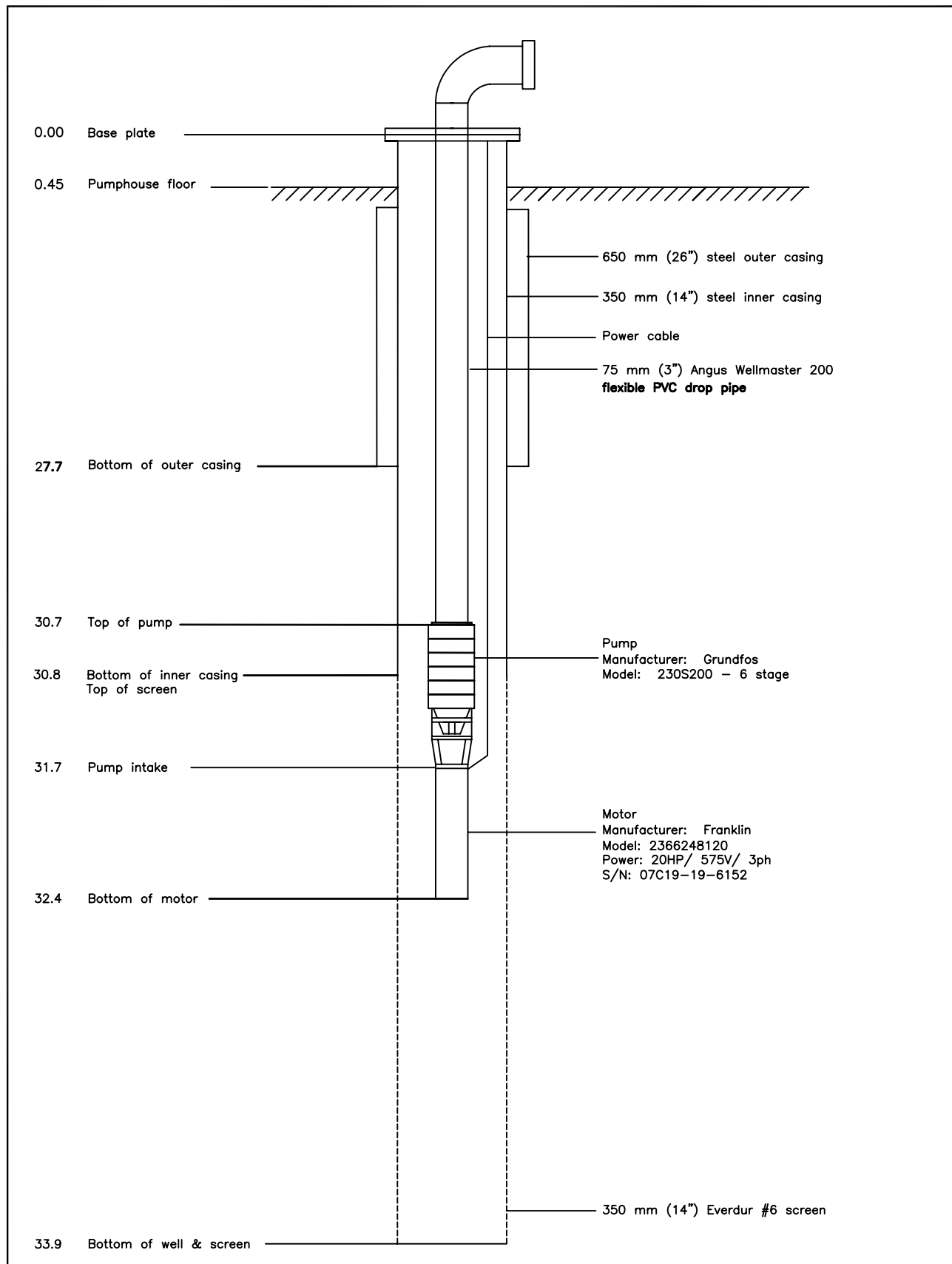
Installer:

INTERNATIONAL WATER SUPPLY LTD.
LONDON, CANADA APR 12/62
WATER SUPPLY CONTRACTORS

KITCHENER WATER COMMISSION
KITCHENER, ONT.

DRAWN BY D.H.C.

APPROVED BY

**NOTES**

(1) All measurements referenced to top of casing.

**CLIENT**

Regional Municipality of Waterloo

TITLEK13 Well
Pump Installation Drawing

PROJECT No. 006-133

G:\Lotowater Projects\006 Region of Waterloo\133 Submersible Pump Installation Drawing\K13.dwg

DESIGN

REVISION No. FINAL

SCALE N.T.S.

DRAWN

EH 2009/11/06

SCALE (m)



CHECKED



FIGURE

3

Borehole: K-SS-TW1-13

Project: 2013 Well Construction and Testing
Client: Regional Municipality of Waterloo
Location:Region of Waterloo; Strange Street Well Field
Number: 1609-00734

Field Investigator: J. Koch
Contractor: Gerrits Well Drilling Inc.
Drilling method: DR24, truckmount, air rotary
Date started/completed:02-Oct-2013 / 20-Jan-2014

K13A

SUBSURFACE PROFILE				HYDROGEOLOGY	SAMPLE DETAILS	GEOPHYSIC DETAILS	WELL DETAILS	
Depth	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Type	Gamma (cps)	Name: K-SS-TW1-13 Location: 9207059 GS Elev: 345.27 m AMSL TOC Elev: 345.88 m AMSL Easting: 4810223.0 Northing: 537876.8 Stick-up: 0.61 m
(ft) (m)			345.88 345.27 0.00				20 40 60 80	
0		Ground Surface						← Capped Steel Casing
5		SILTY SAND TO SANDY SILT fine grained sand, trace fine grained gravel, brown, dry		AFB1	Upper Waterloo Moraine	GB		
10						GB		
15						GB		
20			338.78			GB		
25		CLAYEY SILT brown	6.49	ATB2	Middle Maryhill Till	GB		← 508 mm Diameter Borehole (0 to 32.3 m BGS)
30		SAND fine to medium grained sand, trace fine grained gravel, brown, moist medium grained sand, little fine sand beginning at 9.1 m BGS	337.29 7.99			GB		← 324 mm (OD) Casing (0.0 m to 28.3 m BGS)
35						GB		
40						GB		
45		some fine grained gravel from 14.0 to 15.2 m		AFB2	Middle Waterloo Moraine	GB		
50			330.28			GB		
55		CLAYEY SAND to SANDY CLAY fine grained sand, trace fine grained gravel, brown, moist	15.00			GB		← Cement Seal (0.0 m to 19.5 m BGS)
60		CLAY trace sand, brown, moist	327.17 18.11			GB		
65		SILTY SAND fine grained sand, trace fine grained gravel, brown, moist	325.67 19.60	AFB2	Middle Waterloo Moraine	GB		← Bentonite Chips (19.5 m to 22.6 m BGS)
70						GB		
75			322.08			GB		
80		CLAYEY SAND to SANDY CLAY fine grained sand, trace fine grained gravel, brown, moist	23.20			GB		
85				ATB3	Lower Maryhill Till	GB		← Natural Cave (22.6 m to 32.3 m BGS)
90		SAND fine and medium grained, little coarse grained sand, trace gravel, brown, wet	318.27 27.01			GB		← Lead Pipe and K-Packer (27.1 m to 28.3 m BGS)
95						GB		
100		some coarse grained sand beginning at 30.4 m BGS				GB		
105		medium and coarse grained sand, some fine grained sand being at 32.0 m BGS	312.78	ATB3	Lower Maryhill Till	GB		← 286 mm OD Stainless Steel Telescopic Screen No. 15 to No. 25 Slot from 28.3 m to 32.3 m BGS
110		SILTY CLAY TILL	32.49			GB		
115								
120		End of Borehole	309.61 35.66					← Gravel from 32.3 m to 35.7 m BGS within 152 mm Borehole
125								

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

Geophysics completed on October 29, 2013

Stainless Steel Telescopic Screen No. 15 Slot from 28.3 m BGS to 30.2 m BGS
Transition from 30.2 m BGS to 30.8 m BGS
No. 25 Slot from 30.8 m BGS to 32.3 m BGS

WRAS No. 9207059



Drawn By/Checked By: NS/ LV

Sheet 1 of 1

Production Well: K13B

Project: K13B Well Installation
Client: Region of Waterloo
Location: Westwood Park, Waterloo
Number: 160900966

Field Investigator: D. Smith / J. Murray
Contractor: Well Initiatives Limited
Drilling method: Mud Rotary
Date started/completed: 27-Jan-2022 / 10-Jun-2022

Ground surface elevation: 345.40 m AMSL
Top of casing elevation: 346.10 m AMSL
Easting: 537868.5
Northing: 4810209.9

SUBSURFACE PROFILE

SAMPLE DETAILS

GEOPHYSIC DETAILS

WELL DETAILS



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

m AGS - metres above ground surface
Region sys_loc_code: 9207913
MECP Well Tag: A345890



STANTEC BOREHOLE AND WELL - MASTER TX11 160900966_K13B.GPJ DATA TEMPLATE_ENVS_CA_140725.GDT 1/13/23 A HEALEY

Production Well: K13B

Project: K13B Well Installation
Client: Region of Waterloo
Location: Westwood Park, Waterloo
Number: 160900966

Field Investigator: D. Smith / J. Murray
Contractor: Well Initiatives Limited
Drilling method: Mud Rotary
Date started/completed: 27-Jan-2022 / 10-Jun-2022

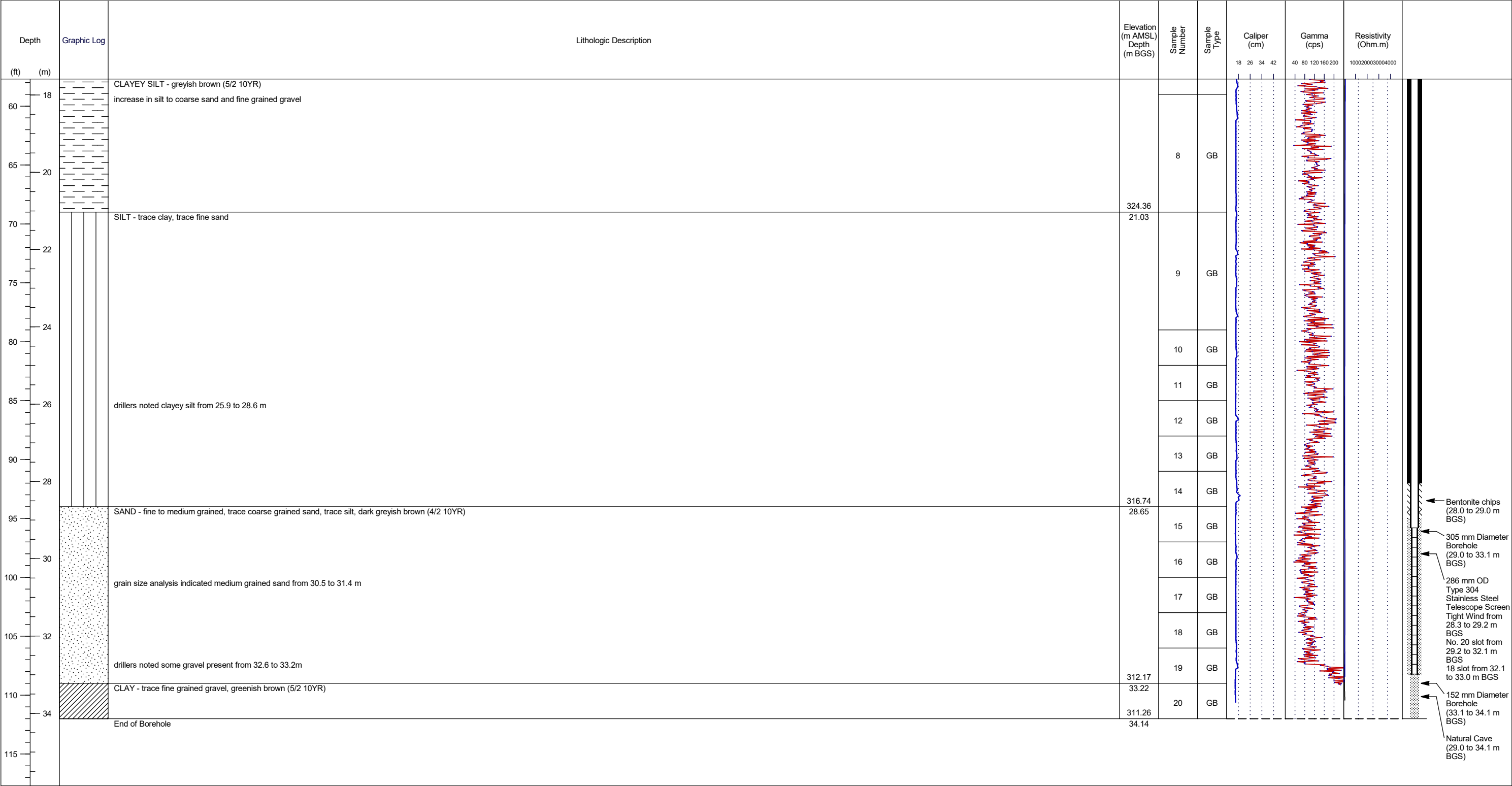
Ground surface elevation: 345.40 m AMSL
Top of casing elevation: 346.10 m AMSL
Easting: 537868.5
Northing: 4810209.9

SUBSURFACE PROFILE

SAMPLE DETAILS

GEOPHYSIC DETAILS

WELL DETAILS

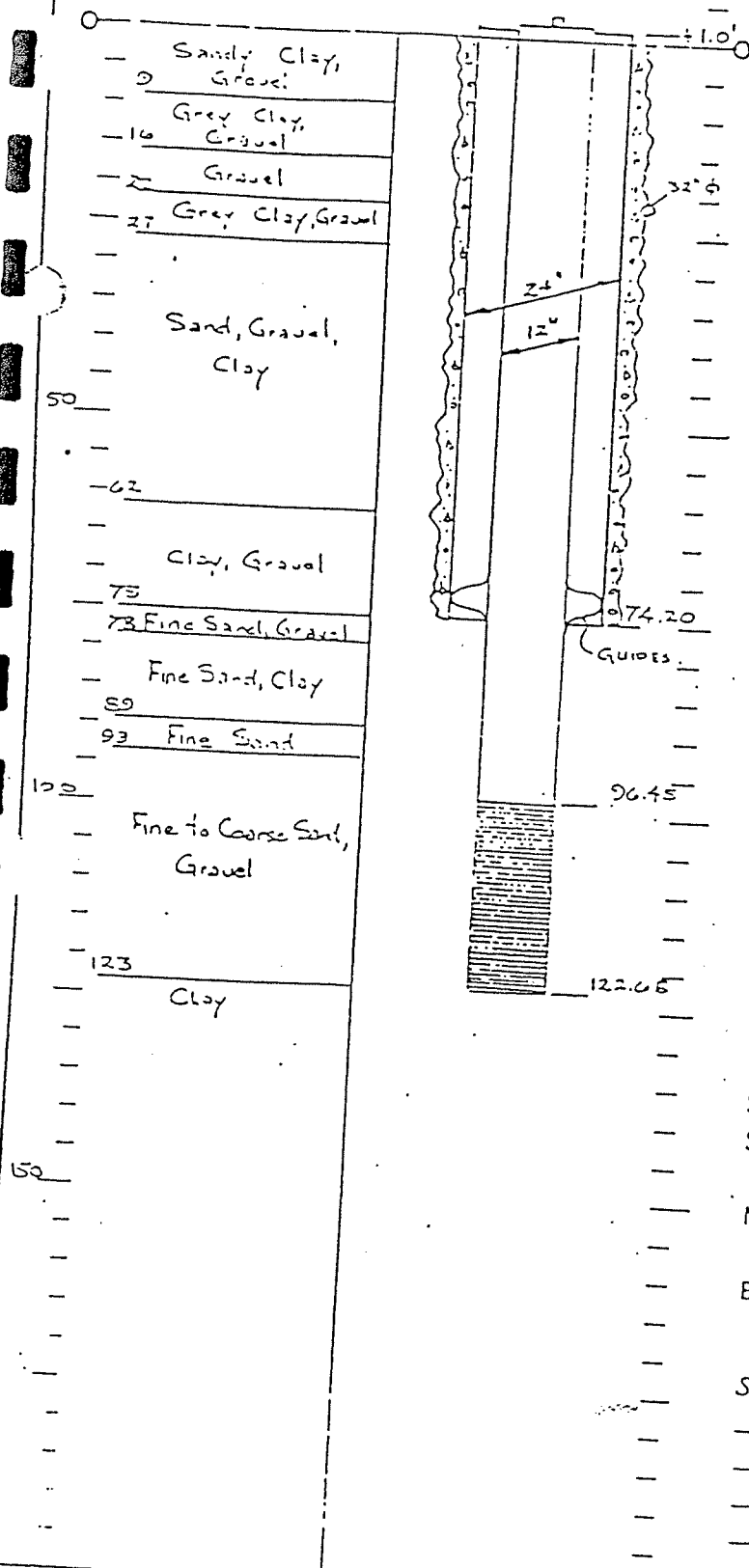


Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
GB - grab sample
n/a - not available/applicable

m AGS - metres above ground surface
Region sys_loc_code: 9207913
MECP Well Tag: A345890

WELL DIAGRAM

LOG



WELL MATERIAL

L-18

Outer Casing: 24" dia., 330" Wall Thk. Matl.: STL
 Cemented from 74' 2 1/2" to G.L.
 Inner Casing: 12" dia., 330" Wall Thk. Matl.: STL
 Screen: Make C&K, 12" dia., Opening & Matl.: S.S.
 Plug: Type PLATE Matl. S.S. Other: —
 Gravel: Type Silica Size 1/2 x 1/4 Quantity 15T

WELL TEST DATA

Preliminary Test Date: Mar 24-25/75 by J. Gray
 Static Level: 11.53 ft " below M.P. + 2.0
 Pumping Rate IGM: 750
 Pumping Duration: 24 hrs. — min.
 Pumping Level at Test End: 58.76 ft
 Performance Plots: dd-t Dwg. A-75126-7-8-9
 dd-r Dwg. A-75131
 Step Test: B-75141

Final Test: Date — by —
 Rated Well Capacity IGM —
 Pumping Rate IGM — Static level —
 Pumping level — " at — hrs. — min.
 Pump pressure: — psi Main pressure — psi
 Shut off: AGH — psi W.L. —
 Clear Well Depth from B.P. — " Air Line — "

PUMP & MOTOR DATA

Pump Make — Rating — IGM @ — TH
 Head: Type — S.N. —
 Column: — X — " X — " : Shaft Mtl: —
 Bowl: — Stage — Curve: —
 Suction: — " dia. — " Long
 Special: Zinc Sleeves — : Taped Oil Line —
 Other —
 Motor Make: — Frame: — SN: —
— HP. — ph. — hz. — rpm
 Bearing No. Upper —
 Lower —

Special Equipment

SCREEN 50 SLOT. WIRE WRAP
GRAVEL 1/8 X 10 MESH SILICA (3 TO)
RE: M ABBOTT

WELL REVISIONS AND REHABILITATION

DATE	WORK DONE	BY

International Water Supply Limited

SASKATOON - BARRIE - MONTREAL

CLIENT: REGIONAL MUNICIPALITY OF WATERLOO

K18

WELL NO: WESTMOUNT 6-CDRILLED BY: J. GrayDATE: Mar 75 DRAWN: 1501INSTALLED BY: —



Ontario

MINISTRY OF THE ENVIRONMENT
The Ontario Water Resources Act
WATER WELL RECORD

K18

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

11

Township, Range, County, Village
City, Block, Fract., Survey, Etc.

Waterloo Region of Waterloo
Hitcher
Marshland Center Hitcher Ont

DATE COMPLETED
DAY 27 - 3

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	WELL COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH FEET
Brown	F. 11			0
Brown	Sandy clay	Gravel	Loose	1
Brown	Clay	Gravel	Firm	9
Brown	Gravel		Hard	16
Grey	Clay	Gravel	Hard	22
Grey	Sand	Gravel, Clay	Firm	27
Grey	Clay	Gravel	Hard	62
Brown	Sand	Gravel, Clay	Loose	75
Brown	Sand fine		Loose	89
Brown	Sand fine to coarse, Gravel		Loose	93
Grey	Clay			123

41 WATER RECORD

WATER FOUND AT - FEET
89-123

KIND OF WATER
☒ FRESH ☐ SULPHUR
☐ SALT ☐ MINERAL
☐ FRESH ☐ SULPHUR
☐ SALT ☐ MINERAL
☐ FRESH ☐ SULPHUR
☐ SALT ☐ MINERAL
☐ FRESH ☐ SULPHUR
☐ SALT ☐ MINERAL

51 CASING & OPEN HOLE RECORD

DEPTH - FEET	WELL DIAMETER INCHES	WELL FINISHES INCHES	DEPTH - FEET	WELL DIAMETER INCHES	WELL FINISHES INCHES
24"	24"	330	72' 0"	12"	330
12"	12"	330	96' 0"		

SCREEN

WELL SIZE OF OPENING
1/2" 50 12" 26

MATERIAL AND TYPE
COOK SS 96

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET

MATERIAL AND TYPE
12" SS Plate

71 PUMP TEST

WATER LEVELS DURING

11.55 58.76 52.11 54.36 55. 55.73

WATER LEVELS DURING

50 700

FINAL STATUS OF WELL

WATER USE

METHOD OF DRILLING

LOCATION OF WELL 1/75

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

2750'

3/14

15'

Well location

Glasgow St

Abertown St

Well on Westmount Golf Club Property

K18

NAME OF WELL

1 W.S.

Box 310 Bartie Ont

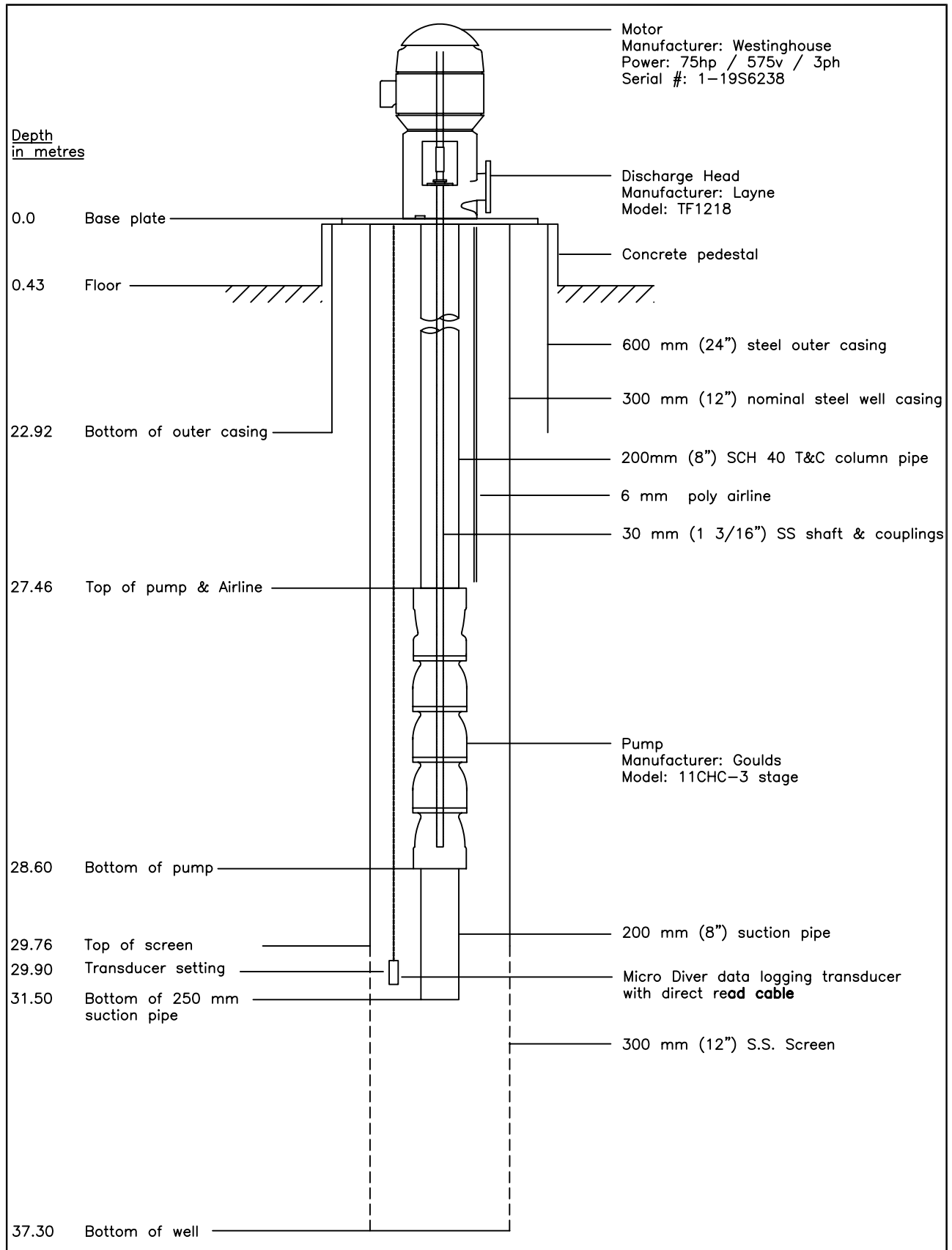
J.C. Gray

31 MAR 75

OFFICE USE ONLY

DATE OF INSPECTION

INSPECTION

**NOTES**

- (1) All measurements below top of base plate which is 0.43 m above pumphouse floor.
- (2) Pump De-staged March 29, 2010
- (3) Static water level = 2.50 m below top of base plate measured March 29, 2010
- (4) All existing components, unless otherwise specified.



CLIENT

Regional Municipality of Waterloo

TITLE

K18
Pump Installation Details

PROJECT No. 006-150

G:\Lotowater Projects\006 Region of Waterloo\150 K18 & K19\K18 Lineshaft Installation.dwg

DESIGN: EH 2010/03/16

DRAWN: EH 2010/03/17

CHECKED:

REVISION No. 2010/05/21

SCALE **N.T.S.**

FIGURE
4

Production Well No.: K19

Project: Construction and Testing of Production Well K19

Date: 20-Dec-04

Project No: 611-10371

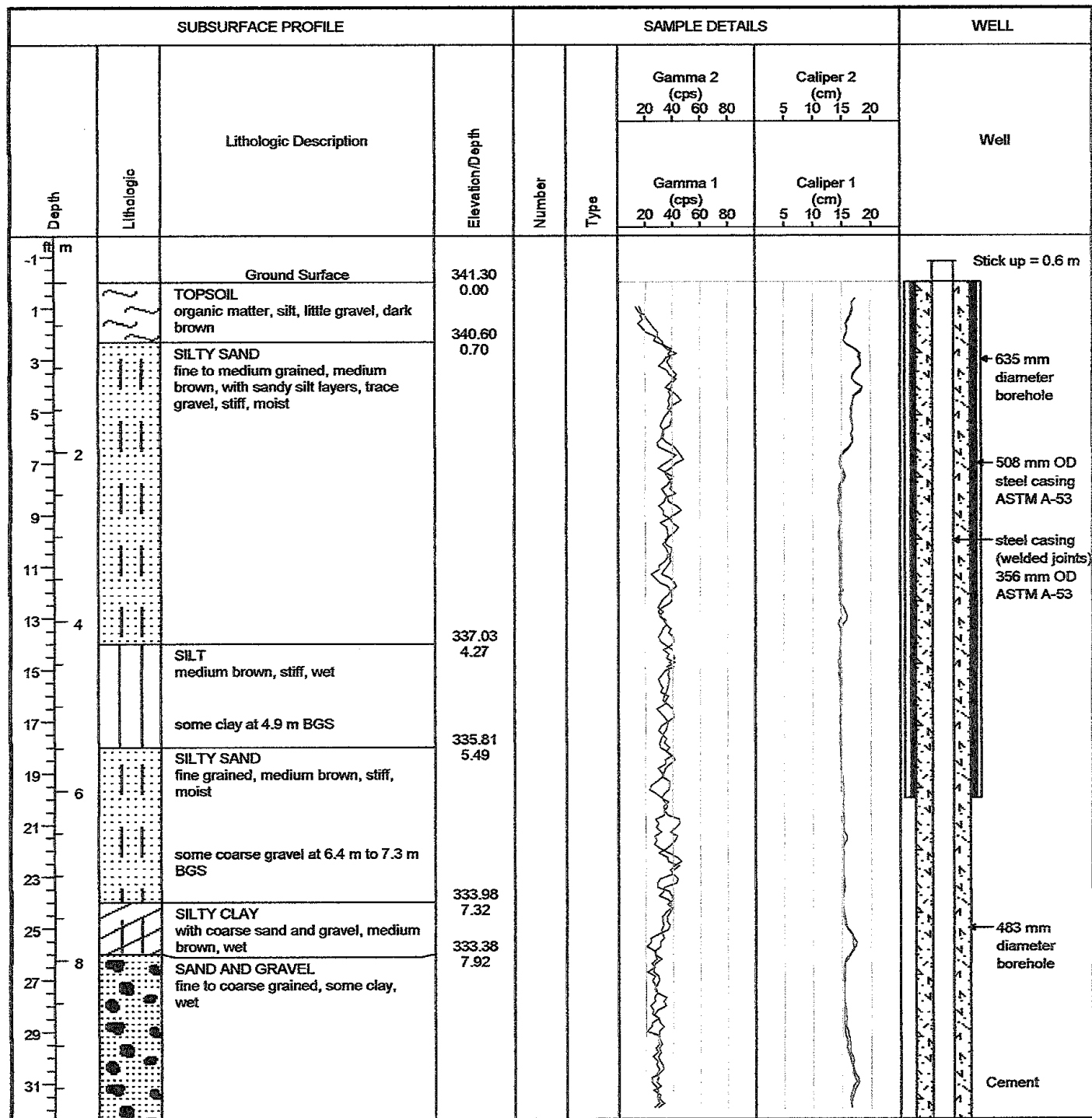
Field Investigator: L.Veale

Location: Westmount Golf and Country Club

Ground Surface: 341.3 m AMSL

Contractor: Davidson Drilling Ltd.

Drilling Method: Mud Rotary



Drawn By/Checked By: OR/LV

Northing: 4810650

Easting: 537262

Notes:
mBGS - metres below ground surface
GRAB - grab sample


Stantec

Stantec Consulting Ltd.
49 Frederick Street
Kitchener, Ontario
N2H 6M7

Production Well No.: K19

Project: Construction and Testing of Production Well K19

Date: 20-Dec-04

Project No: 611-10371

Field Investigator: L.Veale

Location: Westmount Golf and Country Club

Ground Surface: 341.3 m AMSL

Contractor: Davidson Drilling Ltd.

Drilling Method: Mud Rotary

SUBSURFACE PROFILE				SAMPLE DETAILS				WELL
Depth	Lithologic	Lithologic Description	Elevation/Depth	Number	Type	Gamma 2 (cps)	Caliper 2 (cm)	Well
						20 40 60 80	5 10 15 20	
34	11	SAND AND GRAVEL medium to coarse grained sand	330.63 10.67					
36								
38								
40								
42	13	SAND fine grained, medium brown grain size decreasing with depth	328.50 12.80	1	GRAB			
44								
46								
48								
50	15	SILT TO SILTY FINE SAND some clay, medium brown, stiff, moist some sand and coarse gravel at 14.9 m BGS increased clay content at 15.1 m BGS some fine sand at 16.5 m BGS	327.28 14.02					
52								
54								
56								
58	17	SILT AND SAND fine grained, grey brown, stiff, wet some medium grained sand at 17.1 m BGS	324.38 16.92					
60								
62								
64								
	19			2	GRAB			

Drawn By/Checked By: OR/LV

Northing: 4810650

Easting: 537262

Notes:
mBGS - metres below ground surface
GRAB - grab sample



Stantec Consulting Ltd.
49 Frederick Street
Kitchener, Ontario
N2H 6M7

Stantec

Production Well No.: K19

Project: Construction and Testing of Production Well K19

Date: 20-Dec-04

Project No: 611-10371

Field Investigator: L.Veale

Location: Westmount Golf and Country Club

Ground Surface: 341.3 m AMSL

Contractor: Davidson Drilling Ltd.

Drilling Method: Mud Rotary

SUBSURFACE PROFILE				SAMPLE DETAILS				WELL						
Depth	Lithologic	Lithologic Description	Elevation/Depth	Number	Type	Gamma 2 (cps)				Caliper 2 (cm)				Well
						20	40	60	80	5	10	15	20	
						Gamma 1 (cps)				Caliper 1 (cm)				
20						20	40	60	80	5	10	15	20	
67	21	little fine gravel at 20.4 m BGS	318.44 22.86											21 m BGS
69														
71														
73														
75	23	SILTY CLAY TO CLAY SILT grey medium brown, stiff, moist	317.53 23.77											Bentonite
77														
79														
81														
83	25	SAND fine to coarse grained, medium brown, stiff, moist	313.87 27.43											24 m BGS
85														
87														
89														
91	27	streak of silty clay at 24.5 m BGS	312.34 28.96											
93														
95														
97														
	29	some coarse sand at 26 m BGS												
		some clay and gravel at 28.8 m BGS												
		SAND medium grained, medium brown, stiff, moist												

Drawn By/Checked By: OR/LV

Notes:
mBGS - metres below ground surface
GRAB - grab sample

Northing: 4810650

Easting: 537262



Stantec

Stantec Consulting Ltd.
49 Frederick Street
Kitchener, Ontario
N2H 6M7

Production Well No.: K19

Project: Construction and Testing of Production Well K19

Date: 20-Dec-04

Project No: 611-10371

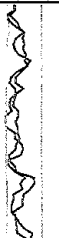
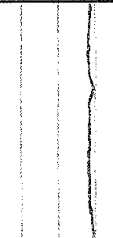
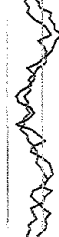
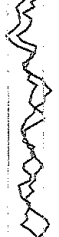
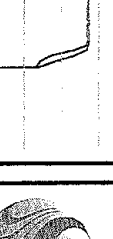
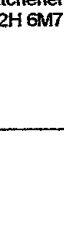
Field Investigator: L.Veale

Location: Westmount Golf and Country Club

Ground Surface: 341.3 m AMSL

Contractor: Davidson Drilling Ltd.

Drilling Method: Mud Rotary

SUBSURFACE PROFILE				SAMPLE DETAILS				WELL							
Depth	Lithologic	Lithologic Description	Elevation/Depth	Number	Type	Gamma 2 (cps)				Caliper 2 (cm)				Well	
						20	40	60	80	5	10	15	20		
						Gamma 1 (cps)				Caliper 1 (cm)					
						20	40	60	80	5	10	15	20		
100	31	SAND medium to coarse grained, medium brown, stiff, moist	310.82	5	GRAB										Top of screen (30 m BGS)
102			30.48												
104			309.30												
106	33	SILT with some clay	32.00	6	GRAB										No.20 Slot Continuous wrap stainless steel Johnson High Capacity well screen (14" pipe size diameter)
108			308.69												
110			32.61												
112	35	SAND fine to coarse grained, medium brown, stiff, moist	33.22	7	GRAB										
114			308.08												
116			33.83												
118	37	SAND medium to coarse grained, medium brown, stiff, moist	307.47	8	GRAB										
120			35.05												
122			306.25												
124	39	some clayey silt at 35.9 m BGS	304.72	9	GRAB										38.1 m BGS Bottom of screen
126			36.58												
128			303.20												
130		CLAY grey, hard	38.10												38.7 m BGS Bottom of borehole
		End of Log	302.90												
			38.40												

Drawn By/Checked By: OR/LV

Notes:
mBGS - metres below ground surface
GRAB - grab sample

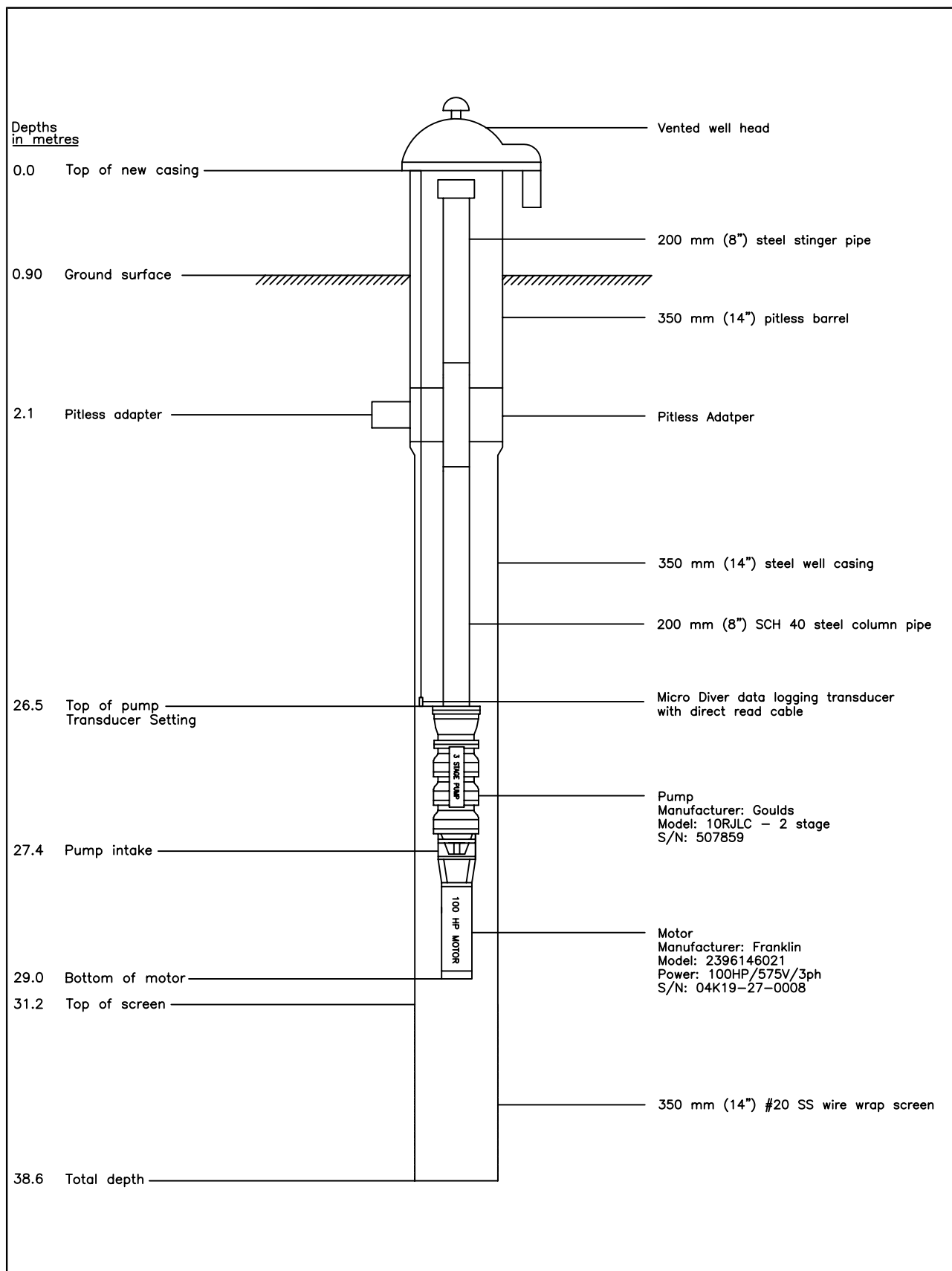
Northing: 4810650

Easting: 537262



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49 Frederick Street
Kitchener, Ontario
N2H 6M7

**NOTES**

- (1) All measurements below top of casing which is 0.90 m above ground.
- (2) Static water level = 1.92 m below top of casing measured March 9, 2010.
- (3) All existing components, unless otherwise specified.
- (4) Pump De-staged March 30, 2010



CLIENT

Regional Municipality of Waterloo

TITLE

K19
Pump Installation Drawing

PROJECT No. 006-150

G:\Lotowater Projects\006 Region of Waterloo\150 K18 & 19\K19 Submersible Installation

DESIGN: EH 2010/03/16

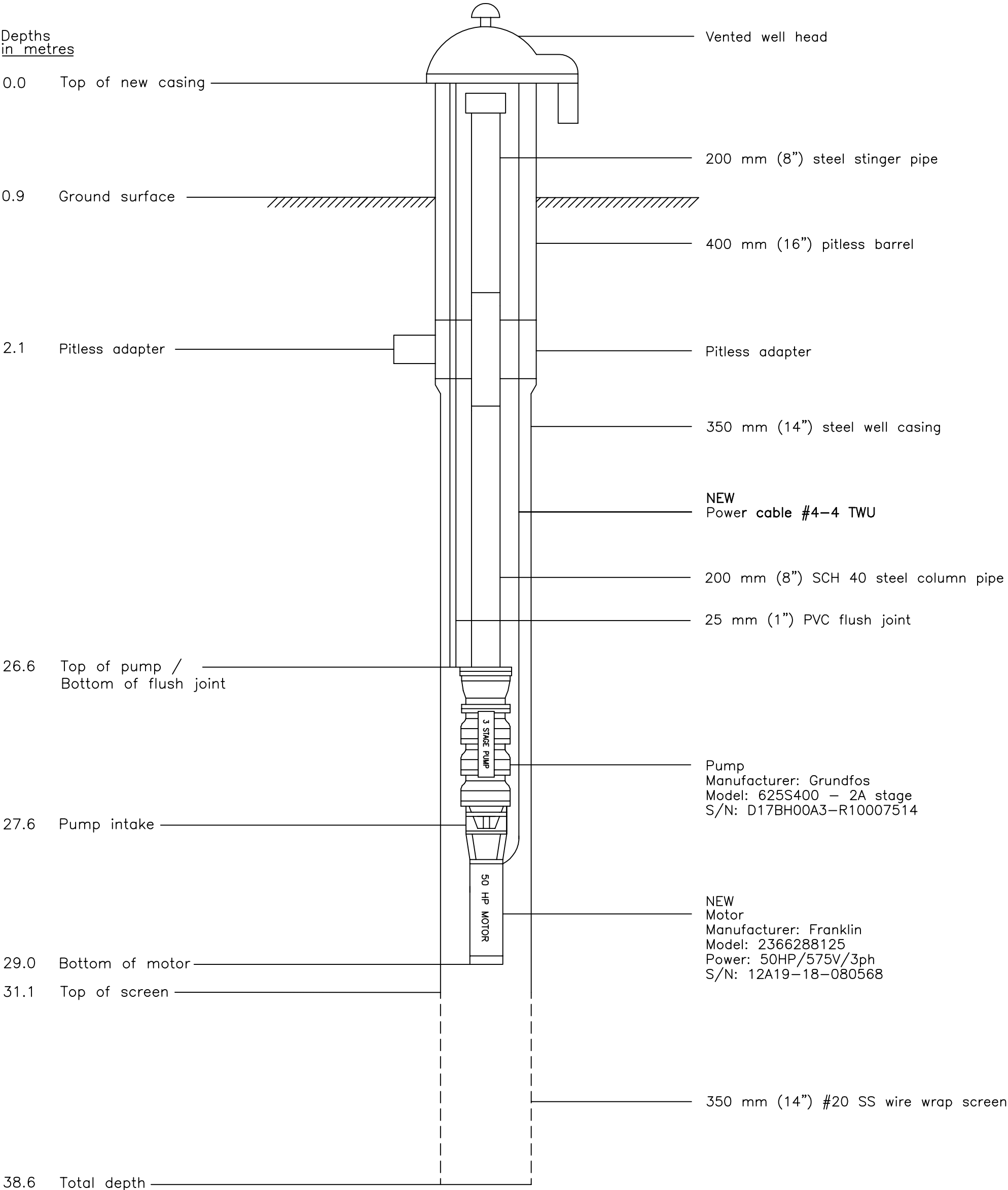
DRAWN: EH 2010/03/16

CHECKED:

REVISION No. 2010/05/21

SCALE N.T.S.

FIGURE
3



NOTES (1) All measurements below top of casing which is 0.90 m above ground. (2) All existing components, unless otherwise specified.				CLIENT Regional Municipality of Waterloo		
				TITLE Well K19 Pump Installation Drawing		
	PROJECT No. 006-253			G:\Lotowater Projects\006 Region of Waterloo\253 K19 Emergency Service\K19 Pump Installation.dwg		
	DESIGN			REVISION No. 2013/02/05	SCALE N.T.S.	FIGURE 2
	DRAWN	EH	2013/02/05			
	CHECKED					

Project: 2013 Well Construction and Testing
Client: Regional Municipality of Waterloo
Location: Region of Waterloo; Strange Street Well Field
Number: 1609-00734

Field Investigator: J. Koch
Contractor: Gerrits Well Drilling Inc.
Drilling method: DR24, truckmount, air rotary
Date started/completed: 03-Oct-2013 / 24-Jan-2014

K-SS-OW1-13-A
K-SS-OW1-14-B

[illegible]

n/a - not available/applicable

WRAS No. 9207052 for K-SS-OW1A-13
WRAS No. 9207053 for K-SS-OW1B-14

Drawn By/Checked By: NS/ LV

9200064

REGIONAL MUNICIPALITY OF WATERLOOWATER SUPPLY DIVISIONTEST WELL LOGS

Borehole 21

TW1-82

LOG: TW 1-82

DATE: July 21, 1982

LOCATION: K10

DRILLER: H. Peterman

N. Barnhardt

0	1	Top soil
1	4	Hard clay & black muck
4	12	Coarse sand & fine gravel
12	23	Fine & Coarse sand and fine gravel
23	37	Coarse & fine gravel & sand
37	43	Sand (fine & coarse) & marl
43	51	Sand, fine & coarse
51	60	Sand, coarse, fine little gravel & odd bit of marl
60	70	Sand, some gravel & odd bit of clay
70	73	Hard packed gravel & clay
73	76	Hard packed clay, some gravel

Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: University Ave, south of Erb St.

Contractor: All-Terrain Drilling Ltd.

Drilling Method: 108 mm HSA/PQ Coring

Monitoring Well No.: SS08-99

Date: 4 May 1999

Supervisor: C. Stewart Bourne

Ground Surface: ~340.0 mAMS

Top of Casing: ~340.75 mAMS

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
0		Ground Surface	340					
1		SAND (FILL) fine grained, trace gravel, light brown, dry - darker brown @ 0.35 m		1	CC			Above ground protective casing set in a concrete surface seal
2		- reddish brown, medium to fine grained @ 1.0 m						
3		- brown @ 1.2 m						
4			338.63					
5		SILTY SAND (FILL) some gravel, dark brown to black, moist		2	CC			Bentonite grout
6		- some organics (leaves) @ 2.1 m						
7		- fine sand seam, grey, dry @ 2.6 m						
8		- wet @ 2.7 m						
9			336.95					
10		GRAVEL AND COBBLES cobbles 1 to 7 cm in size. Loss of drilling mud.		3	CC			End of HSA hole at 2.74 m and start of PQ coring. HSA hole is 203 mm in diameter and PQ hole is 122.6 mm in diameter.
11								
12								
13								
14								
15			335.28					
16		SILT AND SAND (TILL) little gravel, grey, very moist (contact based on drilling conditions)		4	CC			
17								
18								
19			334.18					
20		SAND AND GRAVEL medium to coarse grained, grey, wet		5	CC			
21								
22		- mainly gravel and cobbles @ 6.7 m						
23			333.14					
24		SILT trace gravel, brownish grey, hard, dry to moist	332.84					
25		SAND AND GRAVEL wet	332.64	6	CC			
		SILT trace gravel, brownish grey, hard, moist to dry	332.38					

Screen Details: No. 10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 17.58 to 20.63 mBGS

Sand Pack Interval: 15.85 to 21.03 mBGS

Well Seal Interval: 0.91 to 15.85 mBGS

**Stantec**

Stantec Consulting Ltd.
871 Victoria Street North
Kitchener, Ontario
N2B 3S4

Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: University Ave, south of Erb St.

Contractor: All-Terrain Drilling Ltd.

Drilling Method: 108 mm HSA/PQ Coring

Monitoring Well No.: SS08-99

Date: 4 May 1999

Supervisor: C. Stewart Bourne

Ground Surface: ~340.0 mAMS

Top of Casing: ~340.75 mAMS

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
26	8	<i>SILT (con't)</i>		6	CC			Bentonite Grout
27			331.77					
28		<i>SAND AND GRAVEL</i> wet	331.52					
29		<i>SILT</i> trace gravel, brownish grey, hard, moist to dry						
30	9	<i>FINE SAND</i> trace medium sand, trace silt, soft, wet to moist		7	CC			
31								
32		- wet @ 9.7 m						
33	10							
34				8	CC			
35								
36	11							
37								
38		- medium grained from 11.6 to 12.0 m						
39	12			9	CC			
40								
41								
42		- medium grained from 12.8 to 12.9 m	327.08					
43	13	<i>SILT</i> trace fine sand, brownish grey, hard, moist	326.77					
44		<i>FINE SAND</i> trace medium grained sand, wet						
45			326.28	10	CC			
46	14	<i>SILT</i> brownish grey, hard, moist						
47			325.68					
48		<i>FINE SAND</i> trace medium grained sand, trace silt, wet						
49	15			11	CC			
50			324.76					

Screen Details: No.10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 17.58 to 20.63 mBGS

Sand Pack Interval: 15.85 to 21.03 mBGS

Well Seal Interval: 0.91 to 15.85 mBGS



Stantec

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871 Victoria Street North
Kitchener, Ontario
N2B 3S4

Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: University Ave, south of Erb St.

Contractor: All-Terrain Drilling Ltd.

Drilling Method: 108 mm HSA/PQ Coring

Monitoring Well No.: SS08-99

Date: 4 May 1999

Supervisor: C. Stewart Bourne

Ground Surface: ~340.0 mAMS

Top of Casing: ~340.75 mAMS

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
51		FINE SAND (con't)						
52		- thin hard silt layer @ 15.4 m		11	CC			Bentonite Grout
53		SILT	324.15					
54		trace fine sand, firm to hard, moist	323.75					No. 1 Silica Sand Pack
55		FINE SAND						
56		wet	323.46	12	CC			
57		SILT						
58		trace fine sand, firm to hard, moist						
59		- 1 cm thick medium sand seam, wet @ 17.1 m						
60				13	CC			No. 10 slot, 3.05 m long, 50 mm diameter, PVC Well Screen
61								
62		- trace gravel @ 18.7						
63		FINE SAND	320.93					
64		wet	320.78					
65		SILT	320.56					
66		trace fine sand, firm to hard, moist		14	CC			
67		FINE SAND						
68		wet						
69		SILT	319.2					
70		trace fine sand, firm to hard, moist	318.89	15	CC			
71		FINE SAND						
72		wet						
73		SILTY CLAY TILL						
74		MARYHILL TILL		16	CC			Bentonite Holeplug
75		occasional trace fine gravel, brown, very hard, dry to slightly moist						
				17	CC			
			317.14					

Screen Details: No.10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 17.58 to 20.63 mBGS

Sand Pack Interval: 15.85 to 21.03 mBGS

Well Seal Interval: 0.91 to 15.85 mBGS



Stantec

Stantec Consulting Ltd.
871 Victoria Street North
Kitchener, Ontario
N2B 3S4

Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: University Ave, south of Erb St.

Contractor: All-Terrain Drilling Ltd.

Drilling Method: 108 mm HSA/PQ Coring

Monitoring Well No.: SS08-99

Date: 4 May 1999

Supervisor: C. Stewart Bourne

Ground Surface: ~340.0 mAMSL

Top of Casing: ~340.75 mAMSL

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
76	23	SILTY CLAY TILL (con't)		17	CC			Bentonite Holeplug
77								
78								
79								
80	24			18	CC			
81								
82								
83								
84	25			19	CC			
85								
86								
87								
88	26	STONEY, SANDY, SILTY TILL CATFISH CREEK TILL gravel and cobbles, medium sand, silt, light grey to brown colour, dense, moist to dry	313.86					
89								
90								
91								
92	27			20	CC			
93								
94								
95								
96	28	End of Borehole						
97								
98								
99								
100	29							
	30							

Screen Details: No.10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 17.58 to 20.63 mBGS

Sand Pack Interval: 15.85 to 21.03 mBGS

Well Seal Interval: 0.91 to 15.85 mBGS



Stantec

Stantec Consulting Ltd.
871 Victoria Street North
Kitchener, Ontario
N2B 3S4

Ontario environment

The Ontario Water Resources Act
WATER WELL RECORD

PAGE 1 OF 1

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

COUNTY OR DISTRICT: WATERLOO REGION TOWNSHIP BOROUGH CITY VILLAGE: WATERLOO CON. BLOCK TRACT SURVEY ETC.: LOT

OWNER (SURNAME FIRST): REGION OF WATERLOO ADDRESS: University Ave DATE COMPLETED: DAY 4 MO MAY YR 1991

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)					
GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET	
				FROM	TO
LI Brown	SAND	fine gravel	(11) (fine sand and silt)	0	4.5
LT tan - grey	CL. Sand	fine gravel	(11)	4.5	10
	Gravel - Cobble			10	15
Grey	Silt & Sand	fine gravel	(11) - 1-7 cm	15.5	19.1
Grey	Silt & Sand			19.1	22.5
Black & grey Silt		fine gravel	bedrock to coarse gravel	22.5	23.5
	Silt & (Gravel)		bedrock	23.5	24.2
tan & grey Silt		fine gravel		24.2	27
	Silt & (Gravel)		bedrock	27	27.4
Black & grey Silt		fine gravel		27.4	27.9
	CL. Sand		bedrock	27.9	42.4
Black & grey Silt		fine gravel		42.4	43.5

WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
19	☒ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS

CASING & OPEN HOLE RECORD

INSIDE DIA. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH FEET
			FROM TO
19	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC		0 57.75
2'	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC		0 57.75

SCREEN

SIZE OF OPENING SLOT NO. 1: NL 10 Slot DIAMETER: 3" LENGTH: 10'

MATERIAL AND TYPE: PVC DEPTH TO TOP OF SCREEN: 57.75'

PLUGGING & SEALING RECORD

DEPTH SET AT - FEET: 57.75' MATERIAL AND TYPE: Benitic Grout CEMENT GROUT: Benitic Grout

PUMPING TEST

PUMPING TEST METHOD: ☐ PUMP ☐ BAILEY

PUMPING RATE: N/A GPM

WATER LEVELS DURING:

15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
1.2			

IF FLOWING GIVE RATE: 1.2 FEET

PUMP INTAKE SET AT: 1.2 FEET

WATER AT END OF TEST: 1.2 FEET

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☐ DEEP

RECOMMENDED PUMP SETTING: 1.2 FEET

RECOMMENDED PUMPING RATE: 1.2 GPM

FINAL STATUS OF WELL

☒ WATER SUPPLY ☐ ABANDONED - INSUFFICIENT SUPPLY

☐ OBSERVATION WELL ☐ ABANDONED - POOR QUALITY

☐ TEST HOLE ☐ UNFINISHED

☐ RECHARGE WELL ☐ DEWATERING

WATER USE

☐ DOMESTIC ☐ COMMERCIAL

☐ STOCK ☐ MUNICIPAL

☐ IRRIGATION ☐ PUBLIC SUPPLY

☐ INDUSTRIAL ☐ COOLING OR AIR CONDITIONING

☐ OTHER: 1.2 ☐ NOT USED

METHOD OF CONSTRUCTION

☐ CABLE TOOL ☐ BORING

☐ ROTARY (CONVENTIONAL) ☐ DIAMOND

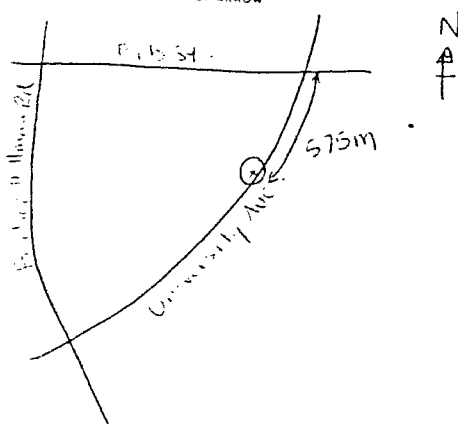
☐ ROTARY (REVERSE) ☐ JETTING

☐ ROTARY (AIR) ☐ DRIVING

☐ AIR PERCUSSION ☐ DIGGING

SS08-99 LOCATION OF WELL

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



CONTRACTOR

NAME OF WELL CONTRACTOR: ALL-TERRAIN DRILLING LIMITED WELL CONTRACTOR'S LICENCE NUMBER: 1179

ADDRESS: 2-661 Colby Dr., Waterloo, Ont. N2L 1C3

NAME OF WELL TECHNICIAN: Rich Buckner/Mike Pollock WELL TECHNICIAN'S LICENCE NUMBER: 0268

SIGNATURE OF TECHNICIAN/CONTRACTOR: [Signature]

SUBMISSION DATE: DAY 07 MO 07 YR 91

DRILLER'S REMARKS

143656

OWNER'S COPY



Ministry
of the
Environment

The Ontario Water Resources Act

WATER WELL RECORD

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

PAGE 2 OF 2

COUNTY OR DISTRICT WATERLOO REGION	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE WATERLOO	CON. BLOCK, TRACT, SURVEY, ETC. 1.1
OWNER (SURNAME FIRST) REGION OF WATERLOO	ADDRESS University Ave.	DATE COMPLETED DAY 4 MO MAY YR 88

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)					
GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET	
				FROM	TO
	SAND	fine medium grained	fine	43.5'	45'
	SILT		hard	45'	47'
	SAND	fine and medium grained	fine	47'	50'
	SILT	fine to sand	fine to hard	50'	53'
	SAND		fine	53.3'	54.3'
	SILT	fine to sand	fine to hard	54.3'	62.0'
	SAND		fine	62.0'	63'
	SILT	fine to sand	fine to hard	63'	63.8'
	SAND		fine	63.8'	68'
	SILT	fine to sand	fine to hard	68.3'	69.3'
	SAND		fine	69.3'	69.6'
	Strong Clay Till		fine to hard	69.6'	85.8'
	Strong Clay Till		fine to hard	85.8'	93'

WATER RECORD	
WATER FOUND AT - FEET	KIND OF WATER
	☐ FRESH ☐ SULPHUR MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR MINERALS ☐ GAS

CASING & OPEN HOLE RECORD			
INSIDE DIA. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC		FROM TO
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC		
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC		

SCREEN	SIZES OF OPENING (SLIT NO. 1)	DIA. INCHES	LENGTH FEET
	MATERIAL AND TYPE	INCHES	DEPTH TO TOP OF SCREEN

PLUGGING & SEALING RECORD			
DEPTH SET AT - FEET	TO - FEET	MATERIAL AND TYPE	CEMENT GROUT LEAD PACKER ETC.

PUMPING TEST	PUMPING TEST METHOD		PUMPING RATE	DURATION OF PUMPING
	☐ PUMP ☐ BAILEY		GPM	HOURS MIN.
	STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING	
			☐ PUMPING ☐ RECOVERY	
			15 MINUTES	30 MINUTES
			45 MINUTES	60 MINUTES
	IF FLOWING GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST	
		GPM	☐ CLEAR ☐ CLOUDY	
	RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE	GPM
	☐ SHALLOW ☐ DEEP			

FINAL STATUS OF WELL	☐ WATER SUPPLY ☐ ABANDONED - INSUFFICIENT SUPPLY ☐ OBSERVATION WELL ☐ ABANDONED - POOR QUALITY ☐ TEST HOLE ☐ UNFINISHED ☐ RECHARGE WELL ☐ DEWATERING
WATER USE	☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER ☐ COMMERCIAL ☐ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED
METHOD OF CONSTRUCTION	☐ CABLE TOOL ☐ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☐ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING ☐ DIGGING ☐ OTHER

5508-99 LOCATION OF WELL	
IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.	
SEE PAGE 1	
DRILLER'S REMARKS	
143657	
CONTRACTOR	OFFICE USE ONLY
NAME OF WELL CONTRACTOR	WELL CONTRACTOR'S LICENCE NUMBER
ADDRESS	
NAME OF WELL TECHNICIAN	WELL TECHNICIAN'S LICENCE NUMBER
SIGNATURE OF TECHNICIAN/CONTRACTOR	SUBMISSION DATE
	DAY MONTH YEAR

OWNER'S COPY

Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: Fischer-Hallman Rd, north of Stoke Dr.

Contractor: All-Terrain Drilling Ltd.

Drilling Method: 108 HSA/PQ Coring

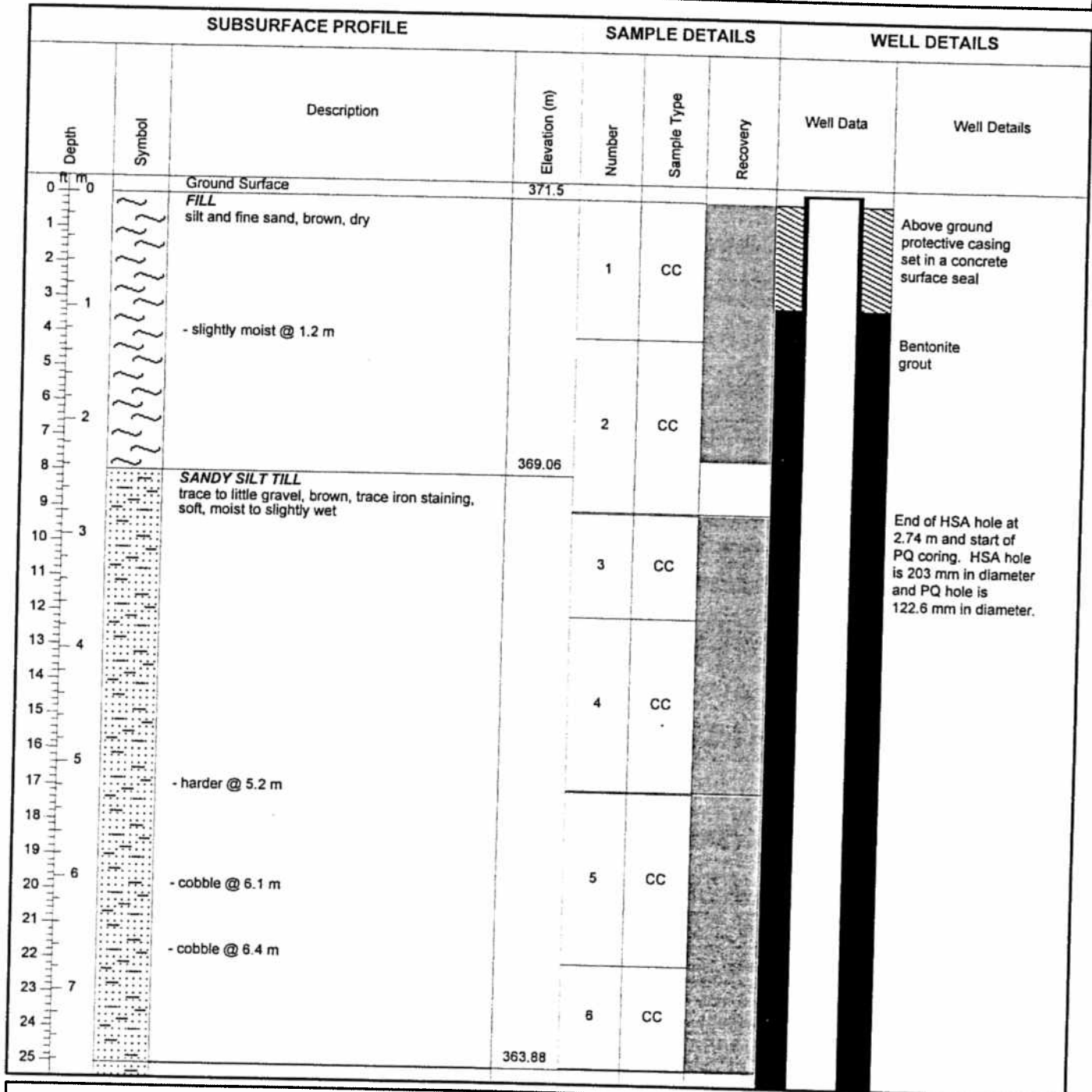
Monitoring Well No.: SS11-99

Date: 25 May 1999

Supervisor: C. Stewart Bourne

Ground Surface: ~371.5 mAMS

Top of Casing: ~372.37 mAMS



Screen Details: No.10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 39.01 to 42.06 mBGS

Sand Pack Interval: 36.58 to 42.67 mBGS

Well Seal Interval: 0.91 to 36.58 mBGS

**Stantec**
 Stantec Consulting Ltd.
 871 Victoria Street North
 Kitchener, Ontario
 N2B 3S4

Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: Fischer-Hallman Rd, north of Stoke Dr.

Contractor: All-Terrain Drilling Ltd.

Drilling Method: 108 HSA/PQ Coring

Monitoring Well No.: SS11-99

Date: 25 May 1999

Supervisor: C. Stewart Bourne

Ground Surface: ~371.5 mAMS

Top of Casing: ~372.37 mAMS

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
26 8		SANDY SILT TILL (cont.)		6	CC			Bentonite grout
27								
28								
29 9		- wet sand seam @ 8.7 m		7	CC			
30								
31								
32 10		- cobble @ 9.4 m	361.65	8	CC			
33		FINE SAND brown, slight sulphurous odour, moist						
34								
35 11				9	CC			
36								
37								
38 12			358.7	10	CC			
39								
40								
41 13		MEDIUM SAND brown/grey, no odour, wet		11	CC			
42								
43								
44 14		- gravel seam @ 13.5 m		10	CC			
45								
46								
47 15		- silt seam, hard @ 13.8 to 13.9 m	356.26	11	CC			
48								
49								
50								

Screen Details: No.10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 39.01 to 42.06 mBGS

Sand Pack Interval: 36.58 to 42.67 mBGS

Well Seal Interval: 0.91 to 36.58 mBGS



Stantec

Stantec Consulting Ltd.
871 Victoria Street North
Kitchener, Ontario
N2B 3S4

Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: Fischer-Hallman Rd, north of Stoke Dr.

Contractor: All-Terrain Drilling Ltd.

Drilling Method: 108 HSA/PQ Coring

Monitoring Well No.: SS11-99

Date: 25 May 1999

Supervisor: C. Stewart Bourne

Ground Surface: ~371.5 mAMS

Top of Casing: ~372.37 mAMS

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
51	16	MEDIUM SAND (cont)		11	CC			Bentonite grout
52		- dry to moist beginning @ 15.8 m						
53				12	CC			
54								
55								
56	17							
57								
58								
59	18			13	CC			
60								
61								
62	19							
63								
64								
65	20			14	CC			
66								
67								
68	21	- slightly moist @ 20.4 m						
69								
70				15	CC			
71	22							
72		- silty sand @ 21.9 to 22.0 m						
73								
74				16	CC			
75			348.64					

Screen Details: No.10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 39.01 to 42.06 mBGS

Sand Pack Interval: 36.58 to 42.67 mBGS

Well Seal Interval: 0.91 to 36.58 mBGS



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Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: Fischer-Hallman Rd, north of Stoke Dr.

Contractor: All-Terrain Drilling Ltd.

Drilling Method: 108 HSA/PQ Coring

Monitoring Well No.: SS11-99

Date: 25 May 1999

Supervisor: C. Stewart Bourne

Ground Surface: ~371.5 mAMS

Top of Casing: ~372.37 mAMS

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
76 23		MEDIUM SAND (con't)		16	CC			Bentonite grout
77		- moist to wet beginning @ 23.5 m						
78								
79 24				17	CC			
80								
81								
82 25		- slight increase in grain size @ 25.0 m	345.77	18	CC			
83								
84								
85 26		VERY FINE SAND brown/grey, wet						
86		- moist, dense beginning @ 26.5 m						
87								
88 27				19	CC			
89								
90								
91 28								
92								
93								
94 29		SILTY VERY FINE SAND brown/grey, dense, moist	342.57	20	CC			
95								
96								
97 30				21	CC			
98								
99								
100		SILTY CLAY	341.04					

Screen Details: No. 10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 39.01 to 42.06 mBGS

Sand Pack Interval: 36.58 to 42.67 mBGS

Well Seal Interval: 0.91 to 36.58 mBGS



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Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: Fischer-Hallman Rd, north of Stoke Dr.

Contractor: All-Terrain Drilling Ltd.

Drilling Method: 108 HSA/PQ Coring

Monitoring Well No.: SS11-99

Date: 25 May 1999

Supervisor: C. Stewart Bourne

Ground Surface: ~371.5 mAMS

Top of Casing: ~372.37 mAMS

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
101	31	SILTY CLAY till like structure	340.84	21	CC			Bentonite grout
102		MEDIUM SAND brown/grey, no odour, wet						
103								
104								
105	32			22	CC			
106								
107	33							
108								
109				23	CC			
110	34							
111								
112								
113								
114	35			24	CC			
115								
116								
117	36		335.84					
118		FINE TO MEDIUM SAND brown/grey, no odour, wet						
119								
120	37		334.8	25	CC			No. 1 Silica Sand Pack
121		MEDIUM TO COARSE SAND brown/grey, no odour, wet						
122	38		334.31					
123		MEDIUM SAND brown/grey, no odour, wet						
124				26	CC			
125								

Screen Details: No.10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 39.01 to 42.06 mBGS

Sand Pack Interval: 36.58 to 42.67 mBGS

Well Seal Interval: 0.91 to 36.58 mBGS



Stantec

Stantec Consulting Ltd.
871 Victoria Street North
Kitchener, Ontario
N2B 3S4

Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: Fischer-Hallman Rd, north of Stoke Dr.

Contractor: All-Terrain Drilling Ltd.

Drilling Method: 108 HSA/PQ Coring

Monitoring Well No.: SS11-99

Date: 25 May 1999

Supervisor: C. Stewart Bourne

Ground Surface: ~371.5 mAMS

Top of Casing: ~372.37 mAMS

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
126		FINE SAND brown/grey, no odour, wet		26	CC			No. 1 Silica Sand Pack
127								
128				27	CC			No. 10 slot, 3.05 m long, 50 mm diameter, PVC well screen
129								
130								
131								
132		- slight sulphurous odour @ 40.2 m						
133								
134				28	CC			
135			330.23					
136		MEDIUM SAND brown/grey, no odour, wet						
137								
138			329.46					
139		FINE SAND slight odour, wet	329.21					
140		SILT till like structure	328.93	29	CC			
141		FINE SAND slight odour, wet	328.73					
142		SILT till like structure	328.22					
143		MEDIUM SAND slight odour, wet						
144		SILTY CLAY TILL MARYHILL TILL occasional trace fine gravel, brown, very hard, dry to slightly moist		30	CC			
145								
146								
147								
148				31	CC			
149								
150			325.78					

Screen Details: No. 10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 39.01 to 42.06 mBGS

Sand Pack Interval: 36.58 to 42.67 mBGS

Well Seal Interval: 0.91 to 36.58 mBGS



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871 Victoria Street North
Kitchener, Ontario
N2B 3S4

Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: Fischer-Hallman Rd, north of Stoke Dr.

Contractor: All-Terrain Drilling Ltd.

Drilling Method: 108 HSA/PQ Coring

Monitoring Well No.: SS11-99

Date: 25 May 1999

Supervisor: C. Stewart Bourne

Ground Surface: ~371.5 mAMS

Top of Casing: ~372.37 mAMS

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
151	46	SILTY CLAY TILL (con't)		31	CC			Bentonite Holeplug
152								
153								
154	47	- mm thick fine sand seam @ 46.6 m		32	CC			
155		- fine sand, wet, slight sulphurous odour from 47.2 to 47.5 m						
156								
157	48	- mm thick fine sand seam @ 48.1 m		33	CC			
158		- mm thick fine sand seam @ 48.3 m						
159		- mm thick fine sand seam @ 48.5 m						
160	49	- mm thick fine sand seam @ 48.9 m		34	CC			
161		- mm thick fine sand seam @ 49.1 m						
162		- mm thick fine sand seam @ 49.3 m						
163	50	- cobbles from 50.0 to 50.2 m		35	CC			
164								
165								
166	51			36	CC			
167								
168								
169	52							
170								
171								
172			318.87					
173	53	SANDY SILT AND FINE SAND Alternating layers of sandy silt and fine sand, grey, soft to dense, moist to wet		36	CC			
174								
175			318.16					

Screen Details: No.10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 39.01 to 42.06 mBGS

Sand Pack Interval: 36.58 to 42.67 mBGS

Well Seal Interval: 0.91 to 36.58 mBGS



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871 Victoria Street North
Kitchener, Ontario
N2B 3S4

Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: Fischer-Hallman Rd, north of Stoke Dr.

Contractor: All-Terrain Drilling Ltd.

Drilling Method: 108 HSA/PQ Coring

Monitoring Well No.: SS11-99

Date: 25 May 1999

Supervisor: C. Stewart Bourne

Ground Surface: ~371.5 mAMSL

Top of Casing: ~372.37 mAMSL

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
176		SANDY SILT AND FINE SAND (con't)		36	CC			Bentonite Holeplug
177		FINE SAND grey, dense, moist to wet	317.55					
178		COBBLES some sand, moist	316.94	37	CC			
179		SAND AND GRAVEL wet	316.64					
180		SAND fine to medium grained, wet, slight sulphurous odour	316.33					
181								
182		STONEY, SANDY, SILT TILL CATFISH CREEK TILL gravel and cobbles, medium sand, silt, light grey to brown, dense, moist to dry	315.57	38	CC			
183								
184								
185								
186								
187								
188		End of Borehole						
189								
190								
191								
192								
193								
194								
195								
196								
197								
198								
199								
200								

Screen Details: No.10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 39.01 to 42.06 mBGS

Sand Pack Interval: 36.58 to 42.67 mBGS

Well Seal Interval: 0.91 to 36.58 mBGS



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Stantec Consulting Ltd.
871 Victoria Street North
Kitchener, Ontario
N2B 3S4



Ministry
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WATER WELL RECORD

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PAGE 1 of 2

COUNTY OR DISTRICT WATERLOO REGION	TOWNSHIP, BOROUGHS, CITY, VILLAGE WATERLOO	CON. BLOCK, TRACT, SURVEY, ETC.	LOT
OWNER (SURNAME FIRST) PIETRO U. WATERLOO	ADDRESS FISCHER-HALLMAN RD, north of St. D.	DATE COMPLETED DAY 25 MO MAY YEAR 99	

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)				
GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH FEET FROM TO
BROWN	FILL	Silt and fine sand		0 8'
BROWN	SANDY SILT FILL	light to medium	fine, some coarse sand	8' 32.4'
BROWN	SAND	fine to medium	fine	32.4' 43'
BROWN/RED	SAND	medium	medium	43' 84.5'
BROWN/RED	SAND	very fine	very fine	84.5' 95'
BROWN/RED	SAND	very fine	very fine	95' 99.9'
BROWN/RED	CLAY	clay	clay, very fine	99.9' 100.6'
BROWN/RED	SAND	medium	medium	100.6' 117'
BROWN/RED	SAND	fine to medium	fine to medium	117' 130.4'
BROWN/RED	SAND	medium to coarse	medium to coarse	130.4' 135.5'
BROWN/RED	SAND	medium	medium	135.5' 135.4'

WATER RECORD	
WATER FOUND AT FEET	KIND OF WATER
42	☒ FRESH ☐ SALTY ☐ SULPHUR MINERALS GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR MINERALS GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR MINERALS GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR MINERALS GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR MINERALS GAS

CASING & OPEN HOLE RECORD			
INSIDE DIA. INCHES	MATERIAL	WELL THICKNESS INCHES	DEPTH FEET FROM TO
2"	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC		0 128'

SCREEN	SIZE OF OPENING SLIT NO. 10	DIAMETER 2"	LENGTH 10'
	MATERIAL AND TYPE PVC	DEPTH TO TOP OF SCREEN 138'	

PLUGGING & SEALING RECORD			
DEPTH SET AT FEET	TO	MATERIAL AND TYPE	CEMENT GROUT LEAD PACKER ETC.
3'	120'	Bentonite Grout	
140'	187'	Bentonite Grout	

PUMPING TEST METHOD		PUMPING RATE	DURATION OF PUMPING
☐ PUMP ☐ BAILEY		N/A	
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING	☐ PUMPING ☐ RECOVERY
83.7		15 MINUTES 30 MINUTES 45 MINUTES 60 MINUTES	
FEET	FEET	FEET FEET FEET FEET	
IF FLOWING GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST	☐ CLEAR ☐ CLOUDY
GPM	FEET	FEET	GPM
RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE	
☐ SHALLOW ☐ DEEP	FEET	FEET	

FINAL STATUS OF WELL	☐ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL ☐ ABANDONED INSUFFICIENT SUPPLY ☐ ABANDONED POOR QUALITY ☐ UNFINISHED ☐ DEWATERING
WATER USE	☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☒ OTHER Mining ☐ COMMERCIAL ☐ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED
METHOD OF CONSTRUCTION	☐ CABLE TOOL ☐ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☐ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING ☐ DIGGING ☒ OTHER Hand

SS11-99 LOCATION OF WELL	
IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE	INDICATE NORTH BY ARROW
DRILLER'S REMARKS	143663

CONTRACTOR	NAME OF WELL CONTRACTOR ALL-TERRAIN DRILLING LTD.	WELL CONTRACTOR'S LICENCE NUMBER 1109
	ADDRESS 3-661 CORY DR., WATERLOO, ONT. N0V 1C0	
	NAME OF WELL TECHNICIAN RICK BUCKLEY/HIV	WELL TECHNICIAN'S LICENCE NUMBER 0268
	SIGNATURE OF TECHNICIAN/CONTRACTOR 	SUBMISSION DATE DAY 02 MO 07 YEAR 99

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The Ontario Water Resources Act

WATER WELL RECORD

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PAGE 2 OF 2

COUNTY OR DISTRICT WATERLOO REGION	TOWNSHIP & BOUNDARY CITY/TOWN/VILLAGE WATERLOO	CON. BLOCK TRACT SURVEY ETC. LOT
OWNER (SURNAME FIRST) REGION OF WATERLOO	ADDRESS FISHER-HUTCHIN RD., north of St. Clair Dr.	DATE COMPLETED DAY 25 MO MAY YR 88

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)				
GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM TO
Light Grey	SAND	medium	medium	135.4' 138'
Light Grey	SAND	fine	fine	138' 138.8'
	SILT		fine	138.8' 139'
	SAND		fine	139.2' 139.5'
	SILT		fine	139.5' 140.25'
	SAND		medium	140.25' 143'
	Silty Clay Fill		clayey fill	143' 172'
	Silt/Clay		clayey layers of silt/clay	172.75' 177'
	SAND		fine	177' 179'
	CLAY			179' 180'
	SAND & GRAVEL			180' 181'
	SAND			181' 183'
				183.5' 187'

1. 1/2" to 1" CLAY, SAND, SILT FILL

CLAY, SAND, SILT FILL

WATER RECORD		CASING & OPEN HOLE RECORD				SCREEN		PLUGGING & SEALING RECORD	
WATER FOUND AT - FEET	KIND OF WATER	INSIDE DIA. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM TO	SIZES OF OPENING SLOT NO.	DIA. INCHES	DEPTH SET AT - FEET 1/4" 1/2" 1"	MATERIAL AND TYPE CEMENT GROUT LEAD PACKER ETC.
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS		☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC						
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS		☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC						
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS		☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC						
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS		☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC						

PUMPING TEST	PUMPING TEST METHOD ☐ PUMP ☐ BAILEY	PUMPING RATE GPM	DURATION OF PUMPING HOURS MIN.
	STATIC LEVEL FEET	WATER LEVEL END OF PUMPING FEET	WATER LEVELS DURING 15 MINUTES 30 MINUTES 45 MINUTES 60 MINUTES FEET FEET FEET FEET
	IF FLOWING GIVE RATE GPM	PUMP INTAKE SET AT FEET	WATER AT END OF TEST ☐ CLEAR ☐ CLOUDY
	RECOMMENDED PUMP TYPE ☐ SHALLOW ☐ DEEP	RECOMMENDED PUMP SETTING FEET	RECOMMENDED PUMPING RATE GPM

SS11-99 LOCATION OF WELL

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

SEE PAGE 1

FINAL STATUS OF WELL ☐ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL	☐ ABANDONED INSUFFICIENT SUPPLY ☐ ABANDONED POOR QUALITY ☐ UNFINISHED ☐ DEWATERING
WATER USE ☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER	☐ COMMERCIAL ☐ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED
METHOD OF CONSTRUCTION ☐ CABLE TOOL ☐ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☐ ROTARY (AIR) ☐ AIR PERCUSSION	☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR	NAME OF WELL CONTRACTOR	WELL CONTRACTOR'S LICENCE NUMBER
	ADDRESS	
	NAME OF WELL TECHNICIAN	WELL TECHNICIAN'S LICENCE NUMBER
	SIGNATURE OF TECHNICIAN/CONTRACTOR	SUBMISSION DATE DAY _____ MO _____ YR _____

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Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: Gowski Park, Kitchener

Contractor: All-Terrain Drilling Limited

Drilling Method: 108 mm HSA/PQ Coring

Monitoring Well No.: SS13-99

Date: 16 October 1999

Supervisor: C. Bourne

Ground Surface: ~339.0 mAMS

Top of Casing: ~338.9 mAMS

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
0 ft m		Ground Surface	339					
1		TOPSOIL silt, dark brown, moist						Flush mount protective casing set in a concrete surface seal
2		SILTY SAND (FILL) little gravel, brown, dry		1	CC			Sand
3		- dark brown silt/organics 0.8 to 0.9 m						
4		- dark brown silt/organics 1.2 to 1.4 m						
5			337.63					Bentonite Holeplug
6		SAND few cobbles, brown, dry	337.43					
7		SILT grey, iron staining, soft, moist to wet		2	CC			
8		- colour change to reddish grey @ 2.1 m						
9			336.61					
10		SAND fine grained, brown to white colour, loose, dry to very slightly moist	336.05	3	CC			End of HSA hole at 3.05 m and start of PQ Coring. HSA hole is 203 mm in diameter and PQ hole is 122.6 mm in diameter.
11		SILTY VERY FINE SAND brown, dense, moist		4	CC			
12		- soft and wet at 3.1 m						
13								Bentonite Grout
14				5	CC			
15								
16								
17		- slight increase in grain size below 5.2 m						
18								
19		- cobbles from 5.6 to 6.0 m		6	CC			
20			332.83					
21		CLAY trace gravel, brown, hard, dry						
22								
23				7	CC			
24								
25		- fine to medium sand seam 7.5 to 7.6 m	331.38					

Screen Details: No.10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 17.98 to 21.03 mBGS

Sand Pack Interval: 17.83 to 21.94 mBGS

Well Seal Interval: 0.61 to 17.83 mBGS

Stantec Consulting Ltd.
871 Victoria Street North
Kitchener, Ontario
N2B 3S4

Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: Gowski Park, Kitchener

Contractor: All-Terrain Drilling Limited

Drilling Method: 108 mm HSA/PQ Coring

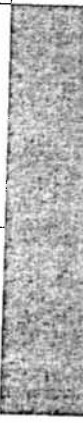
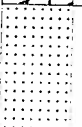
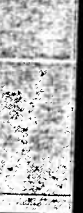
Monitoring Well No.: SS13-99

Date: 16 October 1999

Supervisor: C. Bourne

Ground Surface: ~339.0 mAMSL

Top of Casing: ~338.9 mAMSL

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS	
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details
26		CLAY (con't)	330.49	7	CC			Bentonite Grout
27		- increase in grain size to silty clay below 8.2 m						
28		SILTY FINE SAND		8	CC			
29		grey, soft to dense, wet						
30		- very soft and wet from 8.8 to 9.2 m						
31								
32								
33								
34		- very densr 10.3 to 10.7 m						
35								
36		- fine to medium grained, soft, wet from 10.8 to 11.1 m						
37								
38								
39								
40								
41								
42		- dense from 12.8 to 13.7 m						
43								
44								
45								
46		- very soft and wet 14.2 to 14.5 m						
47								
48		- dense from 14.5 to 14.6 m						
49		- very soft and wet 14.6 to 15.0 m						
50			323.76	12	CC			

Screen Details: No. 10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 17.98 to 21.03 mBGS

Sand Pack Interval: 17.83 to 21.94 mBGS

Well Seal Interval: 0.61 to 17.83 mBGS

Stantec Consulting Ltd.
871 Victoria Street North
Kitchener, Ontario
N2B 3S4

Project: Kitchener West Side Water Project

Project No.: 611-09551

Location: Gowski Park, Kitchener

Contractor: All-Terrain Drilling Limited

Drilling Method: 108 mm HSA/PQ Coring

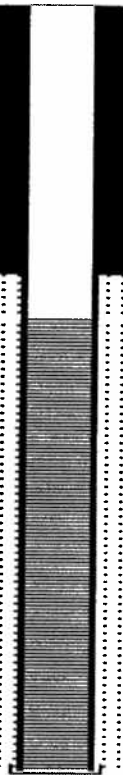
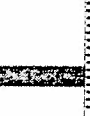
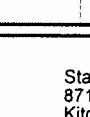
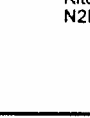
Monitoring Well No.: SS13-99

Date: 16 October 1999

Supervisor: C. Bourne

Ground Surface: ~339.0 mAMS

Top of Casing: ~338.9 mAMS

SUBSURFACE PROFILE				SAMPLE DETAILS			WELL DETAILS						
Depth	Symbol	Description	Elevation (m)	Number	Sample Type	Recovery	Well Data	Well Details					
51		SILTY FINE SAND (con't) - very soft and wet 15.5 to 15.8 m	323.15	12	CC			Bentonite Grout					
52				SAND AND GRAVEL grey, wet grain size increases downwards from fine sand to cobbles with medium/coarse sand	13	CC			Bentonite Holeplug				
53								- fine to medium sand	14	CC		No. 1 Silica Sand Pack	
54											- medium to coarse sand	15	CC
55			- gravel/cobbles and sand				16				CC		
56			SILTY CLAY TILL MARYHILL TILL occasional trace fine gravel, brown, very hard, dry to slightly moist		318.88	16							
57				318.58	16				CC				
58								16				CC	
59							16				CC		
60						16							
61					16				CC				
62								16				CC	
63							16				CC		
64						16							
65					16				CC				
66								16				CC	
67							16				CC		
68						16							
69					16				CC				
70								16				CC	
71							16				CC		
72						16							
73					16				CC				
74								16				CC	
75							16				CC		

Screen Details: No.10 slot, 50 mm diameter, 3.05 m long

Screen Interval: 17.98 to 21.03 mBGS

Sand Pack Interval: 17.83 to 21.94 mBGS

Well Seal Interval: 0.61 to 17.83 mBGS

Stantec Consulting Ltd.
871 Victoria Street North
Kitchener, Ontario
N2B 3S4



WATER WELL RECORD

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

COUNTY OR DISTRICT Waterloo Region				TOWNSHIP/BOROUGH/CITY/TOWN/VILLAGE Waterloo		CON. BLOCK TRACT SUB-ETC.		L.O.F.	
OWNER (SURNAME FIRST) Libran of Waterloo				ADDRESS Goliski Park Kitchen				DATE COMPLETED DAY 16 MO 10 YR 99	

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH FEET	
				FROM	TO
DK BROWN	Topsoil			0	1'
BROWN	SILT	SAND	DENSE, MOIST TO DRY	1	20'
BROWN	CLAY	SILT	TRACE GRAVEL	20	28'
GREY	SAND	SILT	DENSE, WET.	28	52'
GREY	SAND	GRAVEL	WET	52	66'
BROWN	CLAY	SILT	MARSHY FILL,	66'	68'

WATER RECORD		
WATER FOUND AT - FEET	KIND OF WATER	
28	☒ FRESH ☐ SALTY ☐ FRESH ☐ SALTY ☐ FRESH ☐ SALTY ☐ FRESH ☐ SALTY ☐ FRESH ☐ SALTY ☐ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS ☐ SULPHUR ☐ MINERALS ☐ GAS ☐ SULPHUR ☐ MINERALS ☐ GAS ☐ SULPHUR ☐ MINERALS ☐ GAS ☐ SULPHUR ☐ MINERALS ☐ GAS

CASING & OPEN HOLE RECORD			
INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH FEET
			1-2 3-4 5-10
2'	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☒ OPEN HOLE ☐ PLASTIC	SEN 40	0 57
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC		
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC		

SCREEN	SIZE/S. OF OPENING SLOT NO. 1		DIAMETER		LENGTH	
	No 10 SLOT		2"		10' 11"	
	MATERIAL AND TYPE		DEPTH TO TOP OF SCREEN			
	PVC		52' FEET			

PLUGGING & SEALING RECORD			
DEPTH SET AT FEET		MATERIAL AND TYPE	
FROM TO		CEMENT GROUT LEAD PACKER ETC.	
3'	56'	BENTONITE	

PUMPING TEST	PUMPING TEST METHOD ☐ PUMP ☐ BAILER		PUMPING RATE <i>N/A</i> GPM		DURATION OF PUMPING _____ HOURS MIN.	
	STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING ☐ PUMPING ☐ RECOVERY			
			15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
	FEET	FEET	FEET	FEET	FEET	FEET
	IF FLOWING GIVE RATE		PUMP INTAKE SET AT		WATER AT END OF TEST ☐ CLEAR ☐ CLOUDY	
RECOMMENDED PUMP TYPE ☐ SHALLOW ☐ DEEP		RECOMMENDED PUMP SETTING		RECOMMENDED PUMPING RATE		
				GPM		

FINAL STATUS OF WELL	☐ WATER SUPPLY ☒ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL	☐ ABANDONED INSUFFICIENT SUPPLY ☐ ABANDONED POOR QUALITY ☐ UNFINISHED ☐ DEWATERING
WATER USE	☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☒ OTHER	☐ COMMERCIAL ☐ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED
METHOD OF CONSTRUCTION	☐ CABLE TOOL ☐ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☐ ROTARY (AIR) ☐ AIR PERCUSSION	☐ BORING ☒ DIAMOND ☐ JETTING ☐ DRIVING ☐ DIGGING ☐ OTHER

LOCATION OF WELL

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

COMMUNITY CENTRE

SS 13-99

RR. TRACKS

PLAZA HYDRO POLES

WESTWOOD DR.

W. 1st St. N.W.

54163

DRILLERS REMARKS

CONTRACTOR	NAME OF WELL CONTRACTOR	WELL CONTRACTOR'S LICENCE NUMBER
	ALL-TECHNICAL DRILLING LIMITED	1129
	ADDRESS	
	3-661 COLBY DR WATLIDG ONT N2V1K2	
	NAME OF WELL TECHNICIAN	WELL TECHNICIAN'S LICENCE NUMBER
	JEFF WILSON / MIKE POLICE	0268
	SIGNATURE OF TECHNICIAN / CONTRACTOR	SUBMISSION DATE
		DAT 29 MO 05 TR 00

OFFICE USE ONLY			

K-ST-OW2-07

K-SS-STOW2-07



BURNSIDE

R.J. Burnside & Associates Inc.
15 Austin, Wargentin, Wards Sts. 344
Windsor, Ontario N9A 1G7 Tel: (519) 253-1100 Fax: (519) 253-1101

LOG OF DRILLING OPERATIONS

obj# 9203467

STOW2/07

Page 1 of 1

Client: Regional Municipality of Waterloo	Project Name: K11A	Logged by: D. Wilson
Project No.: MSO 09419	Location: Glasgow Street, Kitchener	Ground (m amsl): 346
Drilling Co.: Davidson Well Drilling	Date Started: 1/30/2007	Static Water Level (m amsl):
Drilling Method: Mud Rotary	Date Completed: 2/2/2007	Sand Pack (m amsl):

Depth Scale (ft) (m)	Stratigraphic Description	Strat. Plot	Depth (m)	Num.	Type	Int.	Depth Scale (ft) (m)
	Surface Elevation (m): 346.00						
1.0	Light brown sandy clay TILL.						1.0
5.0							5.0
10.0							10.0
15.0							15.0
20.0	Light grey silty clay TILL.		5.48				20.0
25.0							25.0
30.0							30.0
35.0							35.0
40.0							40.0
45.0							45.0
50.0							50.0
55.0							55.0
60.0							60.0
65.0							65.0
70.0	Light brown medium SAND with trace silt.		21.09				70.0
75.0							75.0
80.0	Light brown coarse SAND and GRAVEL with trace silt.		24.30				80.0
85.0							85.0
90.0							90.0
95.0							95.0
100.0	Light brown medium SAND.		30.83				100.0
105.0							105.0
110.0	Light brown coarse SAND with gravel.		32.31				110.0
115.0							115.0
120.0	Dark grey CLAY, dense.		34.74				120.0
			36.00				36.0

bentonite seal

silica sand pack

silica sand pack

silica sand pack

Prepared By: D. Wilson

Checked By: J. Baxter

Date Prepared: 8/13/2007

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

LEGEND

Water found @ time of drilling
Static Water Level - 3/21/2007

MONITORING WELL DATA

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

SAMPLE TYPE

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

B:\LOG GUELPH P\GINT\PROJECTS\MSO09419.GPJ TEMPLATE.GDT 10/26/07



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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

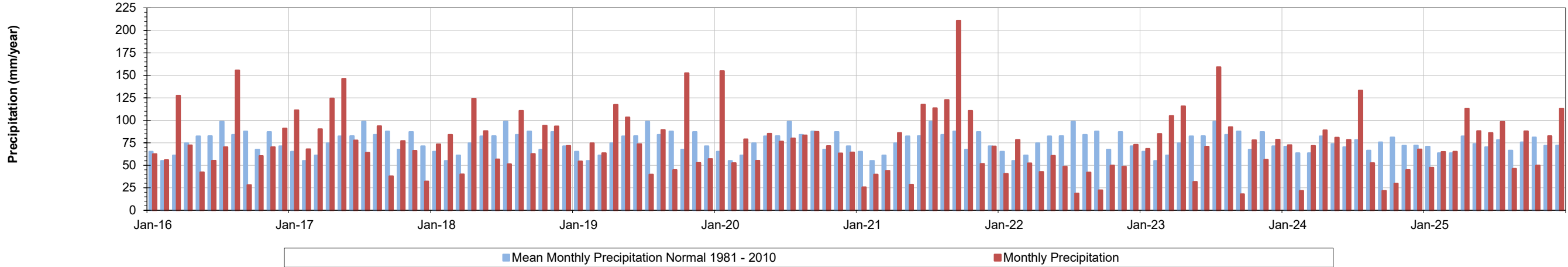


Well Field	Major or Minor Supply	Production Well Name	Status	Permit to Take Water Details			2021 Production Summary			2022 Production Summary			2023 Production Summary			2024 Production Summary			2025 Production Summary		
				MOE Permit Number	Permitted Capacity (total m ³ /year)*	Permitted Rate	Total Production Well Volume	Average Daily Rate	Average Rate	Total Production Well Volume	Average Daily Rate	Average Rate	Total Production Well Volume	Average Daily Rate	Average Rate	Total Production Well Volume	Average Daily Rate	Average Rate	Total Production Well Volume	Average Daily Rate	Average Rate
						(L/s)*	(total m ³ /year)	(m ³ /day)	(L/s)	(total m ³ /year)	(m ³ /day)	(L/s)	(total m ³ /year)	(m ³ /day)	(L/s)	(total m ³ /year)	(m ³ /day)	(L/s)	(total m ³ /year)	(m ³ /day)	(L/s)
Strange Street	Major	K10A K11A K13B K18 K19	Supply Supply Supply Supply Supply	P-300-6221899077	Combined rate of PTTW P-300-6221899077		35,130	96	1.1	478,475	1,311	15	381,894	1,046	12.1	401,278	1,099	12.7	277,216	759	8.8
				P-300-6221899077			159,049	436	5.0	1,152,743	3,158	37	1,165,547	3,193	37.0	975,118	2,672	30.9	921,052	2,523	29.2
				P-300-6221899077			0	0	0	0	0	0	196,383	1,753**	20.3	516,322	1,415	16.4	313,233	858	9.9
				P-300-6221899077			133,567	366	4.2	844,623	2,314	26.8	816,409	2,237	25.9	594,291	1,628	18.8	456,408	1,250	14.5
				P-300-6221899077			59,712	164	1.9	116,777	320	3.7	69,151	189	2.2	289,084	792	9.2	367,309	1,006	11.6
				Well Field Total	3,859,875	191.1	387,458	1,062	12.3	2,592,618	7,103	82.2	2,629,384	7,204	83.4	2,776,093	7,606	88.0	2,335,218	6,398	74.0
				*Maximum taking from the wellfield shall not exceed an annual daily average of 10,575,000 L/day																	

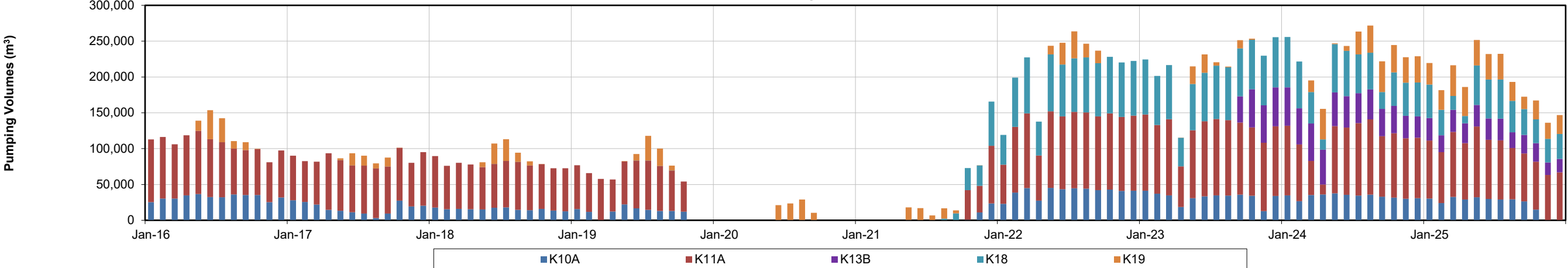
Notes:
- = no applicable data
n/a = data not available
* = rates and volumes based on permitted L/day
** K13B was commissioned in September 2023. The average daily rate is based on 112 days

REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
STRANGE STREET

Actual versus Mean Monthly Precipitation
Weather Station - University of Waterloo Weather Station

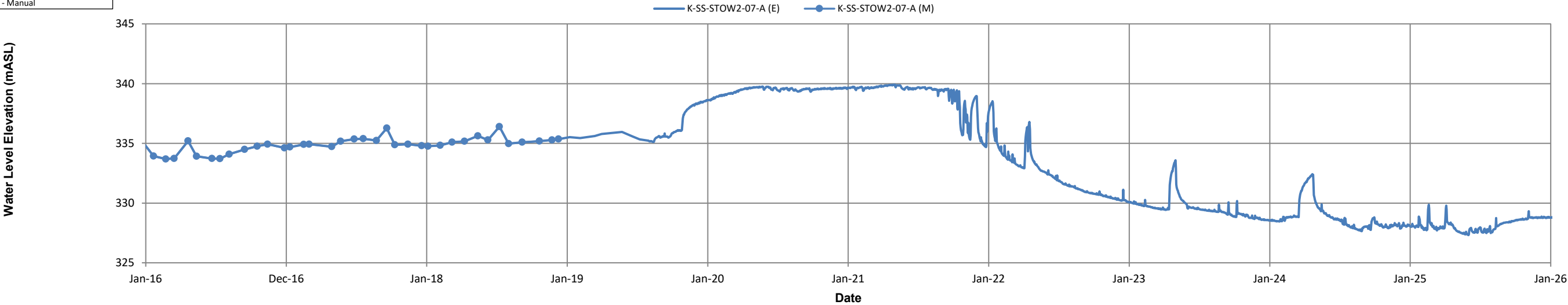


Monthly Total Pumped Volumes
Strange Street Well Field



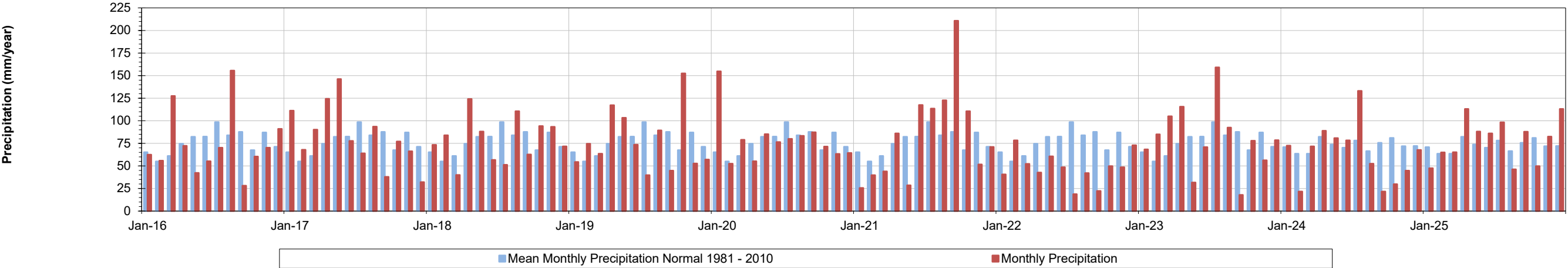
STRANGE ST. WELL FIELD

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

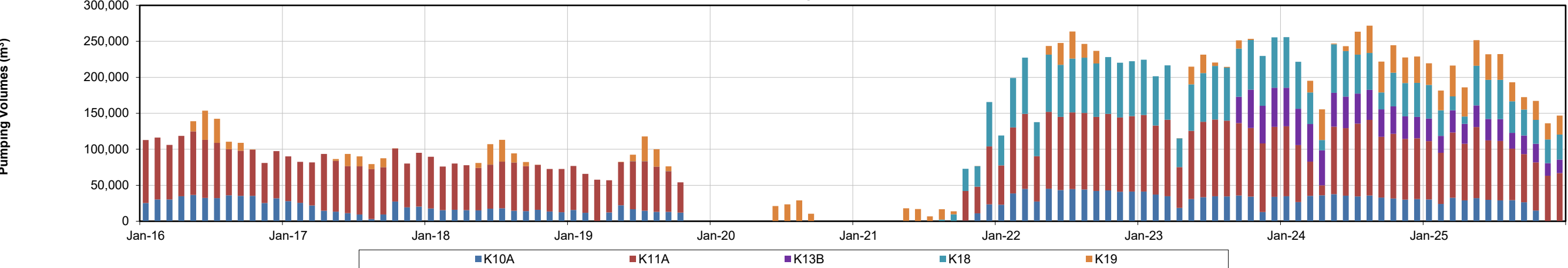


REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
STRANGE STREET

Actual versus Mean Monthly Precipitation
Weather Station - University of Waterloo Weather Station



Monthly Total Pumped Volumes
Strange Street Well Field

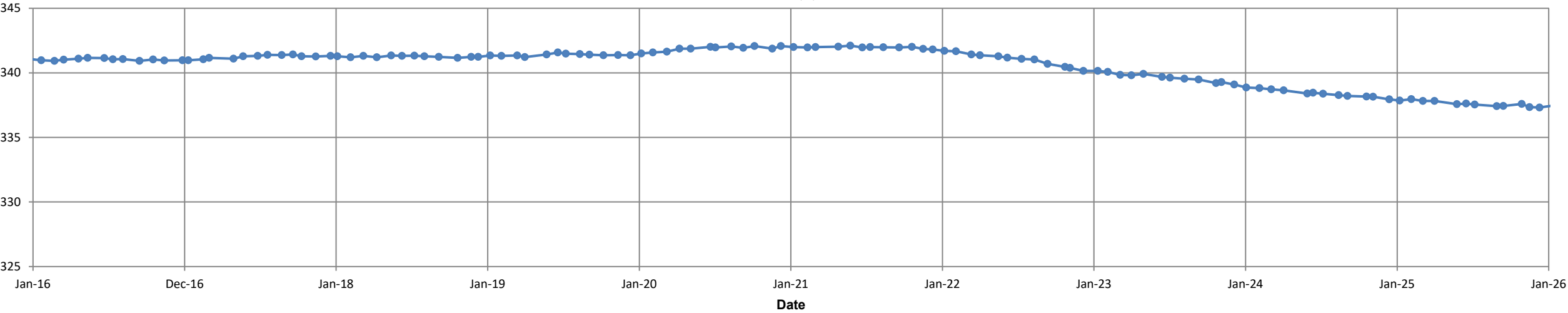


STRANGE ST. WELL FIELD

K-SS-SS11-99-A (M)

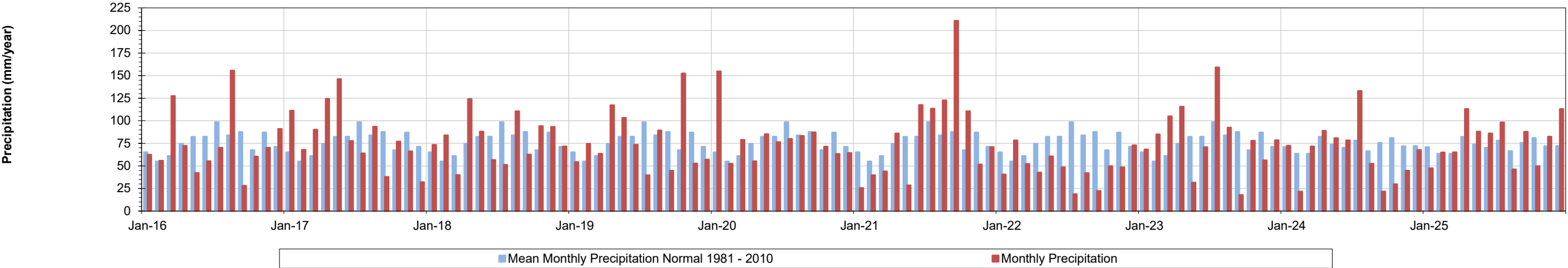
Current Measure Method
(E) - Electronic Datalogger
(M) - Manual

Water Level Elevation (mASL)

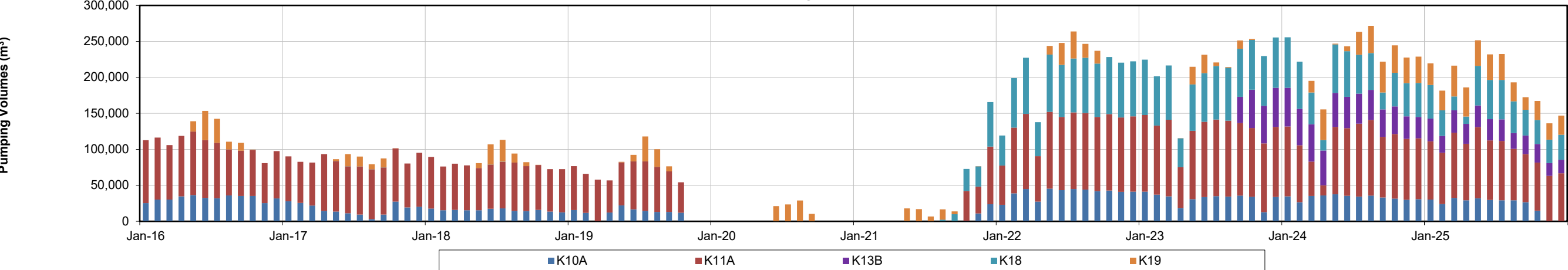


REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
STRANGE STREET

Actual versus Mean Monthly Precipitation
Weather Station - University of Waterloo Weather Station

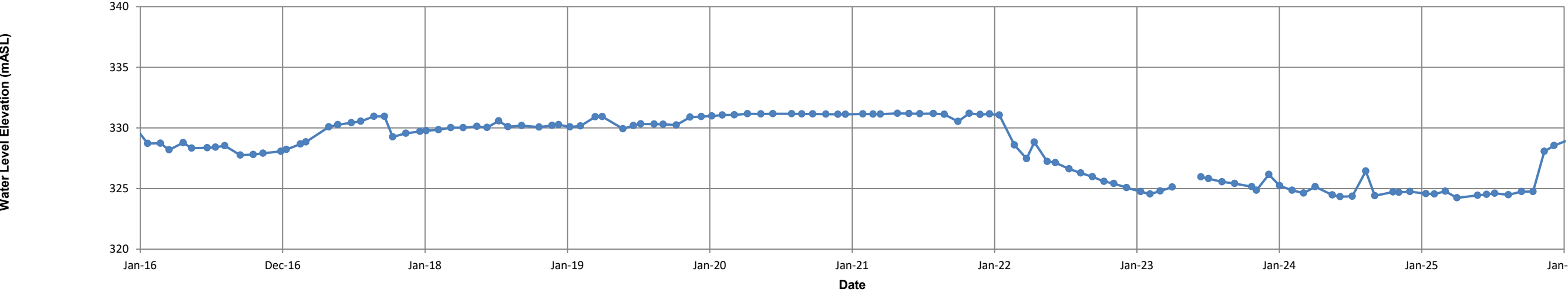


Monthly Total Pumped Volumes
Strange Street Well Field



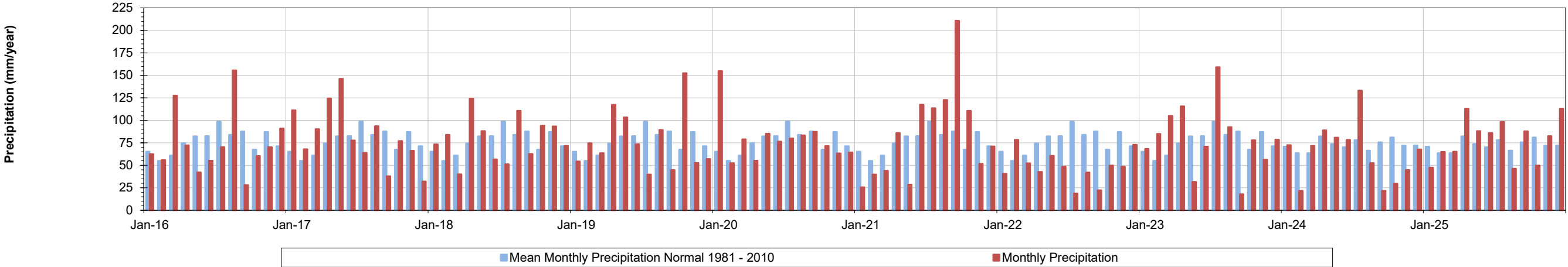
STRANGE ST. WELL FIELD

—●— K-SS-OW1-82-A (M)

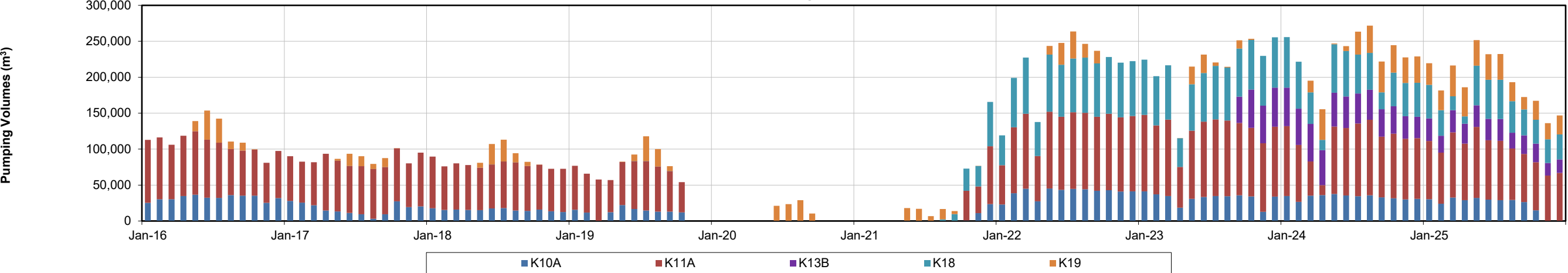


REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
STRANGE STREET

Actual versus Mean Monthly Precipitation
Weather Station - University of Waterloo Weather Station

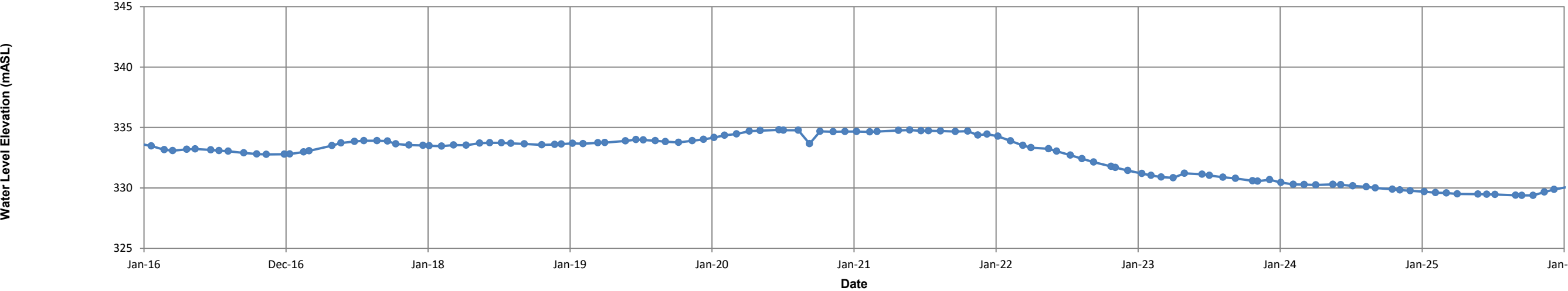


Monthly Total Pumped Volumes
Strange Street Well Field



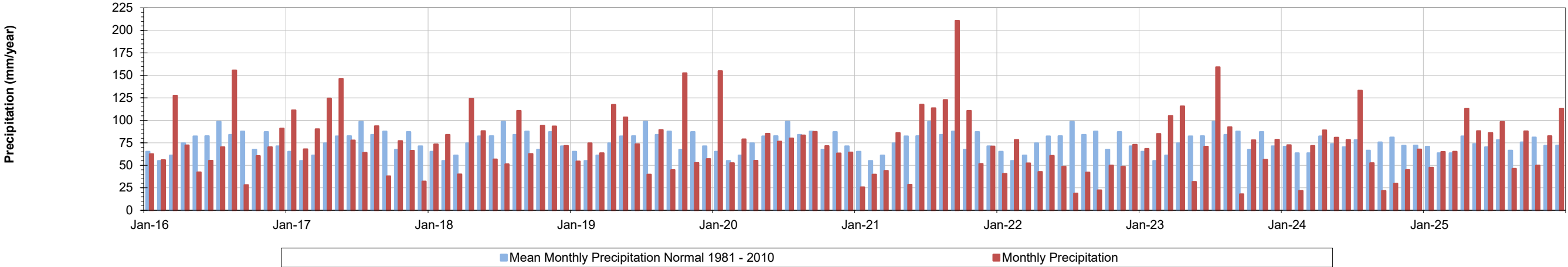
STRANGE ST. WELL FIELD

—●— K-SS-SS13-99-A (M)

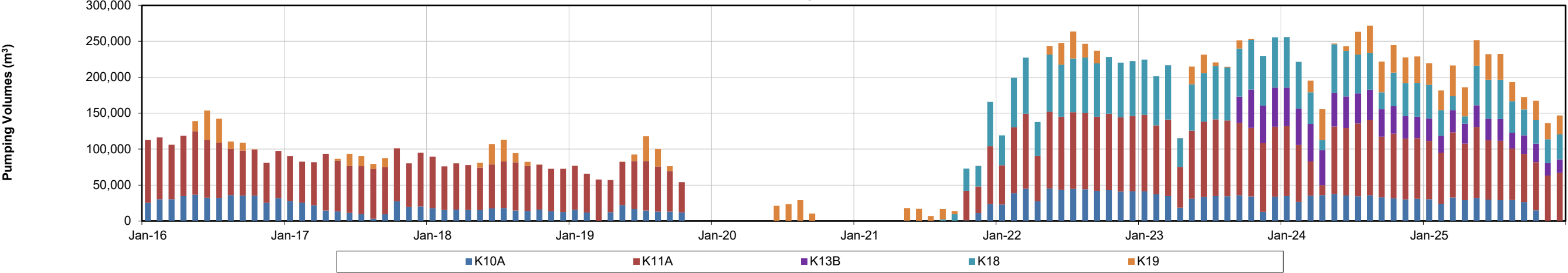


REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
STRANGE STREET

Actual versus Mean Monthly Precipitation
Weather Station - University of Waterloo Weather Station

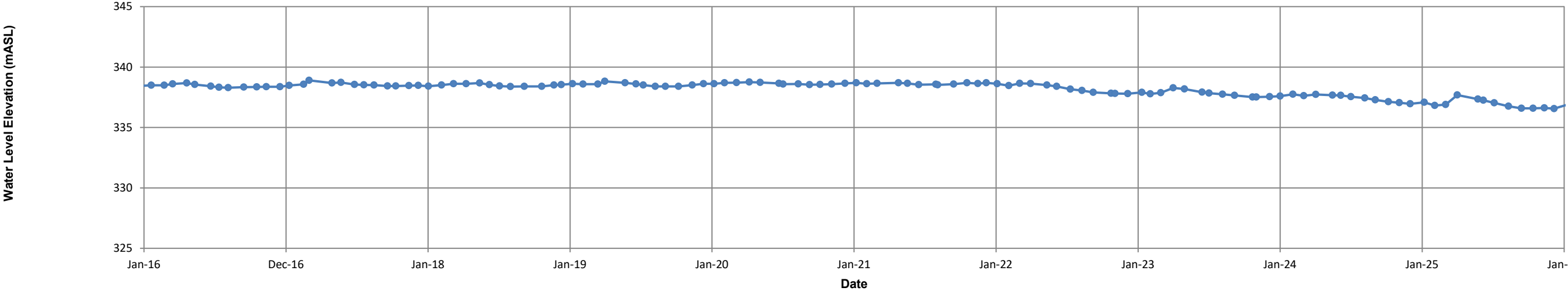


Monthly Total Pumped Volumes
Strange Street Well Field



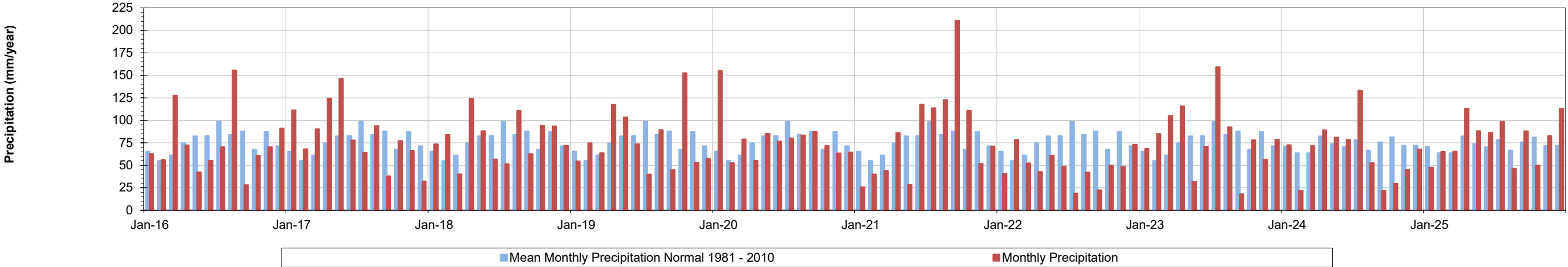
STRANGE ST. WELL FIELD

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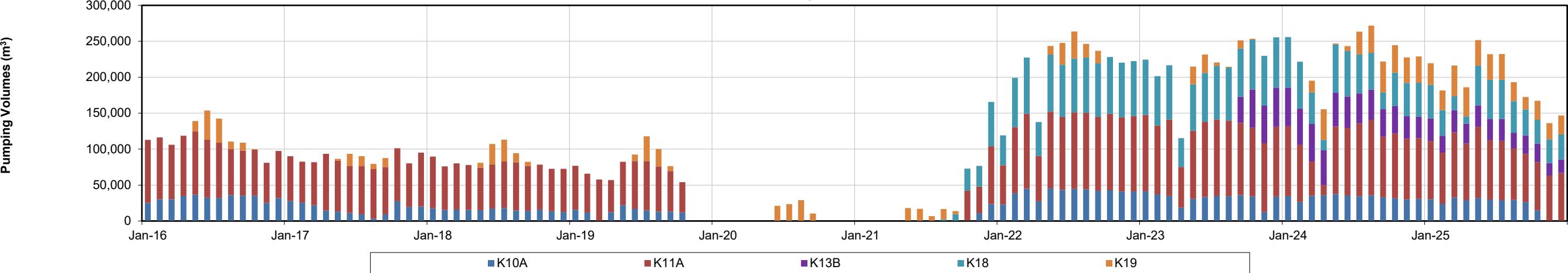


REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
STRANGE STREET

Actual versus Mean Monthly Precipitation
Weather Station - University of Waterloo Weather Station

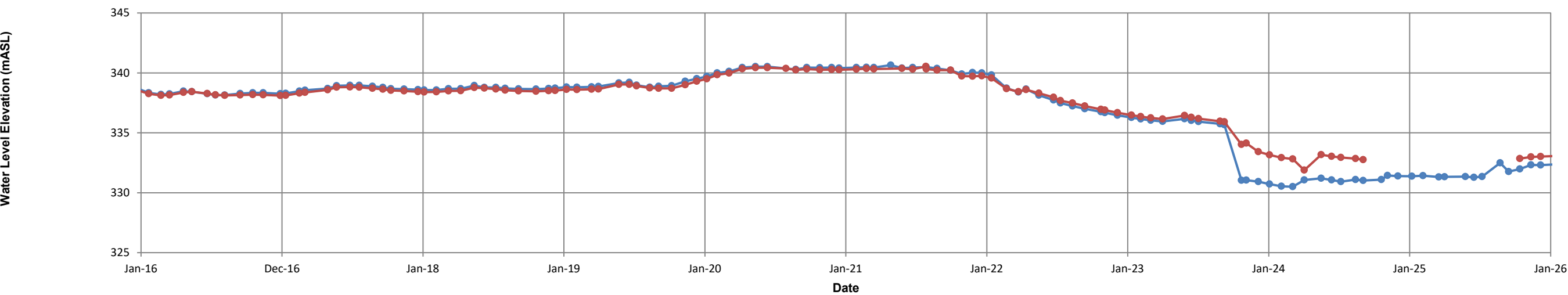


Monthly Total Pumped Volumes
Strange Street Well Field



STRANGE ST. WELL FIELD

—●— K-SS-OW1-13-A (M) —●— K-SS-OW1-14-B (M)





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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

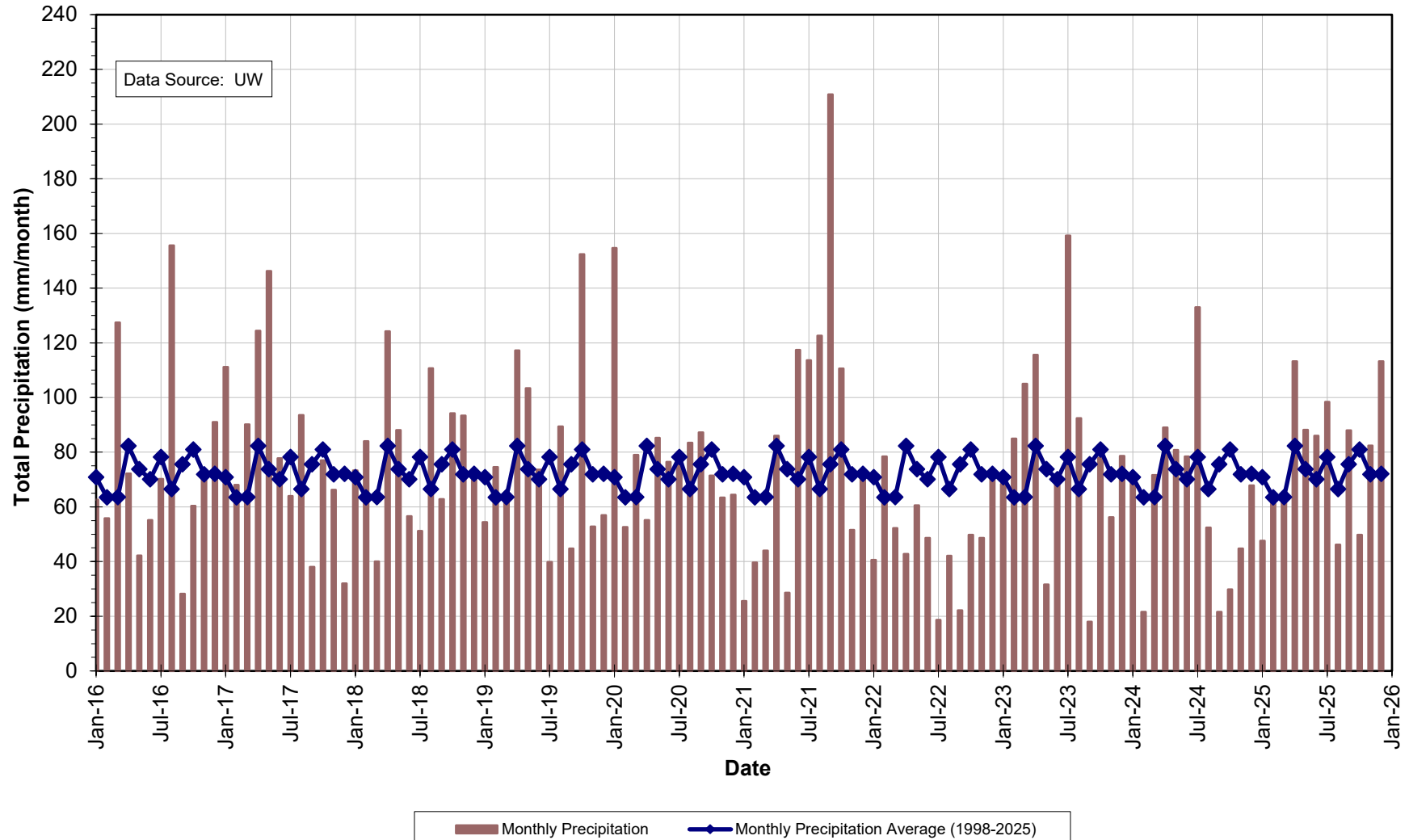
Year	Roseville Weather Station Established 1972		
	Annual Precipitation (mm)	30-yr NORMAL Precipitation 1981-2010 (mm)	Difference (mm)
2016	899	919	-20
2017	882	919	-37
2018	905	919	-14
2019	957	919	38
2020	817	919	-102
2021	832	919	-87
2022	637	919	-282
2023	945	919	26
2024	856	919	-63
2025	786	919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

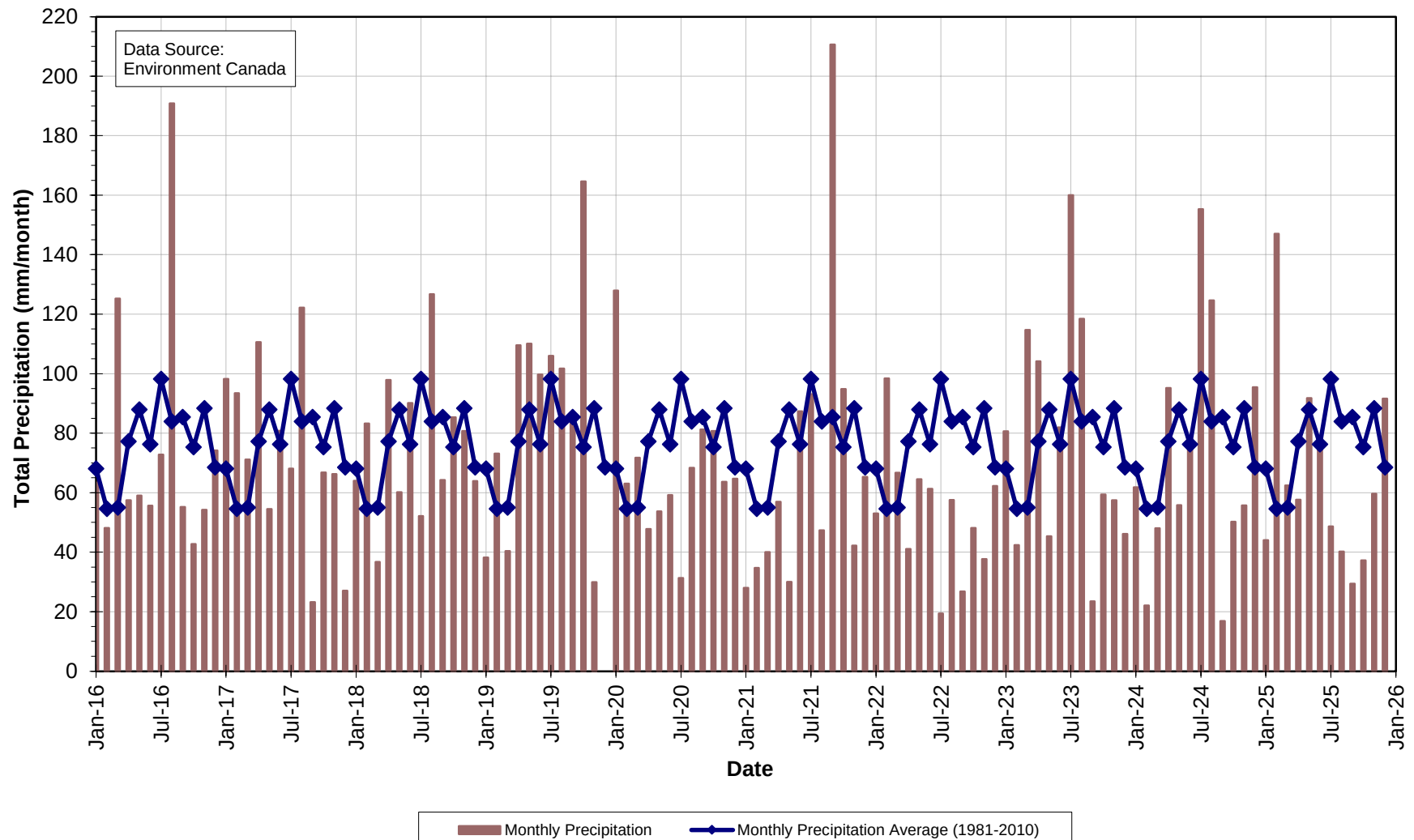
Region of Waterloo – 2025 Groundwater Monitoring Report

Figure D.1
University of Waterloo Weather Station
Monthly Precipitation



Region of Waterloo – 2025 Groundwater Monitoring Report

Figure D.2
Roseville Weather Station
Monthly Precipitation





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Appendix E

Monitoring Program Overview

GROUNDWATER LEVEL MONITORING PROGRAM PROCEDURES

E.1 Overview

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

E.1.1 Production Well Pumping and Water Levels

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

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

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

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

E.1.2 Monitoring Wells and Surface Water levels

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

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

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

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

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

E.1.3 Climatological Data

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

E.2 Groundwater Level Collection Protocols

E.2.1 Groundwater Level Monitoring Network Summary Well Checklist

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

E.2.2 Well Inspection

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

E.2.3 Monitoring Well Manual Water Level Measurement Procedure

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

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

E.2.4 Downloading of Water Levels from Electronic Dataloggers Procedure

For Non-Vented (Absolute) Datalogger Models:

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

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

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

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

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

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

- 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.

