2025 Biennial Groundwater Monitoring Report - Strasburg Well Field (K34, K36)

The Region of Waterloo

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1.0 Introduction

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

The Permit to Take Water (PTTW 6732-A3FJYA) for the Strasburg 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. The Strasburg PTTW expired on October 31, 2025 and a new PTTW 4588-DMHQTG was issued to the Region for the Strasburg production wells K34 and K36 on November 3, 2025. This report has been prepared to meet the reporting conditions of both PTTWs for 2024 and 2025. Copies of the PTTWs are included in Appendix A. The two PTTWs are generally similar except for the following:

- Condition 3.3 of the two permits are slightly different: Condition 3.3 of PTTW 6732-A3FJYA states “Notwithstanding Table A, the maximum combined taking from the two wells shall not exceed 4,772 litres per minute and 6,872,000 litres per day”. Condition 3.3 of PTTW 4588-DMHQTG states “Notwithstanding Table A, the combined volume of water taking from both sources (Well K34 and Well K36) listed in Table A shall not exceed an annual daily average of 6,609,600 litres per day.” This report will compare pumping volumes to the more stringent criteria.
- The monitoring wells listed in Condition 4.2 are slightly different. This is discussed in Section 2.1.2

The location of the Strasburg Well Field is shown on Figure 1 and the production wells in Kitchener are shown on Figure 2 with the monitoring network for K34 and K36 shown on Figure 3. Well records for the production and monitoring wells are found in Appendix B.

1.1 Scope of Work

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

The Region has developed a monitoring program for the Strasburg Well Field (K34, K36) which consists of the following activities:

- Measuring the daily volume pumped from the K34 and K36 production wells (Condition 4.1 of the PTTWs).
- Measuring the water levels in monitoring wells K-SB-OW29-94-A, K-SB-PK5-96-ABC, K-PK-OW2-95-ABCD, K-SB-PK3-95-A, K-SB-SBG-OW01-10-A, K-SB-OW2-18-A, K-SB-OW3-18-A and K-SB-OW5-18-A (Condition 4.2 of the PTTWs).
- Review of precipitation data from the nearest GRCA / Environment Canada weather station.
- Completion of a biennial report (every 2 years) that presents data in compliance with condition 4.3 of the PTTWs).

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 Strasburg Well Field is located in the south portion of Kitchener. Wells K34 and K36 are located in a predominantly residential area. The closest municipal well field is the Parkway Well Field, located 2.5 km to the north. The Mannheim and Greenbrook Well Fields are a little further to the northwest (Figure 2). Well K34 is located adjacent to North Strasburg Creek and K36 is 200 m east of Strasburg Creek (Figure 3).

2.1.1 Pumping Wells

The Strasburg Well Field consists of two production wells K34 and K36 (Figure 3). Well records for the production wells are found in Appendix B. A summary of the production well construction details is provided in Table 1 below.

Table 1: Production Well Construction Details

Well Name	Year Built	Casing / Screen Diameter (mm)	Screened Interval (mbgs)	Aquifer
K34	1967	400	29.7 – 34.7	AFD1
K36	1987	300	46.3 – 49.7	AFD1

The water taking volumes for the Strasburg 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)**
K34	6,872	2,661	3,455	971,408	2,667	2,848	973,432
K36	6,872	1,085	1,383	396,163	1,251	1,728	456,492
Total	6,872	3,747	4,285	1,367,571	3,918	4,318	1,429,924

Condition 3.3 of the PTTW specifies that the maximum combined taking from the two wells shall not exceed 6,872 m^3/day. As shown in Table 2, this requirement was met in both 2024 and 2025.

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

The pumping volumes are based on the total daily volumes as recorded by the Region's SCADA system and are presented in Appendix C as total monthly volumes. Pumping volumes from the well field ranged from 66,974 m^3/month to 127,312 m^3/month in 2024, and from 107,781 m^3/month to 130,324 m^3/month in 2025. In total, 1,367,571 m^3 was produced at this well field in 2024 and 1,429,924 m^3 was produced in 2025. These volumes are within the range of pumping for the previous five years and below the permitted volume of 2,508,280 m^3 per year (Table C-1).

2.1.2 Monitoring Wells

Condition 4.2 of the PTTWs requires monthly water levels at ten monitoring wells. The Region updated their well naming protocol in 2017 and as a result, the well names on the old PTTW differ slightly from the names used on the new PTTW. The monitoring requirements listed in Condition 4.2 of the PTTWs are shown below in Table 3for comparison. The updated Region names will be used throughout this report.

Table 3: PTTW Condition 4.2 Monitoring Requirements

PTTW 6732-A3FJYA	PTTW 4588-DMHQTG
K-SB-OW29-94	K-SB-OW29-94-A
K-SB-PK5ABC-96	K-SB-PK5-96-AB
K-PK-PK2ABCD-95	K-PK-OW2-95-AB

PTTW 6732-A3FJYA	PTTW 4588-DMHQTG
K-SB-PK3-95	K-SB-PK3-95-A
K-SB-SBG-OW01-10	K-SB-SGB-OW01-10-A
	K-SB-OW2-18-A
	K-SB-OW3-18-A
	K-SB-OW5-18-A

Construction and location details for the monitoring wells are described in Table 4 below. Well records for the monitoring wells are provided in Appendix B and well locations are shown on Figure 3.

Table 4: Monitoring Well Construction Details

Monitoring Well ID	Year Built	Screened Depth (mbgs)	Screened Formation	Distance to K34 (m)	Distance to K36 (m)
K-SB-OW29-94-A	1994	30.48 – 35.05	AFD1	11	588
K-SB-PK5-96-A	1996	47.85 – 49.4	Salina Formation	1081	1597
K-SB-PK5-96-B	1996	35.7 – 37.2	AFD1		
K-SB-PK5-96-C	1996	9.8 – 11.25	AFB2		
K-PK-OW2-95-A	1995	90.22 – 91.14	Salina Formation	3127	3306
K-PK-OW2-95-B	1995	64.0 – 65.3	AFD1		
K-PK-OW2-95-C	1995	30.48 – 32.0	AFB2		
K-PK-OW2-95-D	1995	16.76 – 18.29	AFB1		
K-SB-PK3-95-A	1995	19.2 – 20.72	AFB3	12	590
K-SB-SGB-OW01-10-A	2010	3.4 – 4.93	AFB1	567	10
K-SB-OW2-18-A	2018	32.6 – 35.7	AFD1	200	800
K-SB-OW3-18-A	2018	44.2 – 47.2	AFD1	750	150
K-SB-OW5-18-A	2018	52.7 – 55.8	AFD1	1,190	1,080

It should be noted that the new PTTW 4588-DMHQTG issued in November 2025 does not include monitoring wells K-PK-OW2-95-C, K-PK-OW2-95-D and K-SB-PK5-96-C but does include new monitoring wells K-SB-OW2-18-A, K-SB-OW3-18-A and K-SB-OW5-18-A. Water level data from all the wells is included to ensure compliance with both the old and new PTTWs.

2.2 Regional Geology and Hydrostratigraphy

The following sections provide a brief overview of the regional geology and hydrogeology of the Strasburg Well Field. The surficial geology based on regional OGS mapping is provided in Figure 4. The Strasburg Well Field is located near the eastern flanks of the Waterloo Moraine (Figure 5). Representative cross-sections showing the stratigraphy in the vicinity of the Strasburg Well Field are included as Figures 6 and 7. The cross-section locations are provided on Figure 3.

Note that the cross-sections are provided as a visual aid and do not necessarily contain all wells in the monitoring program for the Strasburg Well Field (K34, K36). 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 Strasburg 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 cross-section A-A" (Figure 6) include the following:

- A thinning of ground surface materials at K43 due to updated digital elevation model refining ground topography.
- AFD1 is thicker south of K36 and AFB3 is not present
- Absence of ATB2 in this area, which causes AFB1 and AFB2 to function as single connected aquifer in many places across the well field area

Refinements along cross-section B to B' (Figure 7) include the following:

- ATC1 / AFC1 / ATC2 is thicker at K34 and AFB3 pinches northwest of K34
- AFD1 is thicker northwest of K34

2.2.1 Surficial Geology and Conceptual Hydrostratigraphy

The surficial geology of the Study Area has been mapped and described by the Ontario Geological Survey (2003) and updated in Bajc and Shirota (2007). The surficial geology of the Strasburg Well Field is characterized primarily by silty to sandy till sediments and ice contact sand and gravel (Figure 4). Modern Alluvial and outwash deposits are present along Strasburg Creek and organic deposits are mapped south of K36.

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

Aquitard ATA1 – Whittlesey Clay

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

Aquifer AFA1 - Whittlesey Sand

This very fine to coarse sand unit is interpreted as glaciolacustrine Whittlesey sand (Bajc and Shirota, 2007) and is encountered immediately below ATA1 across the section.

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. Port Stanley Till is mapped at surface (Unit 5b on Figure 4) to the west and east of K36.

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

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

Aquitard ATB3 – Lower Maryhill Till

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

Aquifer AFB3 – Lower Waterloo Moraine Stratified Sediments and Catfish Creek Drift

The Lower Waterloo Moraine Stratified Sediments and Catfish Creek Drift when present is found below Aquitard 2 (ATB3), mainly along the eastern flank of the Moraine. This unit consists of stratified gravels, sands, or silts and is of very limited extent. The Tier 3 Study (Stantec, 2012) indicated that the unit is not considered to be a significant hydrostratigraphic unit in the Strasburg Well Field area.

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. This unit is nearly continuous throughout the Region forming one of the main stratigraphic marker units within the Moraine. The Catfish Creek Till is typically thickest in the core area of the Waterloo Moraine, and thin or absent along the eastern flank. It is considered to be continuous in the vicinity of the Strasburg Well Field.

Aquifer AFD1 – Pre-Catfish Creek Sand and Gravel

Pre-Catfish Creek Till aquifer corresponds to sands and gravel re-worked from Catfish Creek and Pre-Catfish Creek Tills and represents the main supply aquifer in several production wells in the Cities of Kitchener and Waterloo including the Strasburg Well Field.

Aquitard ATE1 – Canning Drift

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

Aquifer AFF1 – Pre-Canning Till

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

2.2.2 Bedrock Geology

The Paleozoic bedrock in the area consists of the Salina and Guelph Formations.

2.3 Local Geology

The following description of local geology is based on borehole descriptions for the Strasburg Well Field production wells and monitoring wells. Borehole logs for the wells are included in Appendix B.

Upper Waterloo Moraine (AFB1 / AFB2) – Near surface deposits predominantly reflect ice contact stratified deposits of sand and gravel (Unit 6 on Figure 4), associated with the Waterloo Moraine (AFB1 / AFB2). The unit is encountered at surface at K-SB-SBG-OW01-10-A extending to 4.9 metres below ground surface (mbgs), at K-SB-PK5-96-C extending to 13 mbgs and at K-PK-OW2-95 extending to 20 mbgs.

Middle / Lower Maryhill Till (ATB2 / ATB3) – This unit is semi-continuous in the area of the Strasburg Well Field ranging in thickness from 1 m to 6 mbgs (Stantec, 2019). The unit was identified at K-SB-SBG-OW01-10-A as silty clay underlying AFB1 at a depth of 4.8 mbgs extending to 9.1 mbgs. At K-SB-PK5-96 the unit was encountered from 13 mbgs to 23 mbgs as silty clay till and at K-PK-OW2-95 the unit was encountered from about 20 mbgs to 45 mbgs.

Catfish Creek Till (ATC1 / ATC2) – This unit consists of dense, stony, sandy silt to silty sand till with little clay content. The Catfish Creek Till is interpreted to be continuous in the Strasburg Wellfield area. The unit was encountered at K-PK-OW2-95 from about 45 m to 56 mbgs and at K-SB-PK5-96 from 23 m to 31 mbgs.

Pre-Catfish Creek Sand and Gravel (AFD1) – This unit consisting of layers of sand, gravel and boulders is the production aquifer for the Strasburg Well Field production wells K34 and K36. The unit was encountered between 25 mbgs and 35 mbgs at K34 and K-SB-OW29-94-A. At K-PK-OW2-95-B the unit extends from about 56 mbgs to 72 mbgs and at K-SB-PK5-96-B the unit was encountered from 31 mbgs to 38 mbgs. AFD1 is interpreted to directly overlies the bedrock in the vicinity of K36 (Stantec 2019).

Bedrock - The bedrock in the area of the Strasburg Wellfield consists of Salina Formation which is comprised of interbedded dolostone and shale with lenses of gypsum and anhydrite. The Strasburg Well Field is located just west of the contact between the Salina and Guelph Formation. Bedrock is interpreted to be located at approximately 250 to 265 masl (Figures 6 and 7). Shale bedrock interpreted as the Salina Formation was encountered at K-SB-PK5-96-A at a depth of 47 mbgs and at K-PK-OW2-95 at a depth of 90 mbgs.

3.0 2024 / 2025 Results

In accordance with condition 4.2 of the PTTW, water levels were measured and recorded once a month in all listed monitoring wells. The following sections summarize groundwater levels at the monitoring wells in relation to precipitation, water taking from the aquifer (in accordance with condition 4.3 of both the PTTWs).

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, University of Waterloo (U of W) or Environment Canada station located closest to the production wells are used. The closest weather stations relative to the Strasburg well field are the Environment Canada stations, Roseville station located 3.9 km south from the well field and Waterloo International Airport station located 10.4 km northeast of the well field. The locations of the meteorological stations are shown on Figure 1. Annual precipitation data from the past 10 years for all stations are compared with long term averages in Table D.1, Appendix D. Monthly precipitation data for the past 10 years at Roseville are shown on Figure D.1, Appendix D. The Roseville and Region of Waterloo International Airport (WIA) have “Climate Normals” calculated by Environment Canada for 1971 to 2000.

Annual 2024 / 2025 precipitation data for the meteorological stations closest to the Strasburg well field are presented in Table 5 below. In 2024 Roseville was missing 5 days of data and 20 days in 2025. Similarly, WIA was missing 6 days of data in 2024 and 6 days in 2025. As a result, the precipitation totals at these stations may be under reported.

Table 5: Summary of Precipitation Data

Station	2024 Precipitation (mm)	2024 Deviation (mm)	Long-Term Average (mm)	2025 Precipitation (mm)	2025 Deviation (mm)
Region of Waterloo International Airport (1)	874	23	851(A)	723	-128
Roseville Station (1)	856	-63	919(A)	786	-133

Sources: Environment Canada (1), A 1991 to 2020 Normal

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 WIA station was 874 mm, which is 23 mm above the long-term average, indicating 2024 was slightly wetter-than-average year at the well field. Alternatively, a 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 at WIA was 723 mm, which is 128 mm below the long-term average. The total precipitation at the Roseville station was also below the long-term average (133 mm), indicating 2025 was a drier-than-average year. However, Roseville was missing 25 days of data in 2024 / 2025 and WIA was missing 12 days of data and as a result, precipitation totals may be under reported. The snow survey conducted by the GRCA on March 15, 2025, showed that the stations in the Region had a high to very high measured snow water equivalent.

3.2 Monitoring Results

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

K-PK-OW2-95-ABCD

Monitoring well K-PK-OW2-95-ABCD is 6 km northwest of K34 and has four screens which are monitored with electronic water level meters.

Screen A located in the upper bedrock, responds to pumping of K34 and K36. Water levels rise in response to reduced pumping in February 2024, April 2024 and after June 2025. Overall 2024 / 2025 levels are within historical ranges. Water levels do not show any long term decreasing trend from pumping

Water levels in Screen B located in AFD1 are relatively stable varying by 2 m over the past 10 years. Water levels show a similar trend to those in the A screen, but responses to pumping are more subdued. Water levels increase by about 1 m during annual shut downs and also show seasonal trends. Water levels in 2024 / 2025 are slightly lower than historical levels by about 1 m and lower than any water levels in the past ten years.

Water levels in Screen C (located in AFB2) and Screen D (located in AFB1) do not show any response to pumping of the Strasburg Well Field. Similar seasonal trends are observed at the wells most years with peak water levels occurring in June and July and decreasing levels through the remainder of the year. Historically, water levels in Screen C have been about 1 m above water levels in Screen D, however starting in 2023 a decreasing trend in water levels is observed in Screen C that is not observed in Screen D resuling in water levels in Screen C at the end of 2025 about 1 m below water levels at Screen D. The decreasing trend in 2024 and 2025 has been observed in many monitoring wells screened in AFB2 across the Region and at this location has been interpreted to be a result of climatic influences. Water levels in Screeen C at the end of 2025 are about 3.5 m lower than water levels in 2020 and are lower than any water levels in the past ten years.

K-SB-OW29-94-A

Monitoring well K-SB-OW29-94-A, located immediately adjacent to production well K34, is screened in AFD1. Water levels at K-SB-OW29-94-A are recorded with an electronic water level meter. The water levels at this location respond to pumping at K34, recovering 10 to 12 m during shut-downs at K34 and declining in response to increased pumping. Water levels in 2024 / 2025 are within historical ranges and there is no long term decreasing trend in water levels observed.

K-SB-PK3-95-A

Water levels at K-SB-PK3-95-A are collected manually on a monthly basis. K-SB-PK3-95 is installed in AFB3 and water levels in 2024 / 2025 are within historical ranges. Water levels at K-SB-PK3-95 range between 299.5 masl and 301.8 masl. The water levels show seasonal trends but also show some response to pumping of K34. Seasonal variations in water levels range from 0.7 to 2.0 m with peak water levels occurring during the spring. Observed water level increases when K34 is shut down range from 0.5 m to 2 m.

K-SB-PK5-96-ABC

Water levels at K-SB-PK5-96-ABC are monitored with electronic water level meters. The electronic water level meter in Screen B was installed in April 2021. Screen A is located in the bedrock and Screen B is located in AFD1. Water level trends in the A and B screens are similar. Water levels fluctuate within 4 m to 5 m in response to pumping at the Strasburg wells. Water levels at K-SB-PK5-96-ABC in 2024 / 2025 are within historical ranges and there is no long term decreasing trend in water levels observed. The Screen C is located in AFB1 and is separated from Screen B by 6 m of clay till. Levels in the C screen are relatively stable varying by about 1 m. Similar to trends observed at K-PK-OW2-95-D, annual seasonal highs occur in June and July. Screen C

is not impacted by pumping at the Strasburg Well Field as there is no response observed during shutdowns

K-SB-SBG-OW01-10-A

Water levels at K-SB-SBG-OW01-10-A are monitored with an electronic water level meter. The well located on the K36 site is screened in AFB1 about 41 m above the top of the screen in K36. Water levels at K-SB-SBG-OW01-10-A are stable varying within a 0.5 m range. Water levels tend to follow a seasonal trend and are typically highest in the spring and lowest in early fall. Water levels in 2024 / 2025 are within historical ranges.

K-SB-OW2-18-A

Water levels at K-SB-OW2-18-A are monitored with an electronic water level meter. The well is screened in the same aquifer as K34/K36, AFD1. In 2024 / 2025 water levels are within historical ranges. Water levels at K-SB-OW2-18-A range between 293.1 and 302.4 masl. Observed water level increases when K34 and K36 are shut down range from 6 m to 9 m. There is no long term decreasing trend in water levels observed.

K-SB-OW3-18-A

Water levels at K-SB-OW3-18-A are monitored with an electronic water level meter. The well is located 150 m south of K36 and is screened in the same aquifer, AFD1. In 2024 / 2025 water levels are within historical ranges. The water levels at this location respond to pumping at K36, recovering 4 m to 5 m during shut-downs at K36 and ranging between 307 masl and 314 masl. Water levels decline about 1.3 m from March 2020 to April 2025. Water levels then recover about 0.5 m and remain stable for the rest of the year when K36 pumping is reduced.

K-SB-OW5-18-A

Water levels at K-SB-OW5-18-A are monitored with an electronic water level meter. K-SB-OW5-18-A is installed in AFD1 and water levels in 2024 / 2025 are within historical ranges. The water levels at this location respond to pumping at K36. Water levels at K-SB-OW5-18-A have a similar pattern to K-SB-OW3-18-A recovering 2 m to 3 m during shut-downs at K36 and ranging between 312 masl and 316 masl. Water levels decline about 1.1 m from March 2020 to April 2025. Water levels then recover about 0.3 m and remain stable for the rest of the year when K36 pumping is reduced.

4.0 Impact Assessment

4.1 Well Interference

PTTW Condition 5.1 of both PTTWs 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 of both PTTWs 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 Strasburg Well Field. When a well interference complaint is received, the Region has a Well Interference Policy in place. A copy of the policy is presented in Appendix F of the 2019 Biennial Groundwater Monitoring Report – Multiple Well Fields (Burnside, 2020). There were no well interference complaints related to pumping of K34 and K36 received in 2024 and 2025, therefore both Conditions 5.1 and 5.2 were met for both PTTWs

Groundwater takings registered in the MECP’s PTTW database in the vicinity of the wellfield were reviewed. There is no other groundwater takings registered in the MECP PTTW database within 2 km of the wellfield (Figure 3).

4.2 Aquifer Response to Pumping and Precipitation

Water levels in the bedrock aquifer vary by 1 m to 4 m in response to pumping of K34 / K36. The water level response to pumping in AFD1 ranges from 1 m to 12 m. Pumping response was also observed in K-SB-PK3-95-A which is screened in AFB3. There were no long-term decreasing trends observed in the bedrock, AFD1 and AFB3 aquifers. Water levels in the surficial AFB1 / AFB2 aquifer(s) did not show a response to pumping at the Strasburg Well Field and show annual seasonal trends in response to precipitation.

5.0 Conclusions

Impacts from pumping the municipal wells at the Strasburg Well Field (K34, K36) 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 the PTTW.
- 2024 and 2025 pumping volumes were within the permitted range.
- Water levels in 2024 / 2025 are within historical ranges.
- There were no reported well interference complaints arising from water takings at the Strasburg well field.
- Water levels in monitoring wells indicate that current pumping rates have not resulted in any adverse impacts to water levels in either the bedrock or overburden aquifers.

6.0 References

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

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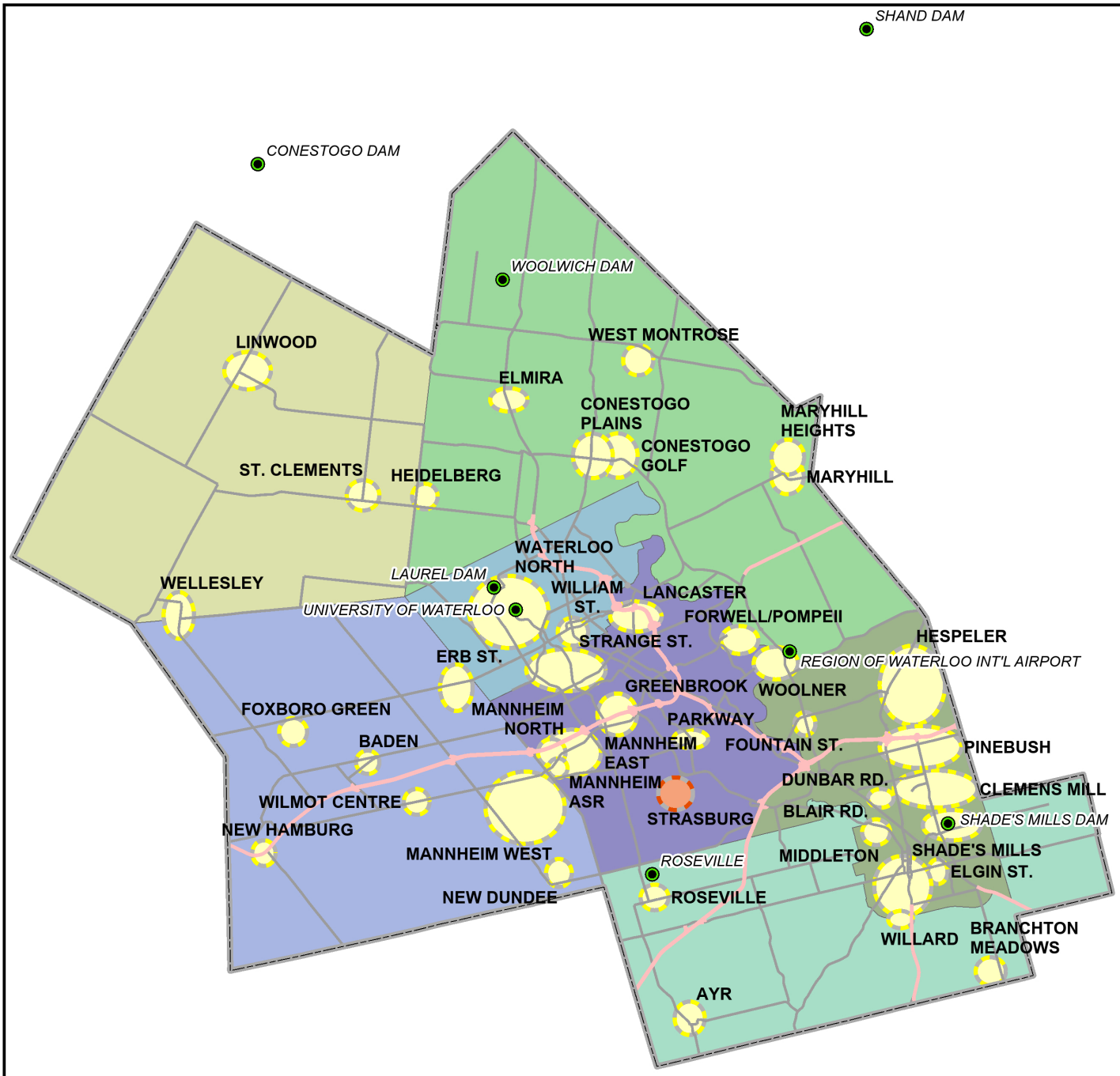
Figures



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Data Source:
Region of Waterloo; Includes material © 2012 of the Queen's Printer for Ontario. All rights reserved.

0 5 10 15 20
Kilometers

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

BURNSIDE

Map Title

2025 GROUNDWATER MONITORING REPORT - STRASBURG WELL FIELD

WELL FIELD LOCATION MAP

Client

REGION OF WATERLOO

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HN	SQ	February 2026	1
Scale		Project No.	
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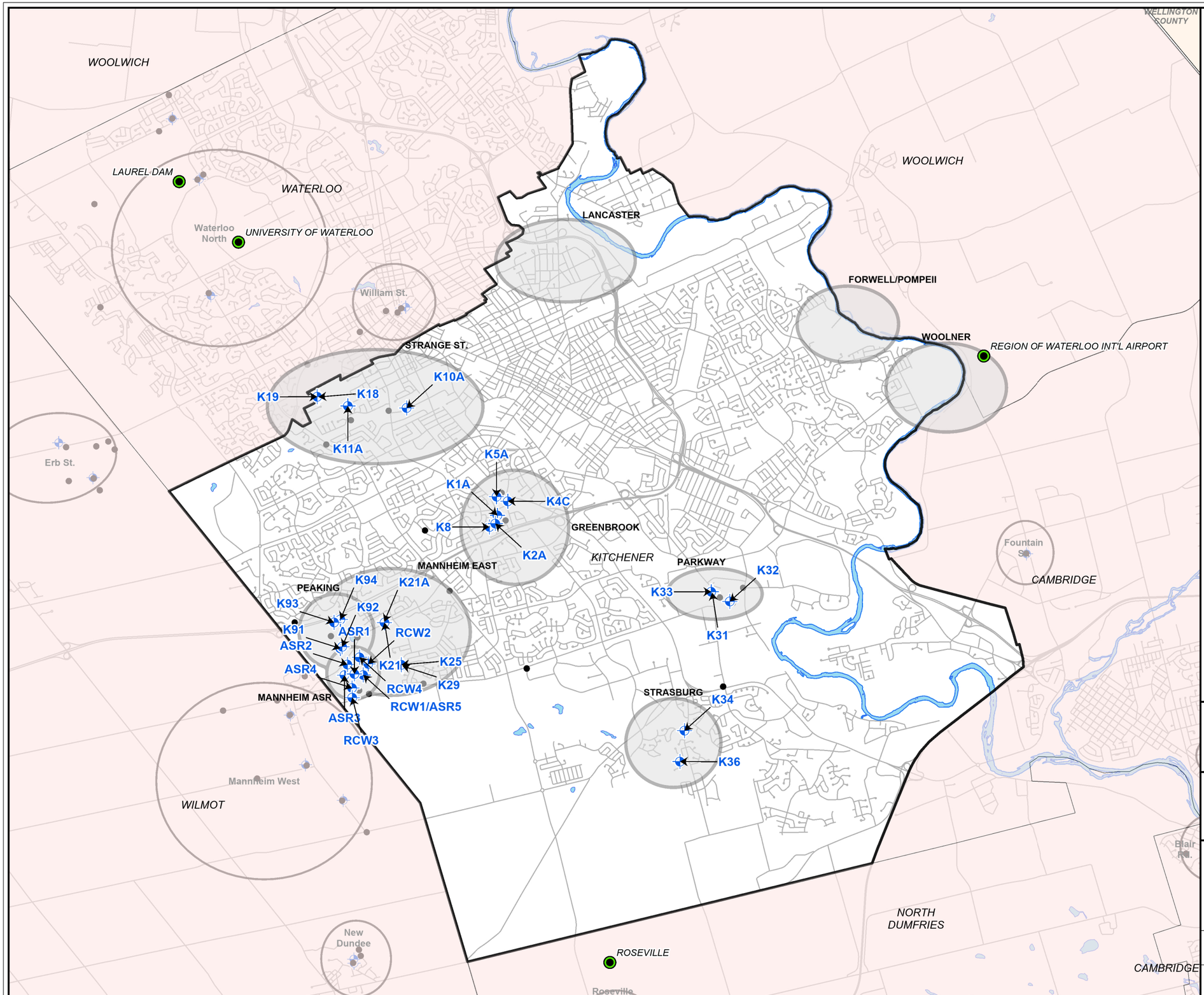

LEGEND

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

Sources:

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

Datum: North American 1983 CSRS

Coord. System: NAD 1983 CSRS UTM Zone 17N

N

0 1 2 3 4 5

Kilometers

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Client

REGION OF WATERLOO

Figure Title

2025 GROUNDWATER MONITORING REPORT - STRASBURG WELL FIELD

KITCHENER WELL FIELDS AND MONITORING NETWORK

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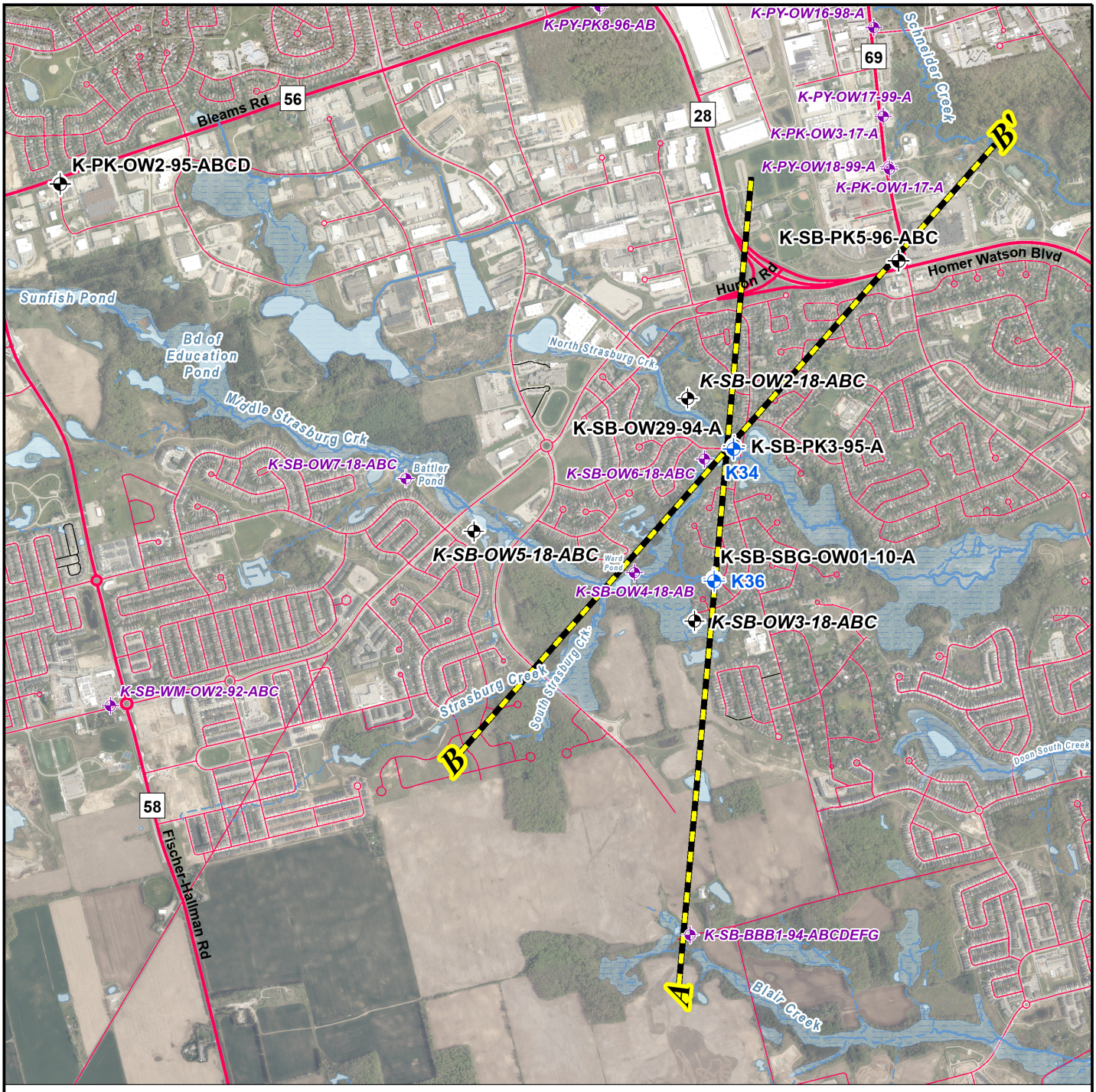

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Data Source:
Region of Waterloo GIS Data; Background 2020 Air Photo: ArcGIS Image Service Region of Waterloo; Ministry of Natural Resources, © Queen's Printer for Ontario; Natural Resources Canada © Her Majesty the Queen in Right of Canada.

0 150 300 450 600 750 900 1,050 1,200 1,350 1,500 1,650

Metres

- PTTW Monitoring Well Location
- Production Well Location
- Nearby Monitoring Well Location
- Cross Section Orientation
- Intermittent Creek
- Creek
- Provincially Significant Wetland (MNR)
- Regional Road
- Local Road
- Private / Other Road

BURNSIDE

Map Title

2025 GROUNDWATER MONITORING REPORT - STRASBURG WELL FIELD

WELL LOCATION MAP

Client

REGION OF WATERLOO

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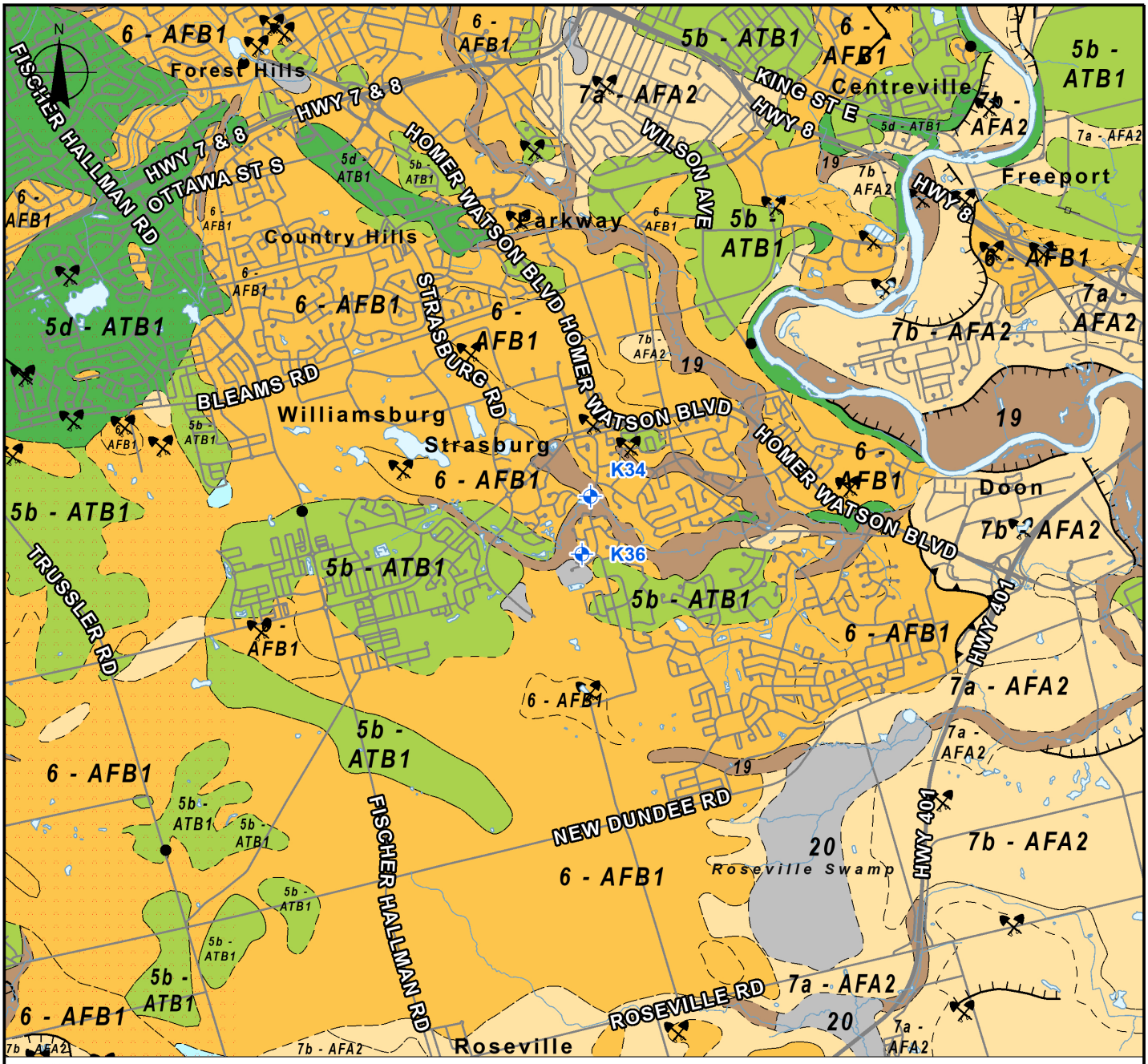

Data Source:
1. Ontario Geological Survey 2003. Surficial Geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128.
2. Region of Waterloo GIS

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

RMOW Supply Well
Watercourse
Waterbody

Surficial Geology

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

BURNSIDE

Map Title
2025 GROUNDWATER MONITORING REPORT - STRASBURG WELL FIELD

SURFICIAL GEOLOGY

Client
REGION OF WATERLOO

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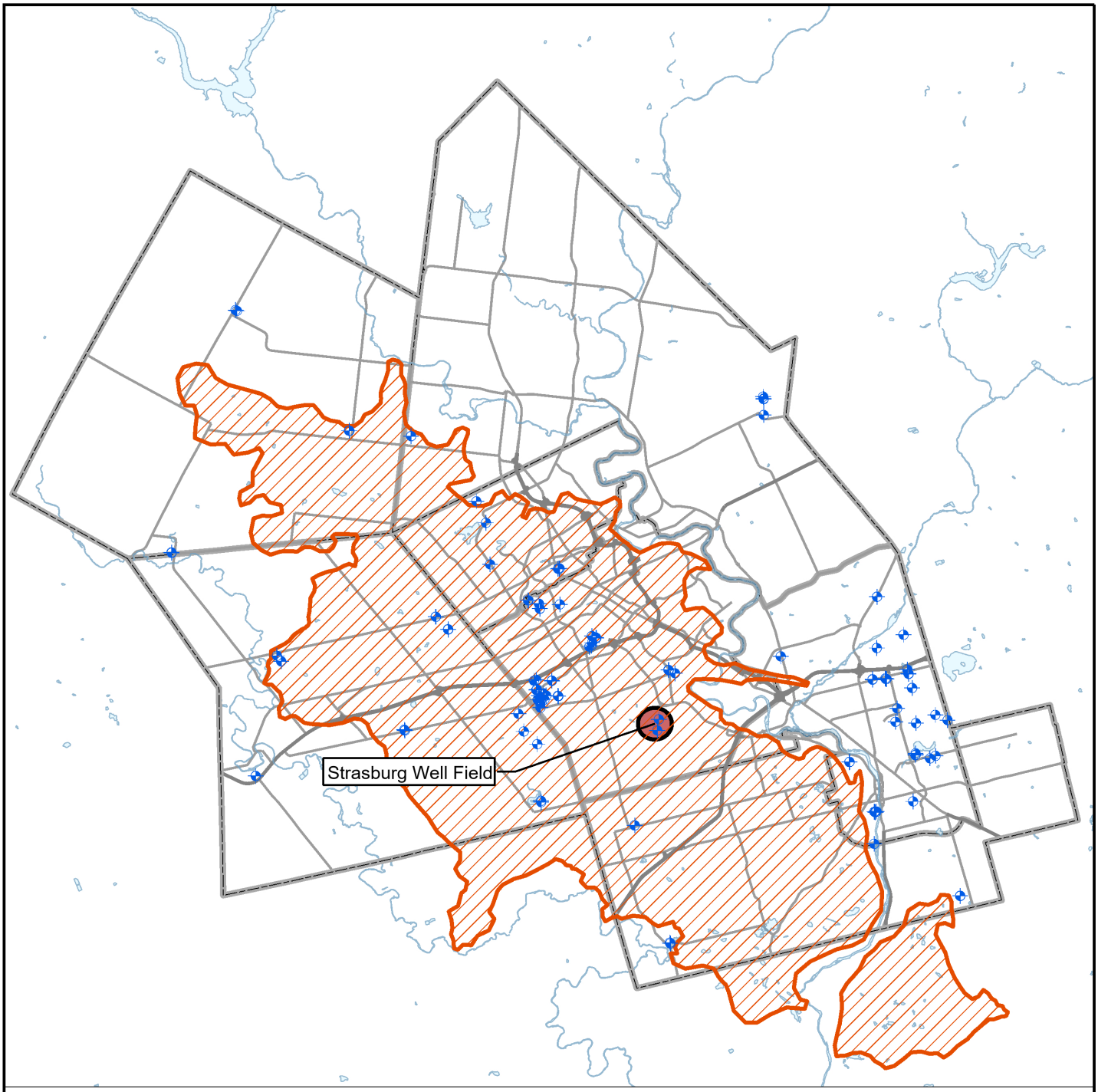

N

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

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

0 5 10 15 20 25
Kilometers

BURNSIDE

Map Title

2025 GROUNDWATER MONITORING REPORT - STRASBURG WELL FIELD

LOCATION OF THE WATERLOO MORAINE

Client

REGION OF WATERLOO

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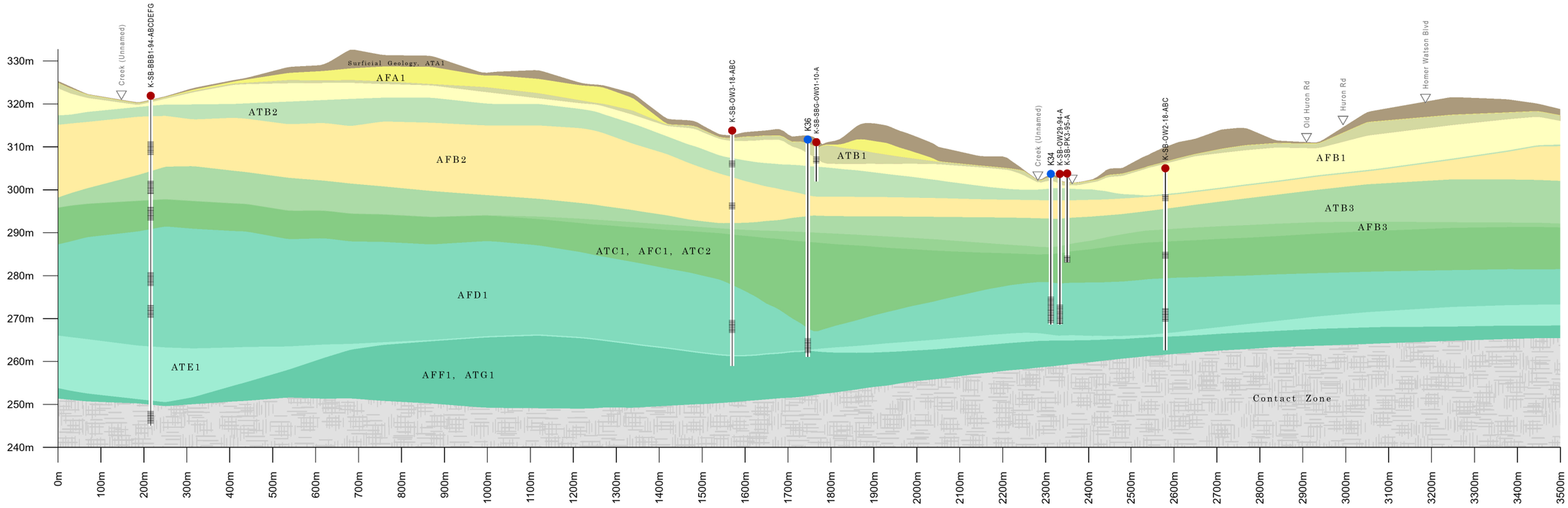
A

A'



Wells

- Production Well (Active)
- Monitoring Well

Moraine Model 2026

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

Wellhead

Well

Screen or Open Hole

BURNSIDE

Client

REGION OF WATERLOO

Figure Title

GEOLOGIC CROSS SECTION REGION OF WATERLOO

Strasburg

Cross Section A - A'

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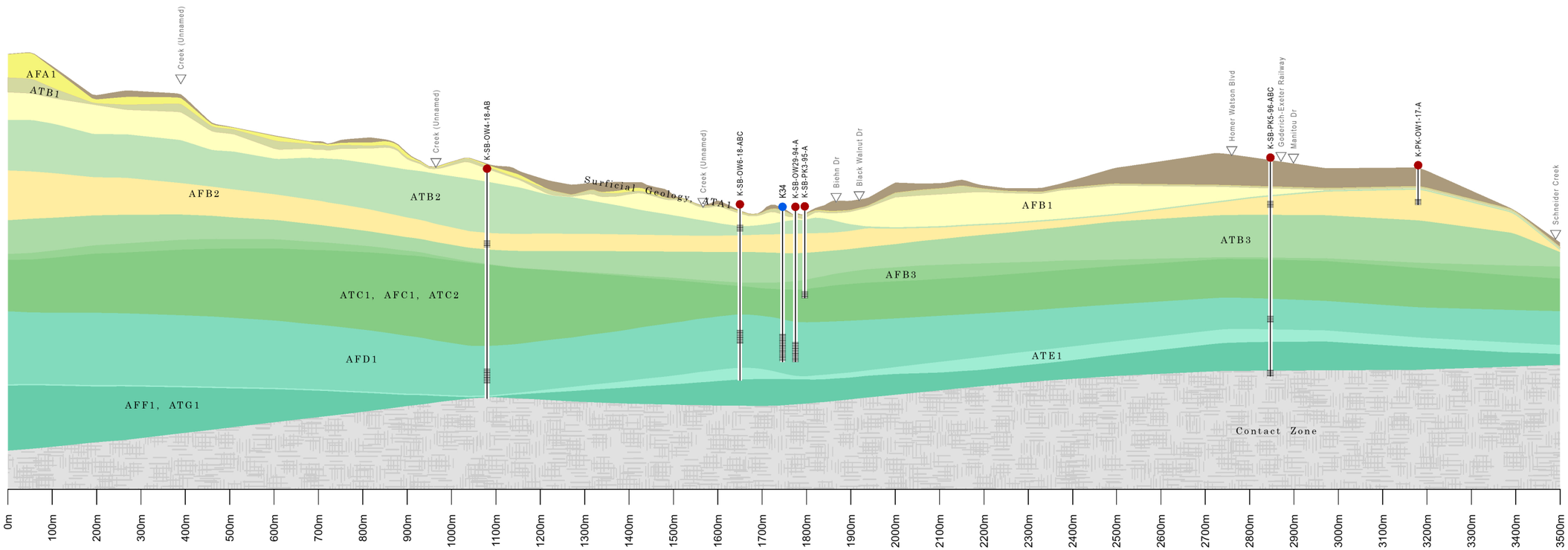
B

B'



Wells

- Production Well (Active)
- Monitoring Well

Moraine Model 2026

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

Wellhead
Well
Screen or Open Hole

BURNSIDE

Client
REGION OF WATERLOO

Figure Title
GEOLOGIC CROSS SECTION REGION OF WATERLOO
Strasburg
Cross Section B - B'

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Appendix A

Permit To Take Water

Ontario

Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique

AMENDED PERMIT TO TAKE WATER
Ground Water
NUMBER 6732-A3FJYA

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

The Regional Municipality of Waterloo
150 Frederick St., 7th Floor
Kitchener, Ontario N2G 4J3

For the water taking from: Well K34, Well K36 (Strasburg Wellfield)

Located at: 163 Biehn Dr at Marl Meadow Drive
Kitchener, Regional Municipality of Waterloo

Lot 7, Concession BIEHNS TRACT, Geographic Township of Waterloo
Kitchener, Regional Municipality of Waterloo

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

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.

(b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment and Climate Change.

(d) "District Office" means the Guelph District Office.

(e) "Permit" means this Permit to Take Water No. 6732-A3FJYA including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.

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

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

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

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated July 20, 2015 and signed by Richard Wootton, and all Schedules included in this Permit.

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

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

1.4 This Permit is not transferable to another person.

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

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

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

2. General Conditions and Interpretation

2.1 Inspections

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

2.2 Other Approvals

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

(a) relieve the Permit Holder or any other person from any obligation to comply with any other

applicable legal requirements, including the provisions of the *Ontario Water Resources Act* , and the *Environmental Protection Act* , and any regulations made thereunder; or

(b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

2.3 Information

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

(a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or

(b) acceptance by the Ministry of the information's completeness or accuracy.

2.4 Rights of Action

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

2.5 Severability

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

2.6 Conflicts

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

3. Water Takings Authorized by This Permit

3.1 **Expiry**

This Permit expires on **October 31, 2025**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted

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

Table A

	Source Name / Description:	Source: Type:	Taking Specific Purpose:	Taking Major Category:	Max. Taken per Minute (litres):	Max. Num. of Hrs Taken per Day:	Max. Taken per Day (litres):	Max. Num. of Days Taken per Year:	Zone/ Easting/ Northing:
1	Well K34	Well Drilled	Municipal	Water Supply	4,772	24	6,872,000	365	17 544033 4804487
2	Well K36	Well Drilled	Municipal	Water Supply	4,772	24	6,872,000	365	17 543953 4803924
						Total Taking:	6,872,000		

3.3 Notwithstanding Table A, the maximum combined taking from the two wells shall not exceed 4,772 litres per minute and 6,872,000 litres per day.

4. Monitoring

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

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

K-SB-OW29-94
K-SB-PK5ABC-96
K-PK-PK2ABCD-95
K-SB-PK3-95
K-SB-SBG-OW01-10

4.3 The Permit Holder shall prepare and submit a report every two years by June 30 commencing June 30, 2016, that presents the results of the wellfield water level monitoring for the two preceding calendar years, assesses changes in water levels in the supply aquifer in relation to precipitation and the water taking from the aquifer, and provides a summary for all interference complaints received by the Permit Holder related to this Permit and reported in the District Office in accordance with Condition 5.1 and the manner in which the Permit Holder has dealt with the complaint.

4.4 Within 5 years following the issuance of this Permit, the Permit Holder shall submit a

wellfield capacity assessment report (final) to the Director for review. The wellfield capacity report shall assess the sustainable aquifer yield that can be obtained from this wellfield on a long-term basis and associated monitoring program that may be needed to monitor the long-term impact of the municipal taking on the aquifer. Upon review and acceptance of the report by the Ministry, the Permit can be amended accordingly.

5. Impacts of the Water Taking

5.1 Notification

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

5.2 For Groundwater Takings

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

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

6. Director May Amend Permit

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

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

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

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

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

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

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

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

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. The municipality within which the works are located;

This notice must be served upon:

The Secretary
Environmental Review Tribunal
655 Bay Street, 15th Floor
Toronto ON
M5G 1E5
Fax: (416) 314-4506
Email: ERTTribunalsecretary@ontario.ca

AND

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

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

by telephone at (416) 314-4600 by fax at (416) 314-4506 by e-mail at www.ert.gov.on.ca

This Permit cancels and replaces Permit Number 7723-6K5MD4, issued on 2006/01/19.

Dated at Hamilton this 23 rd day of October, 2015.

B. Koblik

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

Schedule A

This Schedule "A" forms part of Permit To Take Water 6732-A3FJYA, dated October 23, 2015.

This Permit also cancels and replaces the following additional Permit Number:

1. 5721-78HLAC issued on November 28, 2007.

The Environmental Review Tribunal (ERT) has recently changed its phone and fax phone numbers, and as such you will need to use the following should you wish to contact the ERT:

New Public Inquiry Telephone Number:	**New Fax Number:**
Tel. (416) 212-6349	**Fax: (416) 326-5370**
Toll Free 1(866) 448-2248	**Toll Free: 1(844) 213-3474**

PERMIT TO TAKE WATER
Ground Water
NUMBER 4588-DMHQTG

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

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

For the water taking from: Well K34, Well K36

Located at: 163 Biehn Dr at Marl Meadow Drive
Kitchener, Regional Municipality of Waterloo

103 Kilkerran Cres on Blein Drive
Kitchener, Regional Municipality of Waterloo

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

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.

(b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment, Conservation and Parks.

(d) "District Office" means the Guelph District Office.

(e) "Permit" means this Permit to Take Water No. 4588-DMHQTG including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.

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

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

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

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated July 24, 2025 and signed by Karl Belan, and all Schedules included in this Permit.

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

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

1.4 This Permit is not transferable to another person 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 **November 3, 2035**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted

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

Table A

	Source Name / Description:	Source: Type:	Taking Specific Purpose:	Taking Major Category:	Max. Taken per Minute (litres):	Max. Num. of Hrs Taken per Day:	Max. Taken per Day (litres):	Max. Num. of Days Taken per Year:	Zone/ Easting/ Northing:
1	Well K34	Well Drilled	Municipal	Water Supply	4,772	24	6,872,000	365	17 544033 4804487
2	Well K36	Well Drilled	Municipal	Water Supply	4,772	24	6,872,000	365	17 543953 4803924
						Total Taking:	6,872,000		

3.3 Notwithstanding Table A, the combined volume of water taking from both sources (Well K34 and Well K36) listed in Table A shall not exceed an annual daily average of **6,609,600 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 the total measured 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 shall submit, on or before March 31st in every year, the daily water taking data collected and recorded for the previous year to the Ministry's Water Taking Reporting System.

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

K-PK-OW2-95-A
K-PK-OW2-95-B
K-SB-OW2-18-A
K-SB-OW29-94-A
K-SB-OW3-18-A
K-SB-OW5-18-A
K-SB-PK3-95-A
K-SB-PK5-96-A
K-SB-PK5-96-B
K-SB-SBG-OW01-10-A

4.3 The Permit Holder shall submit to the Director and the Guelph District Office a biennial

monitoring report by **June 30 every two years, commencing June 30, 2026.** The report shall be prepared by a Qualified Person (P.Geo. or equivalent) which 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), and a summary of all interference complaints received by the Permit Holder related to this Permit, and reported to the District Office in accordance with Condition 5.1, including the manner in which the Permit Holder has dealt with the complaint.

5. Impacts of the Water Taking

5.1 Notification

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

5.2 For Groundwater Takings

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

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

6. Director May Amend Permit

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

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

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

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

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

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

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

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

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

This notice must be served upon:

The Secretary
Environmental Review Tribunal
Registrar
Ontario Land Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5
OLT.Registrar@ontario.ca

AND

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

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

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

This Permit cancels and replaces Permit Number 6732-A3FJYA, issued on 2015/10/23.

Dated at Toronto this 3 rd day of November, 2025.

Archana Uprety
Director, Section 34.1
Ontario Water Resources Act , R.S.O. 1990

Schedule A

This Schedule “A” forms part of Permit To Take Water 4588-DMHQTG, dated November 3, 2025.

1. Region of Waterloo. July 2025. Cover Letter and Attachments RE: Category 1 Application for Renewal of Permit to Take Water No. 6732-A3FJYA for Regional Municipality of Waterloo Groundwater Supply Wells K34 and K36 of the Strasburg Well Field (Kitchener, Ontario), signed by Karl Belan, and dated July 24, 2025.

BURNSIDE

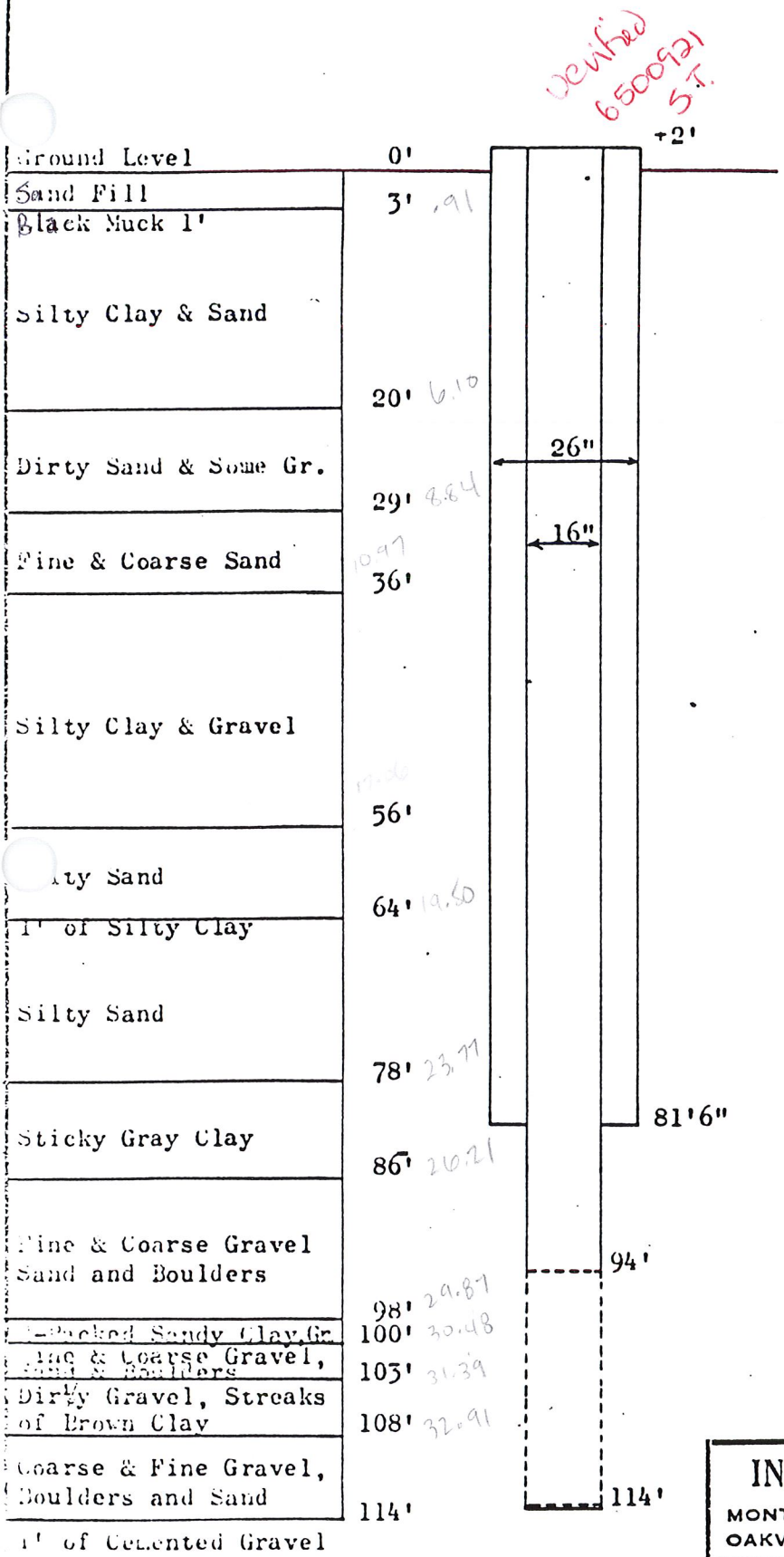
[THE DIFFERENCE IS OUR PEOPLE]

Appendix B

Well Records

K 34

K34



Well Material

Outer Casing 83'6" of 26" welded casing

Inner Casing 96' of 16" welded casing
Screen 20' of Layne S.S. 16", #4 opening
Plug S.S.Plug
Gravel 7 tons

Pump

No.	Setting BP-MB
No. Stages	Length Bowl
Bowl	Size & Lgth. Suction
Head	Size Column

Materials or setting details other than stand
Impellers: Trim

Motor

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

Special Equipment

Well No. 34

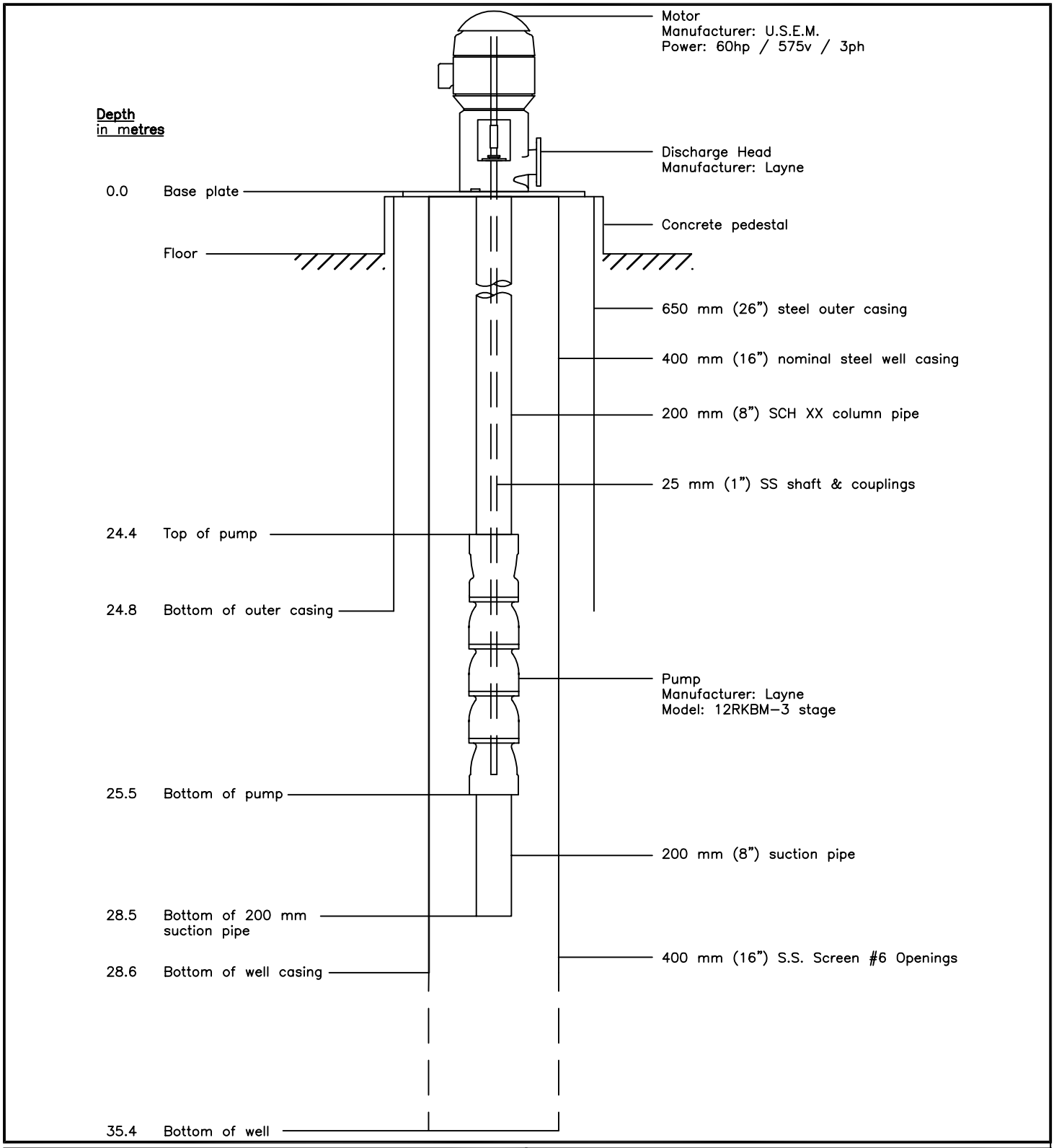
B. P. referred to original ground level.....
Clear depth below B. P.....
Started March 16/67 Final Test.....
Preliminary Test May 16 Static Level.....
Final Test..... Pumping Level.....
Guarantee..... I G P M Capacity..... I G
Contract Pressure..... # Pressure Pump.....
Length Air Line..... Main.....

INTERNATIONAL WATER SUPPLY LT
MONTREAL LONDON, CANADA SASKA
OAKVILLE WATER SUPPLY CONTRACTORS VANCO

KITCHENER WATER COMMISSION

DRILLED BY T. R. Kyle . DRAWN BY mc
INSTALLED BY APPROVED BY

K34



G:\Miscellaneous\Alfredo\Lototech.JPG

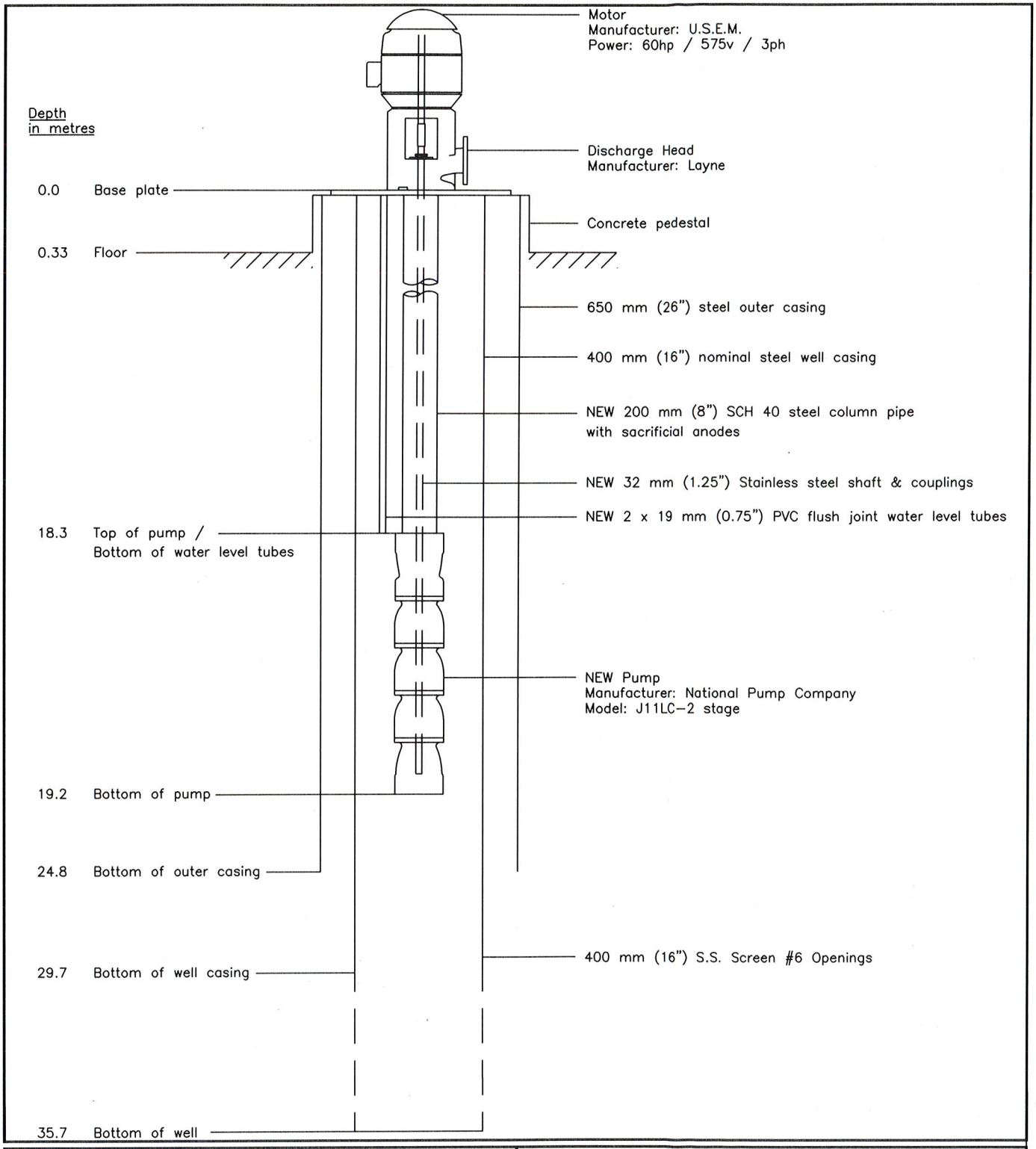
CLIENT

Regional Municipality of Waterloo

TITLE

K34
Pump Installation Drawing

PROJECT No.	006-182	G:\Lotowater Projects\006 Region of Waterloo\182 K34\Lineshaft Pump Installation.dwg			APPENDIX
DESIGN					
DRAWN	EH	2010/10/12	REVISION No. 2010/10/12	SCALE N.T.S.	4D
CHECKED					



Lotowater
TECHNICAL SERVICES INC.

CLIENT
Regional Municipality of Waterloo

TITLE
K34
Pump Installation Drawing

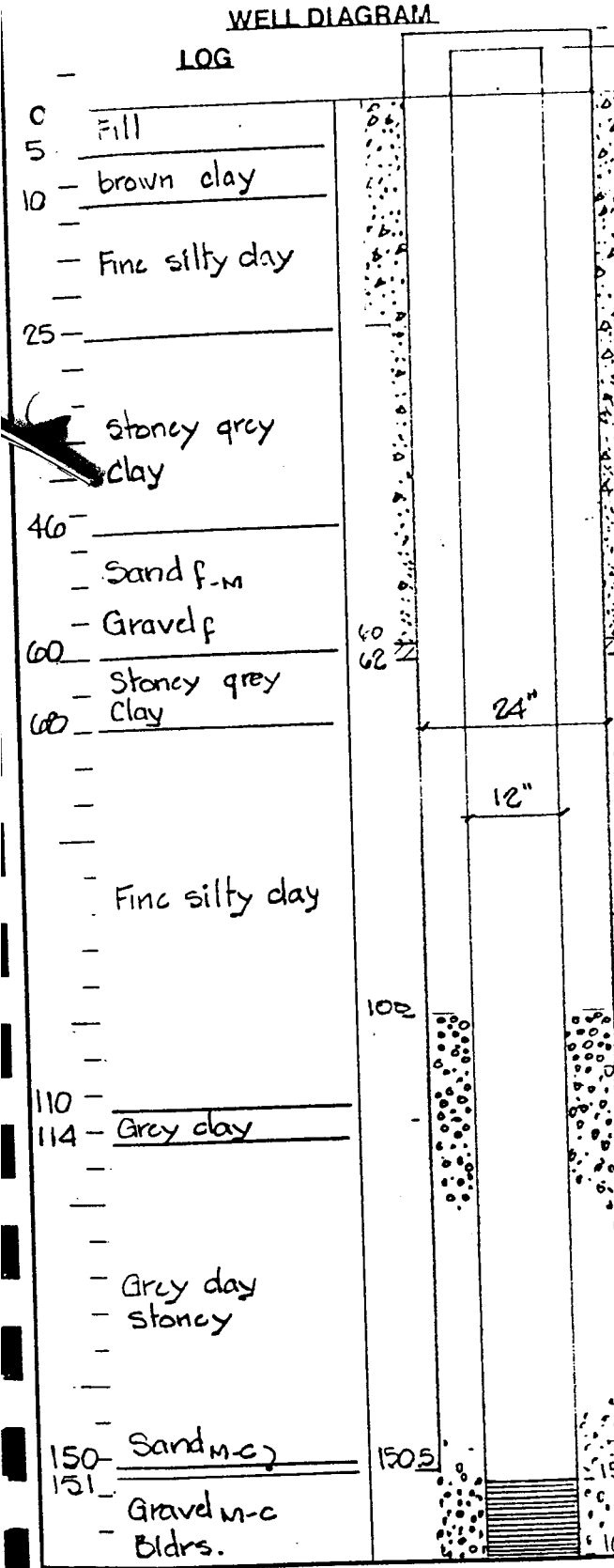
PROJECT No. **006-361**			G:\Lotowater Projects\006 Region of Waterloo\361 K34\Lineshaft Pump Installation.dwg	**FIGURE**
DESIGN			REVISION No. 2016/04/20	SCALE **N.T.S.**	**3**
DRAWN	**EH**	**2016/04/20**		
CHECKED				

K-56

K36

WELL DIAGRAM

LOG



WELL MATERIAL

Outer Casing: 24 " dia.: 375" Wall Thk. Matl.: steel
Cemented from 0 ' " to 60 ' "
Inner Casing: 12 " dia.: 375 " Wall Thk. Matl.: steel
Screen: Make 12 " dia., Opening & Matl.: 80 slot ss
Plug: Type plate Matl st. steel Other:
Gravel: Type silica Size 1/4 x 16 Quantity 2 tons

WELL TEST DATA

Preliminary Test Date: Dec. 9-13, 1987 by N.B.
Static Level: 4.25 ' " below M.P. (+) 4.0'
Pumping Rate IGM: 350
Pumping Duration: 72 hrs. — min.
Pumping Level at Test End: 41.68 ' "
Performance Plots: dd-t Dwg. A87288, A87289
dd-r Dwg. A87280
Step Test B87279

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, Volts
Bearing No. Upper
Lower

Special Equipment

NOTE- T.D. 166.30' TOP of 12'ø PIPE (+) 3.5' AGL.

WELL REVISIONS AND REHABILITATION

DATE	WORK DONE	BY

International Water Supply Limited

SASKATOON – BARRIE – MONTREAL

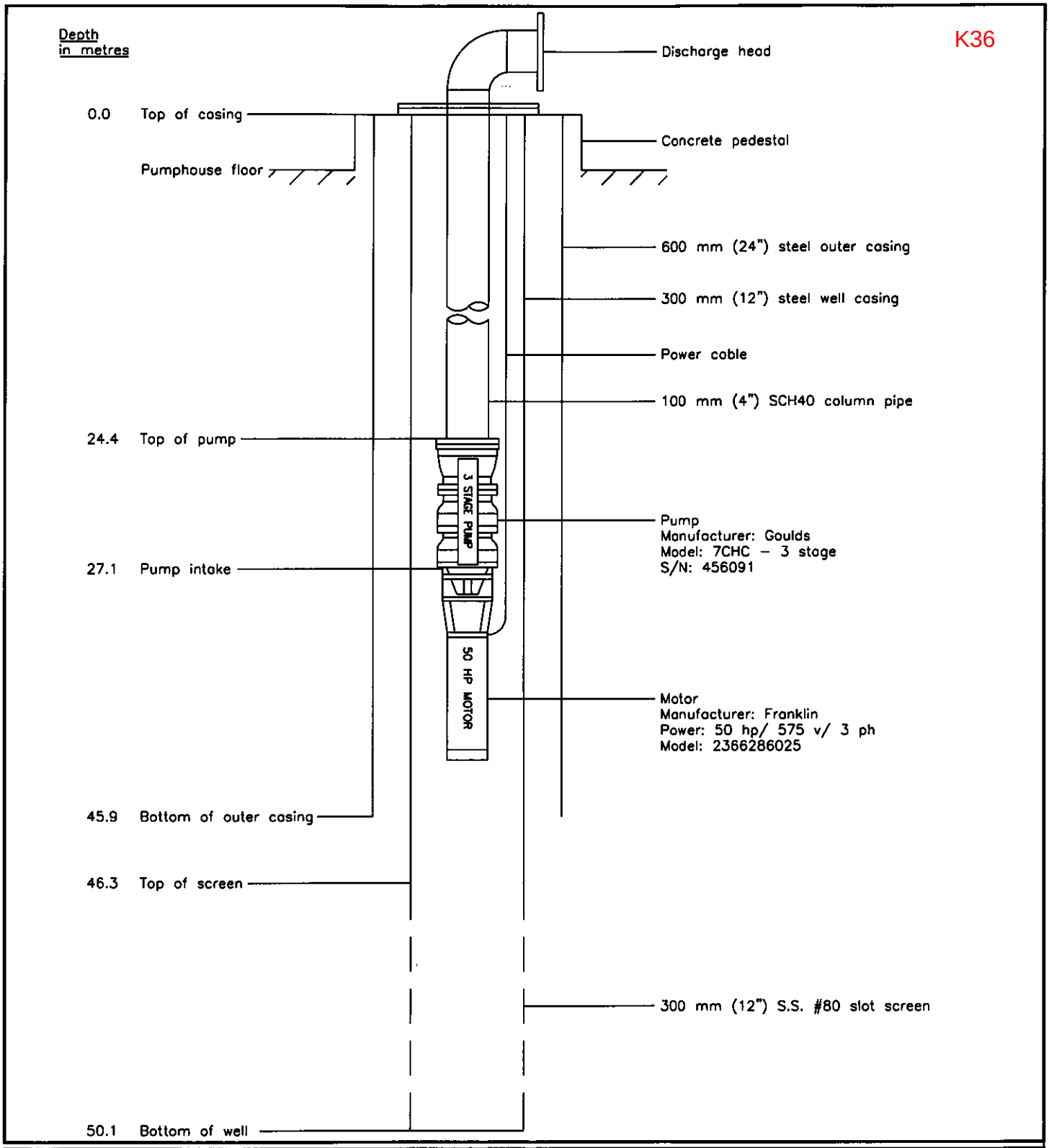
CLIENT: REGION of WATERLOO
WELL NO: K-36

DRILLED BY: N Bamforth DATE: '87
INSTALLED BY: DATE:

DRAWN: J Wall
DATE: Dec. 1987

RECORDING CHARTS
GRAPHIC CONTROLS CANADA LTD.
BAMANOGUE, ONTARIO

K36



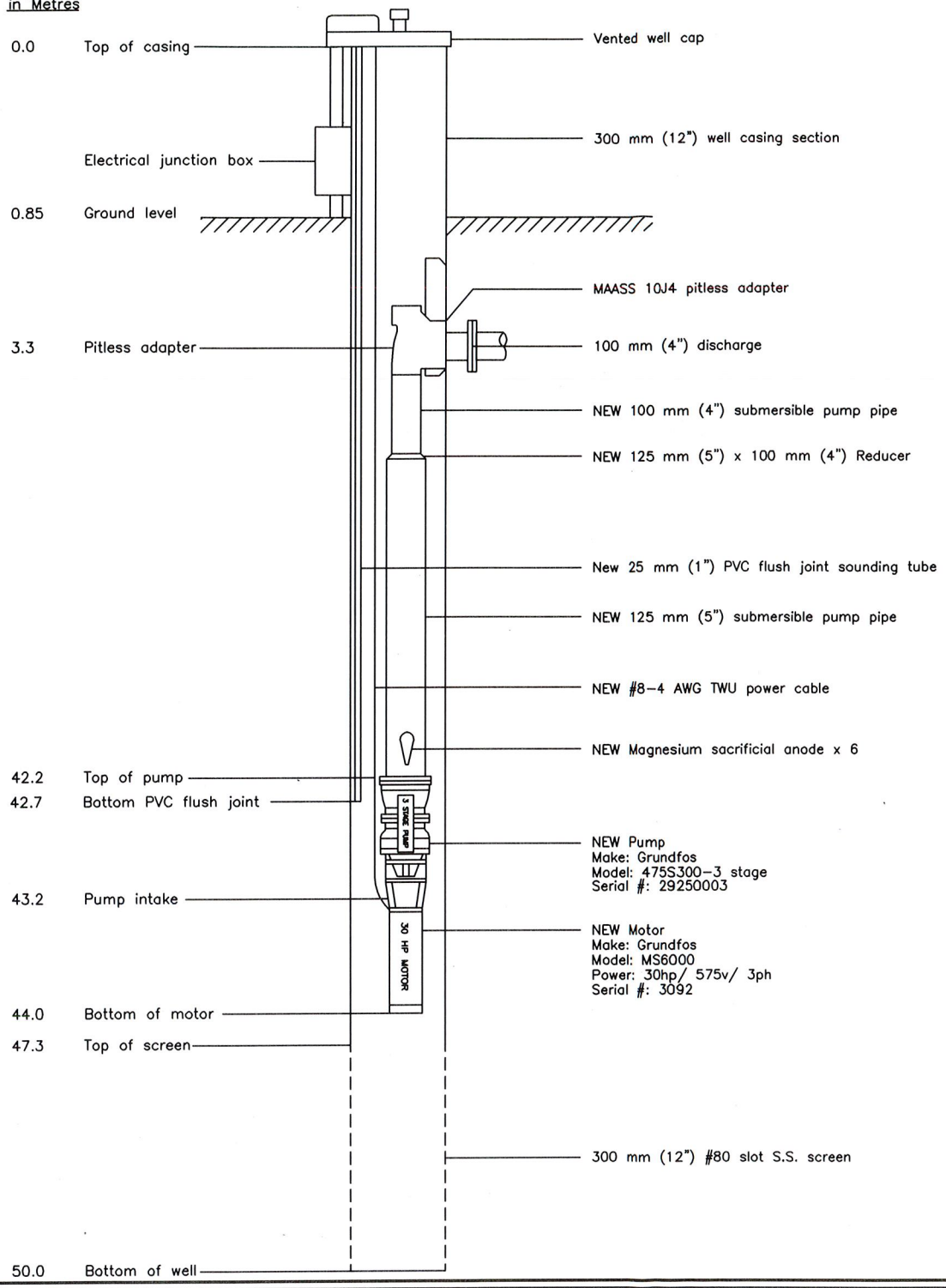
Lotowater
TECHNICAL SERVICES INC.

CLIENT
Regional Municipality of Waterloo

TITLE
K36
Pump Installation Drawing

PROJECT No.	**006-182**	G:\Lotowater Projects\006 Region of Waterloo\182 K36\Submersible Pump Installation.dwg			**APPENDIX**
DESIGN					
DRAWN	**EH**	**2010/10/12**	REVISION No. 2010/10/12	SCALE **N.T.S.**	**5D**
CHECKED					

K36



Lotowater
TECHNICAL SERVICES INC.

CLIENT
Regional Municipality of Waterloo

TITLE
Well K36
Pump Installation Drawing

PROJECT No. 006-357			G:\Lotowater Projects\006 Regional Municipality of Waterloo		FIGURE 3
DESIGN	EH	2016/02/12	REVISION No. 2016-02-12	SCALE N.T.S.	
DRAWN	EH	2016/02/12			
CHECKED	BP	2016/02/12			

Terraqua Investigations Ltd.

BOREHOLE NO. : PK 2'

650Box1 (1900130)

PROJECT – CLIENT : Parkway Area Hydrogeological Study - R.M.O.W.

PROJECT NO. : TA516

CONTRACTOR : All Terrain Drilling Ltd.

METHOD : Mud Rotary (Christensen Wireline Method) with 6 1/4" Hollow Stem Augers

DATE : November 23 to December 6, 1995 and January 22 to February 16, 1996

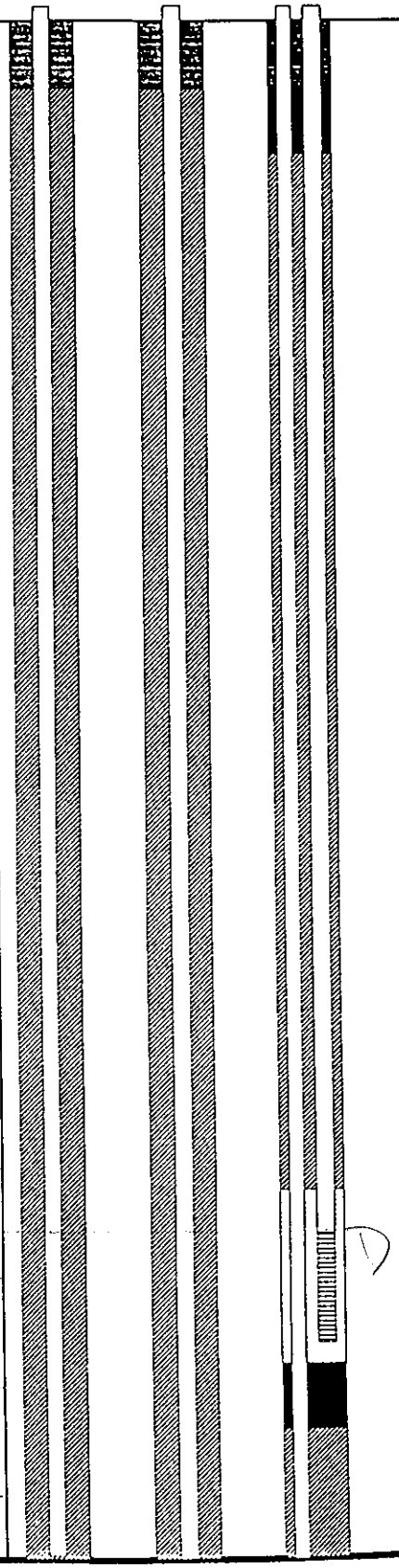
SUPERVISOR : W. Best

K-PK-OW2-95-(A-B-C-D)

GEOLOGIC DESCRIPTION	DEPTH ft	DEPTH m	ELEV. (mAMSL)	SAMPLES #	type	rec	interval
	0	0	344.260			ft	ft
TOPSOIL			(surveyed) 343.65	1	CS	1'9"	3'8"
FINE SAND - brown	5	2		2	CS	1'9"	5'
	10	4		3	PQ	3'6"	3'2"
	15			4	PQ	4'	5'
- Medium Sand: 18'4" to 19'4", 21'3" to 23'4"	20	6		5	PQ	4'1"	5'
- laminated from 19'4" to 20'10" and 23'4" to 36'10"							
- silty from 16'6" to 18'4", 20'10" to 21'3", 33'9" to 34'9", 36'10" to 38'7", 46'10" to 47'6"	25	8		6	PQ	3'6"	5'
	30	10		7	PQ	3'6"	5'
	35			8	PQ	5'	5'
	40	12	332.10	9	PQ	4'3"	5'
MEDIUM SAND - brown, structureless	45	14	330.39	10	PQ	3'1"	5'
FINE SAND - brown, structureless	50	16	329.17	11	PQ	3'4"	5'
FINE and MEDIUM GRAVEL - some sand grading to MEDIUM and COARSE SAND - some fine gravel	55			12	PQ	4'6"	5'
	60	18	326.15	13	PQ	3'6"	5'
MEDIUM SAND grading to SILTY FINE SAND	65	20	324.75 324.39	14	PQ	4'	5'
GRAVEL and SAND							
CLAY-SILT TILL - grey, trace fine gravel, dense	70			15	PQ	4'6"	5'

GROUND WATER MONITOR

PK2-1	PK2-2	PK2-3,-4		TOC
344.96	344.96	344.96	344.96	(mamsl)



Terraqua Investigations Ltd.

BOREHOLE NO. : PK 2

PROJECT – CLIENT : Parkway Area Hydrogeological Study - R.M.O.W.
DATE : November 23 to December 6, 1995 and
PROJECT NO. : TA516
SUPERVISOR : W. Best
CONTRACTOR : All Terrain Drilling Ltd.
METHOD : Mud Rotary (Christensen Wireline Method) with 6 1/4" Hollow Stem Augers

GEOLOGIC DESCRIPTION	DEPTH ft	DEPTH m	ELEV. (mAMSL)	SAMPLES #	type	rec	interval	GROUND WATER MONITOR
	70					ft	ft	
CLAY-SILT TILL continued - Silt : 70' to 71'10", 74'1" to 74'7"	75	22 24		16	PQ	2'5"	5'	
SILTY CLAY TILL - grey, trace very fine to fine gravel, dense - Clayey Silt: 78'11" to 79'4" - Silt: 79'8", 81'10" to 82'11", 89'6" to 91'10" - Clayey Silt Till: 88'11" to 89'6"	80 85 90	26 28	320.03	17 18 19	PQ PQ PQ	4'7" 5' 3'3"	5' 5' 5'	
ALTERNATING CLAYEY SILT TILL and SILTY CLAY TILL	95		315.88	20	PQ	5'4"	5'	
STONY CLAYEY SILT TILL		30	314.82					
SANDY GRAVEL / COBBLES - Stony Clayey Silt Till: 106'6" to 106'10"	100 105	32	313.93	21 22	PQ PQ	4'6" 4'9"	5' 5'	
	110	34		23	PQ	1'6"	5'	
CLAY TILL **(probable Maryhill Till)** - grey, trace very fine gravel, minor fine sand, dense - fine sand partings at: 128', 130', 139'11", 140'9", 141'5"	115 120 125 130 135	36 38 40 42	309.36	24 25 26 27 28	PQ PQ PQ PQ PQ	2'4" 2' 1'11" 5' 1'9"	5' 5' 5' 5' 5'	
	140			29	PQ	5'	5'	

Terraqua Investigations Ltd.

BOREHOLE NO. : PK 2

PROJECT – CLIENT : Parkway Area Hydrogeological Study - R.M.O.W.
DATE : November 23 to December 6, 1995 and
PROJECT NO. : TA516
SUPERVISOR : W. Best
CONTRACTOR : All Terrain Drilling Ltd.
METHOD : Mud Rotary (Christensen Wireline Method) with 6 1/4" Hollow Stem Augers

GEOLOGIC DESCRIPTION	DEPTH ft	DEPTH m	ELEV. (mAMSL)	SAMPLES #	type	rec ft	interval ft	GROUND WATER MONITOR
	140							
CLAY TILL continued - silt partings at: 143'7", 144'6"	145	44	299.82	30	PQ	4'9"	5'	
STONY SAND TILL **(probable Catfish Creek Till)** - grey, some silt to silty, fine to medium gravel, dense	150	46		31	PQ	5'	5'	
	155	48		32	PQ	3'2"	5'	
	160	50		33	PQ	5'	5'	
	165			34	PQ	5'	5'	
STONY SILT-SAND - grey, similar composition to till above but relatively soft	170	52	293.02	35	PQ	4'	5'	
- Stony Silt-Sand Till: 171' to 172', 177'10" to 178'4"	175	54		36	PQ	3'9"	5'	
	180			37	PQ	4'3"	5'	
MEDIUM SAND - brown structureless			289.27 288.79					
STONY SILT-SAND TILL	185	56	288.05	38	PQ	4'	5'	
SAND WITH SOME GRAVEL - brown, medium and coarse sand, fine to medium gravel	190	58		39	PQ	8"	5'	
			285.74					
MEDIUM SAND - brown, minor fine to medium gravel, structureless	195	60		40	PQ	1'8"	5'	
	200		283.00	41	PQ	8"	5'	
SILTY FINE SAND - brown, structureless	205	62	281.65	42	PQ	1'10"	5'	
SAND with some GRAVEL - grey-brown, medium and coarse sand, fine to medium gravel, minor fines	210	64		43	PQ	0	5'	

Terraqua Investigations Ltd.

BOREHOLE NO. : PK 2

PROJECT – CLIENT : Parkway Area Hydrogeological Study - R.M.O.W.
DATE : November 23 to December 6, 1995 and
PROJECT NO. : TA516
SUPERVISOR : W. Best
CONTRACTOR : All Terrain Drilling Ltd.
METHOD : Mud Rotary (Christensen Wireline Method) with 6 1/4" Hollow Stem Augers

	DEPTH ft	DEPTH m	ELEV. (mAMSL)	SAMPLES #	type	rec ft	interval ft	GROUND WATER MONITOR
	210	64						
SAND with some GRAVEL continued								
	215	66		44	PQ	2'	5'	
	220	68		45	PQ	0	5'	
	225	70		46	PQ	9"	5'	
	230			47	PQ	1'	5'	
			273.55					
SILT - grey, moderately dense, dark grey clay bands approx. 1" thick spaced at about 6" intervals - 239'9" - 240'7" intensly banded with alternating Silt and Clay	235	72		48	PQ	5'	5'	
	240	74		49	PQ	4'9"	5'	
			270.93					
SANDY GRAVEL - grey, medium and coarse sand, fine to coarse gravel	245	76		50	PQ	4'9"	5'	
	250			51	PQ	4'6"	5'	
	255	78	266.78	52	PQ	5'	5'	
SILT TILL - red-brown, minor fine gravel and coarse sand sized stones, minor fine sand, dense with occassional softer zones	260	80		53	PQ	5'	5'	
	265			54	PQ	2'2"	5'	
			263.34					
CLAY TILL - red-brown, trace very fine to fine gravel, dense - Silt Till: 272' to 275', brown, some fine gravel	270	82		55	PQ	9"	5'	
	275	84		56	PQ	5'	5'	
	280			57	PQ	5'	5'	

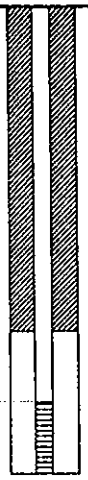
Terraqua Investigations Ltd.

BOREHOLE NO. : PK 2

PROJECT – CLIENT : Parkway Area Hydrogeological Study - R.M.O.W.
DATE : November 23 to December 6, 1995 and
PROJECT NO. : TA516
SUPERVISOR : W. Best
CONTRACTOR : All Terrain Drilling Ltd.
METHOD : Mud Rotary (Christensen Wireline Method) with 6 1/4" Hollow Stem Augers

	DEPTH ft	DEPTH m	ELEV. (mAMSL)	SAMPLES #	type	rec ft	interval ft
	280						
CLAY TILL continued		86					
	285		257.54	58	PQ	5'	5'
STONY SAND TILL - grey, fine to medium gravel, 4" to occassional 4" to 6" long cobbles from 287' to 296'6", dense		88					
	290			59	PQ	5'	5'
		90					
	295			60	PQ	4'3"	5'
			253.89				
BEDROCK - shale with dolostone interbeds			253.19	61	PQ	1'3"	2'
	300	92					
Bottom of Hole: 299'6"	305						
		94					
	310						
		96					
	315						
	320	98					
	325						
		100					
	330						
		102					
	335						
	340	104					
	345						
		106					
	350						

GROUND WATER MONITOR



Notes:
- PK2-2 and PK2-3/2-4 drilled using mud rotary method with 5" diameter tricone bit

- Installation for PK2-1 consists of 2" I.D. P.V.C. riser pipe and no.10 slot well screen
- Installation for PK2-2 consists of 1 1/2" I.D. P.V.C. riser pipe and no.10 slot well screen
- Installation for PK2-3/2-4 consists of 1 1/4" I.D. P.V.C. riser pipe and no.10 slot well screen

LEGEND
- Cement
- Bentonite Holeplug
- Benseal Grout
- Graded Silica Sand
- Native Material
- PVC Well Screen
- CS Continuous Sample (Hollow Stem Auger Method)
- PQ Continuous Sample (Christensen Wire Line Method)

Terraqua Investigations Ltd.

BOREHOLE NO. : PK3

PROJECT – CLIENT : Parkway Area Hydrogeological Study - R.M.O.W.
PROJECT NO. : TA516
CONTRACTOR : All Terrain Drilling Ltd.
METHOD : 4 1/4" I.D. Hollow Stem Auger

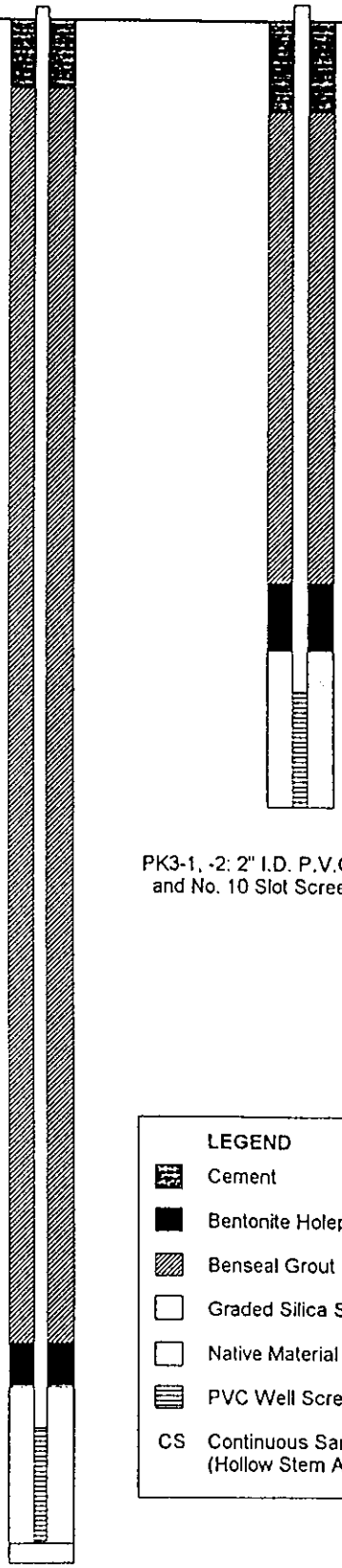
DATE : December 4-5. 1995
SUPERVISOR : W. Best

K-SB-PK3-95-(A-B)

GEOLOGIC DESCRIPTION	DEPTH ft	DEPTH m	ELEV. (mAMSL)	SAMPLES #	type	rec	interval
	0	0	303.790 (surveyed)			ft	ft
TOP SOIL			303.64	1	CS	2'9"	4'
FINE SAND FILL - light brown, structureless, dry	5	2		2	CS	1'	5'
ORGANIC MATERIAL - dark brown/black, with roots and other woody material - 10'7" to 11'4"; silt and sand, dark brown, moderately dense small shells	10	4	300.96 300.04	3	CS	4'9"	5'
FINE SAND - grey, structureless	15	6		4	CS	3'	5'
- Silty Fine Sand: 21'6" to 29'	20	8		5	CS	2'6"	5'
	25	10		6	CS	3'6"	5'
	30	12		7	CS	3'4"	5'
	35	14		8	CS	1'4"	5'
	40	16		9	CS	1'10"	5'
	45	18		10	CS	1'	5'
	50	20		Auger - No Sampling			
	55						
	60						
	65			11	SS	2'	2'
	70			Auger - No Sampling			
Bottom of Hole: 69'			282.76				

GROUND WATER MONITOR

PK3-1 304.62
PK3-2 304.52 TOC elev (mamsl)



PK3-1, -2: 2" I.D. P.V.C. Riser Pipe and No. 10 Slot Screen

LEGEND
- Cement
- Bentonite Holeplug
- Benseal Grout
- Graded Silica Sand
- Native Material
- PVC Well Screen
- CS Continuous Sample (Hollow Stem Auger Method)

1000433

Terraqua Investigations Ltd.

BOREHOLE NO. : PK5

PROJECT – CLIENT : Parkway Area Hydrogeological Study - R.M.O.W.

DATE : December 18 to 22,1995 and January 3 to 5, 1996

PROJECT NO. : TA516

CONTRACTOR : All Terrain Drilling Ltd.

SUPERVISOR : W. Best

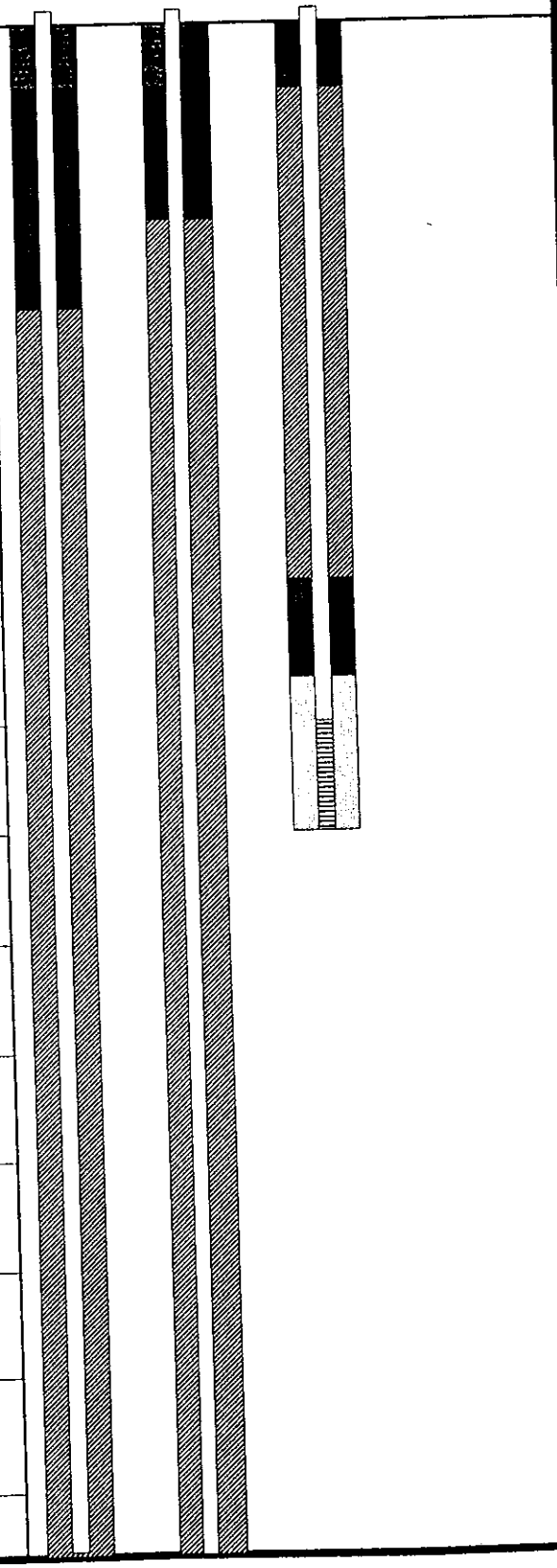
METHOD : Mud Rotary (Christensen Wireline Method) with 6¼" I.D. Hollow Stem Augers

K-SB-PK5-96-(A-B-C)

GEOLOGIC DESCRIPTION	DEPTH ft	DEPTH m	ELEV. (mAMSL)	SAMPLES #	type	rec	interval
	0	0	314.785			ft	ft
FINE SAND - brown, structureless				Auger - No Sampling			
	5	2					
	10			1	PQ	1'4"	3'
		4		2	PQ	3'9"	5'
- Silt: 16'6" to 17'6"	15						
	20	6	308.54	3	PQ	3'	5'
SAND and GRAVEL - medium to coarse sand, medium and coarse gravel				4	PQ	0'	5'
	25	8					
	30		305.43	5	PQ	2'	5'
FINE SAND - brown, structureless		10					
	35		304.30	6	PQ	3'10"	5'
MEDIUM SAND - brown, structureless, minor fine sand		12		7	PQ	2'9"	5'
	40		302.17				
SILTY CLAY TILL - grey, trace gravel, dry feel				8	PQ	5'	5'
	45	14					
	50		299.85	9	PQ	5'	5'
SAND TILL - grey, minor fine gravel, dense		16	298.94				
CLAY TILL - grey, some sand, minor fine gravel, "sandy" appearance, dense	55			10	PQ	5'	5'
		18	297.32				
CLAY TILL - grey, trace very fine to fine gravel, "smooth" appearance, dense	60			11	PQ	4'1"	5'
- no stones noted from 64' except for coarse sand bands, 0.5 to 1.0 cm wide at 69'5", 70'5" and 71'	65	20		12	PQ	5'	5'
	70			13	PQ	5'	5'

GROUND WATER MONITOR

PK5-1 315.56 | PK5-2 315.57 | PK5-3 315.64 TOC elev (mamsl)



1000433

Terraqua Investigations Ltd.

BOREHOLE NO. : PK5

PROJECT – CLIENT : Parkway Area Hydrogeological Study - R.M.O.W.
DATE : December 18 to 22,1995 and January 3 to , 1996
PROJECT NO. : TA516
CONTRACTOR : All Terrain Drilling Ltd.
SUPERVISOR : W. Best
METHOD : Mud Rotary (Christensen Wireline Method) with 6¼" I.D. Hollow Stem Augers

GEOLOGIC DESCRIPTION	DEPTH ft	DEPTH m	ELEV. (mAMSL)	SAMPLES #	type	rec ft	interval ft	GROUND WATER MONITOR
	70							
		22						
			292.53					
STONY SILT-SAND TILL (possible Catfish Creek Till) - grey, predominantly dense with occasional softer zones.	75			14	PQ	9"	5'	
		24						
	80			15	PQ	4'6"	5'	
	85	26		16	PQ	5'	5'	
	90			17	PQ	5'	5'	
		28						
	95		286.13	18	PQ	5'1"	5'	
CLAY TILL - grey, minor very fine to fine gravel, minor sand, dense		30						
	100		284.43	19	PQ	4'8"	5'	
STONY SAND TILL - dark green, some silt, dense			283.70					
SAND and GRAVEL - rusty orange/oxidized appearance, intermittent till layers, fine to coarse sand, medium to coarse gravel, occasional cobble, odour	105	32		20	PQ	3'9"	5'	
	110			21	PQ	3'9"	5'	
		34						
	115		279.95	22	PQ	3'3"	5'	
SAND and GRAVEL - fine to coarse sand, medium to coarse gravel, occasional cobble		36						
	120			23	PQ	1'6"	5'	
		38						
	125		276.99	24	PQ	3'3"	5'	
SILT - grey, strong odour, occasional 1" sand seams - Sandy Silt: 128'9" to 130'9"								
	130	40		25	PQ	3'4"	5'	
			274.40					
STONY SILT-SAND TILL - grey, dense	135			26	PQ	3'4"	5'	
		42						
	140			27	PQ	1'3"	5'	

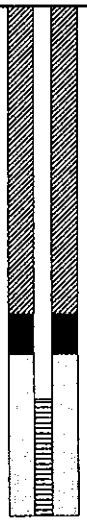
1000433

Terraqua Investigations Ltd.

BOREHOLE NO. : PK5

PROJECT – CLIENT : Parkway Area Hydrogeological Study - R.M.O.W.
DATE : December 18 to 22,1995 and January 3 to , 1996
PROJECT NO. : TA516
CONTRACTOR : All Terrain Drilling Ltd.
SUPERVISOR : W. Best
METHOD : Mud Rotary (Christensen Wireline Method) with 6¼" I.D. Hollow Stem Augers

GEOLOGIC DESCRIPTION	DEPTH ft	DEPTH m	ELEV. (mAMSL)	SAMPLES #	type	rec ft	interval ft	GROUND WATER MONITOR
	140							
STONY SILT-SAND TILL continued		44	271.20					
SILT TILL - red-brown, some fine to medium gravel, minor sand, dense	145			28	PQ	5'	5'	
STONE TILL - grey with red tinge, many shale fragments	150	46	269.98	29	PQ	2'6"	5'	
BEDROCK - green-grey shale, well fractured, relatively soft, some well weathered zones, some vesicular dolostone interbds	155	48	268.46	30	PQ	5'	5'	
	160			31	PQ	5'	5'	
BOTTOM OF HOLE: 162'		50	265.41					
	165							
	170	52						
	175	54						
	180	56						
	185	58						
	190	60						
	195	62						
	200	64						
	205							
	210							



Notes:
- PK5-2 drilled using Mud Rotary method with 5" diameter tricone bit
- PK5-3 drilled using 4 1/4" Hollow Stem Auger method

- Installation at PK5-1 consists of 2" I.D. P.V.C. riser pipe and no. 10 slot screen
- Installations at PK5-2 and PK5-3 consist of 1 1/4" P.V.C. riser pipe and no. 10 slot screen

LEGEND
- Cement
- Bentonite Holeplug
- Benseal Grout
- Graded Silica Sand
- Native Material
- PVC Well Screen
- PQ Continuous Sample (Christensen Wireline Method)

PROJECT: 08-1112-0150

BOREHOLE LOG OF: K-SBG-OW01-10

SHEET 1 OF 1

LOCATION: N 4803931.0 ;E 543948.0

DRILLING DATE: January 12, 2010

DATUM: NAD83

DRILL RIG: PQ Coring

DRILLING CONTRACTOR: All Terrain Drilling

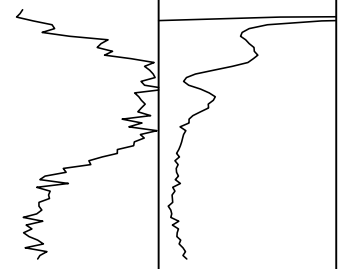
K-SB-SBG-OW01-10-A

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	OGS CODE
	GROUND SURFACE		311.50	
0	Compact, moist, brown, medium to fine SAND, trace gravel, trace silt, trace organics		0.00	
			309.52	
2	Compact, moist, grey, cohesive, medium to fine SAND, some gravel, trace stones, trace silt, trace clay		1.98	AFB1
			308.45	
	Loose, wet, brown, medium to fine SAND, trace gravel, trace coarse sand		3.05	
			3.25	
	Compact, moist, brown, cohesive, medium to fine SAND, trace gravel, trace stone, trace silt		307.64	
4			3.86	
	Compact, wet, brown, cohesive, medium to fine SAND, trace gravel, trace stone, trace silt		306.62	
	Hard, moist to wet, grey, cohesive, SILTY CLAY, trace gravel		4.88	ATB2
6	SA-1 (5.8-6.7 m)			
8				
			302.36	
	END OF BOREHOLE		9.14	
10				
12				
14				
16				
18				
20				

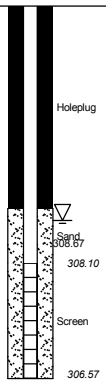
GEOPHYSICAL RECORD

GAMMA (cps) 25 50 75 100

CONDUCTIVITY (mS/m) 10 20 30 40



PIEZOMETER OR STANDPIPE INSTALLATION



DEPTH SCALE

1 : 100

Golder Associates

LOGGED: BH

CHECKED: CM

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

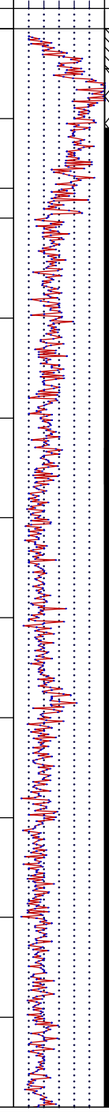
Monitoring Well: K-SB-OW5-18

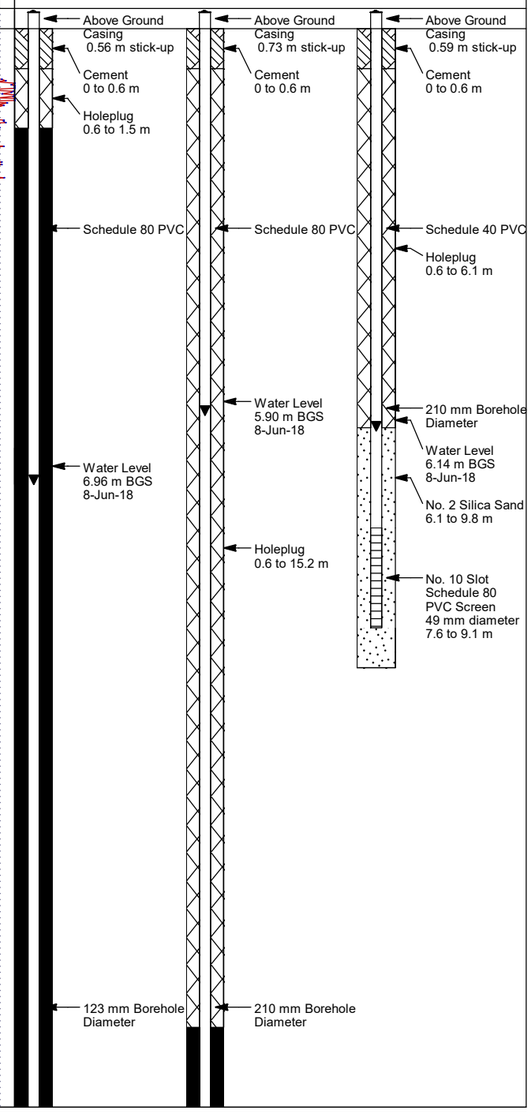
Project: K34/K36 Hydrogeological Assessment
Client: Regional Municipality of Waterloo
Location: Kitchener, Ontario
Number: 160900878

Field Investigator: RD/KM
Contractor: Aardvark Drilling, Inc
Drilling method: PQ / Tri-cone
Date started/completed: 23-Apr-2018 / 27-Apr-2018

Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Hydro Stratigraphic Unit	Description
0	0		Ground Surface			
			SILTY SAND TOPSOIL 10 YR 4/2 dark greyish brown fine grained silty sand with organics, trace medium and coarse sand, trace fine gravel, moist	0.00 0.13		
			SAND FILL Loose, 10 YR 5/3 brown fine grained sand, some medium and coarse sand, some fine angular gravel, dry	0.53		
			SAND FILL Hard, 10 YR 3/4 dark yellowish brown, fine grained sand, trace to some silt, trace medium and coarse sand, trace fine and coarse subrounded to rounded gravel, dry to moist			
5	2					
10	4					
15			Becoming wet at 5.4 m			
20	6		10 cm seam of 10 YR 2/1 black sand	6.10		
			SAND AND GRAVEL Fine grained sand, subrounded gravel, wet		AFB1	Upper Waterloo Moraine stratified sediments and equivalents
25	8					
30						
35	10		SILTY CLAY Very soft, 10 YR 5/3 brown, trace fine sand, moist	9.84	ATB2	Middle Maryhill Till and equivalents
			SAND AND GRAVEL Fine grained sand, subrounded gravel, wet 8 cm seam of silty clay at 11.3 m	10.82 11.35	AFB2	Middle Waterloo Moraine stratified sediments and equivalents
40	12		SAND Loose, 10 YR 4/3 brown well graded sand, wet Changes to medium sand with trace coarse sand at 12.0 m Trace fine and coarse gravel			
45	14					
50			Sand becomes coarser at 15.1 m			
	16					

Sample Number	Sample Type	Recovery	SCR	RQD	Lab Analyses
1	CC	51" 94%	n/a	n/a	
2	CC	37" 88%	n/a	n/a	
3	CC	11" 61%	n/a	n/a	
4	CC	53" 88%	n/a	n/a	
5	CC	37" 62%	n/a	n/a	
6	CC	36" 60%	n/a	n/a	
7	CC	12" 20%	n/a	n/a	
8	CC	36" 60%	n/a	n/a	
9	CC	54" 90%	n/a	n/a	
10	CC	60" 100%	n/a	n/a	GSA at 41'
11	CC	36" 60%	n/a	n/a	
12	CC	48" 80%	n/a	n/a	





Screen Interval: 52.73 - 55.78; 19.81 - 21.34; 7.62 - 9.14 m BGS
Sand Pack Interval: 50.29 - 56.39 m BGS
Well Seal Interval: 0.61 - 50.29 m BGS

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

Preliminary log only. Borehole log will be finalized following geophysics and more detailed analysis of additional drilling locations.
GSA - Grain Size Analysis
WRAS No:
OW5A-18 - A
OW5B-18 - B
OW5C-18 - C

Drawn By/Checked By: AH/

STANTEC BOREHOLE AND WELL - MASTER 17X11 160900878_2018DRILLING.GPJ DATA TEMPLATE_ENVS_CA_140725.GDT 6/24/19 AHEALEY

Monitoring Well: K-SB-OW5-18

Project: K34/K36 Hydrogeological Assessment
Client: Regional Municipality of Waterloo
Location: Kitchener, Ontario
Number: 160900878

Field Investigator: RD/KM
Contractor: Aardvark Drilling, Inc
Drilling method: PQ / Tri-cone
Date started/completed: 23-Apr-2018 / 27-Apr-2018

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS						GEOPHYSIC DETAILS	WELL DETAILS
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery	SCR	RQD	Lab Analyses	Gamma (cps) 20 40 60 80 100	Name: K-SB-OW5A-18 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a Name: K-SB-OW5B-18 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a Name: K-SB-OW5C-18 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a
55	18		SAND AND GRAVEL 10 YR 4/3 brown, subrounded, wet	16.34	AFB2	Middle Waterloo Moraine stratified sediments and equivalents	13	CC	48" 80%	n/a	n/a			Bentonite Grout 15.2 to 18.3 m
60							14	CC	29" 48%	n/a	n/a			
65	20		18 cm seam of firm silty clay Trace cobbles at 19.6 m				15	CC	41" 68%	n/a	n/a			No. 2 Silica Sand 18.3 to 21.9 m No. 10 Slot Schedule 80 PVC Screen 49 mm diameter 19.8 to 21.3 m
70	22		8 cm seam of hard 10 YR 4/3 brown silty clay, moist				16	CC	48" 80%	n/a	n/a			
75	24		SILTY CLAY TILL hard, 10 YR 4/2 dark greyish brown silty clay, trace sand and fine gravel, trace cobbles, moist	22.17	ATB3	Lower Maryhill Till	17	CC	38" 63%	n/a	n/a	GSA at 76'		
80			13 cm seam of silty sand, wet				18	CC	60" 100%	n/a	n/a			Bentonite Grout 1.5 to 47.2 m
85	26		25 cm seam of silty sand, wet				19	CC	60" 100%	n/a	n/a			
90	28		SILTY SAND TILL Very dense 10 YR 5/2 greyish brown fine grained silty sand, trace medium and coarse sand, trace fine and corase gravel, moist	26.77			20	CC	60" 100%	n/a	n/a			
95			Cobble at 28.5 m				21	CC	60" 100%	n/a	n/a	GSA at 97'		
100	30						22	CC	60" 100%	n/a	n/a			
105	32						23	CC	60" 100%	n/a	n/a			

Screen Interval: 52.73 - 55.78; 19.81 - 21.34; 7.62 - 9.14 m BGS
Sand Pack Interval: 50.29 - 56.39 m BGS
Well Seal Interval: 0.61 - 50.29 m BGS

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

Preliminary log only. Borehole log will be finalized following geophysics and more detailed analysis of additional drilling locations.
GSA - Grain Size Analysis
WRAS No:
OW5A-18 - A
OW5B-18 - B
OW5C-18 - C

Drawn By/Checked By: AH/

STANTEC BOREHOLE AND WELL - MASTER 17X11 160900878_2018DRILLING.GPJ DATA TEMPLATE_ENVS_CA_140725.GDT 6/24/19 AHEALEY

Monitoring Well: K-SB-OW5-18

Project: K34/K36 Hydrogeological Assessment
Client: Regional Municipality of Waterloo
Location: Kitchener, Ontario
Number: 160900878

Field Investigator: RD/KM
Contractor: Aardvark Drilling, Inc
Drilling method: PQ / Tri-cone
Date started/completed: 23-Apr-2018 / 27-Apr-2018

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS						GEOPHYSIC DETAILS	WELL DETAILS
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery	SCR	RQD	Lab Analyses	Gamma (cps) 20 40 60 80 100	Name: K-SB-OW5A-18 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a	Name: K-SB-OW5B-18 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a	Name: K-SB-OW5C-18 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a
110	34		SILTY SAND TILL Very dense 10 YR 5/2 greyish brown fine grained silty sand, trace medium and coarse sand, trace fine and corase gravel, moist		ATC1	Upper/Main Catfish Creek Till	24	CC	12" 20%	n/a	n/a					
115			Increasing silt and clay content starting at 35.2 m				25	CC	60" 100%	n/a	n/a	GSA at 116'				
	36		SILTY SAND TO SANDY SILT Firm, 10 YR 5/1 grey, very fine grained sand, wet	35.97												
120			SILTY CLAY TILL 10 YR 4/1 dark grey, trace fine sand 2 cm seam of 10 YR 5/1 grey silty clay 5 cm seam of fine sand at 37.7 m	36.60			26	CC	60" 100%	n/a	n/a					
125	38		SAND Loose, 10 YR 4/1 dark grey to 10 YR 5/1 grey fine and very fine grained sand, some silt, trace medium and coarse sand, trace coarse gravel, wet Interbedded silty clay seams 2-13 cm thick	37.95			27	CC	52" 87%	n/a	n/a					
130	40		SILTY CLAY TILL Hard, 10 YR 5/1 grey, trace fine, medium, and coarse sand, moist to wet Laminations and layers of sandy silt 0.1 cm to 2 cm thick 20 cm seam of silty sand at 39.8 m	39.70			28	CC	54" 90%	n/a	n/a	GSA sample				
135			SANDY SILT TILL Hard, 10 YR 5/1 grey, fine grained sand, trace medium and coarse sand, trace fine and coarse gravel, moist	41.00			29	CC	47" 78%	n/a	n/a					
	42		Increased sand and gravel content with sandy silt and silty clay attached													
140							30	CC	37" 62%	n/a	n/a					
145	44						31	CC	39" 65%	n/a	n/a					
150			SAND AND GRAVEL Loose, 10 YR 5/2 greyish brown to 10 YR 5/3 brown, fine grained sand, wet	45.57			32	CC	17" 28%	n/a	n/a					
	46		Interbedded with firm silt and clayey silt and seams of medium and coarse sand													
155							33	CC	39" 65%	n/a	n/a					
	48		Coarse gravel and cobbles beginning at 48.0 m													
160							34	CC	30" 50%	n/a	n/a					

Peltonite
47.2 to 50.3 m

Screen Interval: 52.73 - 55.78; 19.81 - 21.34; 7.62 - 9.14 m BGS
Sand Pack Interval: 50.29 - 56.39 m BGS
Well Seal Interval: 0.61 - 50.29 m BGS

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

Preliminary log only. Borehole log will be finalized following geophysics and more detailed analysis of additional drilling locations.
GSA - Grain Size Analysis
WRAS No:
OW5A-18 - A
OW5B-18 - B
OW5C-18 - C

Drawn By/Checked By: AH/

STANTEC BOREHOLE AND WELL - MASTER 17X11 160900878_2018DRILLING.GPJ DATA TEMPLATE_ENVS_CA_140725.GDT 6/24/19 AHEALEY

Monitoring Well: K-SB-OW5-18

Project: K34/K36 Hydrogeological Assessment
Client: Regional Municipality of Waterloo
Location: Kitchener, Ontario
Number: 160900878

Field Investigator: RD/KM
Contractor: Aardvark Drilling, Inc
Drilling method: PQ / Tri-cone
Date started/completed: 23-Apr-2018 / 27-Apr-2018

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS						GEOPHYSIC DETAILS	WELL DETAILS
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery	SCR	RQD	Lab Analyses	Gamma (cps) 20 40 60 80 100	Name: K-SB-OW5A-18 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a Name: K-SB-OW5B-18 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a Name: K-SB-OW5C-18 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a
165			SAND AND GRAVEL Loose, 10 YR 5/2 greyish brown to 10 YR 5/3 brown, fine grained sand, wet Interbedded with firm silt and clayey silt and seams of medium and coarse sand		AFD1	Pre-Catfish Creek sand and gravel	35	CC	48" 80%	n/a	n/a			
170	52		Sand becoming medium to coarse grained				36	CC	35" 58%	n/a	n/a	GSA at 173'		No. 2 Silica Sand 50.3 to 56.4 m
175	54						37	CC	30" 50%	n/a	n/a			
180	56						38	CC	30" 50%	n/a	n/a			No. 10 Slot Schedule 80 PVC Screen 49 mm diameter 52.7 to 55.8 m
185			SILTY SAND Compact, 10 YR 4/1 dark grey, fine grained sand, trace medium and coarse sand, trace fine gravel, moist	56.52			39	CC	60" 100%	n/a	n/a			
190	58		Cobbles at 57.5 m CLAYEY SILT Compact, 2.5 YR 4/2 dark greyish brown, some fine grained sand, trace to some medium and coarse sand, trace fine and coarse gravel, moist	58.22	ATG1	Pre-Canning coarse textured till	40	CC	36" 60%	n/a	n/a			Peltonite 56.4 to 60.8 m
195	60		BEDROCK Grey, highly fractured	59.44	Bedrock	Salina Formation	41	CC	60" 100%	16" 27%	0" 0%			
200			End of Borehole	60.81										
205	62													
210	64													
215	66													

Screen Interval: 52.73 - 55.78; 19.81 - 21.34; 7.62 - 9.14 m BGS
Sand Pack Interval: 50.29 - 56.39 m BGS
Well Seal Interval: 0.61 - 50.29 m BGS

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

Preliminary log only. Borehole log will be finalized following geophysics and more detailed analysis of additional drilling locations.
GSA - Grain Size Analysis
WRAS No:
OW5A-18 - A
OW5B-18 - B
OW5C-18 - C

Drawn By/Checked By: AH/

STANTEC BOREHOLE AND WELL - MASTER 17X11 160900878_2018DRILLING.GPJ DATA TEMPLATE_ENVS_CA_140725.GDT 6/24/19 AHEALEY

Monitoring Well: K-SB-OW3-18

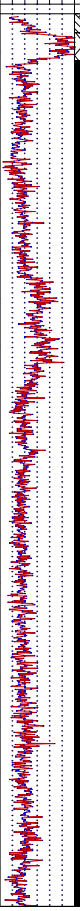
Project: K34/K36 Hydrogeological Assessment
Client: Regional Municipality of Waterloo
Location: Kitchener, Ontario
Number: 160900878

Field Investigator: AH
Contractor: Aardvark Drilling, Inc
Drilling method: PQ / Tri-cone
Date started/completed: 05-Feb-2018 / 13-Feb-2018

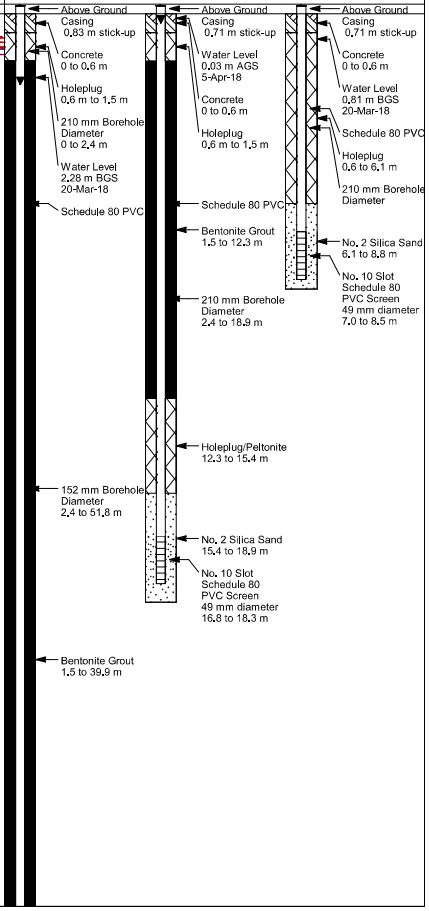
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description
0	0		Ground Surface	313.29 312.99		
			SAND 10 YR 5/2 greyish brown, some silt, trace organics and fine gravel, moist Colour change to 10 YR 5/3 brown at 0.6 m Becomes loose fine and medium sand, some coarse sand and fine gravel, trace coarse gravel at 0.8 m	0.00 310.55	AFB1	Upper Waterloo Moraine stratified sediments and equivalents
10	3		GRAVEL (matrix unknown) 10 YR 7/1 light grey to 10 YR 3/1 very dark grey, fine and coarse gravel, subangular to subrounded, trace medium to coarse sand, trace silt and clay No sand visible starting at 3.7 m, trace fine gravel	2.44 307.32		
20	6		SAND 10 YR 5/2 greyish brown, clean fine grained sand, trace silt and clay, trace gravel, wet Trace medium sand at 8.2 m	5.66 304.76		
30	9		SILT AND CLAY Firm, 10 YR 5/3 brown Seam of soft, 10 YR 5/2 greyish brown fine sand, trace silty clay Seam of fine sand at 10.7 m Seam of fine sand at 11.3 m and 11.4 m Seam of fine sand at 11.6 m and 11.7 m Trace fine and coarse gravel at 11.8 m	8.23 300.88	ATB2	Middle Maryhill Till and equivalents
40	12		SAND Soft, 10 YR 4/3 brown, fine sand, trace silt and clay Trace medium to coarse sand and trace fine gravel starting at 12.9 m, cobble at 13.1 m Hard, 10 YR 4/3 brown silty clay seam at 13.7 m	12.10 298.30		
50	15		GRAVEL (matrix unknown) Coarse gravel, subangular to subrounded, some fine gravel, trace medium to coarse sand, trace silt and clay Cobbles at 14.8 m Cobbles at 16.6 m Coarse sand and fine gravel from 17.7 m to 17.9 m Cobble at 19.7 m	14.68 290.43	AFB2	Middle Waterloo Moraine stratified sediments and equivalents
70	21		SILT AND SAND TILL Hard, with fine gravel, some coarse gravel and cobbles, trace clay Loss of matrix - only coarse gravel and cobbles with coarse sand and fine gravel from 22.6 m to 23.2 m Cobble at 25.3 m Loss of matrix - only coarse gravel and cobbles with coarse sand and fine gravel from 25.6 m to 27 m Seam of softer silty sand till, trace to some coarse sand and fine gravel from 27.0 m to 27.3 m Cobble content increased at 27.3 m	22.56	ATC1	Upper/Main Catfish Creek Till

Sample Number	Sample Type	Recovery	Lab Analyses
1	CC	34" 71%	
2	CC	20" 42%	
3	CC	15" 63%	
4	CC	33" 55%	GSA at 12'
5	CC	24" 40%	
6	CC	48" 80%	GSA at 21'6"
7	CC	36" 60%	
8	CC	42" 70%	GSA at 33'8"
9	CC	40" 67%	
10	CC	32" 53%	GSA at 41'
11	CC	33" 55%	
12	CC	33" 55%	GSA at 54'
13	CC	42" 70%	
14	CC	52" 87%	
15	CC	15" 25%	
16	CC	60" 100%	
17	CC	60" 100%	
18	CC	60" 100%	
19	CC	36" 60%	
20	CC	60" 100%	GSA at 92'7"

GEOPHYSIC DETAILS: Gamma (cps) 20 40 60 80 100



WELL DETAILS



Screen Interval: 44.20 - 47.24; 16.76 - 18.29; 7.01 - 8.53 m BGS
Sand Pack Interval: 44.20 - 47.85 m BGS
Well Seal Interval: 0.61 - 42.82 m BGS

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

Preliminary log only. Borehole log will be finalized following geophysics and more detailed analysis of additional drilling locations.
GSA - Grain Size Analysis
WRAS No:
OW3A-18 - 9207372A
OW3B-18 - 9207372B
OW3C-18 - 9207372C

Drawn By/Checked By: AH/

STANTEC BOREHOLE AND WELL - MASTER 17X11 160900878_2016DRILLING.GPJ DATA_TEMPLATE_ENVS_CA_140725.GDT 6/24/19 AHEALEY

Monitoring Well: K-SB-OW3-18

Project: K34/K36 Hydrogeological Assessment
Client: Regional Municipality of Waterloo
Location: Kitchener, Ontario
Number: 160900878

Field Investigator: AH
Contractor: Aardvark Drilling, Inc
Drilling method: PQ / Tri-cone
Date started/completed: 05-Feb-2018 / 13-Feb-2018

Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery	Lab Analyses
95	29		SILT AND SAND TILL Hard, with fine gravel, some coarse gravel and cobbles, trace clay		ATC1	Upper/Main Catfish Creek Till	21	CC	60" 100%	
100	30						22	CC	60" 100%	
105	32						23	CC	48" 80%	
110	34		Matrix becomes more sandy at 33.0 m	278.24			24	CC	55" 92%	
115	35		SAND Hard, 10 YR 4/4 dark yellowish brown fine sand, homogeneous, moist Silty seams from 34.9 m to 35.0 m and from 35.3 m to 35.5 m Sand softens and becomes wet at 35.0 m, change colour to 10 YR 4/2 dark greyish brown	34.75	AFD1	Pre-Catfish Creek sand and gravel	25	CC	42" 70%	
120	36		Sand coarsens (but still fine-grained) from 36.4 m to 36.6 m				26	CC	33" 55%	
125	38		Trace coarse sand at 38.6 m				27	CC	46" 77%	
130	40		Becomes hard at 39.5 m				28	CC	0" 0%	
135	41			271.23						
140	42		GRAVEL (matrix unknown) Fine gravel, trace coarse gravel, trace silt and clay	41.76			29	CC	42" 70%	
145	44		Seam of fine sand at 43.3 m, fine gravel and trace coarse sand beginning at 43.3 m				30	CC	36" 60%	GSA at 141'9"
150	46						31	CC	45" 75%	
155	47		50 cm seam of fine sand mixed with fine and coarse gravel at 46.6 m	265.74			32	CC	36" 60%	
160	48		SAND Fine to coarse sand, wet	47.24			33	CC	10" 17%	
165	50		Some silt at 48.8 m				34	CC	10" 17%	
170	52		Some coarse gravel and cobbles at 50.3 m				35	CC	10" 17%	
175	53		Coarse gravel from 52.8 m to 52.9 m	260.08			36	CC	23" 38%	
180	54		SILT TILL Hard, 7.5 YR 4/2 brown, some medium to coarse sand, some clay, trace fine gravel Coarse gravel at 53.9 m	52.91 258.12	ATE1	Canning Drift (pre-Catfish Creek Till)	37	CC	60" 100%	GSA at 175'
185	56		End of Borehole	54.86						

GEOPHYSIC DETAILS: Gamma (cps) 20 40 60 80 100

WELL DETAILS

Name:	K-SB-OW3A-18	Name:	K-SB-OW3B-18	Name:	K-SB-OW3C-18
GS Elev:	312.99 m AMSL	GS Elev:	313.03 m AMSL	GS Elev:	312.95 m AMSL
TOC Elev:	313.81 m AMSL	TOC Elev:	313.74 m AMSL	TOC Elev:	313.66 m AMSL
Easting:	543865.647	Easting:	543864.733	Easting:	543863.983
Northing:	4803745.100	Northing:	4803746.985	Northing:	4803748.655
Stick-up:	0.83 m	Stick-up:	0.71 m	Stick-up:	0.71 m

Bentonite/ Peltonite/ Holeplug 39.9 to 42.8 m
No. 2 Silica Sand 42.8 to 47.8 m
No. 10 Slot Schedule 80 PVC Screen 49 mm diameter 44.2 to 47.2 m
Bentonite/ Peltonite/ Holeplug 47.8 to 54.9 m
123 mm Borehole Diameter 51.8 to 54.9 m

Screen Interval: 44.20 - 47.24; 16.76 - 18.29; 7.01 - 8.53 m BGS
Sand Pack Interval: 44.20 - 47.85 m BGS
Well Seal Interval: 0.61 - 42.82 m BGS

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

Preliminary log only. Borehole log will be finalized following geophysics and more detailed analysis of additional drilling locations.
GSA - Grain Size Analysis
WRAS No:
OW3A-18 - 9207372A
OW3B-18 - 9207372B
OW3C-18 - 9207372C

Drawn By/Checked By: AH/

STANTEC BOREHOLE AND WELL - MASTER 17X11 160900878_2016DRILLING.GPJ DATA TEMPLATE_ENVS_CA_140725.GDT 6/24/19 AHEALEY

Monitoring Well: K-SB-OW2-18

Project: K34/K36 Hydrogeological Assessment
Client: Regional Municipality of Waterloo
Location: Kitchener, Ontario
Number: 160900878

Field Investigator: AH/SB
Contractor: Aardvark Drilling, Inc
Drilling method: PQ / Tri-cone
Date started/completed: 23-Jan-2018 / 31-Jan-2018

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS				GEOPHYSIC DETAILS	WELL DETAILS
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery	Lab Analyses	Gamma (cps) 20 40 60 80 100	
				304.38							Name: K-SB-OW2A-18 GS Elev: 304.08 m AMSL TOC Elev: 305.09 m AMSL Easting: 543835.746 Northing: 4804709.132 Stick-up: 1.01 m
0	0		Ground Surface	304.08							Above Ground Casing 1.01 m stick-up Cement 0 to 0.6 m 210 mm Borehole Diameter 0 to 2.4 m Schedule 80 PVC Water Level 7.08 m BGS 20-Mar-18 Bentonite Grout 0.6 to 28.0 m
			SILTY CLAY Soft, 10 YR 2/2 very dark brown, some organics, wet	0.00 303.93	ATB2	Middle Maryhill Till and equivalents					
			SAND Soft, 10 YR 4/4 dark yellowish brown, fine sand, trace silt and medium sand, trace organics, moist	0.15 302.86			1	CC	38" 79%		
5			SILTY CLAY TO CLAY Soft, 10 YR 3/2 very dark greyish brown to 2.5 YR 4/3 olive brown, trace organics, moist	1.22 302.20			2	CC	40" 95%		
	2		SAND Soft, 2.5 YR 4/3 olive brown, fine sand, trace medium sand and silt, trace organics, moist	1.88 301.79							
			2.5 cm thick seam of clay at 2.0 m	2.29			3	CC	18" 100%		
10			CLAYEY SILT Soft, 2.5 YR 3/3 dark olive brown, trace organics, moist	300.83							
			Seam of 10 YR 5/4 yellowish brown fine sand from 2.3 to 2.4 m	3.25			4	CC	21" 35%		
	4		SAND Soft, 2.5 YR 3/3 dark olive brown, trace silt and medium sand, trace organics, moist								
15				299.33							
			CLAYEY SILT TO SILTY CLAY Soft, 10 YR 3/3 dark brown to 5 YR 8/2 pale yellow, trace medium sand and organics, moist	4.75 298.05			5	CC	48" 80%		
20	6		SAND Soft, 10 YR 4/4 dark yellowish brown, fine sand, trace silt and medium sand, moist	6.03 297.45							
			GRAVEL (matrix unknown) Coarse gravel, some fine gravel, trace cobbles, trace to some coarse sand, trace silt and clay, subangular to subrounded	6.63			6	CC	27" 45%		
25	8						7	CC	40" 67%		
30			Trace cobbles at 9.5 m				8	CC	32" 53%		
35	10						9	CC	60" 100%	GSA at 35'	
40	12		Wet at 13.1 m				10	CC	60" 100%		
45	14		SAND Soft, 10 YR 4/3 brown fine sand, trace medium sand, some silt and clay, wet	290.44 13.64	AFB2	Middle Waterloo Moraine stratified sediments and equivalents	11	CC	48" 80%		

			WELL DETAILS
Name: K-SB-OW2B-18 GS Elev: 304.18 m AMSL TOC Elev: 305.01 m AMSL Easting: 543836.097 Northing: 4804707.858 Stick-up: 0.82 m	Name: K-SB-OW2C-18 GS Elev: 304.17 m AMSL TOC Elev: 304.89 m AMSL Easting: 543834.527 Northing: 4804710.179 Stick-up: 0.72 m		Above Ground Casing 0.82 m stick-up Cement 0 to 0.6 m Schedule 80 PVC Water Level 3.26 m BGS 20-Mar-18 Bentonite Grout 0.6 to 14.9 m 210 mm Borehole Diameter
			Above Ground Casing 0.72 m stick-up Cement 0 to 0.6 m Schedule 40 PVC Water Level 3.23 m BGS 20-Mar-18 Holeplug 0.6 to 5.5 m 210 mm Borehole Diameter No. 2 Silica Sand 5.5 to 8.2 m No. 10 Slot Schedule 40 PVC Screen 51 mm diameter 6.1 to 7.6 m

Screen Interval: 32.61 - 35.66; 19.51 - 21.03; 6.10 - 7.62 m BGS
Sand Pack Interval: 32.61 - 36.27 m BGS
Well Seal Interval: 0.61 - 31.09 m BGS

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

Preliminary log only. Borehole log will be finalized following geophysics and more detailed analysis of additional drilling locations.
GSA - Grain Size Analysis
WRAS No:
OW2A-18 - 9207371A
OW2B-18 - 9207371B
OW2C-18 - 9207371C

Drawn By/Checked By: AH/

STANTEC BOREHOLE AND WELL - MASTER 17X11 160900878_2018DRILLING.GPJ DATA TEMPLATE_ENVS_CA_140725.GDT 6/24/19 AHEALEY

Monitoring Well: K-SB-OW2-18

Project: K34/K36 Hydrogeological Assessment
Client: Regional Municipality of Waterloo
Location: Kitchener, Ontario
Number: 160900878

Field Investigator: AH/SB
Contractor: Aardvark Drilling, Inc
Drilling method: PQ / Tri-cone
Date started/completed: 23-Jan-2018 / 31-Jan-2018

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS				GEOPHYSIC DETAILS	WELL DETAILS
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery	Lab Analyses	Gamma (cps) 20 40 60 80 100	Name: K-SB-OW2A-18 GS Elev: 304.08 m AMSL TOC Elev: 305.09 m AMSL Easting: 543835.746 Northing: 4804709.132 Stick-up: 1.01 m Name: K-SB-OW2B-18 GS Elev: 304.18 m AMSL TOC Elev: 305.01 m AMSL Easting: 543836.097 Northing: 4804707.858 Stick-up: 0.82 m Name: K-SB-OW2C-18 GS Elev: 304.17 m AMSL TOC Elev: 304.89 m AMSL Easting: 543834.527 Northing: 4804710.179 Stick-up: 0.72 m
50	16		SAND Soft, 10 YR 4/3 brown fine sand, trace medium sand, some silt and clay, wet Sand coarsens between 14.9 and 15.7 m (still fine-grained)		AFB2	Middle Waterloo Moraine stratified sediments and equivalents	12	CC	60" 100%	GSA at 52'		123 mm Borehole Diameter 2.4 to 42.4 m
55							13	CC	60" 100%			Peltonite 14.9 to 18.0 m
60	18						14	CC	60" 100%			
65	20		5 cm thick seam of coarser fine-grained sand at 19.9 m				15	CC	48" 80%			No. 2 Silica Sand 18.0 to 21.6 m No. 10 Slot Schedule 80 PVC Screen 49 mm diameter 19.5 to 21.0 m
70	22		13 cm seam of 10 YR 3/1 very dark grey silty clay				16	CC	60" 100%			
75			20 cm seam of 10 YR 3/1 very dark grey silty clay	281.22	Reworked ATB3?	Lower Maryhill Till	17	CC	60" 100%			
	24		GRAVEL 10 YR 7/1 light grey to 10 YR 3/1 very dark grey coarse gravel, some cobble, subangular to subrounded, trace angular gravel	22.86								
80							18	CC	55" 92%			
85	26		Cobbles at 25.6 m		AFD1	Pre-Catfish Creek sand and gravel	19	CC	20" 33%			
90			Some silt and trace clay at 27.0 m				20	CC	35" 58%			
95	28		8 cm seam of 10 YR 4/2 dark greyish brown hard clay attached to a cobble with trace fine and coarse gravel				21	CC	16" 27%			Peltonite 28.0 to 31.1 m
	30		Cobbles in a silty clay matrix, trace coarse to fine gravel, some fine sand									

Screen Interval: 32.61 - 35.66; 19.51 - 21.03; 6.10 - 7.62 m BGS
Sand Pack Interval: 32.61 - 36.27 m BGS
Well Seal Interval: 0.61 - 31.09 m BGS

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

Preliminary log only. Borehole log will be finalized following geophysics and more detailed analysis of additional drilling locations.
GSA - Grain Size Analysis
WRAS No:
OW2A-18 - 9207371A
OW2B-18 - 9207371B
OW2C-18 - 9207371C

Drawn By/Checked By: AH/

STANTEC BOREHOLE AND WELL - MASTER 17X11 160900878_2018DRILLING.GPJ DATA TEMPLATE_ENVS_CA_140725.GDT 6/24/19 AHEALEY

Monitoring Well: K-SB-OW2-18

Project: K34/K36 Hydrogeological Assessment
Client: Regional Municipality of Waterloo
Location: Kitchener, Ontario
Number: 160900878

Field Investigator: AH/SB
Contractor: Aardvark Drilling, Inc
Drilling method: PQ / Tri-cone
Date started/completed: 23-Jan-2018 / 31-Jan-2018

SUBSURFACE PROFILE				HYDROGEOLOGY		SAMPLE DETAILS				GEOPHYSIC DETAILS	WELL DETAILS
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Hydro Stratigraphic Unit	Description	Sample Number	Sample Type	Recovery	Lab Analyses	Gamma (cps) 20 40 60 80 100	
100			GRAVEL 10 YR 7/1 light grey to 10 YR 3/1 very dark grey coarse gravel, some cobble, subangular to subrounded, trace angular gravel	273.42								Name: K-SB-OW2A-18 GS Elev: 304.08 m AMSL TOC Elev: 305.09 m AMSL Easting: 543835.746 Northing: 4804709.132 Stick-up: 1.01 m Name: K-SB-OW2B-18 GS Elev: 304.18 m AMSL TOC Elev: 305.01 m AMSL Easting: 543836.097 Northing: 4804707.858 Stick-up: 0.82 m Name: K-SB-OW2C-18 GS Elev: 304.17 m AMSL TOC Elev: 304.89 m AMSL Easting: 543834.527 Northing: 4804710.179 Stick-up: 0.72 m
			SAND 10 YR 4/2 dark greyish brown fine sand, trace medium sand and fine gravel, trace silt, wet	30.66 272.68			22	CC	40" 67%	GSA at 97'6"		
105	32		GRAVEL 10 YR 5/1 grey fine and coarse gravel, subangular to subrounded, trace silt and clay, wet 20 cm seam of 10 YR 5/1 grey fine sand, some medium sand, wet 10 cm seam of coarse sand and fine gravel, some coarse gravel	31.39			23	CC	60" 100%	GSA at 108'		
110	34						24	CC	60" 100%			
115	36		15 cm seam of fine sand, some medium sand Cobbles starting at 35.8 m		AFD1	Pre-Catfish Creek sand and gravel	25	CC	60" 100%			
120			Seams of fine to coarse sand from 37.2 to 37.4 m and 35.6 to 37.8 m				26	CC	60" 100%			
125	38		Some fine to coarse sand from 38.3 to 39.9 m				27	CC	60" 100%			
130	40		Boulder at 39.9 m Trace clayey silt at 40.4 m 5 cm seam of fine to coarse sand at 40.6 m	263.31			28	CC	60" 100%			
135	42		SILT TILL hard, 10 YR 5/3 brown, some clay, some coarse sand and fine gravel, trace coarse gravel and medium sand	40.77	ATE1	Canning Drift (pre-Catfish Creek Till)	29	CC	60" 100%	GSA at 134'		
140			End of Borehole	261.71 42.37								
145	44											

No. 2 Silica Sand
31.1 to 36.3 m

No. 10 Slot
Schedule 80
PVC Screen
49 mm diameter
32.6 to 35.7 m

Peltonite
36.3 to 42.4 m

Screen Interval: 32.61 - 35.66; 19.51 - 21.03; 6.10 - 7.62 m BGS
Sand Pack Interval: 32.61 - 36.27 m BGS
Well Seal Interval: 0.61 - 31.09 m BGS

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

Preliminary log only. Borehole log will be finalized following geophysics and more detailed analysis of additional drilling locations.
GSA - Grain Size Analysis
WRAS No:
OW2A-18 - 9207371A
OW2B-18 - 9207371B
OW2C-18 - 9207371C

Drawn By/Checked By: AH/

STANTEC BOREHOLE AND WELL - MASTER 17X11 160900878_2018DRILLING.GPJ DATA TEMPLATE_ENVS_CA_140725.GDT 6/24/19 AHEALEY

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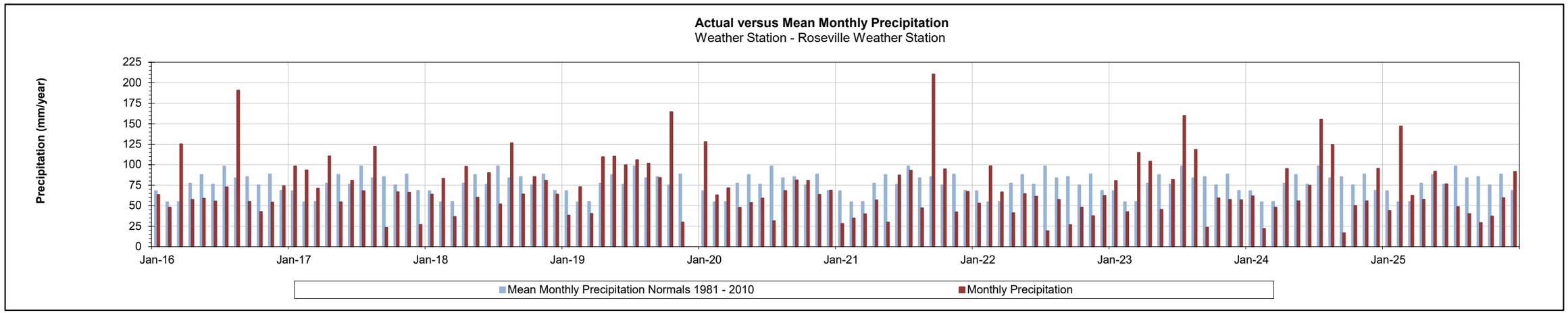
Appendix C

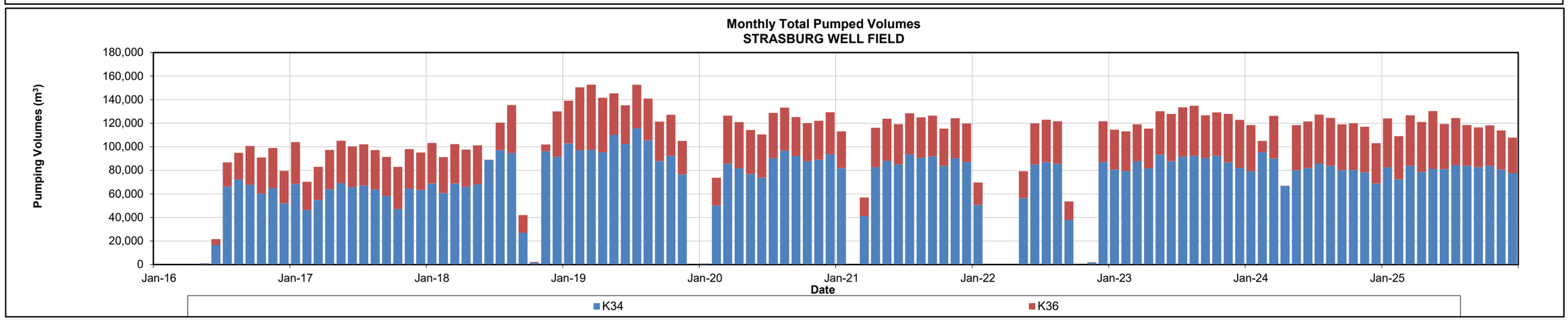
Monitoring Data
(Pumped Volumes and Hydrographs)

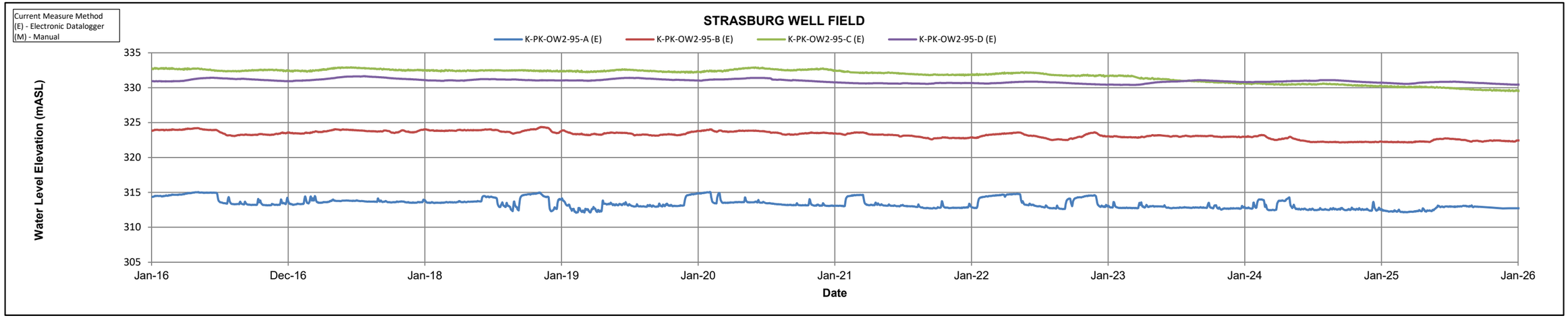
TABLE C-1
WELL FIELD WATER PRODUCTION SUMMARY
REGION OF WATERLOO - 2025 GROUNDWATER MONITORING REPORT

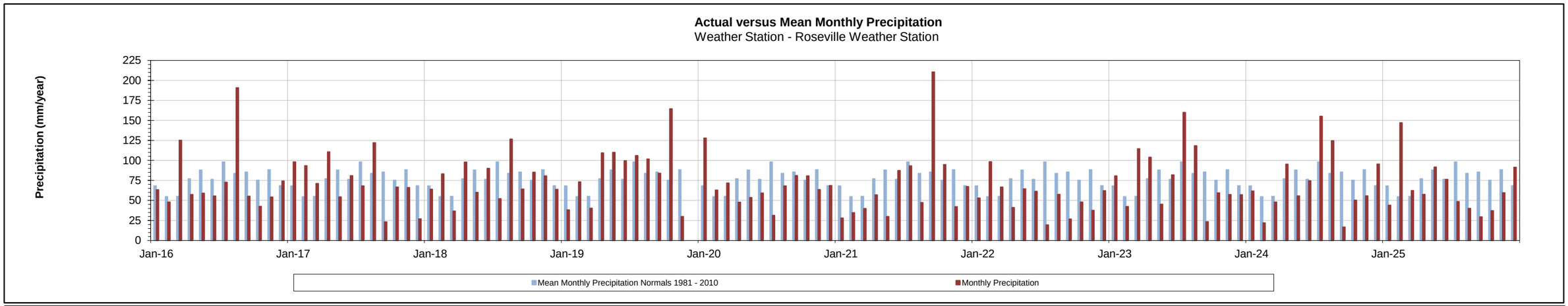
Well Field	Major or Minor Supply	Production Well Name	Permit to Take Water Details			2021 Production Summary			2022 Production Summary			2023 Production Summary			2024 Production Summary			2025 Production Summary		
			MOE Permit Number[1]	Permitted Capacity (total m^3/year)*	Permitted Rate (L/s)*	Total Production Well Volume (total m^3/year)	Average Daily Rate (m^3/day)	Average Rate (L/s)	Total Production Well Volume (total m^3/year)	Average Daily Rate (m^3/day)	Average Rate (L/s)	Total Production Well Volume (total m^3/year)	Average Daily Rate (m^3/day)	Average Rate (L/s)	Total Production Well Volume (total m^3/year)	Average Daily Rate (m^3/day)	Average Rate (L/s)	Total Production Well Volume (total m^3/year)	Average Daily Rate (m^3/day)	Average Rate (L/s)
Strasburg	Minor	K34	6732-A3FJYA	ombined rate for PTTW 6732-A3FJY		916,048	2,510	29.0	491,536	1,347	15.6	1,046,301	2,867	33.2	971,408	2,661	30.8	973,432	2,667	30.9
		K36	6732-A3FJYA	2,508,280	79.5	352,393	965	11.2	198,994	545	6.3	448,758	1,229	14.2	396,163	1,085	12.6	456,492	1,251	14.5
			Well Field Total	***2,508,280***	***79.5***	***1,268,441***	***3,475***	***40.2***	***690,530***	***1,892***	***21.9***	***1,495,059***	***4,096***	***47.4***	***1,367,571***	***3,747***	***43.4***	***1,429,924***	***3,918***	***45.3***
			*Maximum rate and amount shall not exceed 79.5 L/s and 2,508,280 m^3/yr, respectively for both wells																	

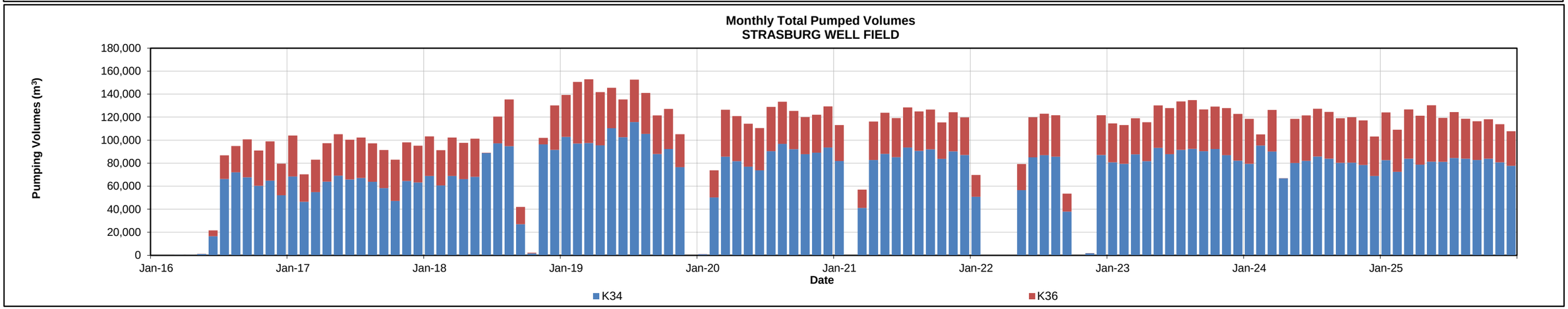
Notes:
- = no applicable data
n/a = data not available
*** = rates and volumes based on permitted L/day**
[1] = Current Permit

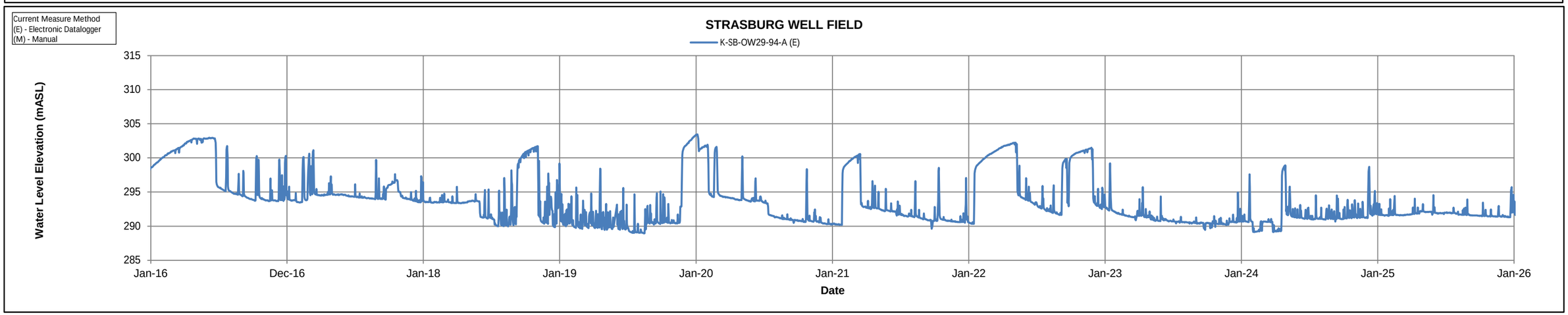

Actual versus Mean Monthly Precipitation
Weather Station - Roseville Weather Station
Precipitation (mm/year)
225
200
175
150
125
100
75
50
25
0
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Mean Monthly Precipitation Normals 1981 - 2010
Monthly Precipitation

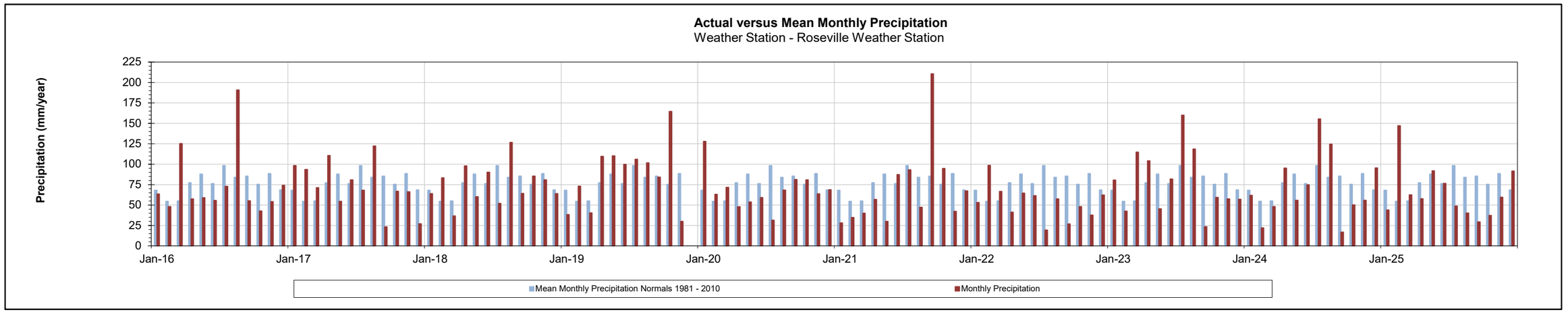

Monthly Total Pumped Volumes
STRASBURG WELL FIELD
Pumping Volumes (m³)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Date
K34
K36

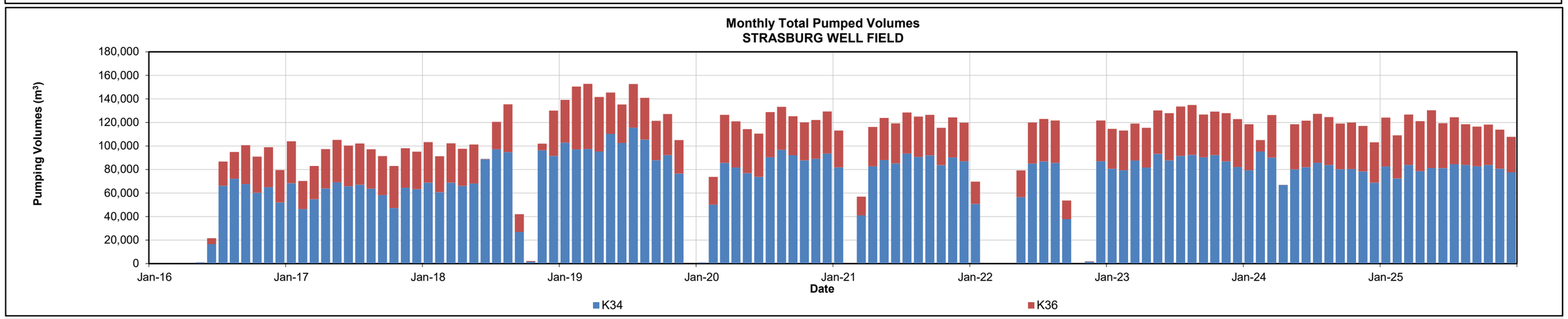

Current Measure Method
(E) - Electronic Datalogger
(M) - Manual
STRASBURG WELL FIELD
K-PK-OW2-95-A (E)
K-PK-OW2-95-B (E)
K-PK-OW2-95-C (E)
K-PK-OW2-95-D (E)
Water Level Elevation (mASL)
335
330
325
320
315
310
305
Jan-16
Dec-16
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Jan-26
Date

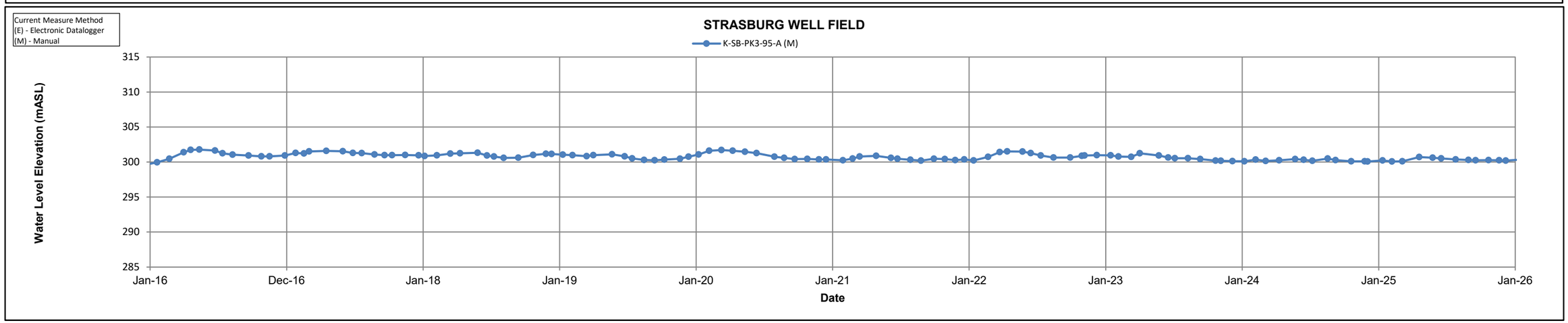

Actual versus Mean Monthly Precipitation
Weather Station - Roseville Weather Station
Precipitation (mm/year)
225
200
175
150
125
100
75
50
25
0
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Mean Monthly Precipitation Normals 1981 - 2010
Monthly Precipitation

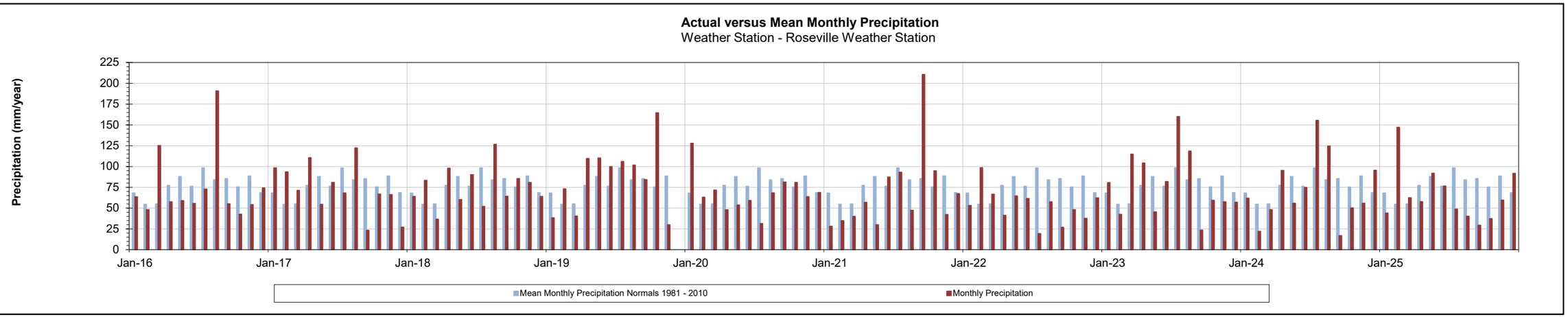

Monthly Total Pumped Volumes
STRASBURG WELL FIELD
Pumping Volumes (m³)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Date
K34
K36


Current Measure Method
(E) - Electronic Datalogger
(M) - Manual
STRASBURG WELL FIELD
K-SB-OW29-94-A (E)
Water Level Elevation (mASL)
315
310
305
300
295
290
285
Jan-16
Dec-16
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Jan-26
Date


Actual versus Mean Monthly Precipitation
Weather Station - Roseville Weather Station
Precipitation (mm/year)
225
200
175
150
125
100
75
50
25
0
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Mean Monthly Precipitation Normals 1981 - 2010
Monthly Precipitation


Monthly Total Pumped Volumes
STRASBURG WELL FIELD
Pumping Volumes (m³)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Date
K34
K36


Current Measure Method
(E) - Electronic Datalogger
(M) - Manual
STRASBURG WELL FIELD
K-SB-PK3-95-A (M)
Water Level Elevation (mASL)
315
310
305
300
295
290
285
Jan-16
Dec-16
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Jan-26
Date


Actual versus Mean Monthly Precipitation
Weather Station - Roseville Weather Station
Precipitation (mm/year)
225
200
175
150
125
100
75
50
25
0
Jan-16
Jan-17
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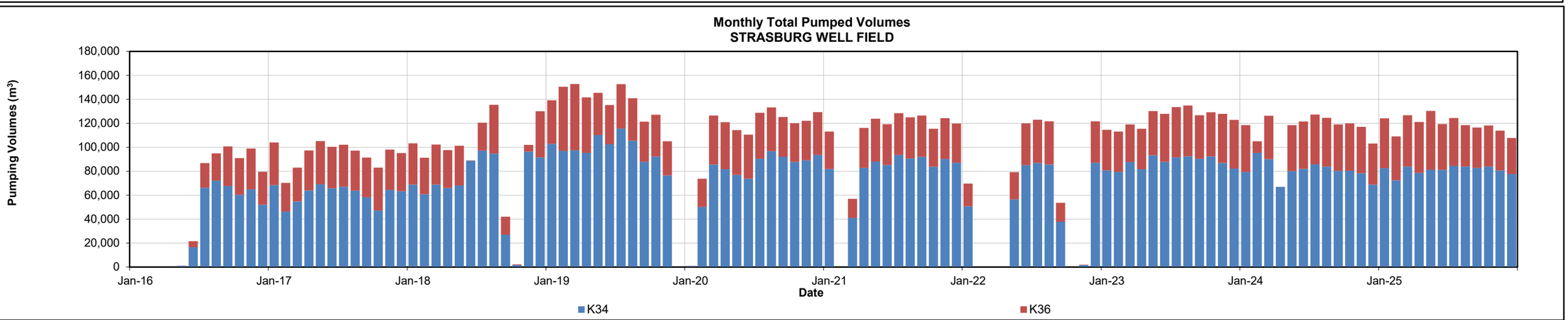
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Mean Monthly Precipitation Normals 1981 - 2010
Monthly Precipitation


Monthly Total Pumped Volumes
STRASBURG WELL FIELD
Pumping Volumes (m³)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Jan-16
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Jan-25
Date
K34
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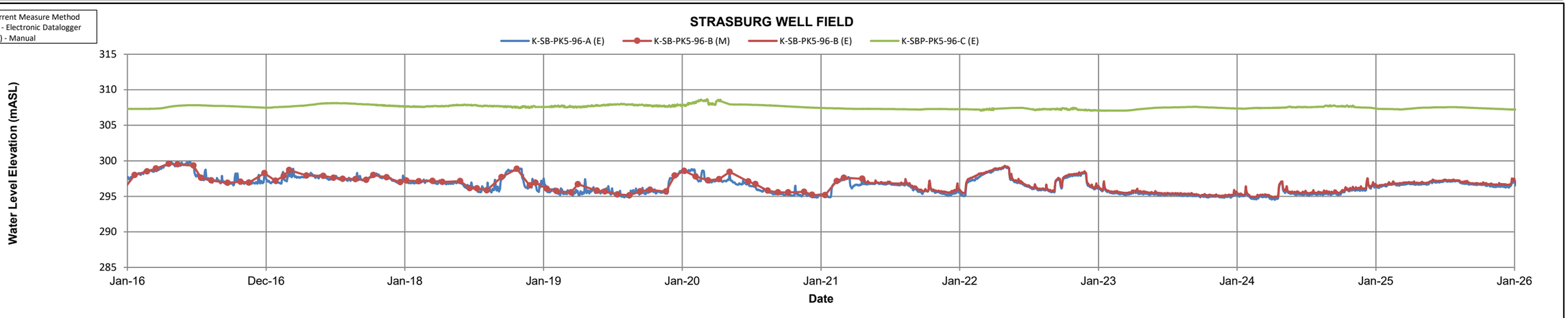
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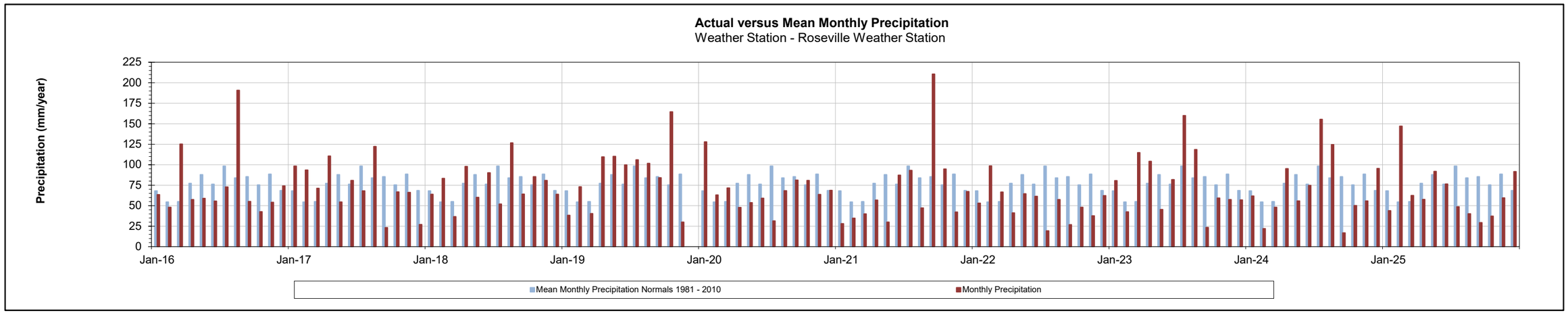
(E) - Electronic Datalogger
(M) - Manual
STRASBURG WELL FIELD
K-SB-PK5-96-A (E)
K-SB-PK5-96-B (M)
K-SB-PK5-96-B (E)
K-SBP-PK5-96-C (E)
Water Level Elevation (mASL)
315
310
305
300
295
290
285
Jan-16
Dec-16
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Jan-26
Date


Actual versus Mean Monthly Precipitation
Weather Station - Roseville Weather Station
Precipitation (mm/year)
225
200
175
150
125
100
75
50
25
0
Jan-16
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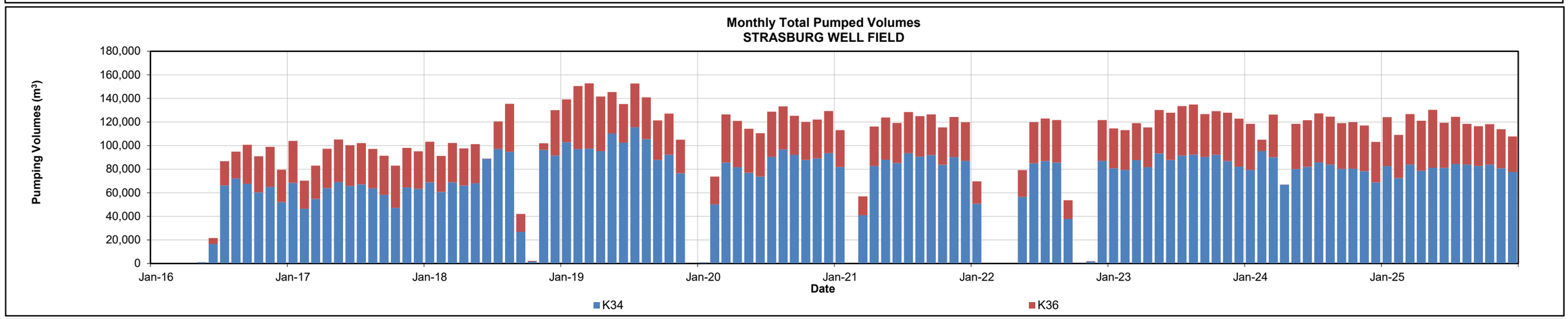
Jan-24
Jan-25
Mean Monthly Precipitation Normals 1981 - 2010
Monthly Precipitation


Monthly Total Pumped Volumes
STRASBURG WELL FIELD
Pumping Volumes (m³)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
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Jan-16
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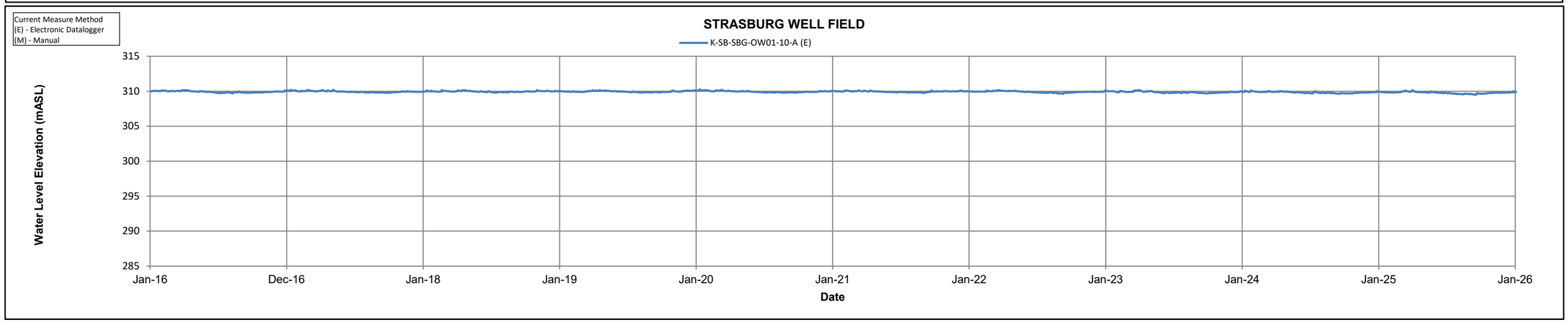
Jan-24
Jan-25
Date
K34
K36


Current Measure Method
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(M) - Manual
STRASBURG WELL FIELD
K-SB-SBG-OW01-10-A (E)
Water Level Elevation (mASL)
315
310
305
300
295
290
285
Jan-16
Dec-16
Jan-18
Jan-19
Jan-20
Jan-21
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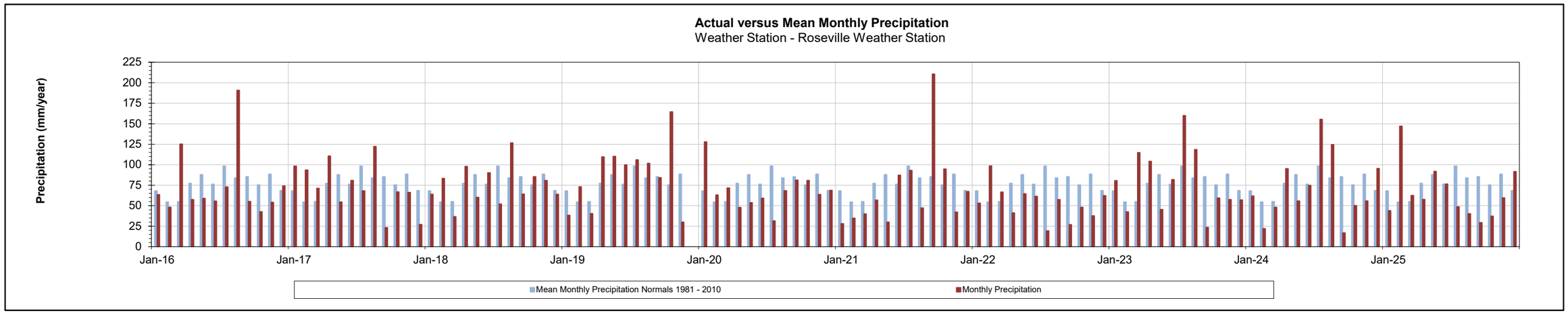
Jan-25
Jan-26
Date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Weather Station - Roseville Weather Station
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75
50
25
0
Jan-16
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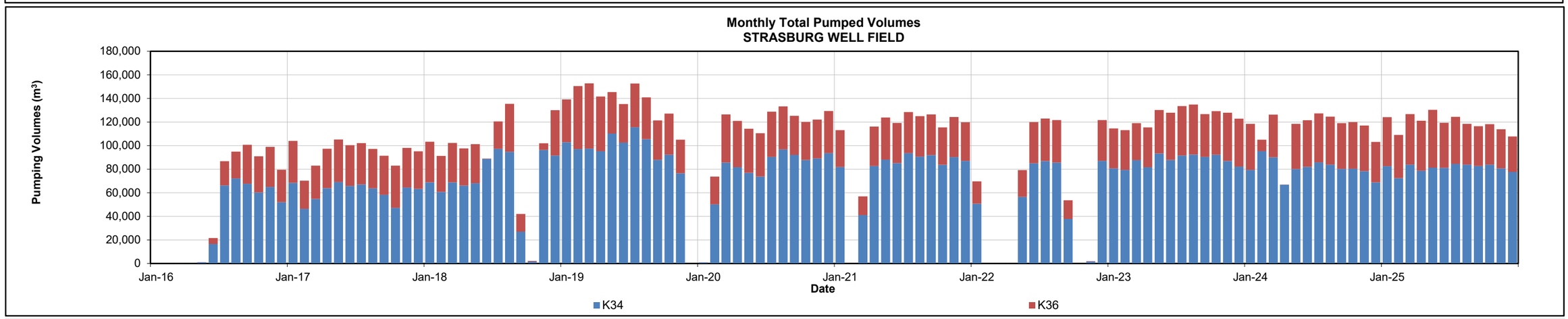
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Mean Monthly Precipitation Normals 1981 - 2010
Monthly Precipitation


Monthly Total Pumped Volumes
STRASBURG WELL FIELD
Pumping Volumes (m³)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Jan-16
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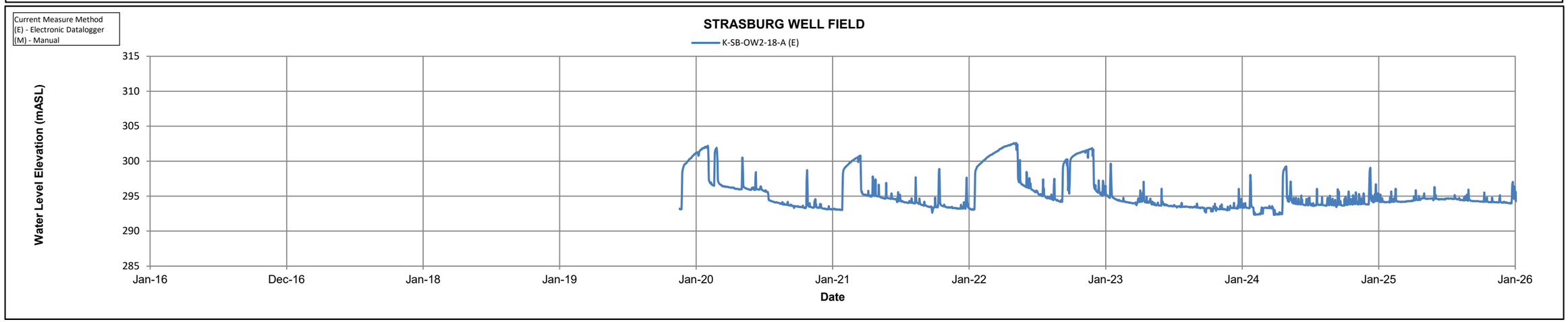
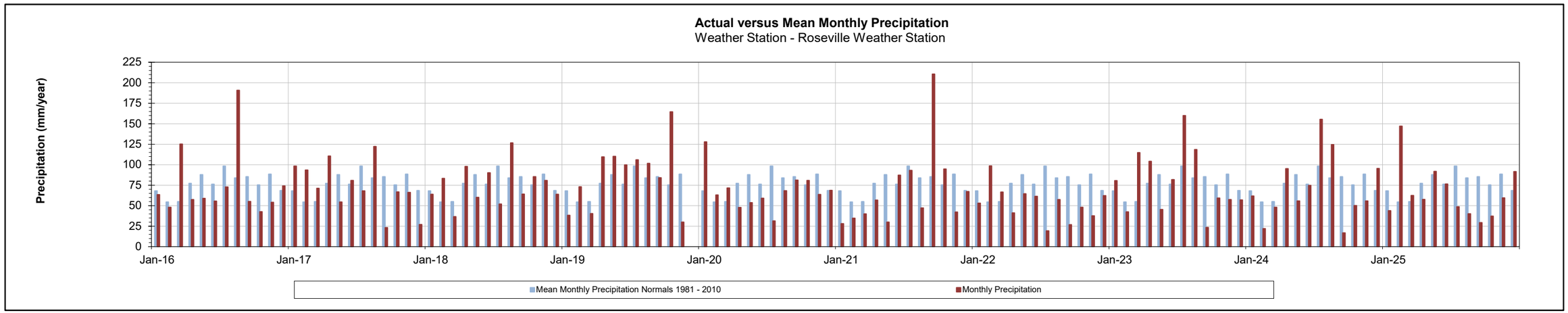
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Date
K34
K36


Current Measure Method
(E) - Electronic Datalogger
(M) - Manual
STRASBURG WELL FIELD
K-SB-OW2-18-A (E)
Water Level Elevation (mASL)
315
310
305
300
295
290
285
Jan-16
Dec-16
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Jan-26
Date


Actual versus Mean Monthly Precipitation
Weather Station - Roseville Weather Station
Precipitation (mm/year)
225
200
175
150
125
100
75
50
25
0
Jan-16
Jan-17
Jan-18
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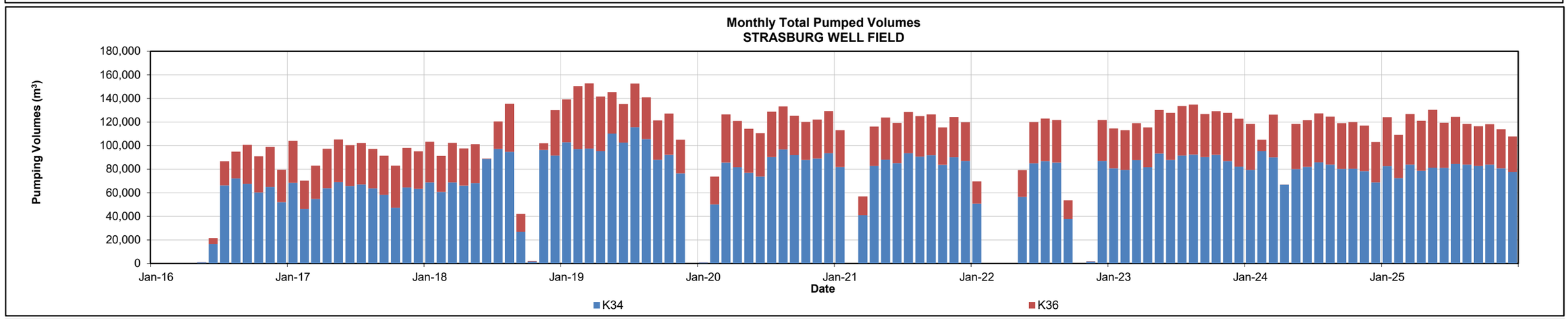
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Mean Monthly Precipitation Normals 1981 - 2010
Monthly Precipitation


Monthly Total Pumped Volumes
STRASBURG WELL FIELD
Pumping Volumes (m³)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Jan-16
Jan-17
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Jan-19
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Jan-21
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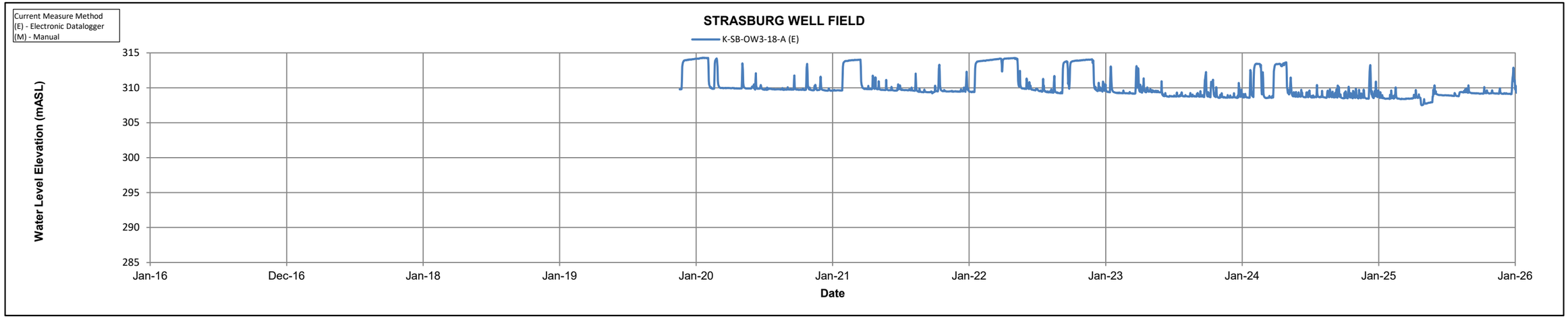
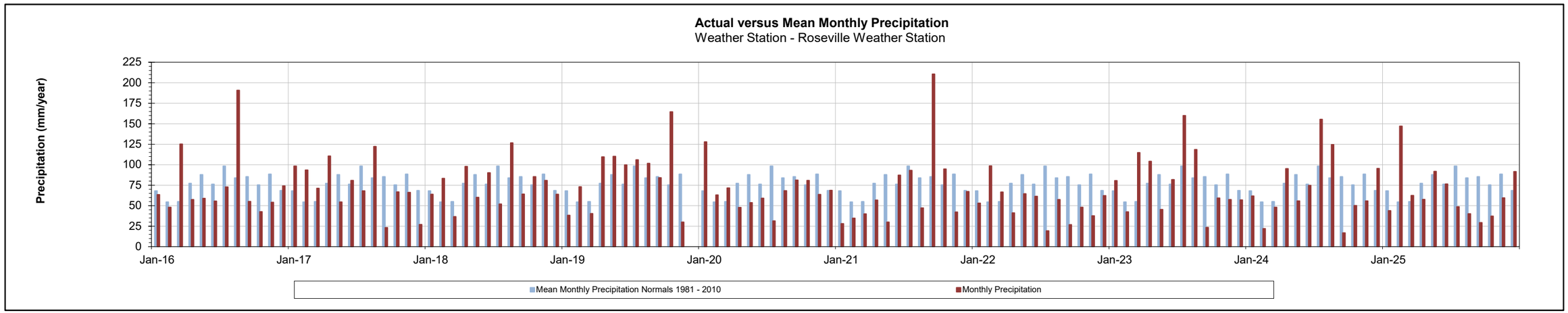
Jan-24
Jan-25
Date
K34
K36


Current Measure Method
(E) - Electronic Datalogger
(M) - Manual
STRASBURG WELL FIELD
K-SB-OW3-18-A (E)
Water Level Elevation (mASL)
315
310
305
300
295
290
285
Jan-16
Dec-16
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Jan-26
Date


Actual versus Mean Monthly Precipitation
Weather Station - Roseville Weather Station
Precipitation (mm/year)
225
200
175
150
125
100
75
50
25
0
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
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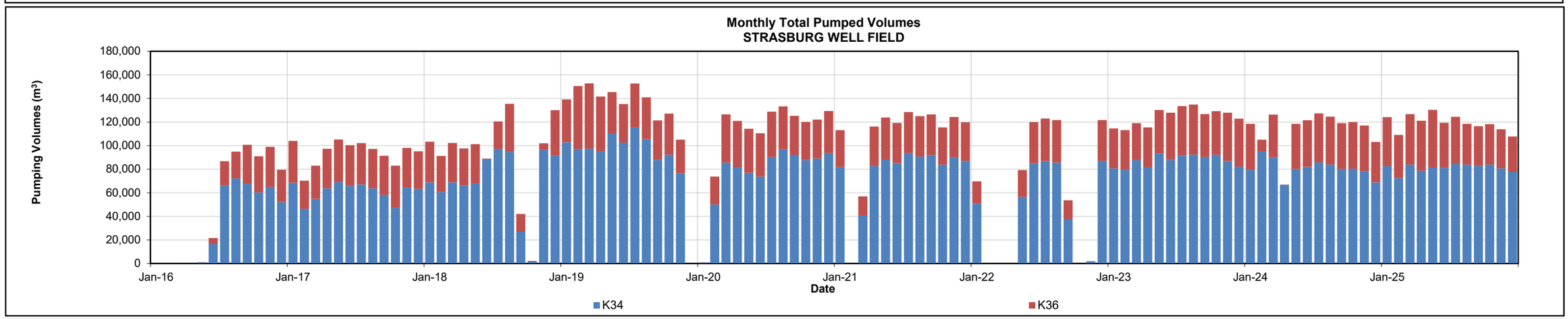
Jan-22
Jan-23
Jan-24
Jan-25
Mean Monthly Precipitation Normals 1981 - 2010
Monthly Precipitation


Monthly Total Pumped Volumes
STRASBURG WELL FIELD
Pumping Volumes (m³)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Jan-16
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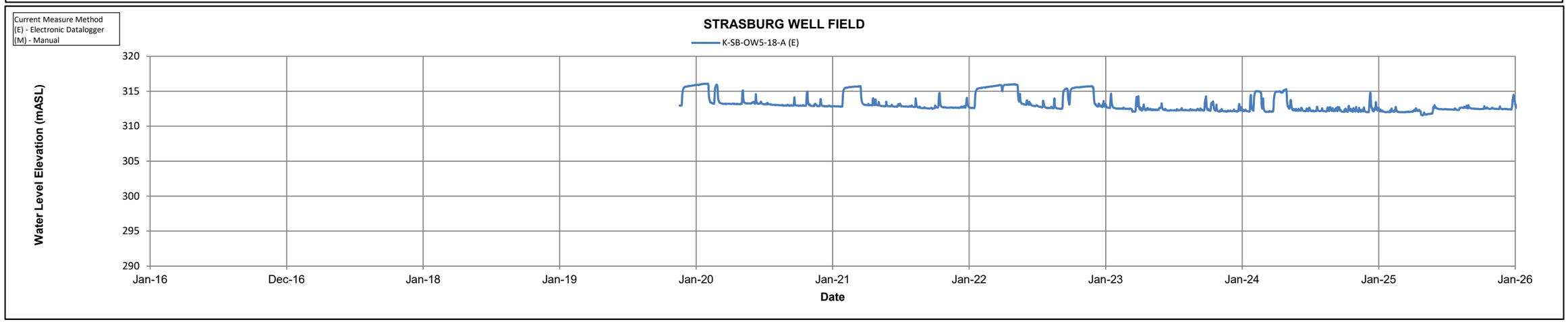
Date
K34
K36


Current Measure Method
(E) - Electronic Datalogger
(M) - Manual
STRASBURG WELL FIELD
K-SB-OW5-18-A (E)
Water Level Elevation (mASL)
320
315
310
305
300
295
290
Jan-16
Dec-16
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Jan-26
Date

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix D

Precipitation Data

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

Year	Kitchener/Waterloo Weather Station Established 1966		
	Annual Precipitation (mm)	30-yr NORMAL Precipitation 1981-2010 (mm)	Difference (mm)
2016	748	851	-103
2017	818	851	-33
2018	749	851	-102
2019	695	851	-156
2020	689	851	-162
2021	772	851	-79
2022	438	851	-413
2023	813	851	-38
2024	874	851	23
2025	723	851	-128

Year	University of Waterloo Station Established 1988		
	Annual Precipitation (mm)	Average Precipitation 1998-2024 (mm)	Difference (mm)
2016	891	871	20
2017	989	871	118
2018	950	871	79
2019	923	871	52
2020	953	871	82
2021	1022	871	151
2022	578	871	-293
2023	959	871	88
2024	763	871	-108
2025	943	871	72

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

Year	Conestogo Dam Established 1961		
	Annual Precipitation (mm)	Average Precipitation 1961-2025 (mm)	Difference (mm)
2016	983	990	-7
2017	1210	990	220
2018	962	990	-28
2019	992	990	2
2020	1021	990	31
2021	975	990	-15
2022	907	990	-83
2023	1053	990	63
2024	972	990	-18
2025	1025	990	35

Year	Woolwich Dam Established 1960		
	Annual Precipitation (mm)	Average Precipitation 1960-2025 (mm)	Difference (mm)
2016	844	835	9
2017	986	835	151
2018	869	835	34
2019	824	835	-11
2020	862	835	27
2021	649	835	-186
2022	668	835	-167
2023	859	835	24
2024	793	835	-42
2025	732	835	-103

Year	Shade's Mills Dam Established 1960		
	Annual Precipitation (mm)	Average Precipitation 1960-2025 (mm)	Difference (mm)
2016	934	909	24
2017	1092	909	183
2018	1042	909	133
2019	1059	909	150
2020	848	909	-62
2021	1020	909	111
2022	682	909	-227
2023	982	909	73
2024	976	909	67
2025	895	909	-14

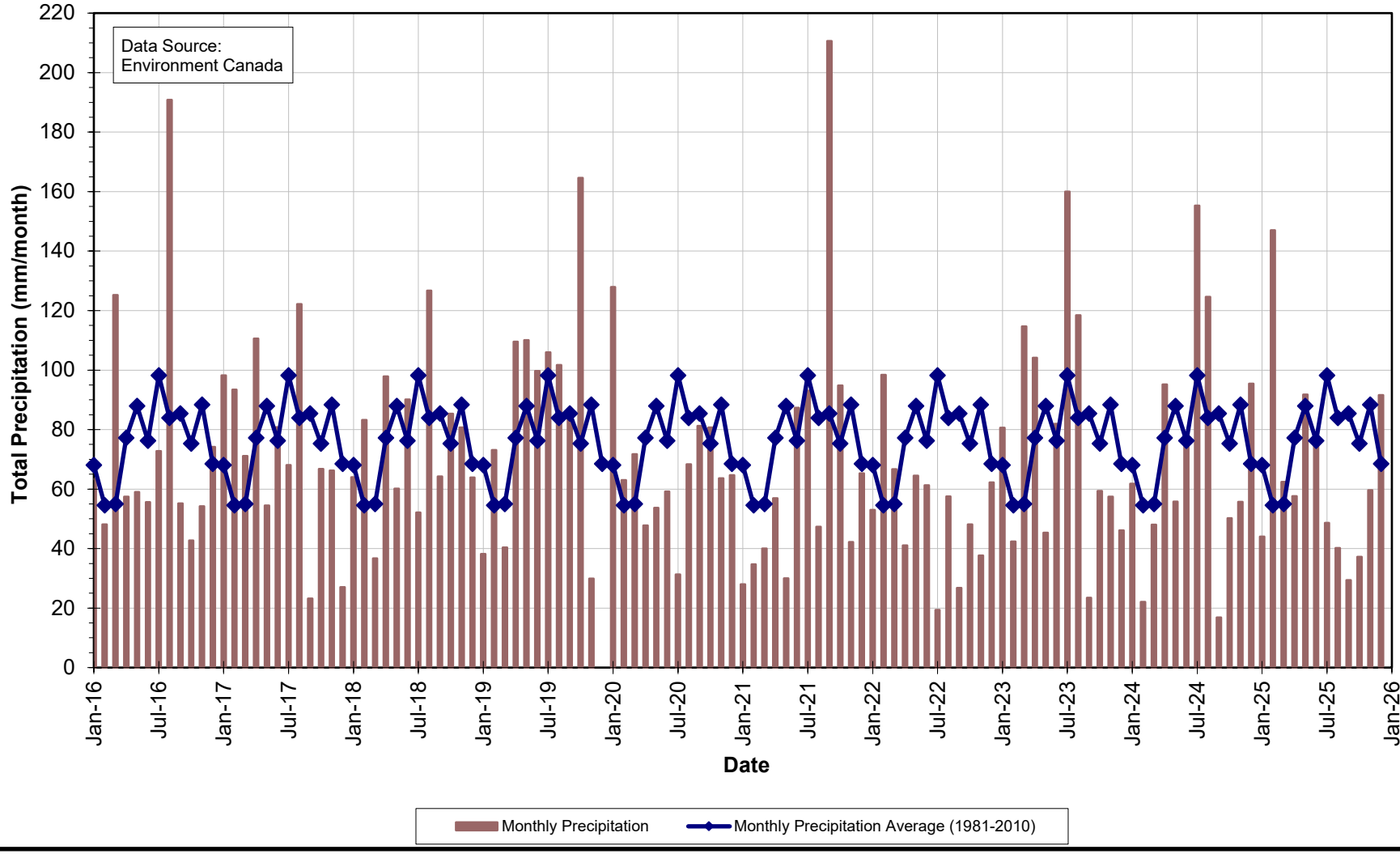
Year	Laurel Dam Established 1960		
	Annual Precipitation (mm)	Average Precipitation 1960-2025 (mm)	Difference (mm)
2016	985	938	47
2017	1062	938	124
2018	1071	938	133
2019	940	938	2
2020	938	938	0
2021	1027	938	89
2022	689	938	-249
2023	921	938	-17
2024	907	938	-31
2025	894	938	-44

Year	Roseville Weather Station Established 1972		
	Annual Precipitation (mm)	30-yr NORMAL Precipitation 1981-2010 (mm)	Difference (mm)
2016	899	919	-20
2017	882	919	-37
2018	905	919	-14
2019	957	919	38
2020	817	919	-102
2021	832	919	-87
2022	637	919	-282
2023	945	919	26
2024	856	919	-63
2025	786	919	-133

NOTES:

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

Figure D.1
Roseville Weather Station
Monthly Precipitation



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File: Appendix D Precipitation Data/Monthly Roseville

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[THE DIFFERENCE IS OUR PEOPLE]

Appendix E

Monitoring Program Overview

GROUNDWATER LEVEL MONITORING PROGRAM PROCEDURES

E.1 Overview

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

E.1.1 Production Well Pumping and Water Levels

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

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

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

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

E.1.2 Monitoring Wells and Surface Water levels

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

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

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

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

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

E.1.3 Climatological Data

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

E.2 Groundwater Level Collection Protocols

E.2.1 Groundwater Level Monitoring Network Summary Well Checklist

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

E.2.2 Well Inspection

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

E.2.3 Monitoring Well Manual Water Level Measurement Procedure

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

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

E.2.4 Downloading of Water Levels from Electronic Dataloggers Procedure

For Non-Vented (Absolute) Datalogger Models:
In-Situ Inc.® LevelTROLLs® and RuggedTROLLs®, *Van Essen Instruments* Divers®, and *Solinst*® Leveloggers®

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

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

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

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

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

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

R.J. Burnside & Associates Limited