2025 Biennial Groundwater Monitoring Report - Roseville Well Field (R5, R6)

The Region of Waterloo

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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 P-300-3116859114) for the Roseville Well Field (R5 R6), requires submission of a well field specific biennial report to the Ministry of Environment Conservation and Parks (MECP) which documents production well pumping volumes and water levels in specific monitoring wells during 2024 and 2025. This report has been prepared to meet the reporting conditions of the PTTW for 2024 and 2025. A copy of the PTTW is included in Appendix A.

The location of the Roseville Well Field is shown on Figure 1 and the production wells in North Dumfries are shown on Figure 2 with the monitoring network for R5 and R6 shown on Figure 3. Well records for the production and monitoring wells are found in Appendix B.

1.1 Scope of Work

The Region records water levels on a regular basis within a network of monitoring wells to satisfy requirements of their Permits to Take Water (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 influence 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 Roseville Well Field in accordance with PTTW P-300-3116859114 which consists of the following activities:

- Measuring the daily volume pumped from the R5 and R6 production wells (Condition 4.1 of the PTTW);
- Measuring the water levels in monitoring wells ND-RV-OW2-95-A and ND-RV-OW2-95-B (Condition 4.2 of PTTW);
- Review of precipitation data from the nearest GRCA/Environment Canada weather station; and
- Completion of a biennial report (every 2 years) that presents data in compliance with condition 4.3 of the PTTW.

The Monitoring data (pumped volumes and hydrographs) are found in Appendix C with precipitation data in Appendix D. The monitoring program procedures and methodology are included in Appendix E.

2.0 Site Setting

2.1 Well Field Description

The Roseville Well Field is located in the northwest portion of North Dumfries Township. Wells R5 and R6 are located in a subdivision northeast of the intersection of Fischer Hallman Drive and Roseville Road (Figure 3). The closest municipal well fields are the Ayr Well Field, located about 7 km to the south, and the Strasburg Well Field located about 7 km to the northeast. (Figure 2). The closest surface water feature to the R5 and R6 site is an unnamed intermittent tributary that bisects Roseville Road just west of the wells (Figure 3).

2.1.1 Pumping Wells

Well records for the production wells are found in Appendix B. Roseville was originally serviced by four private wells in the three major subdivisions of the village; the McLaughlin Well (R1), the Tom Day Well (R2) and the Fedy Wells (R3 and R4). R4 operated as the lead well and R1 and R3 as standby wells until mid-1997 when they were decommissioned because of high nitrate concentrations and replaced by two new deeper wells; R5 and R6. Production Wells R5 and R6 have been supplying the village since 1997 and both wells are screened within the AFB3 aquifer.

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
R5	1995	150	48.8 – 51.8	AFB3
R6	1996	150	48.8 – 51.8	AFB3

The water taking volumes for the Roseville 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 - Roseville

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)
R5	358	35	125	12,758	32	107	11,501
R6	358	20	95	7,395	24	100	8,800
Total	358	55	125	20,152	56	107	20,381

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

The pumping volumes are presented in Appendix C as total monthly volumes. Pumping volumes from the well field ranged from 1,226 m^3/month to 2,195 m^3/month in 2024, and from 1,211 m^3/month to 2,350 m^3/month in 2025. In total, 20,152 m^3 was produced at this well field in 2024 and 20,381 m^3 was produced in 2025. These volumes are lower than total volumes in the last five years and are below the permitted volume of 130,670 m^3 per year (Table C-1).

2.1.2 Monitoring Wells

The Region updated their well naming protocol in 2017 and as a result, the well names in EQuIS may vary from the names listed on the PTTW. The well names on the PTTW are shown below along with the updated name that is used by the Region. The updated Region names will be used throughout this report.

Table 3: Well Nomenclature

Monitoring well names as they appear on the PTTW	Revised well names consistent with Region nomenclature
ND-RV-OW2A-95	ND-RV-OW2-95-A
ND-RV-OW2B-95	ND-RV-OW2-95-B

Observation wells ND-RV-OW2-95-A and ND-RV-OW2-95-B are located approximately 700 m northwest of Roseville production wells R5 and R6 (Figure 3). Construction and monitoring details of the observation wells are described in the table below. Well records for the monitoring wells are provided in Appendix B.

Table 4: Monitoring Well Construction Details

Monitoring Well ID	Year Built	Screened Depth (mbgs)	Screened Formation	Distance to R5/R6 (m)
ND-RV-OW2-95-A	1995	32.9 – 34.1	AFB1	700 m
ND-RV-OW2-95-B	1995	19.5 – 20.7	AFB1	700 m

2.2 Regional Geology and Hydrostratigraphy

The surficial geology based on regional OGS mapping is provided in Figure 4. The village of Roseville is located near the south end of the Waterloo Moraine in the west-central part of the Region (Figure 5). Representative cross-sections showing the stratigraphy in the vicinity of the Roseville Well Field are included as Figures 6 and 7. The cross-section locations are provided in Figure 3. Note that the cross-sections are provided as a visual aid and do not necessarily contain all wells in the monitoring program for the Roseville Well Field (R5, R6). The layers displayed were generated from results of the Hydrogeological Characterization and Conceptual Model Tier 3 Assessment Update Project (Aqua Insight et al, 2023) and associated hydrogeological modelling work.

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 deposition of the Waterloo Moraine in this area resulted in fine to coarse-grained sand and gravel deposits at surface. The surficial geology in the vicinity of the Roseville Well Field consists of glaciofluvial deposits of sand and gravel and ice-contact stratified deposits of sand and gravel (Figure 4).

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

Aquitard ATB1 – Port Stanley Till

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

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

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

Aquitard ATB3 – Lower Maryhill Till

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

Aquifer AFB3 / AFC1 – Lower Waterloo Moraine Stratified Sediments and Catfish Creek Drift

Aquifer AFB3 / AFC1 corresponds to the lower Waterloo Moraine Stratified Sediments and Catfish Creek Drift as referred to by Karrow (1996), and when present is found below the Lower Maryhill Till, mainly along the eastern flank of the Moraine. This unit consists of stratified gravels, sands, or silts and is of very limited extent.

Aquitard ATC1 / ATC2 – Catfish Creek Till

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

Aquifer AFD1 – Pre-Catfish Creek Sand and Gravel

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

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 can occur be quite thin (<5 m) or discontinuous. 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 drilling investigations for the installation of the production wells R5 and R6 (Terraqua, 1995). Borehole logs for wells in the Roseville Well Field are included in Appendix B.

Port Stanley Till (ATB1) – This unit was identified as a surficial silty clay unit with a depth of 6.4 m at R5 and 1 m at ND-RV-OW2-95-AB.

Upper Waterloo Moraine (AFB1) – This unit was identified as a fine to coarse sand and gravel layer of about 2.4 m thick at R5 and R6. At ND-RV-OW2-95-AB the unit was reported from 1 m to 36 m with a thickness of 35 m.

Lower Maryhill Till (ATB3) – This unit which consists of clayey silt to silty clay till was identified in the area of the Roseville Well Field with a thickness of about 17 m at R5 and R6.

Catfish Creek Drift Aquifer (AFB3) - This unit consists of gravel with fine to medium sand associated with Catfish and pre Catfish Creek tills. The Roseville Well Field production wells obtain water from this sand and gravel aquifer located at a depth between 47 m and 53 m below ground (277 and 271 masl).

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 occur in the Roseville Wellfield area between 250 masl and 270 masl (Figures 6 & 7).

Bedrock - The bedrock in the area of the Roseville Wellfield consists of Salina Formation which is comprised of interbedded dolostone and shale with lenses of gypsum and anhydrite. Roseville is located just west of the contact between the Salina and Guelph Formation. There are no wells nearby that are drilled to the bedrock. Based on the regional model (Figures 6 and 7), bedrock is interpreted to be located at approximatley 245 masl (75 meters bgs).

3.0 2024 / 2025 Results

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

3.1 Precipitation

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

Since variations in precipitation totals can occur throughout the Region due to localized events, monthly precipitation data from the GRCA and Environment Canada station located closest to the production wells are used. The closest GRCA weather station relative to the Roseville well field is the Shades Mills Dam station located 15.4 km east of the well field. The closest Environment Canada station is Roseville located 1.2 km north 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 the Roseville climate station are shown on Figure D.1, Appendix D. At the Shades Mills Dam station, the long-term average was calculated from when measurements started until the end of 2025. The Roseville station has “Climate Normals” calculated by Environment Canada for 1981 to 2010 (1991 to 2020 normals are not available for this location).

Annual 2024 / 2025 precipitation data for the GRCA and Environment Canada meteorological station closest to the Roseville well field are presented in Table 5 below. In 2024 the Roseville station was missing 5 days of data and 20 days in 2025. As a result, the precipitation totals may be under reported at this location.

Table 5: Summary of Precipitation Data

Station	2024 Precipitation (mm)	2024 Deviation (mm)	Long-Term Average (mm)	2025 Precipitation (mm)	2025 Deviation (mm)
Roseville Station (1)	856	-63	919(A)	786	-133

Station	2024 Precipitation (mm)	2024 Deviation (mm)	Long-Term Average (mm)	2025 Precipitation (mm)	2025 Deviation (mm)
Shades Mills Dam (2)	976	+67	909(B)	895	-14

Sources: Environment Canada (1), GRCA (2)
A 1981 to 2010 Normal B Average annual precipitation since monitoring began to the end of 2025

Water levels typically follow a seasonal trend with highest levels occurring in the spring with the depth and water content of the snowpack having a significant influence on water levels. Lowest levels occurring in July / August. Widespread synoptic rainfall events can also result in Region-wide water level responses. Summer thunderstorms tend to be short lived and occur over a smaller area resulting in short term, localized water level rises not typically seen in the monitoring wells.

The 2024 total precipitation at Roseville station was 856 mm, which is 63 mm below the long-term average, indicating 2024 was drier-than-average at the well field. At the Shades Mill station precipitation was above the long-term average trend by 67 mm. The March 1 GRCA snow survey indicated a snowpack across the Region that was low compared to normal.

In 2025, the total precipitation at the Roseville station was 786 mm, which is 133 mm below the long-term average. The total precipitation at the Shades Mill Dam station was 14 mm below the long-term average, indicating 2025 was a drier-than-average year. However, Roseville was missing 25 days of data in 2024 / 2025 and as a result, precipitation totals may be under reported. The snow survey conducted by the GRCA on March 15, 2025, showed that the stations in the Region had a high to very high measured snow water equivalent.

3.2 Monitoring Results

In accordance with condition 4.2 of the PTTW, water levels were measured and recorded once per month at ND-RV-OW2-95-AB. Hydrographs showing the results of water level monitoring at each monitoring well over the past 10 years are provided in Appendix C. The method used to collect the water levels (manual or electronic) is indicated on the graphs in Appendix C.

ND-RV-OW2-95-AB

Monitoring wells ND-RV-OW2-95-A and ND-RV-OW2-95-B are located approximately 700 m northwest of the Roseville Well Field and are completed in Aquifer 1 (AFB1) at depths of 34 m (301.3 masl) and 20 m (314.7 masl) respectively. Aquifer AFB1 overlies the municipal aquifer, but is separated by aquitard ATB3. Water levels are measured at the wells manually once a month. The monitoring well nest has a flushmount casing and

is located adjacent to Fischer-Hallman Road which results in access issues in the winter due to plowed snow covering the casing. Water levels could not be collected in February 2024 and February 2025 because the well was buried in snow.

Both monitoring wells typically show a seasonal variations of about 1 m with lowest levels occurring in December / January and highest levels occurring in the middle of the year (May to July). There is no observed response in water levels to decreased pumping at the Roseville production wells in 2024 and 2025. 2024 / 2025 water levels are consistent with levels collected in 2022 and 2023 and about 1 m lower than historical levels observed before 2021.

4.0 Impact Assessment

4.1 Well Interference

PTTW Condition 5.1 states, "The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060."

PTTW Condition 5.2 states: “For Groundwater Takings - If the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide temporary water supplies adequate to meet their normal requirements or shall compensate such persons for their reasonable costs of doing so. If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected."

There are properties within 500 m of the Roseville Well Field that are not serviced with municipal water supply. However, pumping rates at the municipal supply wells are very low (<5 L/s) and result in only 1 to 2 m of drawdown within the pumping wells. Drawdown in the municipal aquifer is likely <2 m. 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 R5 and R6 received in 2024 and 2025.

Other groundwater takings registered in the MECP PTTW database within 2 km of the wellfield are summarized below in Table 6. A PTTW for Unilock Ltd. for use in manufacturing includes three wells located 1.8 km south of the Roseville Well Field (Figure 3).

Table 6: PTTWs in Vicinity of Roseville Well Field

Permit Number	Permit Holder	Purpose	Max Liters per Day	Distance from R5/R6 Supply Wells	Expiry Date
5762-AQKPA2)	Unilock Ltd.	Manufacturing	Well #1 – 47,000 Well #2 – 81,000 Well #3 – 90,000	1.8 km	08/31/2027

4.2 Aquifer Response to Pumping and Precipitation

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

Water levels in ND-RV-OW2-95-A and ND-RV-OW2-95-B are completed in AFB1, which is separated from the municipal aquifer by aquitard ATB3. Peak water levels in the monitoring wells typically occur during the summer months when monthly pumping volumes are the highest. This indicates that AFB1 is not affected by pumping from R5 and R6 from the deeper aquifer (AFB3) at current pumping rates. The overall changes in water levels observed at the monitoring wells are related to climatic conditions and are consistent with water levels noted at other locations in the Region that are outside of the influence of municipal pumping.

Seasonal fluctuations in the aquifer are observed with the highest and lowest levels observed in spring and late summer / fall, respectively. The correlation of individual precipitation events with groundwater levels is difficult due to several reasons including but not limited to hydraulic conductivity, well depth, precipitation intensity and ground cover conditions.

5.0 Conclusions

Impacts from pumping the municipal wells at the Roseville Well Field (R5, R6) were evaluated through implementation of the Groundwater Monitoring Program. Based on the information contained in the report, Burnside offers the following conclusions:

- The information presented in this report satisfies condition 4.3 of PTTW P-300-3116859114;
- There were no reported well interference complaints arising from water takings at the Roseville well field;
- Pumping at the Roseville Well Field in 2024 and 2025 did not exceed the maximum volumes outlined in the PTTW P-300-3116859114; and
- There is no evidence of long-term adverse effects to groundwater levels from pumping at the Roseville Well Field.

6.0 References

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Figures

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Appendix A

Permit To Take Water

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Appendix B

Well Records

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Appendix C

Monitoring Data
(Pumped Volumes and Hydrographs)

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Appendix D

Precipitation Data

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Appendix E

Monitoring Program Overview

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