Technical Memorandum
Casselman Surface and Groundwater Supply Feasibility Study

January 2024

Prepared for:

CORPORATION OF THE MUNICIPALITY OF CASSELMAN
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1.0 Introduction

J.L Richards & Associates Limited (JLR) in association with GEMTEC Consulting Engineering and Scientists Limited (GEMTEC) acting as sub-consultant, were retained by the Municipality of Casselman (Casselman) to conduct a preliminary feasibility analysis of surface or groundwater supply alternatives. Specifically, the analysis will address the feasibility of an increased rate for water taking from the South Nation River, and the availability of a partial of full reliance on groundwater supply. The study forms part of a two-part feasibility study to determine alternative water supply options for Casselman due to their increasing demand and water quality issues with their current source, the South Nation River.

1.1 Background

In 2022, JLR was retained by Casselman to complete a Water and Wastewater Infrastructure Master Plan in accordance with the Municipality Class Environmental Assessment (MECA) requirements. Through the Master Plan, it was determined that water and wastewater infrastructure projects would require prioritization to address future servicing needs and ensure appropriate performance and reliability of the water and wastewater systems in short, mid, and long-term planning horizons.

To address concerns regarding quantity and quality of raw water from the South Nation River, JLR recommended that the Municipality complete a Class EA to determine a water supply source to support mid- and long-term development and increasing water demand. Water sourcing options include the continued supply from the South Nation River, from a new groundwater supply well(s), or from another municipality via a new transmission main.

This study focuses on the feasibility for increased water takings from the South Nation River to support Casselman future water demand and the feasibility for reliance on groundwater supply.

2.0 Existing System Description

Casselman is located along Highway 417 near the South Nation River and is bordered the Nation Municipality. The water distribution system currently services 4,048 people and consists of the Casselman Water Treatment Plant (WTP) located at 832 Laval Street; an elevated water storage tank with a total usable volume of 3,801 m^3 located at 756 Brebeuf Street, and over 22 km of watermains.

2.1 Water Treatment Plant

The Casselman WTP has a rated capacity of 3,182 m^3/day and operates under the Ministry of the Environment, Conservation and Parks (MECP) Drinking Water License Number 173-101, Drinking Water Works Permit No. 173-201, and Permit-to-Take-Water (PTTW) No. 6067-9EGMS2. The facility is owned by Casselman and operated by the Ontario Clean Water Agency (OCWA). It sources raw water from the South Nation River and provides treatment through an Actiflo ® treatment system, dual media filtration, primary disinfection using chlorine and ultraviolet treatment, and secondary disinfection using chloramination with ammonium sulphate. Additionally, raw water is treated with potassium permanganate during the summer months when influent manganese concentrations are elevated. As per the 2023 Phase 1 Master Plan completed by JLR, the Casselman WTP is currently operating at 62% of its rated capacity.

3.0 Projected Water Demands

3.1 Current Flow Rates

As per the Master Plan, the current (2023) water demand was determined by using available flow data over the past five years (2018-2022). The average day demand was determined by averaging the total daily treated flows between 2018 and 2022, and was calculated to be 1,031 m^3/d (12 L/s). The maximum day demand was taken as the average of the maximum day flow reported for each of the past five years, which was calculated to be 1,968 m^3/d (23 L/s). As the peak hourly data was not specifically recorded, the peak hour demand was estimated using a theoretical peaking factor of 1.5 times the maximum day demand, as recommended in Ministry of the Environment, Conservation, and Parks (MECP) Design Guidelines for Drinking Water Systems (2008) for a community of this size. The peak hour is estimated to be 2,953 m^3/d (34 L/s). Table 1: Existing Casselman Water Demand below summarizes the average day, maximum day and peak hour demands within Casselman.

Table 1: Existing Casselman Water Demand

Years	Average Day	Maximum Day	Peak Hour
Current (2023) (m^3/day)	1,031	1,968	2,953 (1)
Current (2023) (L/s)	12	23	34 (1)
Percent (%) of Rated Capacity Used	Not applicable	62%	Not applicable
(1) Peak hour demand calculated using a theoretical peaking factor of 1.5 times the maximum day demand, MECP Design Guidelines for Drinking Water Systems (2008)			

3.2 Future Water Demand

The design parameters used to calculate the future water demands of the water distribution system are summarized in Table 2.

Table 2: Design Parameters – Future Water Flow Demand

Future Water Flow Projection – Design Parameters		
Parameter	**Residential**	**Industrial / Commercial / Institutional**
Average Day Flow (1)	350 L/cap/day	35,000 L/ha/day (Light Industrial) 45,000 L/ha/day (Industrial) 28,000 L/ha/day (Commercial)
Maximum Day Flow (2)	1.92 x Average Day	1.92 x Average Day
Peak Hour Flow (1)	1.5 x Maximum Day	1.5 x Maximum Day

(1) MECP Design Guidelines for Drinking Water Systems (2008)
(2) Peak factor determined from average and maximum day demand data provided in Table 1

Based on these design parameters and the future residential development outlined in the Master Plan, the projected short, mid, and long-term water demands were calculated and are presented in Table 3.

Table 3: Future Water Demands

Demand Scenario	**Short-Term (2023-2027)**	**Mid-Term (2028-2032)**	**Long-Term (2033-2047)**
Total Serviced Population (1)	6,357	8,120	8,902
ICI Development Area (ha)	0.25	2.74	19.64
Future Average Day (m^3/day)	1,850	2,580	3,690
Future Maximum Day (m^3/day)	3,552	4,954	7,085
Future Peak Hour (m^3/day)	5,328	7,430	10,627

(1) The total serviced population represents residential population only and excludes equivalent institutional households and populations.

3.3 Projected Timing for Casselman WTP Expansion

Based on water demands and growth development timelines a graph representing the projected maximum day water demand from the WTP and anticipated timing to reach 80%, 90%, and 100% of the rated capacity was prepared. Refer to Figure 1.

This graph indicates that based on the growth numbers presented in the Master Plan, 80% of the WTP rated capacity will be reached by the end of 2023, 90% WTP rated capacity will be reached by the end of 2024, and the rated capacity of the WTP will be reached by the end of 2025.

4.0 Surface Water

GEMTEC conducted a review of publicly available data and various past studies which discussed the hydrology of the South Nation River with respect to watershed characterization, regional water budget, and water quality.

4.1 South Nation River Watershed

The South Nation River consists of five primary subwatersheds, namely, Upper South Nation River, Middle South Nation River, Lower South Nation River, Bear Brook, and Castor River. The watershed covers an area over 3,800 km^2 with a length of 175 km at its confluence with the Ottawa River. The Upper, Middle, and Castor River subwatersheds provide streamflow to the South Nation River at Casselman.

4.2 Water availability analysis

From a review of available data from the Water Survey of Canada (WSC) Hydrometric Stations, four stations were identified near Casselman; Casselman (02LB013), Plantagenet Springs (02LB005), Castor River at Russell (02LB006), and Bear Brook at Bourget (02LB008). The WSC is responsible for the collection and reporting of standardized water resource and data related to water level, water quantity, sediment transport, and aquatic quality.

4.3 Monthly flow analysis

The hydrometric station at Casselman only collected annual flow data between 1975 and 1986, and currently only collects seasonal flow data between March 1 and June 30, which is representative of the spring freshnet and high flow conditions. Given the lack of recent annual data, the historical flows may not be reflective of present-day low flow hydrology. However, recent and historical annual flow data was available for the Plantagenet Spring station, the Castor River station at Russell, and the Bear Brook station at Bourget. As a result, monthly flows at Casselman were determined by prorating and averaging the historical flows recorded at the Plantagenet Spring station, the Castor River station at Russell, and the Bear Brook station at Bourget. The table below summarizes the prorated monthly average flows at Casselman.

Table 4 Prorated Monthly Average Flows at Casselman

Month	Minimum Monthly		Average Monthly		Maximum Monthly	
	(m^3/s)	(m^3/day)	(m^3/s)	(m^3/day)	(m^3/s)	(m^3/day)
January	0.94	80,823	20.78	1,795,000	90.35	7,806,485
February	1.02	88,107	20.30	1,753,996	163.98	14,168,213
March	6.99	604,041	81.18	7,013,691	218.18	18,850,984
April	22.29	1,926,235	119.04	10,284,816	299.16	25,847,204
May	5.64	487,247	28.60	2,470,971	105.40	9,106,956
June	1.58	136,471	14.50	1,252,596	66.98	5,787,340
July	0.58	50,047	8.26	713,466	79.30	6,851,543
August	0.50	43,071	5.52	476,641	44.19	3,818,027
September	0.49	42,719	5.94	513,202	55.45	4,790,644
October	0.85	73,073	14.04	1,213,440	68.42	5,911,393
November	1.72	148,237	25.45	2,199,080	93.43	8,072,702
December	1.93	166,655	27.87	2,407,617	72.61	6,273,384

The monthly data suggests that the South Nation River has sufficient flow to support future water demands.

4.4 Low flow frequency analysis

A low flow analysis was conducted to determine water supply concerns. A low flow condition is defined as a period, ranging from one to several days, during which average streamflow is a minimum during the year or selected seasonal period. These periods of low flow are critical to managing surface water supplies. Low flow estimates were generated from proration and averaging of available data from the Plantagenet, Castor River at Russell, and Bear Brook at Bourget gauge stations. The tables below summarize prorated low flow rates for the South Nation River at Casselman.

Table 5 Prorated 7-Day Low flow Volume (m^3/d) for South Nation River at Casselman

Month	Return Period (Years)							
	1.005	2	5	10	20	50	100	200
January	2,075,428	485,209	217,339	139,374	99,340	73,475	63,855	58,651
February	1,664,188	364,246	182,541	127,708	99,033	79,950	72,425	68,224
March	11,669,031	859,820	256,905	136,643	88,220	63,620	56,537	53,419
April	13,779,680	2,672,204	1,362,750	1,002,380	823,783	711,528	671,014	649,055
May	3,193,000	723,867	390,726	293,203	242,469	209,612	197,276	190,358
June	1,814,047	286,133	124,336	82,393	62,533	50,638	46,710	44,526
July	2,077,777	122,144	38,524	24,830	20,372	18,334	18,024	18,024
August	792,663	121,072	47,485	27,277	17,013	10,698	8,231	6,965
September	619,350	141,704	62,143	35,676	20,648	9,727	5,026	**2,209**
October	2,309,599	296,482	97,111	46,538	22,912	8,688	4,066	**1,720**
November	3,967,884	706,769	289,884	170,727	110,207	71,197	56,928	48,954
December	3,553,710	657,242	309,541	213,908	166,671	137,567	127,074	121,402
Annual	288,500	95,000	50,100	32,300	20,600	10,500	5,600	**2,200**

Table 6 Prorated Extended Duration Low Flow Volumes (m^3/d) for South Nation River at Casselman

	Return Period (Years)							
	1.005	2	5	10	20	50	100	200
15-Day Low Flow	338,283	109,989	58,053	37,094	23,515	12,009	6,360	**2,522**
30-Day Low Flow	448,300	115,300	61,700	39,300	23,900	13,300	8,000	4,000

The low flow analysis suggests the following:

- The short-term average day water demand (1,850 m^3/d) for Casselman exceeds the 200-year return period 7-day low flow estimate (1,720 m^3/d) for the month of October.
- The mid-term (2,580 m^3/d) and long-term (3,690 m^3/d) average day water demands exceed the 200-year return period 7-day low flow estimates for September (2,209 m^3/d) and October (1,720 m^3/d).
- The long-term ((3,690 m^3/d) average day water demand exceeds the 200 year return period 15-day low flow estimate (2,522 m^3/d).
- Long-term maximum day (7,085 m^3/d) and peak hour water demands (10,627 m^3/d) are estimated to exceed 7-day low flow rates with return periods of 100 and 50 years, respectively. These demands also exceed the longer duration (15- and 30-day) 100- and

200-year return period flow rates. As maximum day and peak hourly demands are short duration events, water impounded by the Casselman weir is expected to be sufficient to ensure demands are satisfied.

4.5 Potential River level drawdown during low flow conditions

During low flow conditions the average day water demand could exceed stream flow rendering the existing weir at Casselman to function as a municipal dam with impounded water retained upstream of the weir, once water levels fall below the elevation of the weir crest. Given that impounded water volume is not available, the impacts of insufficient streamflow were assessed in terms of potential river level drawdown. Table 7 below summarizes the findings of the low flow conditions drawdown.

Table 7 Potential River Drawdown - Low Flow Conditions (200-Year Return Period)

	Current (2022)	Short-Term (2023-2027)	Mid-Term (2028-2032)	Long-Term (2033-2047)
Serviced Population	4,048	6,357	8,120	8,902
Average Day Demand (m^3/day)	1,139	1,850	2,580	3,690
7-day Low Flow Drawdown (2,209 m^3/day streamflow)	---	---	0.03 m	0.10 m
15-day Low Flow Drawdown (2,522 m^3/day streamflow)	---	---	0.01 m	0.16 m
30-day Low Flow Drawdown (3,916 m^3/day streamflow)	---	---	---	---

The low flow conditions drawdown analysis suggests that the maximum drawdown at the long-term average day demand does not exceed 0.16 m. Given that the water intake pipe at the Casselman Water Treatment Plant is submerged to a regular depth of 7 m, the level of drawdown anticipated is relatively minor, suggesting sufficient storage is available upstream of the Casselman Weir to offset low flow periods. This analysis was conducted using average day demands. Under maximum day demand conditions in the water distribution system during a low river flow period, the water levels , an increased river drawdown would be expected. However, given the magnitude of the drawdown using the average day demand, it is anticipated that the Casselman Weir would have sufficient storage to accommodate maximum day flows during these low flow conditions.

4.6 Findings and recommendations

Based on the analysis of available data, the results of the South Nation River assessment suggest there is sufficient water to sustain Casselman's increasing water demand. The assessment outlined short duration periods where the water demand exceeded the low-flow condition flow rate. These short duration (7-day and 15-day) low-flow periods where demand exceeds streamflow are rare (200 year return period) events but is still critical that municipal water demands be met. Additionally, a drawdown analysis suggests that there is sufficient storage available to accommodate Casselman's future water demand during low-flow conditions.

It is recommended that additional studies be completed to assess the risks associated with drawing stagnant water from the weir during low-flow conditions and investigate the bathymetry of the South Nation River and potential water storage volume upstream of the Casselman weir. Additionally, there is a hydroelectric station adjacent to the Casselman Weir that likely collects continuous level and flow data for water passing through the weir bypass channel. Flow data should be requested and analyzed as it would provide a better representation of recent low flow conditions which are key to understanding surface water availability. Review of this data and comparison to historical data used in this feasibility would strengthen the understanding of the South Nation River low flow hydrology at Casselman.

5.0 Groundwater

GEMTEC conducted a review of publicly available data and various past studies pertaining to water resources in and around Casselman. A series of eskers were identified in the vicinity of Casselman, with the Crysler-Finch esker being the nearest. Based on a review of available studies, the configuration of the Crysler-Finch esker is comparable to other eskers within the Champlain Sea basin, consisting of a gravel core with a broad sandy carapace on bedrock or till that is discontinuously overlain with Basin muds and/or Basin Sands.

5.1 Groundwater resources assessment

A review of public well records within two kilometres from the Municipal boundaries of Casselman indicated that most water supply wells are completed within bedrock, aquifers suitable for private servicing are widespread, however, high-yielding wells are scarce.

5.2 Nearby Municipal Groundwater systems Review

To provide regional context of groundwater availability, groundwater systems of nearby municipalities were reviewed. Out of the eleven systems examined, six are believed to withdraw from esker features with a withdrawal rate raging between 393 m^3/d and 4,605 m^3/d. It is noted that the reported groundwater withdrawal limit of the nearby systems may not reflect the maximum safe yield of the aquifers they exploit.

5.3 Preliminary Assessment of Future Groundwater Supply

Based on the findings of available information, the opportunities for a municipal groundwater supply for Casselman include the upper fractured Paleozoic bedrock which may connect to overlying overburden units, and sand and gravel deposits of the Crysler-Finch esker. Given the low yielding rates identified from the non-esker overburden units, it is likely that a large well field would be required to meet Casselman's future water demand. Therefore, water supply from the non-esker overburden units are deemed impractical for large-scale municipal applications. In contrast, nearby eskers have been utilized for municipal applications and it has been reported that the Crysler-Finch esker may be expected to make an effective aquifer due to its storage properties and high hydraulic conductivity.

5.4 Crysler-Finch Esker

Although the Crysler-Finch esker is a locally available source and eskers have demonstrated to be effective drinking water supplies in eastern Ontario, there is much uncertainty relating to its local morphology including the thickness, extent, and conductivity of the aquifer.

Many studies evaluating the extend of the Crysler-Finch esker within the proximity of Casselman have been conducted using borehole drilling and seismic surveys, however, due to lack of availability, the studies were not reviewed as part of the investigation.

5.4.1 Water Quantity

The specific water yield quantity available within the Crysler-Finch esker is unknown.

Further investigation through intrusive studies are required to determine total safe water yield available within the Crysler-Finch esker near Casselman. Available information suggests that the reported withdrawal limits from surrounding municipalities do not reflect the maximum safe yield of the aquifer but instead the municipal demand for which they were designed for. For example, the reported withdrawal limit for the Vars municipal groundwater system is 2,290 m^3/d, whereas the supply feasibility study proposed a safe yield of 3,606 m^3/d and a 20-year theoretical yield of 6,009 m^3/d. Although the Crysler-Finch esker is anticipated to be smaller and more discontinuous than the Vars-Winchester esker, available information suggests that two or more distanced wells with additional backup wells for redundancy would be required to support Casselman's future demand.

5.4.2 Water Quality

The water quality of the Crysler-Finch esker remains uncertain, but it may be expected to be susceptible to surface water impacts in locations where Basin Muds pinch out, exposing the more conductive sand or gravel of the esker formation. A review of the surrounding municipal groundwater systems indicated possible surface water influences within their supply wells. Attributed quality parameters to these impacted waters resulted in the presence of nitrates, organic nitrogen, total coliform, dissolved organic content, and variable turbidity. All municipal reviewed were treatable to meet the Ontario Drinking Water Quality Standards but differing treatment systems were implemented by each municipality depended on the perceived risk of surface water impacts, aesthetic issues, and volume throughput.

Additionally, a review of available water quality data within a 5 km radius of Casselman was conducted which indicated potential surface water influence in the tested wells, mineralized water quality from interface and deep bedrock wells, and sulfur and saline water conditions near-exclusively associated with bedrock or bedrock interface wells. Numerous exceedances of health-based, aesthetic, and operational standards were noted and would require consideration during well construction, well siting, and design of treatment systems.

5.4.3 Potential sources of groundwater contamination

It is expected that overburden and shallow bedrock systems surrounding Casselman may be susceptible to surface water influences depending on the local conditions. A preliminary review of potential sources of contamination near the Crysler-Finch esker identified the following potential sources of groundwater contamination:

- Agricultural land uses (e.g. livestock, crops, and machine storage);
- Commercial and industrial land uses (e.g. vehicle service garages, gas stations, sewage works, pesticide storage, and golf course);
- Runoff from roadways, ditches, and highways entraining vehicle contamination and road salt;
- Landfill facilities (e.g. Casselman Landfill and GFL Environmental Incorporated);
- Railway;
- Drilling muds;
- Existing groundwater wells and septic systems; and
- Surface water features (e.g. tributaries to the South Nation River, agricultural drains, storage lagoons, and wetlands).

Potential sources of contamination would need to be considered when identifying potential communal water supply well locations.

5.5 Findings and recommendations

It is anticipated that the process for determining the most adequate source to meet Casselman's growing demands will be a multi-year process requiring input from a diverse range of stakeholders. The desktop study identified the Crysler-Finch esker as a potential source for supplying groundwater at a municipal scale. Possible constraints and future work necessary to characterize the Crysler-Finch as a potential water supply source include:

- Possibility that no part of the esker is located within Casselman's municipal boundaries which would result in land use agreement or land procurement from the Nation Municipality
- Intrusive borehole and pumping test investigations to confirm water quality and quantity
    - Multiple test wells completed in the proposed water supply aquifer would be required to support technical studies, including at least 72-hour constant rate pumping tests
    - The volume and quantity of water available from the Crysler-Finch esker may not be able to support Casselman's water demands. Multiples supply wells may be required to meet future demand requirements.
    - The Crysler Finch esker may be a groundwater supply under the influence of surface water, thereby requiring additional treatment control measures and monitoring.
- A wellhead protection delineation study and land-use inventory would be required.
- Potential for well interference with existing users and groundwater contamination would need to be assessed.
- There are several established commercial, municipal, and industrial land uses surrounding the esker that may conflict with wellhead protection measures. The feasibility of instituting land-use policies to protect the aquifer would need to be assessed.
- Effects on the distribution system from the new water source would need to be assessed.

- New treatment facilities would be required to treat a groundwater supply.

As a result, the timeline for the completion of a preliminary hydrogeological assessment of the Crysler-Finch is expected to be a multi-year process to allow for test well siting and drilling, hydraulic testing, preliminary wellhead delineation studies, and regulatory approval.

There is a reasonable high likelihood that the esker could be a potential source of water for Casselman, though not necessarily in quantities sufficient to meet their future needs in full. Significant additional studies are required to assess the suitability for groundwater to serve as either the entire or partial source of water for the Municipality in the future. Such studies are likely to require many months or years of assessment before definitive answers are available.

6.0 Conclusion

This study investigated the feasibility for the continued use of the South Nation River as Casselman's drinking water source to support increasing water demands. Based on the review of available information, it was determined that the South Nation River would be able to support Casselman's future average day demand with the support of the Casselman weir during low flow conditions. During a rare 200-year return period, 15-day low-flow conditions event and at the long-term future average day demand, it was estimated that the river drawdown would be a maximum of 0.16 m, a minimal value in comparison to the depth of the Casselman WTP intake, located at 7 m below the water surface. Additional studies were recommended to provide a better understanding of the storage volumes upstream of the Casselman weir and water quality risks associated with sourcing impounded water.

The study also investigated the feasibility for partial or full reliance on a groundwater supply. Based on available information, the Crysler-Finch esker was identified as a nearby potential aquifer. However, given the lack of available information on the characteristics of the aquifer, including the depth, extent, water quantity, and quality, intrusive studies would be required to confirm the overall feasibility to supply Casselman's water demand. Additionally, the timeline for the completion of a preliminary hydrogeological assessment of the Crysler-Finch is expected to be a multi-year process to allow for test well siting and drilling, hydraulic testing, preliminary wellhead delineation studies, and regulatory approval.

This report has been prepared by J.L. Richards & Associates Limited for Casselman's exclusive use. Its discussions and conclusions are summary in nature and cannot properly be used, interpreted or extended to other purposes without a detailed understanding and discussions with the client as to its mandated purpose, scope and limitations. This report is based on information, drawings, data, or reports provided by the named client, its agents, and certain other suppliers or third parties, as applicable, and relies upon the accuracy and completeness of such information. Any inaccuracy or omissions in information provided, or changes to applications, designs, or materials may have a significant impact on the accuracy, reliability, findings, or conclusions of this report.

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Figures

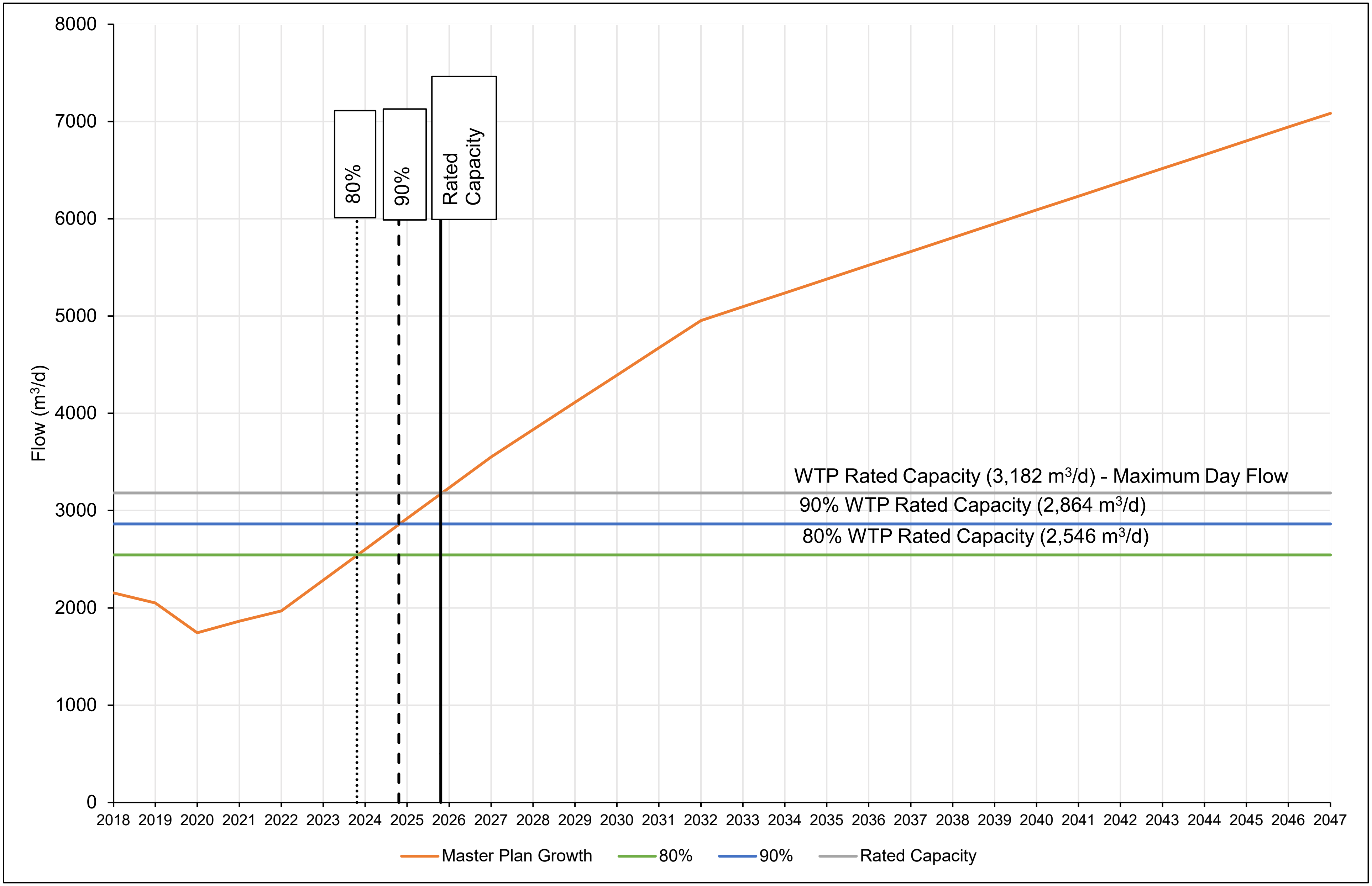

FIGURE 1: CASSELMAN WTP FLOW PROJECTION

Appendix A

GEMTEC Surface Water Feasibility Assessment

GEMTEC

www.gemtec.ca

Water Supply Desktop Feasibility Assessment
South Nation River Surface Water Supply

Casselman, ON

GEMTEC Project: 100117.050

experience • knowledge • integrity   expérience • connaissance • intégrité

GEMTEC
www.gemtec.ca

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Water Supply Desktop Feasibility Assessment
South Nation River Surface Water Supply
Casselman, ON

January 22, 2024
GEMTEC Project: 100117.050

experience • knowledge • integrity

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South Nation River Surface Water Supply
Casselman, Ontario

Please find enclosed the report prepared by GEMTEC Consulting Engineers and Scientist Limited summarizing the desktop feasibility study of the capacity of the South Nation River to satisfy current and future water demands for the Municipality of Casselman. The report was prepared in general accordance with GEMTEC proposal P100117.050 (Rev 0) dated July 18, 2023. If you have any questions or would like to discuss the findings, please contact GEMTEC at your convenience.

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1.0 INTRODUCTION

GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) was retained by J. L. Richards and Associates Limited (JLR) to review the feasibility of a surface water or groundwater supply to service future water demands for the Municipality of Casselman (Casselman). The review was based on desktop information sources and will be included in a Class Environmental Assessment of water supply options.

Casselman has identified water quantity and quality issues related to their current municipal surface water supply that withdraws from the South Nation River. Casselman is anticipating significant expansion of the resident population over the next 25 years and needs to ensure water demands can be sustainably met. As such, GEMTEC has been tasked with assessing the future viability of the South Nation River (this report) and the potential for a practical groundwater supply (companion report).

1.1 Municipality of Casselman

Casselman is one of eight local municipalities within the United Counties of Prescott and Russell. Casselman is located at exit 66 along the Trans-Canada Highway / Ontario Highway 417, approximately 50 km east of Ottawa, Ontario. Casselman covers an approximate 5.25 km^2 area of urban settlement that predominantly consists of low-density residential and vacant land uses (JLR, 2023). A study performed in 2023 by Watson & Associates Economists Ltd reported a population of 4,048 people serviced by municipal water and wastewater services (JLR, 2023).

1.2 Casselman Municipal Water System

Casselman is serviced by a municipal water system consisting of a water treatment plant with a rated capacity of 3,182 m^3/day, an elevated water storage tank, and over 22 km of watermains (JLR, 2023). The water treatment plant is located at 832 Laval Street in Casselman on the banks of its source water supply, the South Nation River. The water treatment plant is owned by Casselman and operated by the Ontario Clean Water Agency, a crown agency of the Government of Ontario, under the Ministry of the Environment, Conservation and Parks (MECP) Drinking Water Works Permit Number 173-201.

Water is drawn to the water treatment plant located on the southeast bank of the river through an intake located in the middle of the river at a depth of approximately 7 m. Flow depth is maintained in the river by backwater effects of a weir located approximately 900 m downstream of the intake, See Figure 1.1. The weir was constructed in 1958 and subsequently raised by 0.6 m in 1996 to increase upstream water storage. The South Nation River bathymetry and average volume of water impounded upstream the weir were not available for review during this study.

Significant population and infrastructural growth are planned for Casselman over the next 25 years, requiring a proportional increase in the capacity of the municipal drinking water system. As a result of growth, the future water demand of Casselman is projected to exceed the rated capacity of the current water supply system by the end of 2025. Based on historical water quality and quantity observations of the South Nation River, it is not clear the existing source water or water treatment plant will be able to independently accommodate the future needs of the growing population.

Figure 1.1 Casselman Water Treatment Plant Location

2.0 PREVIOUS STUDIES

A number of past studies have discussed the hydrology of the South Nation River in terms of watershed characterization, regional water budget, and water quality and availability. The Raisin Region and South Nation Conservation Authorities have led a number of source water characterization and protection studies for watersheds and water supplies (both surface water and groundwater) within their jurisdictions. These studies do not directly address the capacity of the South Nation River to satisfy future water demands at Casselman, however they inform an understanding of the state of the river, while providing supplementary data for this study. Studies reviewed and referenced during this project include but are not limited to those noted below.

- Eastern Ontario Water Resources Management Study, CH2M Hill Canada Limited, 2001

  - This study characterized regional water resources in Eastern Ontario, considering surface water, groundwater, regional water budgets, watershed land uses and servicing infrastructure to develop an Eastern Ontario Water Resources Management Strategy. Statistical analysis of average annual streamflow, low flow and flood flow periods was performed for many of the hydrometric stations within the South Nation River watershed using data collected up to 1998. While the analyses are informative and indicative of surface water availability, the flow data is not up-to-date and some stations evaluated during the study have now been inactive too long to be representative of current conditions.

- Raisin Region Conservation Authority and South Nation Conservation, Water Budget Conceptual Understanding, Version 1.1.0, October 2009

  - This was a study of water budgets within the Raisin and South Nation regions as a requirement of the source water protection program. The conceptual understanding of water budget is a foundation of more detailed Tier 1, 2 or 3 detailed modelling to understand the quantity of water available in the groundwater and surface water regimes. Relevant data within this study included flow analyses for the South Nation River at Plantagenet and Bear Brook at Bourget, which were reanalyzed with more recent data for the Casselman water availability assessment.

- Raisin-South Nation Source Protection Region Tier 1 Water Budget and Water Quantity Stress Assessment, Intera Engineering Ltd., May 13, 2010.

  - This water quantity stress assessment was completed to identify subwatersheds that exhibit surface water or groundwater quantity stresses within the Raisin River and South Nation River watersheds. Water budgets, water takings and municipal demands were evaluated for 67 subwatersheds with annual and monthly surface and groundwater stress ratings developed for each. This assessment indicated low surface water stress ratings for the South Nation River at, and upstream of Casselman, with only the subcatchment near Winchester (a community with a municipal groundwater system) noted to have a moderate surface water stress level. This is an indicator surface water supply takings at Casselman were not at risk for the municipal demand at the time of the study.

- Bush, E. and Lemmen, D.S., editors (2019): Canada's Changing Climate Report; Government of Canada, 2009

  - This study of changing climate conditions in Canada developed a number of findings related to water balance and availability. The primary findings related to future water availability at Casselman include the following:

    - Canada is projected to warm in all seasons with drought risk expected to increase in many regions. In summer, higher temperatures cause increased evapotranspiration and drying of soils. Therefore, as temperatures rise, the threat of drought will increase across many regions of Canada.

    - Precipitation has increased in many parts of Canada, and there has been a shift toward less snowfall and more rainfall. Annual and winter precipitation is projected to increase everywhere in Canada over the 21st century. However, reductions in summer rainfall are projected for parts of southern Canada toward the late century. This could have a negative impact on the typical low flow periods (August – October) of the South Nation River.

    - Warmer summers will increase evaporation of surface water and contribute to reduced summer water availability in the future despite more precipitation in some places.

    - Extreme hot temperatures will become more frequent and more intense. This will increase the severity of heatwaves and contribute to increased drought.

  - Although the study findings are not site-specific to the South Nation River watershed, the potential for more prolonged and severe low flow periods should be considered in the assessment of surface water availability at Casselman.

3.0 SOUTH NATION RIVER HYDROLOGY

3.1 South Nation River Watershed

The South Nation River watershed covers over 3,800 km^2 with a length of approximately 175 km at its confluence with the Ottawa River, northwest of Plantagenet. South Nation Conservation describes the river as having the five primary subwatersheds shown on Figure 3.1. The Upper and Middle South Nation River subwatersheds as well as Castor River provide streamflow to the South Nation River at Casselman, thus contributing to the municipal water supply. Bear Brook and the Lower South Nation River subwatersheds contribute additional streamflow downstream of Casselman.

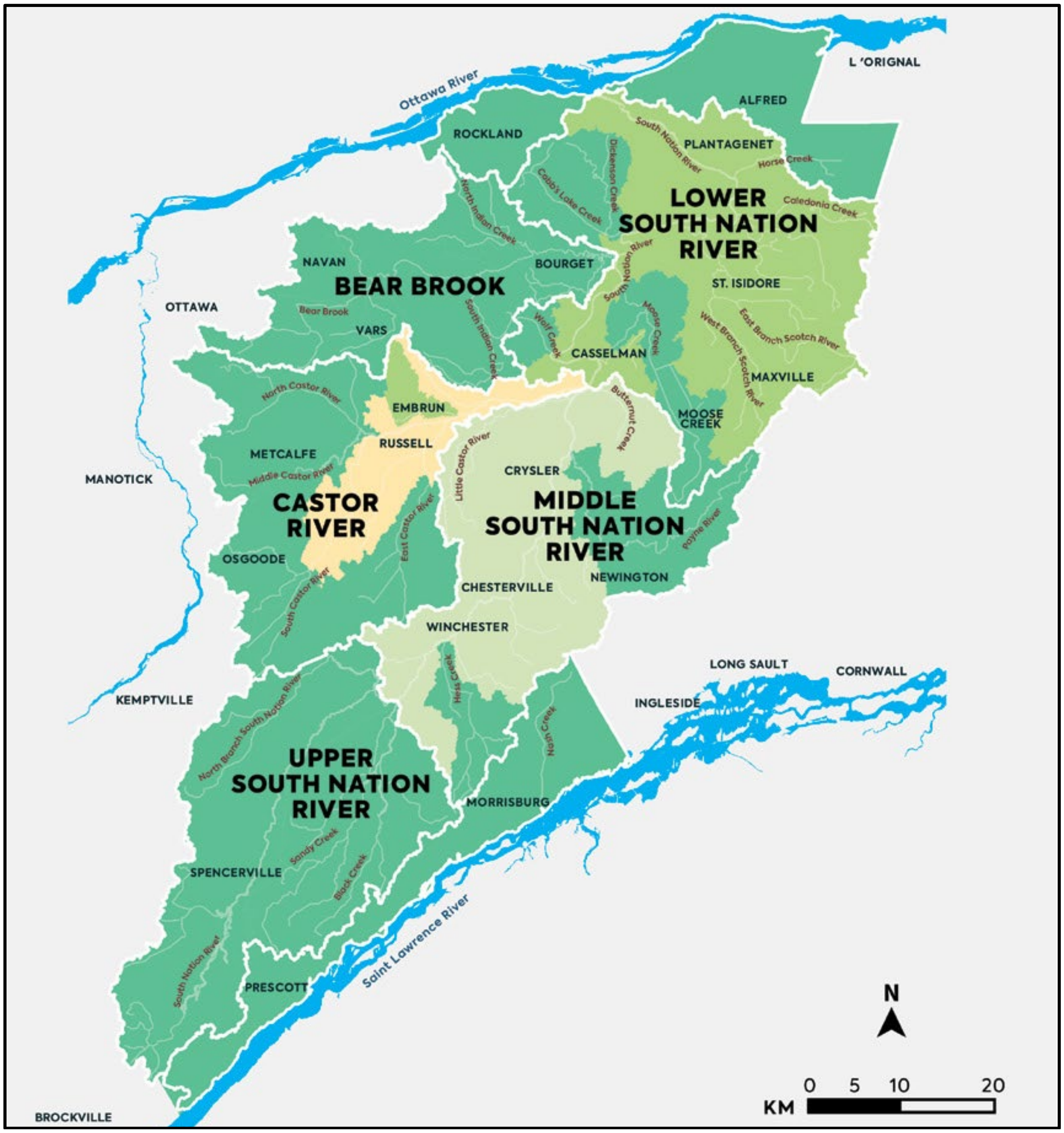

Figure 3.1 South Nation River Subwatersheds

* SNC State of the Nation Watershed Report Card 2023

Figure 3.2 presents watershed delineations for the South Nation River as a whole (yellow line) and at Casselman (white bisecting line).

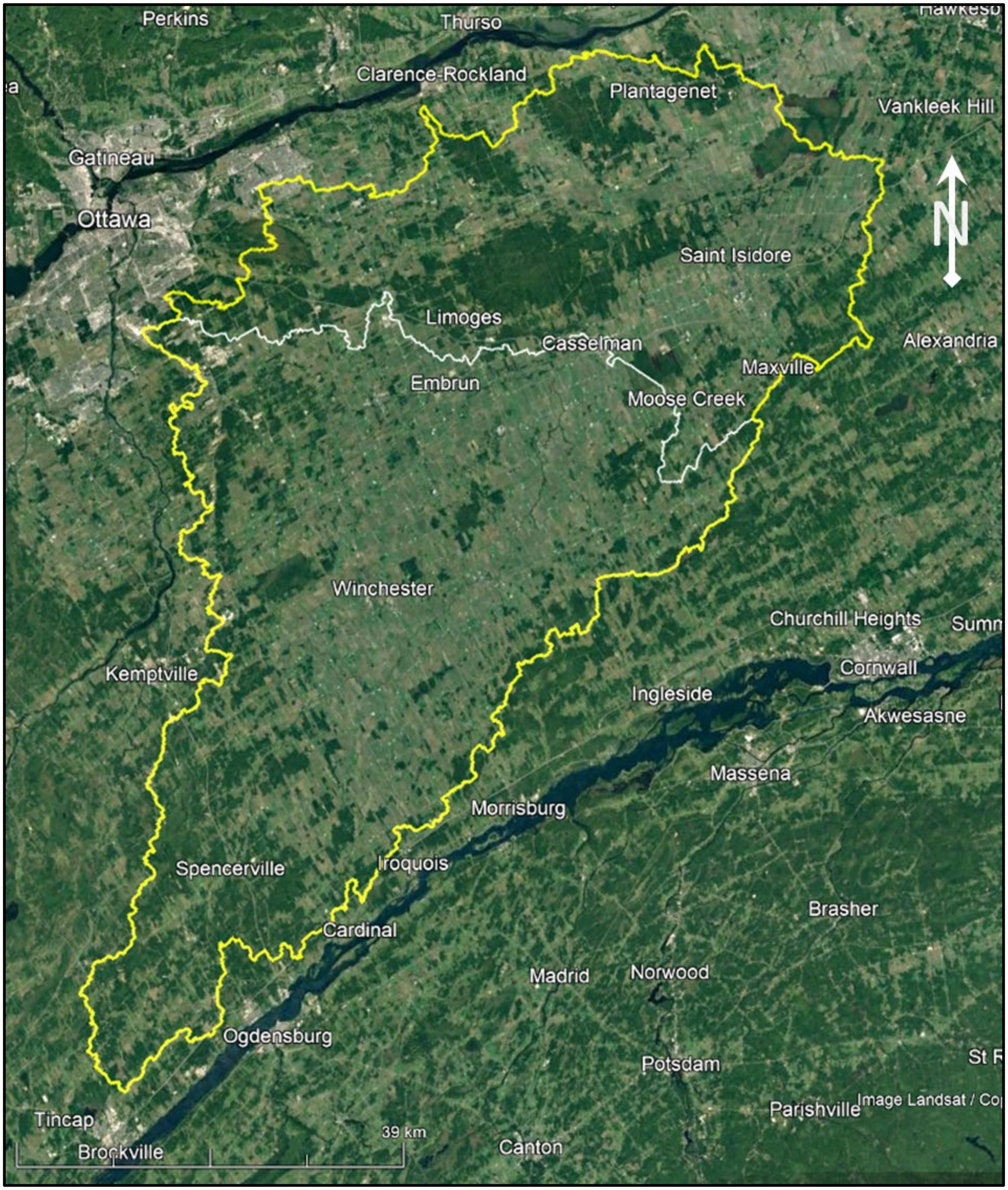

Figure 3.2 South Nation River Watersheds at Casselman and the Ottawa River

3.1.1 Water Survey of Canada Hydrometric Stations

The Water Survey of Canada (WSC) is a branch of Environment Canada responsible for the collection and reporting of standardized water resource data related to water level, water quantity, sediment transport and aquatic quality. WSC currently operates 11 active hydrometric stations (8 upstream of and including Casselman) and had 10 currently inactive hydrometric stations (2 upstream of Casselman) within the South Nation River watershed. Statistical analysis was conducted on a number of these stations to assess the capacity of streamflow to reliably satisfy future water demands at Casselman. Locations of these stations are presented in Figure 3.3, while they are summarized in Tables 3.1 and 3.2 and discussed in detail in the following sections.

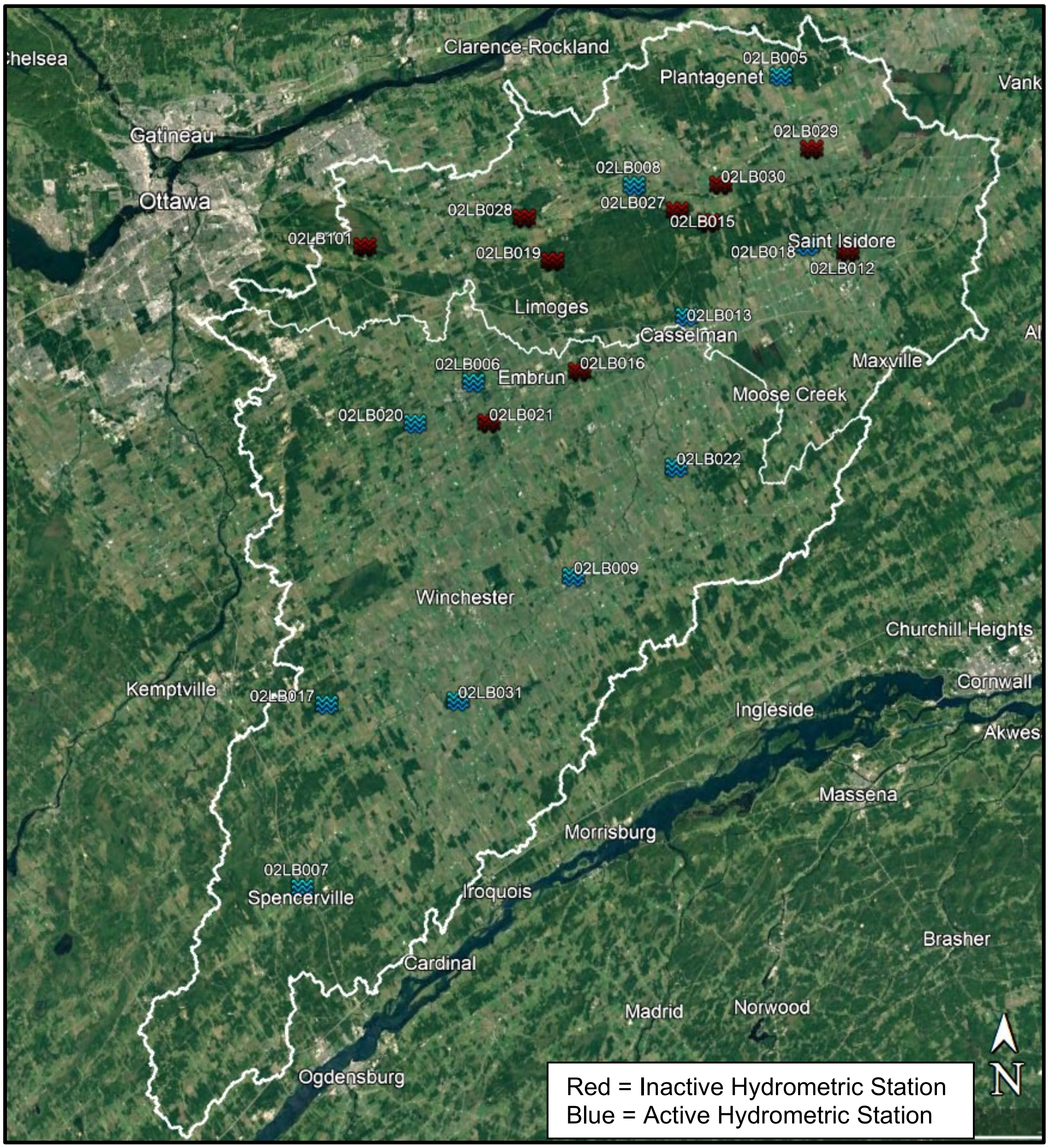

Figure 3.3 Hydrometric Stations within the South Nation River Watershed

Table 3.1 – Active Hydrometric Stations within the South Nation River Watershed

Hydrometric Station Number	Hydrometric Station Name	Drainage Area (km^2)	Periods of Record	Notes	Used in Analysis (Y/N)
02LB005	South Nation River at Plantagenet Springs	3,810	1905; 1908-1909; 1911-1912; 1915-2022	Continuous flow data from 1949-2022, most representative of watershed flows	Y
02LB006	Castor River at Russell	439	1948-2022	Tributary river upstream of Casselman	Y
02LB007	South Nation River at Spencerville	246	1948-2022	Headwaters upstream of Casselman	N
02LB008	Bear Brook near Bourget	448	1949-1953; 1955-1969; 1976-2022	Continuous flow data from 1976 to present; Downstream of Casselman, so only used to verify trends	Y
02LB009	South Nation River at Chesterville	1,050	1949-1952; 1955-1982; 1984; 1987-1990; 1993-2022	Continuous flow data from 1972-74; seasonal to 1984, level data thereafter	N
02LB013	South Nation River at Casselman	2,410	1972-2022	Seasonal flow data, not representative of critical low flow period	Y
02LB017	N. Branch South Nation River near Heckston	n/a	1977-2022	Level measurements only post-2005	N
02LB018	West Branch Scotch River near St. Isidore de Prescott	105	1949-1952; 1955-1982; 1984; 1987-1990; 1993-2022	Seasonal, no flow data post-2008	N
02LB020	South Castor River at Kenmore	185	1978-1997; 2003-2022	Upstream of and included in 02LB006	N
02LB022	Payne River near Berwick	146	1976-1997; 2003-2022	Smaller tributary river upstream of Casselman	N
02LB031	South Nation River near Winchester Springs	311	1998-2022	Only level measurements post-2005	N

Table 3.1 – Inactive Hydrometric Stations within the South Nation River Watershed

Hydrometric Station Number	Name	Drainage Area (km²)	Periods of Record	Notes	Used in Analysis (Y/N)
02LB008	Bear Brook at Carlsbad Springs	65	1976-1978	Small catchment area; outdated period of record	N
02LB012	East Branch Scotch River near St. Isidore de Prescott	76.7	1979-1994	Seasonal, outdated period of record	N
02LB019	South Indian Creek near Limoges	72.3	1978-1983	Small catchment area; outdated period of record	N
02LB020	Little Castor River near Embrun	76.1	1978-1983	Small catchment area; outdated period of record	N
02LB021	East Castor River near Russell	145	1979-1983	Small catchment area; outdated period of record	N
02LB028	Black Creek near Bourget	17.7	1991-1994	Small catchment area; outdated period of record	N
02LB028	Bear Brook above Bourget	168	1993-1994	Seasonal water levels	N
02LB029	South Nation River at Sequin Bridge	n/a	1993-1994	Seasonal water levels	N
02LB030	South Nation River at Pendelton Bridge	n/a	1993-1995	Seasonal water levels	N
02LB031	South Nation River At Lemieux	n/a	1977-1994	Seasonal water levels	N

3.1.1.1 South Nation River at Casselman (02LB013, 2,410 km², 1972-2022)

The active hydrometric station at Casselman currently operates seasonally between March and June and collects both water level and flow data. The monitoring period corresponds to the spring freshet window, when the highest flows of the year typically occur. As such, this station is not representative of the full range of annual flow, nor the critical low flow periods. Continuous daily flow data was previously collected between 1975 to 1986, however this data needs to be interpreted carefully due to changes in meteorological conditions and level of development over the past 40 years.

Flow data for this station was reviewed along with that of others to compare hydrologic trends and evaluate the use of data prorated from other hydrometric stations within the South Nation River watershed to estimate the current streamflow distribution at Casselman.

3.1.1.2 South Nation River at Plantgenet Springs (02LB005, 1,050 km^2, 1915-2022)

The active hydrometric station at Plantgenet Springs operates year-round and collects both water level and flow data. Continuous flow data has been collected from 1915 to 1933 and 1949 to present day, with periods of seasonal measurements during other years of operation. Data from this hydrometric station is the most complete representation of daily flow variability within the South Nation River watershed. Pro-rated flow data for this station was compared to operational periods of the station at Casselman to establish it as an acceptable representation of flow trends at Casselman. This is one of four (4) primary hydrometric stations within the watershed used to analyse water availability at Casselman.

3.1.1.3 Castor River at Russell (02LB006, 448 km^2, 1948-2022)

Castor River is a significant tributary of the South Nation River and discharges approximately 1.5 km upstream of the Casselman Water Treatment Plant. The active hydrometric station at Russell currently operates year-round and collects both water level and flow data. Continuous flow data has been collected between since 1968, with a non-operational period between June 2006 and May 2008. Pro-rated flow data for this station was compared to the operational periods of the station at Casselman to establish that it is an acceptable representation of flow trends at Casselman. This is one of four (4) primary hydrometric stations within the watershed used to analyse water availability at Casselman.

3.1.1.4 Bear Brook at Bourget (02LB008, 439 km^2, 1949-2022)

Bear Brook is a significant tributary of the South Nation River and discharges downstream of Casselman near Ettyville. The active hydrometric station at Bourget operates year-round and collects both water level and flow data. Continuous flow data has been collected between since 1976, with a few periods of missing data when the station was non-operational. Pro-rated flow data for this station was compared to the operational periods of the station at Casselman to establish that it is an acceptable representation of flow trends at Casselman. This is one of four (4) primary hydrometric stations within the watershed used to analyse water availability at Casselman.

3.1.1.5 South Nation River at Chesterville (02LB007, 246 km^2, 1946-2022)

The active hydrometric station at Chesterville operates year-round and has collected continuous flow data since 1946. Environment Canada notes that flow measured at this station represents highly regulated discharge due to the presence of an upstream dam. This results in extreme low flow periods not reflected in the downstream hydrometric stations, suggesting data from this station (which represents 10% of the catchment at Casselman) may not be reflective of South Nation River flow trends at Casselman. Data from this station was not used in the analysis.

3.1.1.6 Other Active Stations within the South Nation River Watershed

A number of other active hydrometric stations collect flow and level data within the South Nation River Watershed. These tend to be smaller subwatersheds, often collecting seasonal data, and do not accurately reflect expected flow trends at Casselman. These stations were noted in Table 3.2, but have not been included in the water availability analysis.

3.1.1.7 Inactive Stations within the South Nation River Watershed

Inactive hydrometric stations can be valuable sources of information if the period of record is sufficient long and recent. The 10 inactive stations within the South Nation River Watershed have relatively short periods of record and have been inactive since 1995 (or earlier). As such, flow data for these stations is considered less reflective of current hydrologic conditions and development within the watershed and has not been included in the water availability analysis.

4.0 PROJECTED WATER DEMANDS

Historical and projected future water demands for Casselman were derived by JLR and presented in the Phase 1 Report (Final) Casselman Water and Wastewater Infrastructure Master Plan (September 25, 2023). Daily treated flow data from the WTP from 2018-2022 was used to determine current water demands, while population projections were used to estimate future demands for short, mid and long-term horizons. These projected water demands are presented below in Table 4.1 in terms of daily volume (m^3/day) and flow rate (m^3/s) to facilitate comparison to streamflow rates, and in Figure 4.1.

Table 4.1 – Casselman Water Demands

Demand Scenario	Water Demand (m^3/day, [m^3/s])			
	Current (2018-2022)	Short-Term (2023-2027)	Mid-Term (2028-2032)	Long-Term (2033-2047)
Serviced Population	4,048	6,357	8,120	8,902
Average Day	1,031 [0.012]	1,850 [0.021]	2,580 [0.030]	3,690 [0.043]
Maximum Day	1,968 [0.023]	3,552 [0.041]	4,954 [0.057]	7,085 [0.082]
Peak Hour	2,953 [0.034]	5,328 [0.062]	7,430 [0.086]	10,627 [0.123]

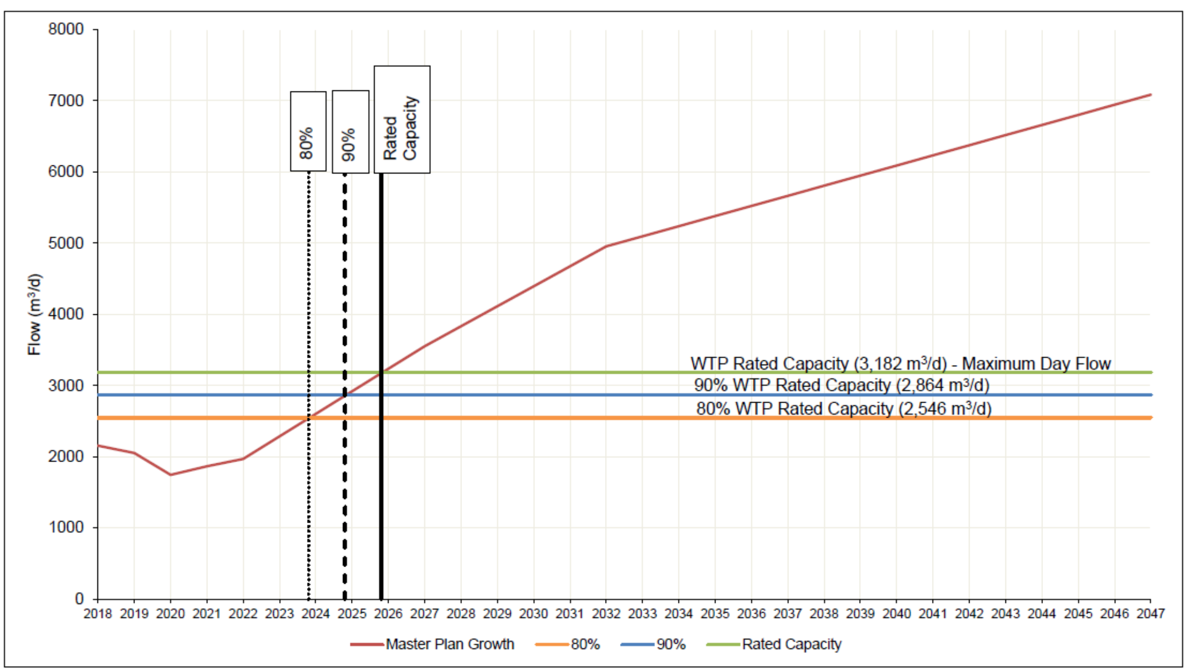

Figure 4.1 Casselman Current and Projected Water Demands
* From JLR Phase 1 Report (Final) Casselman Water and Wastewater Infrastructure Master Plan

5.0 WATER AVAILABILITY ANALYSIS

South Nation River streamflow is the primary factor in determining surface water availability, however the volume of water impounded upstream of the Casselman Weir could be critical during low flow conditions. The following sections provide comparisons of streamflow and water demand during varied hydrologic conditions, with consideration of potential river level drawdown when demand exceeds streamflow.

The Environment Canada hydrometric station at Casselman (02LB013) currently collects seasonal flow data between March 1 and June 30 which typically represents the spring freshet and high flow conditions. Continuous (annual) historical flow was previously collected at this station between 1975 and 1986, and may not be fully reflective of present day low flow hydrology. This gap in current low flow hydrologic data is addressed by data prorated from other hydrometric stations within the South Nation River watershed.

5.1 Historical Extreme Flow Measurements at Casselman

Historical extreme flows and water level measurements for the South Nation River at Casselman (02LB013) are presented in Appendix A. These represent the highest and lowest daily measurements during each year with observations. During the first month of operation of the hydrometric station data recorder, daily flows were logged as 0.00 m^3/s between August 18 and August 25, 1975. These flows were less than those measured at all upstream hydrometric stations as well as downstream at Plantagenet, where the minimum daily flow during this period was 0.538 m^3/s. While the zero flow measurements can not be independently verified as correct, it is an indication of historical no-flow conditions for the South Nation River at Casselman. The next lowest daily flow measurement during the period of record for the hydrometric station was 0.079 m^3/s (6,826 m^3/day), a value that exceeds the future long-term average day water demand for Casselman (3,690 m^3/day).

5.2 Flow Frequency Analysis

5.2.1 Historical Flow Data at Casselman

The hydrometric station on the South Nation River at Casselman collected continuous daily flow data in 1974 (manual gauge readings), and from mid-1975 to 1986 (recorder readings). After this period, the station switched to seasonal operation. A flow frequency curve was developed for the continuous monitoring period to estimate historical annual streamflow variability at Casselman. The historical flow frequency curve includes only years with full annual records (January to December, 1976-1986) and is presented graphically in Appendix B and summarized in Table 5.1.

Exceedance probabilities presented in Table 5.1 represent the percentage of daily measurements greater than a given flow during the period of record (1976-1986). For example, the 50% exceedance flow represents the median flow, with 50% of recorded measurements being greater (and less) than 583,200 m^3/day. The 99% exceedance flow indicates only 1% of daily flow measurements were less that 21,514 m^3/day. Exceedance probabilities provide insight into the distribution of flow measurements that are not as well defined using average annual and monthly flow statistics.

As noted above, the lowest flow measurement during this period was 0.079 m^3/s (6,826 m^3/day), which exceeds the future long-term average day water demand for Casselman (3,690 m^3/day). Review of the historical flow frequency data also indicates the following:

- The historical median flow (50% exceedance probability) at Casselman 583,200 m^3/day greatly exceeds the future projected long-term average day water demand (3,690 m^3/day).
- The historical flow exceeded 99.9% of the time (10,109 m^3/day) is approximately 2.7 times that of the long-term average day water demand.
- Normal flow conditions for the South Nation River at Casselman indicate sufficient surface water availability, however further review of monthly and extreme event analysis is required.

Table 5.1 – Historical Flow Frequency at Casselman (02LB013, 1976-86)

Exceedance Probability (%)	Flow (m^3/s)	Flow (m^3/day)	Exceedance Probability (%)	Flow (m^3/s)	Flow (m^3/day)
0.5	467	40,348,800	60	4.06	350,784
1	333	28,771,200	70	2.39	206,496
5	126	10,886,400	80	1.10	95,040
10	73.6	6,359,040	90	0.692	59,789
20	34.8	3,006,720	95	0.538	46,483
25	25.0	2,160,000	99	0.249	21,514
30	19.2	1,658,880	99.5	0.192	16,589
40	11.5	993,600	99.8	0.157	13,565
50	6.75	583,200	99.9	0.117	10,109

5.3 Monthly Flow Analysis

Review of historical flow data at Casselman and throughout the South Nation River watershed indicates extreme low flows typically occur during the August to October window. Monthly flow analysis was performed using the historical flow data for Casselman as well other representative locations within the South Nation River watershed (South Nation River at Plantagenet Springs, Castor River at Russell and Bear Brook at Bourget). Tables presenting average monthly flows for each station are included in Appendix C.

Data in Table 5.2 show the lowest historic monthly average flow at Casselman was 0.25 m^3/s (21,600 m^3/day), greatly exceeding the 3,690 m^3/day future long-term average day water demand. This is an indication that historic normal monthly flow rates at Casselman were sufficient to satisfy current and future water demands.

Table 5.2 – Historical Monthly Average Flows at Casselman (02LB013, 1975-86)

Month	Minimum Monthly		Average Monthly		Maximum Monthly	
	(m^3/s)	(m^3/day)	(m^3/s)	(m^3/day)	(m^3/s)	(m^3/day)
January	0.97	83,808	11.96	1,033,344	49.50	4,276,800
February	0.83	71,712	23.36	2,018,304	135.00	11,664,000
March	27.40	2,367,360	96.88	8,370,432	185.00	15,984,000
April	21.00	1,814,400	106.60	9,210,240	253.00	21,859,200
May	4.21	363,744	27.98	417,472	95.40	8,242,560
June	0.76	65,664	6.44	556,416	27.90	2,410,560
July	0.51	44,064	3.40	293,760	17.00	1,468,800
August	0.68	58,752	5.13	443,232	28.30	2,445,120
September	0.25	21,600	8.17	705,888	39.50	3,412,800
October	0.57	49,248	18.18	570,752	59.70	5,158,080
November	1.10	95,040	24.49	115,936	48.10	4,155,840
December	1.99	171,936	25.85	233,440	56.30	4,864,320

It is noted that the period of record for the Casselman hydrometric station span from 1975-1986 and may not be fully representative of current hydrologic conditions. As such, monthly flow trends were reviewed for the downstream hydrometric station at Plantagenet Springs (02LB005) to see if a discernable (increasing/decreasing) monthly flow trend occurred from 1976 to 2022 (47 years of data). During the overlapping period of record, flow measured at Casselman and prorated from Plantagenet Springs exhibited a strong correlation, suggesting this to be an acceptable indicator of flow trends at Casselman.

Curve fitting of the data from Plantagenet Springs showed a very slight increase in annual average flow and monthly August flow, with slight decreases in the monthly flow for September and October. R-squared values of 0.004 to 0.04 (very weak),however, suggest monthly flow variability from year to year does not exhibit a statistically significant increasing/decreasing trend.

The short period of record for the Casselman station is of greater concern than the year to year monthly flow variability. Proration and averaging of monthly flows for the South Nation River at Plantagenet Springs, Castor River at Russell (02LB006) and Bear Brook at Bourget (02LB008) provides a longer period of record to review monthly flow variability. This data is presented in Table 5.3 and indicates longer term minimum monthly flows within the South Nation River watershed are likely to be well in excess of the projected future municipal water demand.

Table 5.3 – Prorated Monthly Average Flows at Casselman (Based on Historical Data for 02LB005, 02LB006 and 02LB008)

Month	Minimum Monthly		Average Monthly		Maximum Monthly	
	(m^3/s)	(m^3/day)	(m^3/s)	(m^3/day)	(m^3/s)	(m^3/day)
January	0.94	80,823	20.78	1,795,000	90.35	7,806,485
February	1.02	88,107	20.30	1,753,996	163.98	14,168,213
March	6.99	604,041	81.18	7,013,691	218.18	18,850,984
April	22.29	1,926,235	119.04	10,284,816	299.16	25,847,204
May	5.64	487,247	28.60	2,470,971	105.40	9,106,956
June	1.58	136,471	14.50	1,252,596	66.98	5,787,340
July	0.58	50,047	8.26	713,466	79.30	6,851,543
August	0.50	43,071	5.52	476,641	44.19	3,818,027
September	0.49	42,719	5.94	513,202	55.45	4,790,644
October	0.85	73,073	14.04	1,213,440	68.42	5,911,393
November	1.72	148,237	25.45	2,199,080	93.43	8,072,702
December	1.93	166,655	27.87	2,407,617	72.61	6,273,384

5.4 Low Flow Frequency Analysis

Annual and monthly data for the South Nation River suggest adequate flow to satisfy current and future water demands. If supply concerns occur, they may be associated with shorter-duration low flow conditions. A low flow condition is defined as a period, ranging from one to several days, during which average streamflow is a minimum during the year or selected seasonal period. These periods of low flow are often critical to managing municipal surface water supplies.

A comprehensive statistical low flow frequency analysis of gauged watersheds in Ontario was completed by the National Research Council Canada in 2022. Low flow statistics were generated for all Ontario hydrometric stations that fulfilled screening requirements (i.e., minimum 10 years of continuous data). Although the South Nation River at Casselman did not satisfy screening requirements, estimates were generated for other representative hydrometric stations within the watershed. Drainage area-based prorations of the low flow projections for these stations (South Nation River at Plantagenet, Castor River at Russell and Bear Brook at Bourget) were averaged to generate 7-day, 15-day and 30-day duration low flow estimates for Casselman (see Tables 5.4 to 5.7). The non-prorated data for each of these sites is included in Appendix D.

Table 5.4 – Prorated 7-Day Low Flow Rate (m^3/s) for the South Nation River at Casselman

	Return Period (Years)							
	1.005	**2**	**5**	**10**	**20**	**50**	**100**	**200**
January	24.0	5.616	2.516	1.613	1.150	0.850	0.739	0.679
February	19.3	4.216	2.113	1.478	1.146	0.925	0.838	0.790
March	135.1	9.952	2.973	1.582	1.021	0.736	0.654	0.618
April	159.5	30.92	15.773	11.602	9.535	8.235	7.766	7.512
May	37.0	8.378	4.522	3.394	2.806	2.426	2.283	2.203
June	21.0	3.312	1.439	0.954	0.724	0.586	0.541	0.515
July	24.0	1.414	0.446	0.287	0.236	0.212	0.209	0.209
August	9.17	1.401	0.550	0.316	0.197	0.124	0.095	0.081
September	7.17	1.640	0.719	0.413	0.239	0.113	0.058	**0.026**
October	26.7	3.432	1.124	0.539	0.265	0.101	0.047	**0.020**
November	45.9	8.180	3.355	1.976	1.276	0.824	0.659	0.567
December	41.1	7.607	3.583	2.476	1.929	1.592	1.471	1.405
Annual	3.34	1.098	0.580	0.374	0.238	0.121	0.064	**0.025**

Table 5.5 – Prorated 7-Day Low Flow Volume (m^3/day) for South Nation River at Casselman

	Return Period (Years)							
	1.005	**2**	**5**	**10**	**20**	**50**	**100**	**200**
January	2,075,428	485,209	217,339	139,374	99,340	73,475	63,855	58,651
February	1,664,188	364,246	182,541	127,708	99,033	79,950	72,425	68,224
March	11,669,031	859,820	256,905	136,643	88,220	63,620	56,537	53,419
April	13,779,680	2,672,204	1,362,750	1,002,380	823,783	711,528	671,014	649,055
May	3,193,000	723,867	390,726	293,203	242,469	209,612	197,276	190,358
June	1,814,047	286,133	124,336	82,393	62,533	50,638	46,710	44,526
July	2,077,777	122,144	38,524	24,830	20,372	18,334	18,024	18,024
August	792,663	121,072	47,485	27,277	17,013	10,698	8,231	6,965
September	619,350	141,704	62,143	35,676	20,648	9,727	5,026	**2,209**
October	2,309,599	296,482	97,111	46,538	22,912	8,688	4,066	**1,720**
November	3,967,884	706,769	289,884	170,727	110,207	71,197	56,928	48,954
December	3,553,710	657,242	309,541	213,908	166,671	137,567	127,074	121,402
Annual	288,477	94,901	50,116	32,287	20,553	10,453	5,561	**2,188**

Table 5.6 – Prorated Extended Duration Low Flow Rates (m^3/s) for SNR at Casselman

	Return Period (Years)							
	1.005	**2**	**5**	**10**	**20**	**50**	**100**	**200**
15-Day Low Flow	3.915	1.273	0.672	0.429	0.272	0.139	0.074	**0.029**
30-Day Low Flow	5.189	1.334	0.714	0.454	0.276	0.154	0.092	0.045

Table 5.7 – Prorated Extended Duration Low Flow Volumes (m^3/day) for SNR at Casselman

	Return Period (Years)							
	1.005	**2**	**5**	**10**	**20**	**50**	**100**	**200**
15-Day Low Flow	338,283	109,989	58,053	37,094	23,515	12,009	6,360	**2,522**
30-Day Low Flow	448,302	115,277	61,726	39,254	23,879	13,338	7,987	3,916

Low flow rates and volumes presented in the above tables indicate the following:

- The current average day water demand (1,031 m^3/day) for Casselman is not expected to exceed the 7, 15 or 30-day low flow estimates for return periods up to 200 years. This suggests sufficient streamflow to satisfy current demands without the assistance of water impounded by the Casselman Weir.

- The short-term average day water demand (1,850 m^3/day) for Casselman exceeds the 200 year return period 7-day low flow estimate (1,720 m^3/day) for the month of October.

- The mid-term (2,580 m^3/day) and long-term (3,690 m^3/day) average day water demands exceed the 200 year return period 7-day low flow estimates for September (2,209 m^3/day) and October (1,720 m^3/day).

- The long-term (3,690 m^3/day) average day water demand exceeds the 200 year return period 15-day low flow estimate (2,522 m^3/day).

- Long-term maximum day (7,085 m^3/day) and peak hour water demands (10,627 m^3/day) are estimated to exceed 7-day low flow rates with return periods of 100 and 50 years, respectively. These demands also exceed the longer duration (15- and 30-day) 100 and 200 year return period low flow rates. As maximum day and peak hourly demands are short duration events, extraction of water impounded by the Casselman weir is expected to be sufficient to ensure municipal demands are satisfied during these conditions (see next section).

5.5 Potential River Level Drawdown During Low Flow Conditions

Low flow analysis indicates the average day water demand could exceed streamflow during short duration low flow periods with a 200 year return period. Water impounded by the Casselman Weir is intended to supplement streamflow if these conditions occur. Although the impounded water storage volume was not available for this study, the impacts of insufficient streamflow can be assessed in terms of potential river level drawdown. The following basic assumptions were made for these analyses.

- The extent of water impounded by the weir extends upstream past the Caselman Water Treatment Plant (WTP). This is supported by the water intake being located at a depth of approximately 7 m in the river.

- Although the extent of impoundment likely extends beyond the WTP, a conservative assumption is made to ignore the upstream storage volume.

- The river water surface area between the WTP and the weir is approximately 11 hectares (Figure 5.1). Although the surface area would decrease with lowering water levels, the impounded area upstream of the WTP would likely offset this loss if the drawdown is minor.

Figure 5.1 River Surface Area between the Casselman WTP and Weir

Many communities that rely of streamflow for their water supply employ dams to supplement water availability during low flow conditions. This not only provides water storage but also helps to manage water temperatures, protect submerged intake pipes and promote recreational use. It is therefore critical to understand the potential impacts of water level draw-down during low flow conditions. Table 5.6 summarizes the estimated river level drawdown associated with 200-year return period low flow conditions for each of the municipal water demand planning horizons.

Table 5.8 – Potential River Drawdown - Low Flow Conditions (200-Year Return Period)

	Current (2022)	Short-Term (2023-2027)	Mid-Term (2028-2032)	Long-Term (2033-2047)
Serviced Population	4,048	6,357	8,120	8,902
Average Day Demand (m^3/day)	1,139	1,850	2,580	3,690
7-day Low Flow Drawdown (2,209 m^3/day streamflow)	---	---	0.03 m	0.10 m
15-day Low Flow Drawdown (2,522 m^3/day streamflow)	---	---	0.01 m	0.16 m
30-day Low Flow Drawdown (3,916 m^3/day streamflow)	---	---	---	---

South Nation River level drawdown estimates for low flow conditions with a 1 in 200 year return period do not exceed 0.16 m. This is minor in comparison to the water intake submerged depth of 7 m and suggests storage upstream of the Casselman Weir is sufficient to offset low flow periods when demand exceeds streamflow.

6.0 DISCUSSION

Municipal surface water supplies often depend on a combination of streamflow and impounded water during peak demand and/or low flow conditions. The Municipality of Casselman is serviced by the South Nation River with a large watershed (2,410 km^2) that has provided a historical mean annual streamflow of 2,471,900 m^3/day (28.6 m^3/s). Average day water demand projections produced by JLR range from 1,096 m^3/day (current) to 3,690 m^3/day (long-term), suggesting the river to be a capable water supply. Review of annual and monthly flow frequency curves reveals there are prolonged periods when streamflow is significantly less than the annual mean streamflow but still greater than demand.

Historical monthly flow distributions and annual extreme minimum daily flow measurements for the South Nation River hydrometric station at Casselman show the lowest streamflow typically occurs during late summer to early fall (August to October). Although mean streamflow during these months greatly exceeds projected water demands, there are short duration periods when streamflow is not significantly larger than the municipal water demand. These short duration (7-day and 15-day) low flow periods when demand exceeds streamflow are rare (200 year return period) events, but it is still critical that municipal water demands be met. Not only must demands be satisfied, but water must also remain in the river to support aquatic life and other uses. Drawdown analyses associated with these low flow conditions indicate the water level decreases to be less than 0.2 m and unlikely to have significant adverse impacts (not addressed in this study).

There is a hydroelectric generating station with a bypass channel adjacent to the Casselman Weir. The location of the generating station is downstream of the water treatment plant and as such, does not impact streamflow at the intake. Operation of the generating station and its bypass channel and the impacts on impounded water levels have not been investigated as part of this surface water availability study.

The Casselman municipal water intake is not the only permitted water extraction user along the South Nation River. Hydrometric station flow data records the water remaining in the river after extraction, so no additional accounting has been made for these users (including the Casselman intake) in the streamflow analyses.

7.0 CONCLUSIONS

The following conclusions are based on the findings of this surface water assessment of the South Nation River's capacity to satisfy current and future water demands for the Municipality of Casselman.

1. Surface water is supplied to the Municipality of Casselman by the South Nation River. The river has a drainage area of 2,410 km^2 at Casselman with historical mean annual and median flow rates of 30.2 m^3/s (2,609,280 m^3/day) and 6.75 m^3/s (583,200 m^3/day), respectively.

2. Projected average day water demands for the Municipality of Casselman are expected to range from 1,031 m^3/day (current conditions) to 3,690 m^3/day (long-term, 2033-2047) and are well below mean and median South Nation River flow rates.

3. The lowest recorded flow rates in the South Nation River at Casselman were 0.00 m^3/s during the first month of operation of the hydrometric station data recorder (August 18-25, 1975). These flows were noted to be less than those measured at all upstream hydrometric station and not in agreement with flow measured downstream at Plantagenet Springs. The next lowest recorded single day flow was 0.079 m^3/s (6,826 m^3/day), which exceeds the projected long-term average day water demand (3,690 m^3/day).

4. The lowest average monthly flow recorded at the Casselman hydrometric station was 0.25 m^3/s (21,600 m^3/day, September 1983), indicating sufficient flow to meet water demands during the driest months.

5. Short duration low flow analysis indicates the potential for the short to long term municipal water demands to exceed streamflow during a 1 in 200 year return period, 7 day event. During this extreme event, water impounded by the Casselman Weir would be required to satisfy water demands. The estimated maximum river level drawdown associated with these extreme events is 0.16 m.

6. The South Nation River, with the water impounded by the Casselman Weir, is expected to be capable of satisfying projected long-term municipal water demands.

8.0 RECOMMENDATIONS

The following recommendation are based on findings of this study and are intended to further the understanding of the capacity of the South Nation River to satisfy current and future water demands for the Municipality of Casselman.

1. Request any water level and flow data collected by Hydro Ottawa at Casselman.

    - The flow data The hydroelectric station adjacent to the Casselman Weir Hydrometric likely collects continuous level and flow data for water passing through the weir bypass channel. Although this data may not include flow over the weir, it would be most representative of recent low flow conditions which are key to understanding surface water availability. Review of this data and comparison to historical data used in this feasibility assessment would strengthen understanding of South Nation River low flow hydrology at Casselman.

2. Investigate the bathymetry of the South Nation River and potential water storage volume upstream of the Casselman Weir.

    - Basic assumptions were made to estimate potential river level drawdown during extreme low flow conditions. A better understanding of the extent of water impounded by the Casselman Weir as well as the depth and configuration of channel ross-sections would help refine these estimates.

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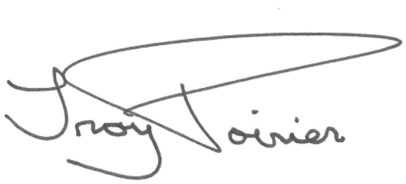
10.0 CLOSING

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.



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APPENDIX A

Historical Extreme Flow and Water Levels at Casselman Hydrometric Station 02LB013

Report to: J.L. Richards & Associates Limited
GEMTEC Project: 100117.050 (January 22, 2024)

Annual Extreme Daily Discharge and Water Level

South Nation River at Casselman - Hydrometric Station 02LB013 (Drainage Area 2,410 km^2)

Discharge Measurements

	Annual Maximum Daily		Annual Minimum Daily	
Year	**Date**	**Flow (m^3/s)**	**Date**	**Flow (m^3/s)**
1972				
1973				
1974	5-Apr		20-Sep	3.090
1975			18-Aug	0.000
1976	28-Mar	903	30-Aug	0.442
1977	14-Mar	680	17-Jun	0.408
1978	14-Apr	736	11-Oct	0.204
1979	25-Mar	536	23-Jul	0.159
1980	22-Mar	516	11-Aug	0.180
1981	21-Feb	499	1-Aug	1.010
1982	1-Apr	846	21-Aug	0.368
1983	20-Mar	263	16-Sep	0.079
1984	6-Apr	491	27-Jul	0.168
1985	14-Mar	392	26-Sep	0.234
1986	20-Mar	270	2-Mar	3.230
1987	26-Mar	567		
1988	27-Mar	272		
1989	29-Mar	430		
1990				
1991				
1992				
1993	10-Apr	581		
1994				
1995				
1996				
1997				
1998				
1999	1-Apr	533		
2000	9-Apr	403		
2001	10-Apr	616		
2002	1-Apr	303		
2003	26-Mar	382		
2004	27-Mar	342		
2005	3-Apr	607		
2006				
2007	17-Apr	333		
2008	10-Apr	591		
2009	30-Mar	242		
2010				
2011	18-Mar	420		
2012	9-Mar	381		
2013	1-Apr	361	6-Jun	5.530
2014	9-Apr	644		
2015	4-Apr	357		
2016	13-Mar	357		
2017	7-Apr	623		
2018				
2019	31-Mar	360		
2020	14-Mar	470		
2021	27-Mar	313		
2022	20-Mar	363		
Minimum			18-Aug	0.000
Maximum	28-Mar	903		

Level Measurements (Local Datum)

	Annual Maximum Daily		Annual Minimum Daily	
Year	**Date**	**Level (m)**	**Date**	**Level (m)**
1972	18-Apr	3.426	22-Jun	1.710
1973	19-Mar	3.633	1-Sep	1.789
1974				
1975				
1976				
1977				
1978				
1979				
1980				
1981				
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989				
1990				
1991				
1992				
1993				
1994				
1995				
1996				
1997				
1998	29-Mar	4.069	22-May	2.054
1999				
2000				
2001				
2002	1-Apr	3.354		
2003	26-Mar	3.513		
2004	27-Mar	3.434		
2005	3-Apr	3.893		
2006				
2007	17-Apr	3.428		
2008	10-Apr	3.868		
2009	30-Mar	3.233		
2010				
2011	18-Mar	3.583		
2012	9-Mar	3.515		
2013	1-Apr	3.479	16-May	2.273
2014	9-Apr	3.959		
2015	4-Apr	3.473		
2016	13-Mar	3.472		
2017	7-Apr	3.924		
2018				
2019	31-Mar	3.479	14-Jul	2.212
2020	14-Mar	3.685		
2021	27-Mar	3.365	8-Jun	2.257
2022	20-Mar	3.489		
Minimum			18-Aug	1.710
Maximum	28-Mar	4.069		

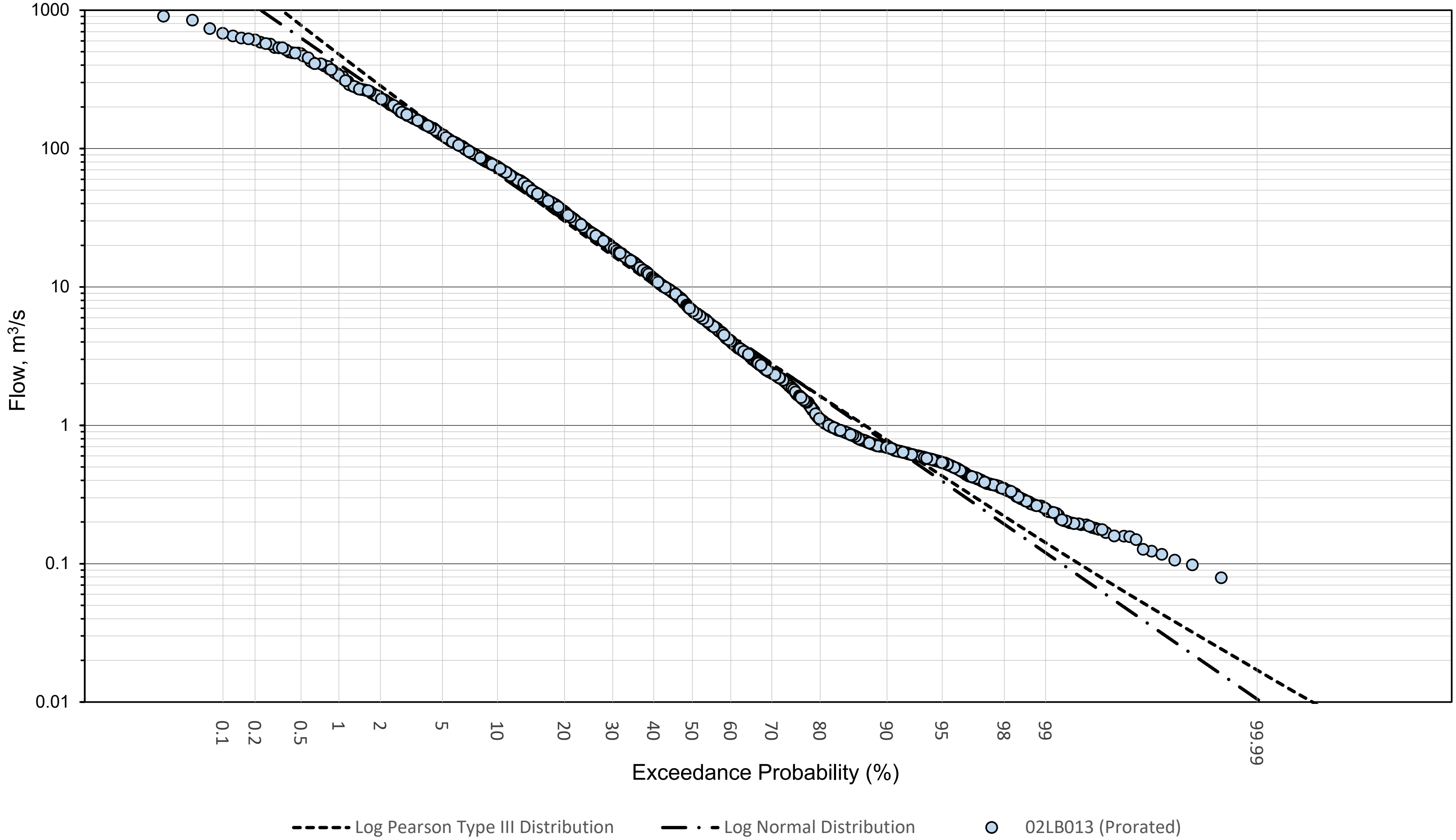
* Note: This hydrometric station currently operates seasonally (March 1 to June 30) and does not report discharges below 4.163 m^3/s.

APPENDIX B

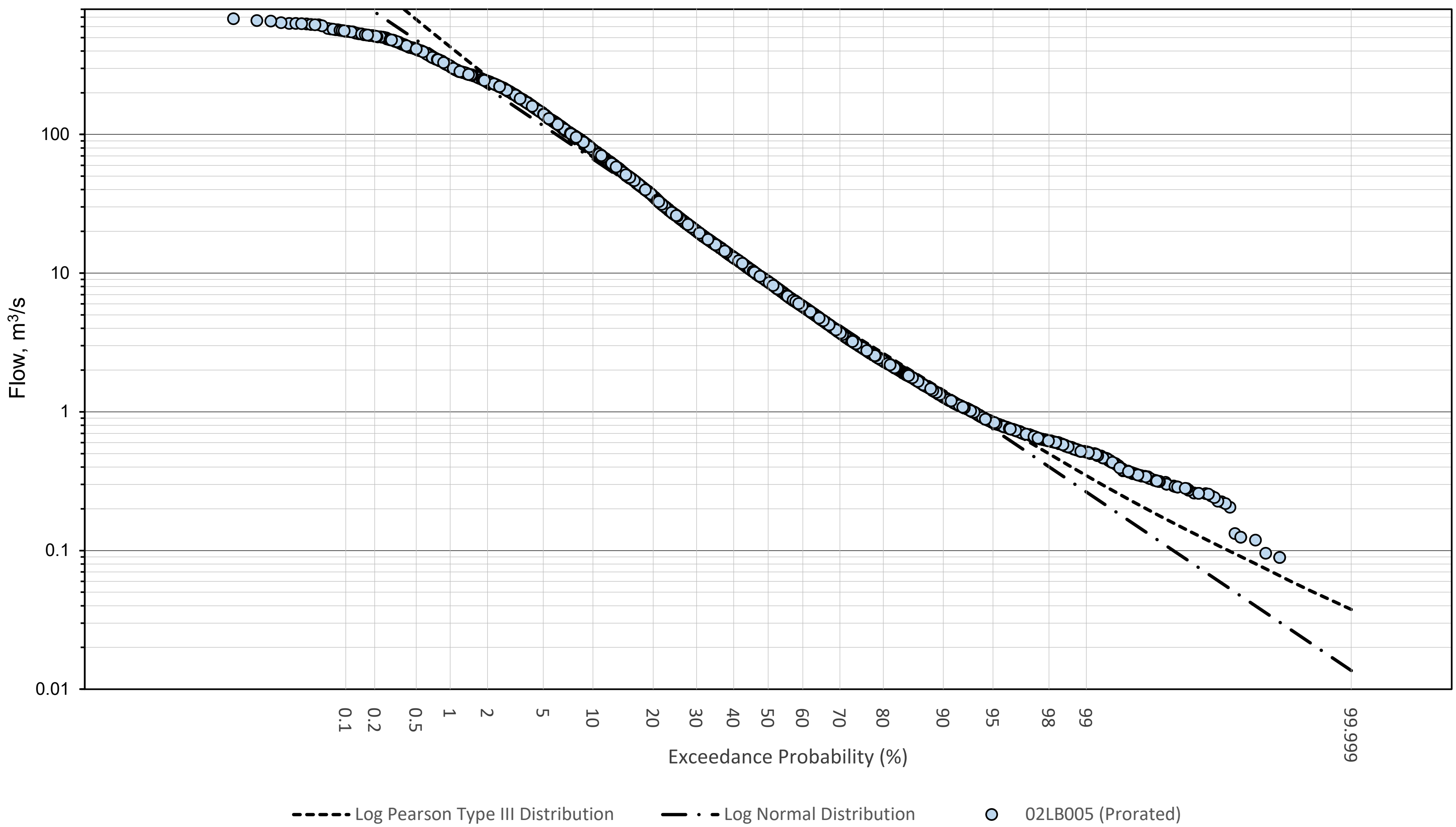
Flow Frequency Curves

Flow Frequency Analysis

SOUTH NATION RIVER AT CASSELMAN (02LB013) 1976 - 1986 Daily Records



SOUTH NATION RIVER AT CASSELMAN - FLOW FREQUENCY
PRORATED FROM SOUTH NATION RIVER NEAR PLANTAGENET SPRINGS (02LB005) 1963 - 2022



APPENDIX C

Monthly Average Flow Data

Monthly Mean Discharge

South Nation River at Casselman - Hydrometric Station 02LB013 (Drainage Area 2,410 km^2)

	Mean Monthly Discharge (m^3/s)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1975								0.68	6.57	22.10	33.40	39.20	
1976	4.36	18.30	185.00	86.80	39.60	3.71	2.54	3.25	2.42	17.70	13.20	3.43	31.80
1977	0.97	0.83	164.00	52.00	4.21	0.76	2.20	1.20	2.54	39.80	33.80	35.00	28.40
1978	49.50	21.60	31.80	253.00	11.20	1.92	0.64	0.70	0.45	0.57	1.25	1.99	31.00
1979	4.99	5.32	139.00	71.50	11.90	4.05	0.87	0.68	13.20	13.50	31.50	46.60	28.80
1980	12.40	1.24	93.20	77.20	17.70	1.72	0.69	0.75	2.91	14.70	32.10	31.00	23.90
1981	4.18	135.00	27.40	26.20	29.20	27.90	7.81	19.80	39.50	48.70	48.10	16.00	35.00
1982	9.36	2.51	57.70	154.00	9.47	5.16	1.67	2.39	2.84	3.56	22.20	53.30	27.00
1983	18.50	20.90	75.30	93.50	55.00	5.84	0.82	0.69	0.25	1.61	40.00	56.30	30.80
1984	10.90	62.90	42.20	165.00	31.90	5.44	0.51	2.40	1.04	0.69	1.68	6.20	27.20
1985	7.74	11.30	120.00	60.30	6.75	5.25	2.66	0.74	0.45	1.73	11.70	8.15	19.80
1986	18.90	4.39	72.50	36.60	24.90	9.06	17.00	28.30	25.90	59.70	37.00	34.80	31.00
1987	8.73	3.13	98.80								13.50		
1988	4.90	16.20	49.50	44.20	12.10					12.00	43.60	4.04	
1989				45.00							33.20		
1990				90.40							23.40		
1991											1.10		
1992													
1993				237.00							32.40		
1994				187.00							5.53		
1995											31.20		
1996				82.70									
1999													
2000													
2001													
2002													
2003													
2004													
2005				141.00									
2006													
2007				92.80									
2008				226.00									
2009				76.50									
2010			98.50	25.00									
2011			136.00										
2012			102.00										
2013				108.00									
2014				223.00									
2015				95.10									
2016			129.00										
2017			72.60	153.00	95.40								
2018			64.00	103.00									
2019				170.00	42.40								
2020			155.00	43.20									
2021				21.00									
2022			121.00	64.50									
Min	0.97	0.83	27.40	21.00	4.21	0.76	0.51	0.68	0.25	0.57	1.10	1.99	19.80
Mean	11.96	23.36	96.88	106.60	27.98	6.44	3.40	5.13	8.17	18.18	24.49	25.85	28.61
Max.	49.50	135.00	185.00	253.00	95.40	27.90	17.00	28.30	39.50	59.70	48.10	56.30	35.00

Monthly Mean Discharge

South Nation River at Plantagenet Springs - Hydrometric Station 02LB005 (Drainage Area 3,810 km^2)

	Mean Monthly Discharge (m^3/s)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Mean**
1949	17.10	8.67	124.00	214.00	16.20	3.91	1.62	1.65	2.58	3.11	4.05	45.60	36.90
1950	72.90	10.10	26.60	315.00	12.20	6.35	6.38	6.03	3.89	3.05	36.20	40.60	44.80
1951	47.90	24.80	193.00	322.00	15.80	5.39	24.20	4.67	6.47	4.32	31.50	36.60	59.70
1952	25.60	66.70	80.30	287.00	59.90	16.00	14.50	25.10	12.70	31.30	16.00	31.90	55.20
1953	17.80	29.30	194.00	75.40	37.80	6.35	3.61	3.77	2.12	1.98	0.71	4.46	31.60
1954	2.07	5.67	66.70	317.00	45.20	10.50	4.53	2.38	36.20	52.70	83.10	32.90	54.70
1955	20.50	4.37	94.60	319.00	8.52	1.60	0.57	1.21	1.01	10.00	7.37	1.90	39.00
1956	6.95	1.28	3.58	185.00	57.00	20.60	8.81	2.25	3.67	1.43	1.78	3.55	24.50
1957	10.80	9.89	83.10	48.80	15.10	8.18	10.90	1.15	0.86	1.32	5.20	24.40	18.40
1958	4.57	1.44	90.50	133.00	24.60	7.01	6.86	4.07	12.70	14.70	18.70	7.37	27.10
1959	3.78	5.96	22.30	174.00	7.08	2.60	2.16	2.32	3.49	8.85	18.90	42.00	24.40
1960	2.41	9.06	22.00	403.00	28.60	27.10	5.30	1.18	0.91	1.30	3.08	1.91	41.60
1961	1.40	2.02	66.70	123.00	25.90	18.00	15.70	10.50	4.93	2.08	4.21	13.80	24.10
1962	3.16	2.14	50.10	255.00	30.90	2.67	2.56	2.06	1.58	6.78	36.00	12.60	33.60
1963	3.80	2.81	23.50	209.00	51.20	7.25	2.00	2.01	12.40	3.74	32.10	19.00	30.50
1964	12.20	7.74	92.50	91.20	9.87	3.26	1.79	0.67	0.64	0.71	1.33	15.10	19.80
1965	4.08	5.55	60.60	80.50	11.10	1.76	0.89	2.16	7.40	24.50	61.60	44.10	25.40
1966	31.40	9.74	190.00	61.50	13.90	6.31	1.51	1.65	1.17	1.10	7.90	33.70	30.20
1967	8.39	8.97	24.50	235.00	17.80	9.18	7.02	3.09	2.86	17.40	68.60	34.10	36.10
1968	5.23	11.50	183.00	106.00	11.40	10.50	26.60	3.03	3.32	2.74	22.30	38.10	35.40
1969	9.41	16.80	86.90	279.00	65.60	22.40	6.58	19.10	2.32	2.13	21.30	30.70	46.70
1970	4.10	11.00	24.20	325.00	33.20	3.97	4.52	1.86	2.77	8.07	45.00	27.30	40.60
1971	9.82	14.00	29.70	412.00	35.50	3.97	2.37	2.22	2.57	3.66	5.48	38.80	46.30
1972	9.33	6.70	10.20	376.00	54.10	51.90	98.40	45.30	4.12	61.20	93.30	36.50	70.30
1973	54.40	36.10	314.00	114.00	82.80	55.40	10.50	41.20	4.74	21.90	23.80	43.30	67.40
1974	42.20	39.10	150.00	263.00	112.00	18.10	4.40	5.09	1.95	2.14	21.30	32.00	57.60
1975	34.90	8.59	103.00	260.00	14.20	10.50	1.48	0.93	9.67	37.60	51.90	58.40	49.20
1976	5.83	25.10	236.00	236.00	72.60	13.40	8.25	6.40	7.31	35.00	29.10	9.44	57.10
1977	3.63	2.97	256.00	111.00	11.10	2.63	4.99	4.52	14.10	79.80	63.60	61.70	51.80
1978	92.40	34.40	44.90	429.00	22.50	5.70	1.61	1.41	1.18	1.68	3.32	3.68	53.00
1979	8.35	8.64	215.00	129.00	23.00	9.46	2.18	2.45	22.60	21.00	50.60	76.50	47.60
1980	23.20	2.69	141.00	122.00	34.30	3.91	2.80	2.61	7.09	23.00	34.70	48.00	37.20
1981	5.98	210.00	49.30	48.10	42.70	57.40	11.90	49.20	69.30	79.10	78.70	23.50	59.20
1982	14.00	5.65	77.40	267.00	16.20	8.95	2.99	4.28	4.93	6.03	34.20	84.80	43.80
1983	34.50	40.90	133.00	141.00	91.00	12.70	2.15	1.47	1.11	4.29	63.20	90.90	51.50
1984	14.30	90.50	63.40	274.00	44.50	10.20	1.96	4.55	1.53	2.28	6.59	15.70	43.50
1985	9.17	20.10	215.00	110.00	12.20	7.01	3.23	1.28	1.39	3.79	16.60	11.20	34.40
1986	28.10	7.95	118.00	64.90	51.40	13.90	18.60	31.50	38.30	84.60	53.20	55.80	47.60
1987	15.30	6.05	160.00	95.70	13.80	18.80	14.10	3.25	8.16	12.00	22.90	104.00	39.90
1988	13.20	33.10	87.50	92.60	28.40	4.36	5.89	2.86	2.30	23.20	79.90	12.60	32.00
1989	5.40	8.69	99.80	101.00	70.50	26.70	3.70	4.43	2.07	7.94	63.40	8.52	33.50
1990	39.80	60.80	152.00	158.00	41.50	8.10	8.21	6.01	2.80	54.00	44.20	100.00	56.20
1991	47.00	48.10	170.00	227.00	25.10	5.52	1.50	2.39	1.76	5.56	5.32	9.17	45.50
1992	6.31	3.69	79.30	238.00	22.10	7.68	14.00	8.30	7.18	8.66	56.20	19.90	39.10
1993	51.30	6.02	14.90	397.00	33.80	46.60	10.30	4.03	5.05	29.10	55.80	47.70	58.20
1994	6.70	17.60	47.10	320.00	38.90	37.70	26.20	10.10	3.99	4.05	18.00	27.20	46.20
1995	107.00	11.80	106.00	35.30	27.30	37.90	8.31	24.40	2.38	54.50	58.10	18.60	41.20
1996	124.00	117.00	87.90	149.00	73.20	11.90	10.50	16.60	9.38	36.50	71.00	90.00	66.10
1997	29.90	58.30	103.00	276.00	55.60	17.40	7.00	2.12	2.86	4.66	23.30	14.20	49.10
1998	42.00	14.30	229.00	161.00	12.50	21.60	22.70	17.20	14.70	18.50	18.40	28.50	50.30
1999	30.00	31.80	112.00	237.00	10.00	9.64	3.76	1.48	4.88	14.30	26.00	48.50	44.00
2000	29.80	28.50	137.00	216.00	125.00	44.90	21.70	9.02	7.62	4.04	21.60	25.70	55.80
2001	10.30	23.90	38.70	226.00	11.20	15.30	2.01	0.97	1.49	3.59	8.39	38.30	31.40
2002	19.70	29.20	95.10	143.00	65.10	108.00	9.41	1.28	0.79	2.36	14.40	8.51	41.20
2003	3.27	2.12	102.00	90.60	62.60	29.60	3.48	10.10	1.85	49.70	88.70	88.20	44.60
2004	25.20	2.92	157.00	111.00	39.70	14.00	7.73	11.10	52.30	6.02	39.80	65.30	44.40
2005	61.40	15.90	38.30	254.00	39.90	45.10	13.80	2.66	5.62	74.30	78.20	43.30	56.00
2006	58.90	47.30	111.00	90.80	83.40	23.20	17.40	18.20	9.34	81.20	99.90	105.00	62.30
2007		6.33	92.50	155.00	20.40	15.80	20.00	2.09	1.15	5.29	14.10	32.60	
2008	174.00	31.60	63.90	386.00	24.90	49.40	48.30	20.20	4.32	22.10	57.00	95.70	81.30
2009	32.80	54.60	152.00	128.00	46.70	10.30	35.20	16.90	3.67	29.40	36.00	53.00	49.80
2010	61.20	23.30	150.00	47.80	18.80	18.20	14.50	20.00	25.40	98.20	70.80	79.70	52.60
2011	24.40	20.30	222.00	180.00	83.60	14.60	3.52	6.42	10.70	16.60	10.60	52.70	54.10
2012	14.70	25.80	175.00	34.00	31.10	15.60	1.41	1.08	2.12	5.51	3.34	11.40	26.90
2013	36.70	35.80	72.40	223.00	28.20	82.20	32.10	5.99	25.70	19.70	45.70	17.50	51.80
2014	58.50	17.60	34.70	377.00	61.40	55.00	11.60	9.39	8.28	21.00	27.00	31.90	59.10
2015	10.00	2.99	11.50	175.00	18.60	43.80	23.70	12.90	15.90	33.50	39.90	50.50	36.40
2016	44.50	65.80	231.00	111.00	12.00	4.84	2.92	4.06	1.87	25.00	21.40	57.80	48.60
2017	60.80	74.40	141.00	288.00	156.00	39.30	126.00	33.00	15.50	32.50	144.00	32.10	95.00
2018	69.10	82.00	114.00	192.00	38.40	23.40	4.85	3.29	4.09	5.55	42.20	61.90	53.00
2019	15.50	12.30	134.00	353.00	72.00	20.80	6.06	1.87	1.85	9.26	60.80	28.30	59.50
2020	81.00	12.90	279.00	102.00	23.40	3.13	1.30	5.39	3.76	25.30	26.60	79.20	54.00
2021	17.90	3.90	197.00	43.70	31.60	5.31	14.10	2.16	4.18	26.30	47.60	60.80	38.30
2022	7.97	23.40	218.00	115.00	51.80	25.20	5.64	10.30	12.20	5.33	18.40	43.80	44.90
Min	1.40	1.28	3.58	34.00	7.08	1.60	0.57	0.67	0.64	0.71	0.71	1.90	18.40
Mean	29.33	25.26	113.16	195.20	39.43	19.55	12.15	8.35	8.18	20.88	36.70	39.51	45.75
Max.	174.00	210.00	314.00	429.00	156.00	108.00	126.00	49.20	69.30	98.20	144.00	105.00	95.00

Monthly Mean Discharge

Castor River at Russell - Hydrometric Station 02BL006 (Drainage Area 439 km^2)

	Mean Monthly Discharge (m^3/s)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Mean**
1968	0.84	0.69	23.00	9.70	1.98	1.48	3.25	0.31	1.26	0.60	2.53	3.11	4.08
1969	1.06	1.68	11.50	30.70	8.97	1.49	0.63	0.42	0.18	0.21	1.69	2.94	5.11
1970	0.19	0.54	1.07	39.90	4.41	0.39	0.30	0.19	0.37	1.49	5.14	3.10	4.72
1971	1.68	0.85	0.70	44.40	4.64	0.49	0.22	0.27	0.36	0.41	0.67	3.11	4.78
1972	1.30	0.70	2.23	52.90	5.50	5.32	14.00	6.33	0.51	5.70	10.00	4.07	9.00
1973	7.51	5.15	45.00	12.60	8.99	6.53	0.58	4.50	0.60	1.77	2.99	4.56	8.45
1974	4.40	4.44	13.80	28.10	10.90	1.54	0.56	0.60	0.27	0.29	1.23	2.65	5.72
1975	4.31	1.80	12.30	26.10	1.57	0.55	0.26	0.15	1.04	2.78	4.23	8.80	5.33
1976	1.11	2.64	31.20	19.40	6.97	2.45	1.45	0.69	0.98	2.92	2.78	1.03	6.15
1977	0.45	0.39	31.00	11.80	1.82	0.43	0.68	0.37	0.85	7.34	6.37	6.86	5.75
1978	8.22	3.27	5.90	46.90	3.19	1.53	0.36	0.31	0.29	0.31	0.53	0.56	5.90
1979	0.49	0.41	23.10	12.80	2.51	1.14	0.43	0.34	0.81	1.57	5.23	9.97	4.94
1980	2.17	0.32	15.60	14.70	3.73	0.60	0.36	0.36	0.97	2.83	3.90	3.63	4.11
1981	0.72	26.20	5.42	5.35	5.95	8.20	1.94	4.55	13.50	9.48	7.97	2.21	7.46
1982	1.49	0.73	5.54	31.30	1.84	0.83	0.46	0.51	0.65	0.80	3.05	11.60	4.88
1983	3.88	3.89	16.70	16.90	11.30	1.96	0.36	0.20	0.16	0.97	9.08	8.86	6.20
1984	1.61	8.52	7.71	34.00	7.49	1.43	0.40	0.99	0.44	0.37	0.83	2.57	5.48
1985	1.74	3.69	24.20	13.50	2.01	1.01	0.30	0.27	0.19	0.44	1.04	1.11	4.13
1986	1.88	0.76	11.20	6.98	8.04	2.08	2.54	2.75	6.73	10.30	5.86	6.21	5.48
1987	1.55	0.74	19.70	11.00	1.76	1.59	1.87	0.47	1.50	1.82	3.63	11.20	4.77
1988	2.17	5.39	10.70	10.50	2.96	0.67	0.68	0.23	0.20	1.55	7.45	1.32	3.63
1989	0.81	1.20	12.00	8.38	8.58	1.46	0.36	0.29	0.17	0.54	5.31	0.85	3.34
1990	3.35	5.94	16.50	16.20	4.78	0.72	0.49	0.42	0.40	5.37	5.19	11.10	5.87
1991	3.01	4.94	17.70	25.20	3.01	0.59	0.24	0.20	0.20	0.43	0.55	0.86	4.72
1992	0.87	0.50	8.47	28.50	2.95	0.86	2.30	1.53	1.00	1.44	7.28	2.74	4.84
1993	6.50	0.78	3.09	43.80	4.13	5.62	1.21	0.60	0.59	3.16	6.72	4.96	6.73
1994	0.71	2.05	5.05	32.10	4.94	4.48	2.59	0.79	0.85	0.75	2.71	3.45	5.01
1995	12.10	1.22	11.30	4.92	3.04	4.55	0.58	4.29	0.36	6.80	6.42	2.67	4.89
1996	9.21	12.40	14.80	18.30	8.30	1.28	0.62	1.16	0.65	2.48	6.22	9.08	7.01
1997	2.59	3.78	13.10	30.00	6.81	1.13	0.83	0.27	0.29	0.40	1.57	1.32	5.15
1998	6.10	1.86	32.60	12.10	1.30	2.03	0.99	0.48	0.42	0.85	1.25	3.27	5.32
1999	2.31	2.85	16.80	27.80	1.45	1.53	0.61	0.25	1.21	1.89	3.63	6.26	5.54
2000	5.30	6.60	13.40	23.10	13.00	5.99	2.51	1.32	1.02	0.69	2.30	2.36	6.45
2001	1.36	2.45	3.96	24.00	2.03	1.73	0.26	0.17	0.32	0.94	1.50	5.77	3.68
2002	2.03	2.82	11.30	16.30	7.87	11.50	1.48	0.26	0.15	0.37	1.45	0.84	4.68
2003	0.39	0.41	12.70	9.34	8.37	3.39	0.75	0.70	0.34	4.79	10.10	11.40	5.26
2004	2.61	0.63	18.20	13.00	4.60	1.47	0.85	0.50	3.96	0.65	4.05	5.18	4.65
2005	5.47	1.88	9.76	26.90	5.04	8.76	2.03	0.40	0.81	6.96	8.60	4.94	6.79
2006	6.60	4.58	15.50	11.40	9.00								
2008						8.03	4.60	1.53	0.50	1.50	3.64	9.97	
2009	3.05	19.00	28.20	13.10	6.44	1.41	4.24	1.85	0.66	3.44	4.42	6.08	7.60
2010	8.90	3.57	18.70	6.30	2.21	1.57	0.76	0.77	1.93	6.88	7.98	8.72	5.72
2011	2.51	2.52	30.00						0.43	0.74	0.73	3.64	
2012	1.24	1.65	18.80	4.10	3.62	0.99	0.15	0.15	0.44	0.71	0.58	1.47	2.84
2013	2.40	1.75	11.70	25.90	3.85	7.68	3.64	0.73	2.31	2.03	3.98	1.52	5.61
2014	6.90	5.40	3.83	40.90	7.86	4.96	1.37	1.70	2.16	3.01	3.06	3.13	6.97
2015	1.70	0.47	1.28	18.90	2.49	4.65	1.78	1.72	1.58	3.37	3.97	4.97	3.89
2016	5.04	6.65	25.90	11.80	1.87	0.81	0.37	0.44	0.27	0.93	1.48	5.01	5.06
2017	5.50	10.20	16.80	32.60	21.40	5.14	19.40	4.00	1.70	7.29	16.50	3.48	12.00
2018	5.95	12.90	12.80	21.10	4.40	2.63	1.15	0.94	0.66	1.21	6.30	7.76	6.41
2019	1.89	1.24	14.50	42.60	9.00	3.49	1.16	0.39	0.34	0.86	4.61	2.43	6.86
2020	8.00	1.41	29.90	10.30	3.60	0.93	0.35	0.76	0.72	1.57	1.67	6.45	5.52
2021	2.13	0.88	19.20	4.37	3.22	0.68	0.87	0.38	0.58	3.73	5.40	7.02	4.07
Min	0.19	0.32	0.70	4.10	1.30	0.39	0.15	0.15	0.15	0.21	0.53	0.56	2.84
Mean	3.37	3.79	15.10	21.23	5.41	2.78	1.77	1.05	1.13	2.49	4.33	4.77	5.57
Max.	12.10	26.20	45.00	52.90	21.40	11.50	19.40	6.33	13.50	10.30	16.50	11.60	12.00

Monthly Mean Discharge

Bear Brook near Bourget- Hydrometric Station 02LB008 (Drainage Area 448 km^2)

	Mean Monthly Discharge (m^3/s)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Mean**
1976				44.00	5.01	1.48	0.59	0.27	1.05	2.51	2.64	0.76	
1977	0.33	0.28	35.20	13.50	1.16	0.43	0.50	0.34	3.52	9.34	7.30	6.95	6.63
1978	7.85	3.04	6.96	58.10	2.89	0.73	0.21	0.18	0.18	0.33	0.63	0.64	6.75
1979	1.20	1.28	33.80	15.50	3.22	1.71	0.49	0.52	1.49	2.90	7.58	9.38	6.64
1980	2.70	0.20	18.30	13.80	4.21	0.50	0.71	0.42	0.87	3.89	3.82	4.30	4.50
1981	0.76	46.10	6.35	6.63	7.84	12.70	1.21	8.43	11.60	10.30	8.42	2.24	9.92
1982	1.04	0.62	4.69	39.30	1.87	0.73	0.39	0.40	0.64	0.82	4.44	12.60	5.60
1983	3.73	4.12	21.30	16.20	13.40	2.04	0.37	0.29	0.16	1.33	10.70	7.56	6.79
1984	1.38	8.10	7.69	39.70	6.55	1.22	0.35	0.98	0.31	0.44	2.04	4.04	6.00
1985	1.47	2.62	34.80	16.00	1.58	0.71	0.28	0.18	0.17	0.50	1.12	1.33	5.10
1986	2.02	0.76	13.10	6.75	9.88	1.10	2.03	1.63	7.45	8.05	5.85	6.81	5.49
1987	1.83	0.89	21.20	11.00	1.60	1.73	1.40	0.43	1.79	2.87	4.50	11.30	5.09
1988	1.34	4.36	11.50	12.20	2.75	0.69	0.67	0.65	0.50	3.39	9.11	1.24	4.01
1989	0.61	0.43	11.70	12.30	7.57	1.92	0.22	0.49	0.47	1.65	8.91	1.00	3.95
1990	4.00	5.07	21.40	16.80	3.56	0.60	0.83	0.77	0.55	7.19	7.34	10.70	6.58
1991	3.98	3.49	22.30	31.80	3.31	0.92	0.29	0.32	0.24	0.90	0.77	0.93	5.75
1992	1.02	0.49	7.04	36.20	2.96	0.67	2.96	1.80	1.06	1.34	8.16	1.99	5.44
1993	6.92	0.79	3.84	47.60	4.33	6.24	0.56	0.28	0.52	4.47	7.49	5.55	7.35
1994	0.60	1.39	4.39	34.30	4.76	6.63	5.02	2.50	1.01	0.76	4.82	5.47	5.94
1995	11.50	1.46	13.80	5.17	3.98	6.87	1.44	4.54	0.30	7.44	7.72	2.63	5.61
1996					7.50	1.18	1.16	2.14	0.94	4.90			
1997					7.12	1.58	0.38	0.23	0.32	0.45	1.81	1.07	
1998	2.38	1.38						2.35	1.31	2.90	4.15	5.21	
1999	2.87	2.54	12.00	29.40	1.22	1.36	0.70	0.20	0.77	1.99	4.27	6.78	5.32
2000	2.81	2.06	18.10	21.80	13.50	7.93	4.96		1.49	1.08	3.85	3.24	
2001	1.26	2.11	3.73	24.40	1.53	1.38	0.31			0.82	1.64	6.29	
2002	1.98	2.57	10.00	18.80	7.96	14.90	0.61	0.14	0.14	0.82	2.41	1.10	5.10
2003	0.37	0.24	11.00	12.40	7.74	2.48	0.59	1.63	0.19	6.58	12.30	15.40	5.94
2004						1.20	1.31	1.92	9.77	1.16	4.89	6.21	
2005	4.97	1.97	6.69	33.90	6.59	12.40	1.91	0.32	1.00	5.56	9.30	6.63	7.58
2006	7.46	6.23	20.70	12.10	11.10	2.47	2.11	3.82	2.73	13.30	12.40	12.60	8.96
2007	8.94	0.82	15.70	18.40	2.44	1.47	3.51	0.38					
2008	15.80	3.13	9.53	51.30	4.04	5.15	3.70	1.72	0.43	3.38	6.21	9.84	9.48
2009	4.56	11.10	31.30	16.30	6.30	1.82	8.21	2.29	0.55	3.95	4.05	7.16	8.13
2010	7.23	4.65	21.60	6.79	1.30	1.13	0.70	2.48	5.74	9.08	9.24	10.70	6.75
2011	3.62	4.00				2.48	0.53	0.42	0.67	1.33	1.08	6.04	
2012	1.21	1.98	24.00	4.48	4.00	2.52	0.26	0.26	0.91	1.46	0.67	2.74	3.74
2013	4.48	3.87	12.00	36.60	4.83	9.43	2.70	0.60	0.80	1.49	5.27	1.97	6.96
2014	6.04	2.35	3.81	44.60	7.09	8.19	1.21	0.88	1.25	3.48	4.15	5.47	7.34
2015	2.16	0.56	2.98	23.20	2.19	4.60	1.19	1.12	1.25	3.14	4.26	5.83	4.36
2016	5.68	6.97	31.70	15.80	1.84	0.54	0.29	0.49	0.44	3.14	1.82	5.73	6.22
2017	6.46	7.80	19.10	41.50	19.80	5.69	14.90	2.26	1.59	4.45	16.40	4.17	12.00
2018	5.52	9.12	17.30	22.30	4.33	3.47	1.18	0.76	0.75	0.99	6.79	7.74	6.66
2019	1.24	2.63	8.65	50.80	10.30	2.50	0.86	0.23	0.33	1.07	5.76	2.63	7.20
2020	6.58	1.30	35.50	15.60	3.17	0.61	0.40	1.03	0.86	3.89	2.58	9.90	6.84
2021	2.04	0.74	23.90	6.10	3.29	1.10	0.92	0.53	0.86	5.03	6.21	8.60	5.00
2022	0.88	4.04	28.50	16.90	6.39	3.48	0.43	1.53	1.72	0.90	2.47	5.14	6.05
Min	0.33	0.20	2.98	4.48	1.16	0.43	0.21	0.14	0.14	0.33	0.63	0.64	3.74
Mean	3.74	3.95	16.27	23.82	5.41	3.28	1.64	1.23	1.57	3.41	5.50	5.68	6.39
Max.	15.80	46.10	35.50	58.10	19.80	14.90	14.90	8.43	11.60	13.30	16.40	15.40	12.00

Prorated Monthly Mean Discharge for South Nation River at Casselman

Monthly Flow Rates for the South Nation River at Casselman (Drainage Area 2,410 km^2) based on Proration from South Nation River at Plantagenet Springs - Hydrometric Station 02BL005 (Drainage Area 3,810 km^2)

	Mean Monthly Discharge (m3/s)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Min	0.89	0.81	2.26	21.51	4.48	1.01	0.36	0.42	0.41	0.45	0.45	1.20	11.64
Mean	18.55	15.98	71.58	123.47	24.94	12.37	7.69	5.28	5.17	13.21	23.21	24.99	28.94
Max.	110.06	132.83	198.62	271.36	98.68	68.31	79.70	31.12	43.84	62.12	91.09	66.42	60.09

Monthly Flow Rates for the South Nation River at Casselman (Drainage Area 2,410 km^2) based on Proration from Castor River at Russell - Hydrometric Station 02LB006 (Drainage Area 439 km^2)

	Mean Monthly Discharge (m3/s)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Min	1.06	1.77	3.82	22.51	7.14	2.12	0.85	0.81	0.81	1.17	2.93	3.05	15.59
Mean	18.51	20.83	82.92	116.56	29.68	15.26	9.70	5.79	6.21	13.70	23.79	26.20	30.58
Max.	66.43	143.83	247.04	290.41	117.48	63.13	106.50	34.75	74.11	56.54	90.58	63.68	65.88

Monthly Flow Rates for the South Nation River at Casselman (Drainage Area 2,410 km^2) based on Proration from Bear Brook near Bourget- Hydrometric Station 02LB008 (Drainage Area 448 km^2)

	Mean Monthly Discharge (m3/s)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Min	1.80	1.07	16.03	24.10	6.24	2.33	1.11	0.76	0.76	1.76	3.41	3.44	20.12
Mean	20.12	21.22	87.53	128.12	29.10	17.62	8.83	6.59	8.45	18.33	29.57	30.56	34.37
Max.	85.00	247.99	190.97	312.55	106.51	80.15	80.15	45.35	62.40	71.55	88.22	82.84	64.55

Monthly Flow Rates for the South Nation River at Casselman (Drainage Area 2,410 km^2) based on Average Proration SNR at Plantagenet Springs (02LB005, 3,810 km^2), Castor River (02LB006, 439 km^2) & Bear Brook (02LB008, 448 km^2

	Mean Monthly Discharge (m3/s)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Min	0.94	1.02	6.99	22.29	5.64	1.58	0.58	0.50	0.49	0.85	1.72	1.93	15.58
Mean	20.78	20.30	81.18	119.04	28.60	14.50	8.26	5.52	5.94	14.04	25.45	27.87	31.10
Max.	90.35	163.98	218.18	299.16	105.40	66.98	79.30	44.19	55.45	68.42	93.43	72.61	62.01

APPENDIX D

7-day, 15-day and 30-day Duration Low Flow Estimates

Low Flow Analysis of Watercourses within the South Nation River Watershed

South Nation River at Plantagenet Springs - Hydrometric Station 02BL005 (Drainage Area 3,810 km^2)

	7-Day Low Flow (m^3/s)										
Return Period (Years)	**1.005**	**1.01**	**1.111**	**1.25**	**2**	**5**	**10**	**20**	**50**	**100**	**200**
January	40.666	35.870	19.366	14.081	6.651	2.418	1.233	0.642	0.271	0.138	0.066
February	27.893	25.070	14.833	11.301	5.941	2.467	1.354	0.741	0.311	0.138	0.036
March	299.892	236.054	72.851	39.678	9.499	1.379	0.378	0.103	0.012	NA	NA
April	204.560	184.041	110.283	85.156	47.521	23.655	16.181	12.133	9.348	8.250	7.612
May	52.791	47.139	27.347	20.849	11.480	5.907	4.275	3.433	2.885	2.681	2.568
June	25.709	22.795	12.663	9.371	4.673	1.927	1.138	0.736	0.479	0.384	0.333
July	29.356	24.699	10.570	6.814	2.422	0.594	0.228	0.086	0.017	NA	NA
August	12.324	10.937	6.083	4.491	2.199	0.839	0.441	0.237	0.104	0.054	0.027
September	11.079	9.920	5.762	4.351	2.245	0.917	0.504	0.281	0.129	0.069	0.035
October	43.910	36.835	15.537	9.942	3.472	0.832	0.314	0.116	0.022	NA	NA
November	66.953	58.559	30.330	21.587	9.701	3.303	1.616	0.812	0.330	0.166	0.081
December	53.567	47.481	26.252	19.325	9.394	3.547	1.853	0.986	0.427	0.220	0.106
Annual	5.480	4.994	3.160	2.489	1.411	0.638	0.364	0.201	0.076	0.022	NA

Return Period (Years)	**1.005**	**1.01**	**1.111**	**1.25**	**2**	**5**	**10**	**20**	**50**	**100**	**200**
15-Day Low Flow	6.475	5.895	3.711	2.918	1.647	0.747	0.430	0.243	0.101	0.040	0.001
30-Day Low Flow	8.555	7.755	4.786	3.726	2.062	0.917	0.527	0.302	0.137	0.067	0.024

Castor River at Russell - Hydrometric Station 02BL006 (Drainage Area 439 km^2)

	7-Day Low Flow (m^3/s)										
Return Period (Years)	**1.005**	**1.01**	**1.111**	**1.25**	**2**	**5**	**10**	**20**	**50**	**100**	**200**
January	4.600	4.101	2.351	1.777	0.949	0.456	0.312	0.237	0.189	0.171	0.161
February	3.748	3.330	1.897	1.441	0.804	0.446	0.346	0.297	0.267	0.256	0.250
March	20.091	17.020	7.589	5.034	1.992	0.686	0.416	0.308	0.255	0.240	0.234
April	28.969	25.560	14.081	10.519	5.668	3.049	2.356	2.025	1.826	1.758	1.723
May	6.734	6.069	3.701	2.904	1.726	0.995	0.772	0.652	0.572	0.541	0.523
June	3.996	3.511	1.883	1.381	0.702	0.339	0.244	0.199	0.172	0.163	0.158
July	4.993	3.963	1.315	0.772	0.273	0.137	0.120	0.116	0.114	0.114	0.114
August	2.302	1.952	0.878	0.586	0.239	0.090	0.059	0.046	0.040	0.038	0.038
September	1.118	1.027	0.676	0.544	0.325	0.160	0.098	0.060	0.030	0.016	0.007
October	4.699	4.120	2.158	1.545	0.703	0.243	0.120	0.061	0.024	0.012	0.005
November	7.627	6.830	3.977	3.011	1.571	0.668	0.388	0.237	0.134	0.094	0.071
December	8.538	7.496	4.010	2.939	1.494	0.726	0.527	0.432	0.377	0.358	0.348
Annual	0.665	0.618	0.429	0.355	0.226	0.120	0.078	0.050	0.026	0.015	0.006

Return Period (Years)	**1.005**	**1.01**	**1.111**	**1.25**	**2**	**5**	**10**	**20**	**50**	**100**	**200**
15-Day Low Flow	0.737	0.686	0.481	0.400	0.257	0.140	0.091	0.059	0.031	0.017	0.008
30-Day Low Flow	0.959	0.889	0.613	0.506	0.322	0.175	0.117	0.079	0.048	0.033	0.022

Bear Brook near Bourget- Hydrometric Station 02BL008 (Drainage Area 448 km^2)

	7-Day Low Flow (m^3/s)										
Return Period (Years)	**1.005**	**1.01**	**1.111**	**1.25**	**2**	**5**	**10**	**20**	**50**	**100**	**200**
January	3.920	3.524	2.110	1.634	0.927	0.488	0.352	0.280	0.231	0.212	0.202
February	3.637	3.261	1.929	1.484	0.832	0.433	0.312	0.249	0.207	0.190	0.181
March	19.553	16.878	8.212	5.671	2.400	0.796	0.413	0.243	0.149	0.120	0.106
April	35.326	30.851	16.122	11.701	5.876	2.903	2.163	1.824	1.630	1.567	1.536
May	7.530	6.691	3.798	2.870	1.561	0.812	0.602	0.496	0.430	0.406	0.393
June	4.608	3.965	1.913	1.324	0.581	0.230	0.149	0.114	0.095	0.090	0.087
July	4.864	3.931	1.382	0.804	0.225	0.039	0.011	0.003	NA	NA	NA
August	1.318	1.184	0.699	0.532	0.279	0.116	0.064	0.035	0.016	0.008	0.003
September	1.554	1.393	0.813	0.615	0.319	0.130	0.071	0.039	0.017	0.008	0.003
October	4.949	4.358	2.331	1.687	0.788	0.281	0.141	0.072	0.029	0.014	0.006
November	9.955	8.810	4.864	3.599	1.818	0.801	0.516	0.374	0.284	0.252	0.234
December	7.926	7.031	3.960	2.982	1.613	0.840	0.625	0.519	0.453	0.429	0.416
Annual	0.539	0.507	0.373	0.318	0.216	0.126	0.086	0.058	0.032	0.018	0.008

Return Period (Years)	**1.005**	**1.01**	**1.111**	**1.25**	**2**	**5**	**10**	**20**	**50**	**100**	**200**
15-Day Low Flow	0.670	0.627	0.453	0.382	0.254	0.144	0.096	0.063	0.034	0.019	0.008
30-Day Low Flow	0.909	0.627	0.517	0.327	0.173	0.112	0.072	0.038	0.021	0.010	NA

* Low Flow Characteristics of Ontario Streams, National Research Council Canada, Report No.: NRC-OCRE-2022-TR-026, June 23, 2022

Low Flow Analysis of South Nation River at Casselman

Low Flow Rates for the South Nation River at Casselman (Drainage Area 2,410 km^2) based on Proration from SNR at Plantagenet Springs (02LB005, 3,810 km^2), Castor River (02LB006, 439 km^2) & Bear Brook (02LB008, 448 km2)

	7-Day Low Flow Rate (m^3/s)										
Return Period (Years)	**1.005**	**1.01**	**1.111**	**1.25**	**2**	**5**	**10**	**20**	**50**	**100**	**200**
January	24.021	25.780	14.541	10.875	5.616	2.516	1.613	1.150	0.850	0.739	0.679
February	19.261	17.227	10.058	7.681	4.216	2.113	1.478	1.146	0.925	0.838	0.790
March	135.058	111.182	43.973	27.747	9.952	2.973	1.582	1.021	0.736	0.654	0.618
April	159.487	140.898	77.929	58.186	30.928	15.773	11.602	9.535	8.235	7.766	7.512
May	36.956	33.043	19.349	14.856	8.378	4.522	3.394	2.806	2.426	2.283	2.203
June	20.996	18.341	9.546	6.877	3.312	1.439	0.954	0.724	0.586	0.541	0.515
July	24.048	19.509	7.113	4.291	1.414	0.446	0.287	0.236	0.212	0.209	0.209
August	9.174	8.001	4.143	2.973	1.401	0.550	0.316	0.197	0.124	0.095	0.081
September	7.168	6.469	3.910	3.016	1.640	0.719	0.413	0.239	0.113	0.058	**0.026**
October	26.731	23.120	11.405	7.949	3.432	1.124	0.539	0.265	0.101	0.047	**0.020**
November	45.925	40.643	22.395	16.515	8.180	3.355	1.976	1.276	0.824	0.659	0.567
December	41.131	36.336	19.974	14.800	7.607	3.583	2.476	1.929	1.592	1.471	1.405
Annual	3.339	3.093	2.120	1.745	1.098	0.580	0.374	0.238	0.121	0.064	0.025

Return Period (Years)	**1.005**	**1.01**	**1.111**	**1.25**	**2**	**5**	**10**	**20**	**50**	**100**	**200**
15-Day Low Flow	3.915	3.623	2.475	2.032	1.273	0.672	0.429	0.272	0.139	0.074	**0.029**
30-Day Low Flow	5.189	4.386	3.058	2.298	1.334	0.714	0.454	0.276	0.154	0.092	0.045

Low Flow Volumes for the South Nation River at Casselman (Drainage Area 2,410 km^2) based on Proration from SNR at Plantagenet Springs (02LB005, 3,810 km^2), Castor River (02LB006, 439 km2) & Bear Brook (02LB008, 448 km2)

	7-Day Low Flow Volume (m^3/day)										
Return Period (Years)	**1.005**	**1.01**	**1.111**	**1.25**	**2**	**5**	**10**	**20**	**50**	**100**	**200**
January	2,075,428	2,227,412	1,256,344	939,638	485,209	217,339	139,374	99,340	73,475	63,855	58,651
February	1,664,188	1,488,419	869,000	663,617	364,246	182,541	127,708	99,033	79,950	72,425	68,224
March	11,669,031	9,606,100	3,799,281	2,397,326	859,820	256,905	136,643	88,220	63,620	56,537	53,419
April	13,779,680	12,173,594	6,733,093	5,027,238	2,672,204	1,362,750	1,002,380	823,783	711,528	671,014	649,055
May	3,193,000	2,854,911	1,671,754	1,283,594	723,867	390,726	293,203	242,469	209,612	197,276	190,358
June	1,814,047	1,584,662	824,776	594,183	286,133	124,336	82,393	62,533	50,638	46,710	44,526
July	2,077,777	1,685,543	614,576	370,752	122,144	38,524	24,830	20,372	18,334	18,024	18,024
August	792,663	691,299	357,927	256,885	121,072	47,485	27,277	17,013	10,698	8,231	6,965
September	619,350	558,905	337,804	260,554	141,704	62,143	35,676	20,648	9,727	5,026	**2,209**
October	2,309,599	1,997,606	985,371	686,753	296,482	97,111	46,538	22,912	8,688	4,066	**1,720**
November	3,967,884	3,511,565	1,934,887	1,426,899	706,769	289,884	170,727	110,207	71,197	56,928	48,954
December	3,553,710	3,139,433	1,725,758	1,278,717	657,242	309,541	213,908	166,671	137,567	127,074	121,402
Annual	288,477	267,235	183,182	150,737	94,901	50,116	32,287	20,553	10,453	5,561	2,188

Return Period (Years)	**1.005**	**1.01**	**1.111**	**1.25**	**2**	**5**	**10**	**20**	**50**	**100**	**200**
15-Day Low Flow	338,283	312,991	213,836	175,583	109,989	58,053	37,094	23,515	12,009	6,360	**2,522**
30-Day Low Flow	448,302	378,971	264,204	198,540	115,277	61,726	39,254	23,879	13,338	7,987	3,916

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Appendix B

GEMTEC Groundwater Feasibility Assessment

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Water Supply Desktop Feasibility Assessment
Groundwater Resources
Casselman, Ontario

GEMTEC Project: 100117.050

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Submitted to:

J.L. Richards & Associates Limited
343 Preston Street
Ottawa, Ontario
K1S 1N4

Water Supply Desktop Feasibility Assessment
Groundwater Resources
Casselman, Ontario

January 22, 2024
GEMTEC Project: 100117.050

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GEMTEC Consulting Engineers and Scientists Limited
32 Steacie Drive
Ottawa, ON, Canada
K2K 2A9

January 22, 2024 File: 100117.050 – R0

J.L. Richards & Associates Limited
343 Preston Street
Ottawa, Ontario
K1S 1N4

Attention: Susan Jingmiao Shi

Re: Water Supply Desktop Feasibility Assessment
Groundwater Resources
Casselman, Ontario

Please find enclosed the report prepared by GEMTEC Consulting Engineers and Scientist Limited summarizing the desktop feasibility study on the South Nation River and groundwater resources available to the Municipality of Casselman. The report was prepared in general accordance with GEMTEC proposal P100117.050 (Rev 0) dated July 18, 2023.

Andrius Paznekas, M.Sc., P.Geo. Jason KarisAllen, M.A.Sc., E.I.T. (NS)

JKA/DC/AP

Enclosures
N:\Projects\100100\100117.050\05_Technical Work\Reporting\100117.050_RPT_Casselman Groundwater Resources_2024-01-22_Rev0.docx

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1.0 INTRODUCTION

GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) was retained by J. L. Richards and Associates Limited (JLR) to assess the feasibility of local groundwater resources to inform decision making regarding the future of the Casselman water supply. The Municipality of Casselman (Casselman) is anticipating significant expansion of their resident population over the next 25 years and needs to take action to meet their future water needs.

This assessment is based on desktop resources and will be included in a Class Environmental Assessment of water supply options. Information pertaining to water resources in and around Casselman were received by GEMTEC from the South Nation Conservation Authority on November 12, 2023. In addition, a review of public resources for the region was also conducted by GEMTEC.

1.1 Municipality of Casselman

Casselman is one of eight local municipalities within the United Counties of Prescott and Russell. Casselman is located off exit 66 along the Trans-Canada Highway / Ontario Highway 417, approximately 50 km east of Ottawa, Ontario.

Casselman consists of approximately 5.25 km^2 of urban settlement area that predominantly consists of low-density residential and vacant land uses (JLR, 2023). The location and municipal boundaries of Casselman are shown on Figure A.1 in Appendix A.

1.2 Current Water Supply and Future Demand

Casselman is serviced by a municipal water system consisting of a water treatment plant with a rated capacity of 3,182 m^3/day, an elevated water storage tank, and over 22 km of watermains (JLR, 2023).

The water treatment plant is located at 832 Laval Street, Casselman, Ontario, and draws water from the South Nation River. The water treatment plant is owned by Casselman and operated by the Ontario Clean Water Agency, a crown agency of the Government of Ontario, under the Ministry of the Environment, Conservation and Parks (MECP) Drinking Water Works Permit Number 173-201.

The 5-year average day water demand for Casselman from 2018 to 2022 was 1,031 m^3/day, and the maximum daily demand over this same period was 2,154 m^3/day (JLR, 2023). Based on conventional design guidelines for municipal systems in Ontario, JLR (2023) has estimated the 5-year average peak-hour demand for Casselman between 2018 and 2022 as approximately 2,953 m^3/day.

A study performed in 2023 by Watson & Associates Economists Limited reported a population of 4,048 people on municipal water and wastewater services (JLR, 2023). Significant population and infrastructural growth are planned for Casselman over the next 25 years, requiring a proportional increase in the capacity of the municipal drinking water system. The future water demand of Casselman is projected to exceed the rated capacity of the current water supply system by the end of 2025. By the year 2047 Casselman is projected to have a daily average drinking water demand of 3,690 m^3/day, a daily maximum of 7,085 m^3/day, and a peak hourly demand of 10,627 m^3/day (JLR, 2023). Therefore, the municipal water system must be augmented or supplemented to accommodate the future needs of the growing population.

2.0 CONCEPTUAL GEOLOGICAL MODEL

Available mapping (e.g., OGS, 2010; Gao et al., 2006), public well records (MECP, 2021), the geological model of the South Nation Watershed Region (Logan et al., 2009), Eastern Ontario Water Resources Management Study (CH2M Hill Canada Limited, 2001), and Cummings (2008) are some the resources referenced to inform the development of a high level conceptual geological model to visualize local stratigraphy. This conceptual cross-section is presented in Figure A.2, wherein overburden terminology follows the conventions of WESA (2011a, 2011b) for consistency.

2.1 Regional Physical Geography

2.1.1 Land Use and Designated Areas

Casselman is an urban centre surrounded by agricultural land uses with sparse forested areas and surface water features (RRCA-SNC, 2007). Commercial, industrial, institutional, park, and residential land-uses are distributed within the municipal boundaries as presented in Figure 2 of JLR (2023). The South Nation watershed is reported to be 60.7% agricultural managed lands, 8.5% residential lands, 0.1% commercial/industrial land, 0.4% parks and golf courses, and 25.4% unmanaged lands (e.g., wetland, bedrock, forest, and water features; Intera Engineering Ltd., 2010).

A small (0.6 km^2) Area of Natural and Scientific Interest (ANSI) is identified to the north of the municipal area named the Casselman Unconformity (MNRF, 2023). Additionally, a candidate ANSI called the Moose Creek Bog is located approximately 2.5 kilometres to the southeast.

Portions of the South Nation River and surrounding catchment area are designated as source water protection zones associated with the Casselman municipal water supply.

2.1.2 Topography and Drainage

The ground elevations within the municipal boundaries of Casselman range between 45 and 70 metres above sea level (MNRF, 2019).

The South Nation River bisects Casselman, flowing from the southwest and meandering northeast, and local overland and shallow flows are expected to flow towards the South Nation River or its tributaries following topography and/or stormwater management features.

Deeper regional flows are anticipated to flow north following surface and bedrock topography, towards the Ottawa River (RRCA-SNC, 2007).

2.1.3 Surficial Geology

Overburden units surrounding Casselman range in thickness between 3 and 30 metres (Gao et al., 2006). The prevalent soil units mapped in the area are fine-grained, offshore marine deposits composed of clays and silts (Basin Muds), which are often overlain by sandy deposits (Basin Sands; OGS, 2010). Basin Sands are mapped as areas of significant groundwater recharge and aquifer vulnerability and are primarily mapped north and west of Casselman (MECP, 2023). These marine layers commonly overly a silty sand layer with minor gravel, clay and frequent cobbles and boulders (composition varies spatially) referred to as glacial till that is mapped at surface across the eastern half of Casselman (OGS, 2010).

A series of eskers are present in the vicinity of Casselman. Eskers are long deposits of sand and gravel formed in a glacial environment and are distributed across south-eastern Ontario. The approximate locations of eskers in the vicinity of Casselman are shown on Figures A.1 to 3.

The nearest esker to Casselman is the Crysler-Finch esker (Cummings, 2008; Gorrell, 1991), outcrops of which can be seen on geological maps (OGS, 2010; Gorrell, 1991) to the south and east of Casselman (Figure A.1). Cummings (2008) reports that the configuration of the Crysler-Finch esker is comparable to other eskers within the Champlain Sea basin, consisting of a gravel core with a broad sandy carapace on bedrock or till that is discontinuously overlain with Basin Muds and/or Basin Sands. The depth and extent of the Crysler-Finch esker was inferred by Logan et al. (2009) using boreholes logs, well records, and seismic surveys; based on their mapping products, the Crysler-Finch esker may be expected to be less than approximately 17 metres thick near Casselman. Esker mapping by Gorrell (1991) used to develop the figures in this report is expected to be imprecise based on more recent evaluations of the Vars-Winchester esker by Pullan et. al. (2007).

Bedrock outcrops are present along the channel of the South Nation River, as well as more localized clays and silts deposited more recently by the South Nation River during the recession of the Champlain Sea.

High permeability organic rich deposits are found approximately 2.8 km southeast of Casselman.

In addition to these mapped soil units, fill material associated with anthropogenic activities may be present in developed areas.

2.1.4 Bedrock Geology

Casselman is underlain by sublithographic to fine crystalline limestone with interbeds of calcarenite and shale of the Lindsay Formation and Simcoe Group (Armstrong & Dodge, 2007). It is likely that the upper 4 metres of carbonate bedrock has a higher fracture frequency than underlying sections, and the productivity of this fractured zone as an aquifer may be reduced by the presence of fines in the overburden at the bedrock interface. Where coarser tills overlay the bedrock fracture zone, greater yield may be expected (Charron, 1978). Deeper bedrock fractures also provide significant water volumes, but the location and water quality of these sources is expected to be variable.

2.1.5 Hydraulic Conductivity

Deltaic and estuarine deposits reported as medium- to fine-grained sands are regarded as high-permeability units (Basin Sands). Similarly, recent organic rich deposits are mapped as high permeability (OGS, 2010). Fine-grained offshore marine deposits composed of clays and silts (Basin Muds) are typically low-permeability units. Glacial till is typically a low-medium permeability unit, though its composition and permeability may be highly variable.

WESA (2011a) reviewed public well records and available consultant reports for eastern Ontario to estimate regional hydraulic conductivity and transmissivity values for their modelling exercise. These regional values for hydraulic conductivity and transmissivity (Tables 1, 2, and 3) provide estimates of the hydraulic properties for local subsurface units. These values should not be used for design in place of location specific measurements.

Table 1. Regional Estimates of Geological Units for Eastern Ontario Based on MECP Public Well Records (Data sourced from Table 3 of WESA, 2011a)

Unit	Arithmetic Mean Transmissivity (m^2/s)	Arithmetic Mean Hydraulic Conductivity (m/s)	Geometric Mean Hydraulic Conductivity (m/s)	Number of Wells
Basin Sand	0.00047	0.00004	2.6E-05	2
Basin Mud	0.0020	0.00012	2.7E-05	55
Esker Deposits	0.0067	0.0011	1.4E-04	119
Glacial Till	0.0013	0.00024	4.7E-04	220
Bedrock (upper 15 metres)	0.53	0.036	1.9E-05	3338

Table 2. Regional Hydraulic Conductivity Estimates of Geological Units for Eastern Ontario based Consultant Reports (WESA, 2011a)

Unit	Geometric Mean[1] (m/s)	Median (m/s)	Third Quartile (m/s)	First Quartile (m/s)	Sample Number
Basin Sand	1.3E-06	2.0E-06	3.3E-06	1.1E-06	20
Basin Mud	8.8E-07	9.2E-07	1.6E-06	2.9E-08	12
Esker Deposits	7.0E-04	1.3E-03	1.6E-03	9.9E-04	14
Glacial Till	2.5E-04	8.7E-04	1.7E-03	8.3E-05	5
Bedrock (upper 15 metres)	2.4E-06	1.2E-05	3.5E-05	6.2E-07	6

Note 1. Geometric mean from Tables 4 and 5 of WESA, 2011a. Median, first and third quartiles calculated from average values presented in Tables 4 and 5 of WESA, 2011a.

Table 3. Regional Transmissivity Estimates of Geological Units for Eastern Ontario based Consultant Reports (WESA, 2011a)

Unit	Geometric Mean[1] (m/s)	Median (m/s)	Third Quartile (m/s)	First Quartile (m/s)	Sample Number
Basin Sand	ND	ND	ND	ND	0
Basin Mud	4.2E-03	1.6E-02	4.8E-02	3.1E-03	4
Esker Deposits	1.2E-02	1.1E-02	1.5E-02	1.0E-02	14
Glacial Till	1.8E-02	1.7E-02	1.8E-02	9.3E-03	5
Bedrock (upper 15 metres)	1.5E-04	9.3E-04	1.9E-03	1.4E-05	4

Note 1. Geometric mean from Tables 4 and 5 of WESA, 2011a. Median, first and third quartiles calculated from average values presented in Tables 4 and 5 of WESA, 2011a.

3.0 GROUNDWATER RESOURCES ASSESSMENT

A desktop review of available data regarding groundwater resources was performed. Findings regarding local and regional groundwater resources are summarized in the following subsections to support the feasibility assessment of a municipal groundwater supply for Casselman.

3.1 Public Well Records Review

Public well records (MECP, 2021) within two kilometres of the municipal boundaries of Casselman were compiled and reviewed. A total of 593 records were identified, summarized, and tabulated in Appendix B. The records include wells classified as domestic (421), commercial (34), municipal (7), monitoring and/or testing (54), livestock (33), public (16), and air conditioning (1) well types and 42 records for wells no longer in use due to abandonment or lack of water. Some of the well records have multiple reported well uses, resulting in the cumulative number of well uses exceeding the total number of records – refer to the summary table in Appendix B for further details.

Well records appear to indicate that:

- water supply wells (domestic, commercial, livestock, and public wells) are primarily completed within the bedrock. Of the total number of well records (593), 405 wells are reported as completed within the bedrock and 188 are either within the overburden or their unit is unknown / not indicated.
- bedrock interface aquifers are most frequently used for a water supply in the area.
- Many wells presently or historically exploit overburden wells for water supply, indicating that overburden aquifers are present.

Aquifers suitable for private services are widespread, but high-yielding wells (e.g., 55+ gpm) are scarce, appearing to be the exceptions among more numerous lower-yielding wells. Specific capacities of the wells appear to vary greatly; however, this is primarily based on the well drillers limited testing following completion of well drilling. Theoretical maximum yields are likely to vary from those presented in the well records.

Water yielding zones have been identified at depths between 0.5 and 61 metres below ground surface (mbgs). Median static water level is approximately 5 mbgs (n = 457). The typical water bearing depths appear to be in the bedrock between depth of 9 and 22 metres. Although the predominant water type from water bearing zones is fresh, as was reported for 397 water bearing zones, there are also 37 instances of sulphur water, 9 instances of unknown water quality, and 7 instances of saline water on record. A total of 113 well records have no reported information on water bearing units or water quality. The occurrence of unfavourable water quality may be a residual of the Champlain Sea or a product of the geological materials present.

Charron (1978) synthesized available well records to make broad assessments of groundwater systems across southern-eastern Ontario. Their findings corroborate that groundwater well yields surrounding Casselman typically remain ≤ 10 gpm (55 m^3/day), including bedrock and overburden wells.

3.2 Vars-Winchester Esker Study (SN-GSC-UO, 2007)

A detailed characterisation of the Vars-Winchester esker was underway in 2007 through the combined efforts of South Nation Conservation, Geological Survey of Canada, and the University of Ottawa (SN-GSC-UO). This study involved a review of public reports and databases, geophysical surveys, coring programs, geochemistry, outcrop data compilation, hydrogeological modelling, etc. This work was motivated by the number of municipalities that relied on the Vars-Winchester esker formation for their drinking water and the apparent data deficit.

Key findings reported in SN-GSC-UO (2007) include:

- Wells completed in the esker commonly yield greater than 2,725 m^3/day;
- The Vars-Winchester esker is approximately 40 km long and consists of a highly permeable gravely central ridge (typically atop bedrock) and a moderately permeable sandy-fan carapace;
- The average thickness of the gravel ridge is 15 m (2 to 20 metres) and width is approximately 150 m (100 to 200 metres wide);
- The morphology of the esker is complex, and the continuity of the esker is difficult to predict, despite the extensive dataset;
- Water quality in the esker is fresh, more comparable to precipitation than to groundwater within the Basin Mud or bedrock stratigraphy; and
- The esker is proposed to be primarily recharged by direct/or indirect infiltration of precipitation and by connections with surface water bodies that intersect the esker formation.

3.3 Provincial Groundwater Quality Monitoring Programs

Two provincial groundwater quality monitoring programs have been considered as part of this study, those being the Provincial Groundwater Monitoring Network (PGMN) and the Ambient Groundwater Geochemistry Project (AGGP). Monitoring points from these water quality programs reviewed during this investigation are presented in Figure A.1.

3.3.1 Provincial Groundwater Monitoring Network

The MECP maintained a long-term groundwater level and water quality monitoring station located within the High Falls Conservation Area within the Casselman municipal limits. The monitoring well (PGMN Well ID: W0000363-2) consists of a two-inch piezometer screened from 3.0 to 4.5 mbgs within a shallow gravel deposit (overburden well).

Groundwater quality samples were collected from the monitoring well annually in the fall between 2007 and 2021, excluding fall of 2020. The raw water quality data record were compared against the Ontario Drinking Water Quality Standards (ODWQS; CVC, 2003) where parameters were identified with applicable standards, as presented in Appendix C.

Water levels were monitored in the monitoring well at an hourly resolution from 2003 to 2016. The data displays typical seasonal trends (i.e., water level peaks in spring and fall, is generally elevated over winter, and is depressed over the summer), considering interannual variability. Ground surface at the well location is reportedly 60.34 metres above mean sea level (masl); water levels recorded within the well ranges from above ground surface (-0.08 mbgs) to 57.55 masl (2.79 mbgs). The median water level is 58.06 masl (2.28 mbgs) and is likely associated with the water level within the South Nation River.

3.3.2 Ambient Groundwater Geochemistry Project

The Ontario Geologic Survey (OGS) began collecting and reporting ambient groundwater geochemical data across southern Ontario and has published the results of their work from 2007 to 2019 (Hamilton, S.M., 2007). Available data within approximately five kilometres of the Casselman municipal boundaries were reviewed. Descriptions of the wells within this search radius are summarized below:

- Three (3) dug/bored wells within the overburden.
  - Well depths ranging from 4.9 to 6.1 mbgs.
  - Static water levels ranging from 0.3 to 2.0 mbgs.
- Four (4) drilled bedrock interface wells, defined as less than 3 metres into bedrock (bedrock surface would likely be connected to the overburden interface aquifer in this area).
  - Well depths ranging from 19.5 to 26.2 mbgs.
  - Static water level ranging from 3.6 to 15.3 mbgs
- Three (3) drilled deep bedrock wells (completed deeper than 3 metres into bedrock).
  - Well depths ranging from 18.2 to 43 mbgs
  - Static water levels ranging from 2.7 to 12 (approximate) mbgs

The geochemical parameters collected by the OGS (Hamilton, 2007) with ODWQS were compiled and compared against prescribed limits in Appendix C. Exceedances of the health, aesthetic, and operational ODWQS for raw water samples are summarized in the subsections below.

3.4 Health-Based Exceedances, PGMN and AGGP

- Nitrate – standard of 10 mg/L was exceeded in 1 of 4 overburden wells, 0 of 4 bedrock interface wells, and 0 of 3 deep bedrock wells.

- Boron – interim standard of 5 mg/L was exceeded in 3 of 3 overburden wells, 4 of 4 bedrock interface wells, and 3 of 3 deep bedrock wells.
- Total coliform – standard of 0 counts per 100 mL was exceeded in 2 of 3 overburden wells, whereas no exceedances were noted for the subset of interface or deep wells tested.
- Sodium – Warning level of 20 mg/L for persons on sodium restricted diets was exceeded in 2 of 3 overburden wells, 4 of 4 bedrock interface wells, and 3 of 3 deep bedrock wells.

Nitrates were noted in one of the shallow overburden wells, indicating the likely influence of septic systems or fertilizers on the shallow aquifer. Nitrate levels beyond 10 mg/L may induce methemoglobinemia (a blood related issue) in susceptible infants (CVC, 2003). The public should be informed by the appropriate health authority of the potential dangers of using the water for infants in affected areas.

Elevated boron concentrations were noted in all wells surrounding Casselman included in the Ambient Groundwater Geochemistry Project. Typical treatment options are limited to distillation and reverse osmosis. Infants, the elderly, and those with kidney diseases are the most likely to experience the toxic effects of boron compounds (CVC, 2003), which may be related to drilling muds or geological factors.

The presence of total coliform is also an indication of surface water influence and potential contamination. Total coliform must be non-detect following water treatment as it may indicate inadequate disinfection.

The warning level of 20 mg/L for sodium was exceeded in all wells except for 12-AG-147 (overburden; Appendix C). This warning level was established for persons on sodium restricted diets. Should a municipal supply be developed with elevated sodium levels, the local Medical Officer of Health should be notified so that local physicians may be informed.

3.5 Aesthetic Objective Exceedances

The following Aesthetic Objective exceedances were noted:

- Sodium – standard of 200 mg/L was exceeded in 1 of 4 overburden wells, 2 of 4 bedrock interface wells, and 2 of 3 deep bedrock wells.
- Sulphide – standard of 0.05 mg/L was exceeded in 1 of 4 overburden wells, 2 of 4 bedrock interface wells, and 1 of 3 deep bedrock wells.
- Chloride – standard of 250 mg/L was exceeded in 1 of 4 overburden wells, 1 of 4 bedrock interface wells, and 1 of 3 deep bedrock wells.

- DOC – standard of 5 mg/L was exceeded in 2 of 4 overburden wells, 2 of 4 bedrock interface wells, and 3 of 3 deep bedrock wells.
- Iron – standard of 0.3 mg/L was exceeded in 2 of 4 overburden wells, 4 of 4 bedrock interface wells, and 3 of 3 deep bedrock wells.
- Lab-measured colour – limit of 5 True Colour Units exceeded in all wells measured (2 deep bedrock, 2 interface wells and 1 overburden well).
- Methane – limit of 3 L/m3 was exceeded in 0 of 4 overburden wells, 2 of 4 bedrock interface wells, and 2 of 3 deep bedrock wells.
- Total Dissolved Solids (TDS) – limit of 500 mg/L was exceeded in 1 of 4 overburden wells, 2 of 4 bedrock interface wells, and 3 of 3 deep bedrock wells.
- Manganese – limit of 50 mg/L was exceeded in 2 of 4 overburden wells, 0 of 4 bedrock interface wells, and 1 of 3 deep bedrock wells.
- Turbidity – limit exceeded in 1 of 4 overburden wells.

Source water may require treatment to meet aesthetic requirements for domestic uses due to the constituent exceedances listed above. Water flavour may be impacted by constituents such as sodium, sulphide, chloride, iron, TDS, and manganese. Water odour may be impacted by sulphide. Iron, manganese, and organic constituents may impart unfavourable colour characteristics. Furthermore, iron and manganese may cause staining of fixtures and formation of precipitates in conduits. Bacterial growth in conduits may be promoted by methane and iron, and methane may also cause spurting from taps and “water hammer”, which may lead to mechanical damage. If allowed to accumulate, methane presents a risk of explosion. TDS may lead to corrosion or deposition within conduits or reduce the effectiveness of surfactants often used as cleaning agents; the bedrock and interface aquifers above are highly mineralized.

DOC is a useful diagnostic parameter for water quality deterioration throughout water treatment, storage, and distribution systems. DOC serves as a growth nutrient for bacteria and may also be an indicator of surface water influences in a supply aquifer (Chapelle, 2022). DOC may be contributed to excessive chlorine dis-infection by-products in treated water if not effectively managed before chlorination (CVC, 2003).

Control of turbidity in drinking-water systems is important for both health and aesthetic reasons. The substances and particles that cause turbidity can interfere with disinfection, thereby protecting pathogenic organisms. Turbidity is an important indicator of treatment efficiency and the efficiency of filters in particular.

3.6 Operational Guideline Exceedances:

The following Operational Guideline exceedances were noted:

- Alkalinity – limit of 500 mg/L exceeded in 0 of 4 overburden wells, 2 of 4 interface wells, and 3 of 3 deep bedrock wells.
- pH – One deep bedrock well was slightly more acidic (pH of 6.47) than the recommended pH range of 6.5 to 8.5; the remaining wells were within this range.
- Organic nitrogen – limit of 0.15 mg/L as N exceeded in 2 of 4 overburden wells, 2 of 4 interface wells, and 2 of 3 deep bedrock wells.
- Hardness – limit exceeded in 1 of 4 overburden wells.

Operational guidelines associated with alkalinity and aluminum do not apply to this investigation, as they are in place for assessing water treatments and monitoring treatment effectiveness. Conversely, the operational guideline for organic nitrogen (0.15 mg/L) was established because it may be an indicator of septic tank or sewage effluent contamination, is often associated with taste and odour problems when it interacts with chlorine disinfectants, and may reduce the effectiveness of disinfection.

Water pH that falls outside of the operational guidelines may lead to excessive corrosion (acidic), encrustation (basic), and/or reduced coagulant efficiency (basic).

The operational guideline for hardness in drinking water is set at between 80 and 100 mg/L as calcium carbonate. This value is set to aid in water source selection where a choice exists. Hardness is caused by dissolved calcium and magnesium and is expressed as the equivalent quantity of calcium carbonate. On heating, hard water tends to form scale deposits and can form excessive scum with soaps; however, certain detergents are largely unaffected by hardness. Conversely, soft water may result in accelerated corrosion of water pipes. Hardness levels between 80 and 100 mg/L as calcium carbonate ($CaCO_3$) are considered to provide an acceptable balance between corrosion and incrustation. Water supplies with a hardness greater than 200 mg/L are considered poor but tolerable. Hardness above 500 mg/L in drinking water is considered unacceptable for most domestic purposes (CVC, 2003).

3.7 Nearby Municipal Groundwater Systems Review

Nearby municipal groundwater systems were reviewed to evaluate the available groundwater resources in a regional context. Eleven wells / systems were examined, six of which are believed to withdraw, at least in part, from esker features. The municipal well locations and the withdrawal limit of the municipal systems are shown in Figure A.3, and a summary of the municipal groundwater systems is provided in Table 4. Public well records that were identified for the municipal systems are included in Appendix D. It is noted that the reported groundwater withdrawal limit of these systems ranging from 393 to 4,605 m^3/day may not reflect the maximum safe yield of the aquifers they exploit.

Table 4. Reviewed Municipal Groundwater Supplies

Source ID	Aquifer Formation	Number of Wells	Groundwater Withdrawal Limit (m^3/day)
Crysler	Crysler-Finch Esker	2	1,685
Finch	Limestone and / or Shale Bedrock	2	778
Limoges	Vars-Winchester Esker	2	2,080
Moose Creek	Shale Bedrock / Dunvegan-Maxville-Warina Esker	3	940
Newington	Crysler-Finch Esker	2	393
Chesterville	Vars-Winchester Esker	2	4,605
Winchester (Well Field 7)	Vars-Winchester Esker	3	2,955
Winchester (Well 1)	Dolostone and/or Limestone Bedrock	1	752
Winchester (Well 5)	Dolostone and/or Limestone Bedrock	1	657
Winchester (Well 6)	Dolostone and/or Limestone Bedrock	1	717
Vars	Vars-Winchester Esker	2	2,290

The following subsections provide a general overview of the active drinking water supplies used by nearby municipalities.

3.7.1 Limoges

The Limoges water supply is a mixed supply owned by the Nation that incorporates groundwater withdrawn from the Vars-Winchester esker using two wells west of Limoges (withdrawal limit of

2,080 m^3/day), and the Ottawa River via the Clarence-Rockland municipal system (30-year maximum daily supply of 6,257 m^3/day; The Nation Municipality, 2022).

The wells are regarded as a groundwater supply under the direct influence of surface water, and groundwater is treated accordingly using coagulation, flocculation, sedimentation, filtration, and chlorination.

Water quality results have been generally acceptable over the past five years in the context of the OWDQS (The Nation Municipality, 2023, 2022, 2021, 2020a, 2019), although the primary production well has been experiencing annually increasing turbidity levels. It is uncertain if the root cause of this increase has been investigated. Treated surface and groundwater are mixed before being delivered to the municipal distribution system servicing approximately 1,400 residential connections and 30 hectares of industrial, commercial, and institutional land (The Nation Municipality, 2022).

The Clarence-Rockland system was connected in April 2022 and supplied approximately 25% of the total water usage of the town for that year (The Nation Municipality, 2022). The connection to the Clarence-Rockland system was motivated by a combination of increasing future water demands, limited local groundwater resources, and limited alternative sources of drinking water. During the options analysis performed to evaluate different water supply options for Limoges (The Nation Municipality, 2020b), several findings were noted that may support this investigation:

- Three exploratory wells were installed within the Vars-Winchester esker to assess the option of meeting future water demands by expanding groundwater extraction.
    - Pumping tests were performed by Golder Associates in 2014, who concluded that only two wells capable of producing 11.2 L/s (968.7 m^3/day) each could be sustainably pumped at the tested location (maximum total flow of 1,935 m^3/day).
    - This was inadequate to meet the growing water needs of Limoges (30-year maximum daily demand of 7,076 m^3/day).
- Purchasing the Embrun/Marionville groundwater supply was considered but excluded due to the risk of being permanently shut down because of groundwater contamination associated with an adjacent landfill site.
- The Township of Russell's agreement with the City of Ottawa restricted their water infrastructure "for the use and benefit of Russel Township residents" only (The Nation Municipality, 2020b), meaning negotiations and alterations to the agreement would likely be needed to permit extension of the infrastructure for Casselman's purposes. Further, the cost of water and the compromised negotiating position of this option were not considered amenable to The Nation Municipality when their assessment was performed (The Nation Municipality, 2020b).
- The Clarence-Rockland system was not offering sufficient water to meet the future water demand without supplementation by another source.

3.7.2 Vars

The Vars drinking water system is owned and operated by the City of Ottawa. The system comprises of two drilled overburden wells with approximate depths of 24.3 metres (see Figure A.3 for location of well system) and serves approximately 1,206 people with a design capacity of 2,290 m^3/day (City of Ottawa, 2019). The source aquifer is the Vars-Winchester esker, with the gravel core serving as the primary water yielding unit. The esker is bounded by silty glaciomarine clays, underlain by glacial till, and capped by silty sand of variable thickness (WESA, 1992). The Carlsbad bedrock formation lies beneath the esker, which is known to be sulphurous and high in iron (WESA, 1992).

The source water is reported to be mildly corrosive, supersaturated in calcium carbonate, high in organic carbon, colour, iron, and manganese (City of Ottawa, 2023; WESA, 1992), and to have a sulphurous smell (MECP, 2021). Treated water quality has been generally acceptable (City of Ottawa, 2023, 2022, 2021, 2020, 2019a); however, sodium levels are regularly above the ODWQS warning level of 20 mg/L in treated water. This may be a symptom of treatment with sodium hypochlorite or by virtue of the geologic materials.

Annual reports provide limited information regarding the raw water quality of the source aquifer (i.e., the Vars-Winchester esker). The communal water supply well has not been reported to present with indications of surface water influence (MECP, 2009), but may be intrinsically vulnerable due to its construction and source aquifer. Regardless, the aquifer water quality was deemed preferable compared to other formations in the area (WESA, 1992).

Analyses of a step test and long-term pumping test performed within the primary production well (WESA, 1992) suggested that the well could likely sustain greater withdrawal than the designed capacity of the system of 2,290 m^3/day. WESA (1992) computed a safe perennial yield of 3,606 m^3/day, accounting for a reduction in yield to account for well efficiency and a safety factor, and a theoretical 20-year aquifer yield of 6,009 m^3/day.

Aquifer recharge to the esker was explored in subsequent studies and was proposed to be between 15 and 32% or precipitation (MECP, 2009c).

3.7.3 Crysler

Crysler's drinking well supply is considered groundwater under the direct influence of surface water (GUDI) with in-situ filtration that services approximately 600 residents (WESA, 2011a). The system is owned by the Township of North Stormont and has a maximum design capacity of 1,685 m^3/day. A primary and backup 10-inch drilled well are believed to be installed within gravel and sand of the Crysler-Finch esker (MECP, 2009a; MECP, 2021) to approximate depths of 12.2 and 13.4 mbgs, respectively (OCWA, 2019a).

Only the 2018 annual report and 2009 and 2012 MECP drinking water system inspections were located for review to assess the water quality of the aquifer. Reported water quality within these three reports was generally favourable when compared to the OWDQS, noting there were exceedances of total coliform in 2018 in the raw and treated water (OCWA, 2019a). Variability in total coliform and heterotrophic plate counts between samples are likely indicative of surface influences, whereas turbidity measurements were relatively stable between measurements.

3.7.4 Moose Creek

The Moose Creek municipal system is owned by the Township of North Stormont and was reported to be serving approximately 300 people in 2016 (MECP, 2017). The system is described to consist of three drilled, 8-inch water supply wells that are installed at depths ranging between 14.3 and 32.0 mbgs (OCWA, 2019c). The newest well is 14.3 metres deep and targets a sand and gravel deposit and a shale bedrock interface aquifer (WESA, 2011a). This well is used as the primary production well, which is supplemented by the other two wells that alternate weekly (MECP, 2017). The original primary well was decommissioned in 2002 and replaced due to low well yield (MECP, 2009b). The deeper wells are reportedly completed within the shale bedrock, which is prone to producing sulphurous waters based on a review of nearby well records (MECP, 2021).

The maximum allowable flow from the primary well is 642 m^3/day and for the secondary wells is 298 m^3/day each (OCWA, 2019c). These wells (Figure A.3) are installed near the mapped area of the Dunvegan-Maxville-Warina System identified by Gorrell (1991).

3.7.5 Finch

The Finch municipal supply is owned by the Township of North Stormont and consists of two groundwater productions wells (OCWA, 2019b). The primary well is drilled to 54 mbgs and is equipped with a pump with a rated capacity of 5.0 L/s, whereas the second well was drilled to 54 mbgs and equipped with a pump with a rated capacity 9.5 L/s. The treatment system was designed for 777.6 m^3/day, which is reflected in the maximum daily water taking from either well in the Permit To Take Water for the facility.

A thin gravel and sand deposit was identified atop the bedrock (MECP, 2021). The utilized bedrock aquifer is reported to be characterised by elevated levels of hydrogen sulphide, hardness, and sodium (MECP, 2004). A forced aeration system is installed to manage hydrogen sulphide, and sodium hypochlorite is used for disinfection. In the 2018 annual report (OCWA, 2019b), raw water had relatively stable turbidity readings across both wells and there were no recorded instances of *E. coli* or total coliforms.

3.7.6 Newington

The Village of Newington municipal supply is owned by the Corporation of the Township of South Stormont (CW&SO, 2021) and services a population of approximately 150 people. The system consists of a well dug to 5 mbgs and a secondary drilled well that reaches 15 mbgs (CW&SO,

2021). When the water level within the shallow well declines during dry periods, the secondary well is operated for modest yields of up to 65.5 m^3/day.

The treatment systems consist of cartridge filtration and sodium hypochlorite disinfection. No adverse water conditions in the raw or treated water were reported for the 2020 reporting year (CW&SO, 2021); however, some of the raw water samples had detectable total coliform.

Well records surrounding the reported well locations frequently indicate the presence of water bearing sand, gravel, and boulders atop limestone bedrock (MECP, 2021).

3.7.7 North Dundas Drinking Water System

The Winchester and Chesterville groundwater supply wells are collectively known and managed as the North Dundas Drinking Water System (OCWA, 2023). Like Casselman, the municipality of North Dundas is reportedly evaluating their system in the context of their future water demands via a Class Environmental Assessment (Morin, 2022). The present system consists of 8 groundwater production wells (OCWA, 2023) distributed throughout the municipality:

- Chesterville wells 5 and 6 have a combined capacity of 4,605 m^3/day.
    - Wells are installed between 9.5 and 12.5 mbgs within coarse gravel, sand, and boulders (MECP, 2021) in the area mapped as the Vars-Winchester esker by Gorrell (1991).
- Winchester wells 1, 5, and 6 have reported pumping capacities of 752, 657, and 717 m^3/day, and well depths are reported as 57.9, 28.0, and 15.9 mbgs, respectively (OCWA, 2023).
    - Well 1 was reportedly completed in limestone bedrock. The total depth of the borehole is reported as 94.5 mbgs in the well record (Appendix D; MECP, 2021), which is much deeper than the well depth reported in the annual reports for the system (OCWA, 2023).
    - Wells 5 and 6 were reportedly completed in dolomite and/or limestone bedrock.
- Winchester well field 7 has 3 wells (7A, 7B, and 7C) with a combined pumping capacity of 2,955 m^3/day.
    - Well depths are between 12 and 15 mbgs within gravel, sand, and till deposits in locations mapped as the Vars-Winchester esker (Gorrell, 1991).
    - At least two of the three wells report only 50 cm of drawdown after 72 hours of pumping at 1,635 m^3/day, suggesting that the theoretical yield is higher than the reported withdrawal limits of the pumps.

The annual reports for the North Dundas drinking water system were reviewed for the previous five years (OCWA, 2023, 2022, 2021, 2020, 2019d). The only adverse water quality condition reported over this monitoring period included sodium exceedances above 20 mg/L in Winchester wells 5 and 6 on January 17, 2022. Aesthetic water colour complaints have been reported between 2020 and 2022, including 7 for Winchester wells and 30 for Chesterfield Wells (Morin, 2022). No instances of *E.coli*. in the raw water were reported over this monitoring period; however, instances of total coliform have been noted every year, though it is unclear in which wells, and the turbidity of raw water from the many supplies present with a broad range. Treatment is reported to include sodium hypochlorite disinfection only (OCWA, 2023).

4.0 FUTURE GROUNDWATER SUPPLY, PRELIMINARY ASSESSMENT

Although private residences utilise non-esker overburden units (Basin Sand/Mud and till), they are not anticipated to be practical for large-scale municipal applications due to low yields or quality. It is likely that a large well field would be needed at the rates reflected in the well records to meet the target water demand of Casselman.

The opportunities for a municipal groundwater supply for Casselman include the upper fractured Paleozoic bedrock, which may connect to overlying overburden units, and sand and gravel deposits of the Crysler-Finch esker. Many eskers have been utilised for municipal water supplies in eastern Ontario (Figure A.3). Cummings (2008) reports that the Crysler-Finch esker may be expected to make an effective aquifer due to its storage properties and high hydraulic conductivity. Conversely, bedrock aquifers are more likely to be saline or mineralised.

4.1 Crysler-Finch Esker (Preferred Aquifer – Preliminary)

There remains much uncertainty relating to the local morphology of the Crysler-Finch esker, including the thickness, extent, and connectivity of the aquifer; however, the Crysler-Finch esker is a locally available source, and eskers in eastern Ontario have been demonstrated to serve as effective drinking water supplies to many nearby municipalities. Using local water resources keeps the ownership and costing of the water supply within Casselman's control.

To establish an effective groundwater supply, Casselman needs to decide on a potential aquifer, secure access to the aquifer, evaluate the water quality of the aquifer, and assess how much water can be sustainably withdrawn from the aquifer. GEMTEC recommends that Casselman evaluates opportunities for accessing and evaluating the Crysler-Finch esker. If cost-effective opportunities exist, we recommend a preliminary intrusive investigation involving a boring and hydraulic testing program to inform subsequent decision-making regarding water supply, design considerations, financial assessments, and other stakeholder issues.

It should be noted that studies have been performed evaluating the extent of the Crysler-Finch esker in proximity of Casselman using boreholes and seismic surveys. These studies were not reviewed as part of this investigation due to availability but include at least Pullan et al. (2007, 2008), Cummings et al. (2009), and Pugin et al. (2008). These data could be considered by GEMTEC as a next stage to further inform the evaluation and accelerate intrusive investigations.

The following subsections summarize the findings that relate to the feasibility of a local groundwater supply for Casselman.

4.1.1 Water Quantity

From a water volume perspective, the most favourable potential aquifer is anticipated to be the gravel core of the Crysler-Finch esker. Overburden thickness is mapped as highly variable (3 – 30 metres; Gao, 2006) surrounding where the esker is believed to be located, and the thickness of the esker deposits in the vicinity of Casselman are anticipated to be up to 15 metres thick (SN-GSC-UO, 2007). The esker formation may be hydraulically connected to the surrounding glacial tills, interface aquifer, or surface water features, and it is expected that the level of isolation from surface processes permitted by Basin Muds varies spatially. The extent, depth, water yield, and water quality of the Crysler-Finch esker would need to be investigated further via intrusive studies.

For context, active municipal supplies in the region report withdrawal limits of 393 to 4,605 m^3/day. The values tabulated in Section 3.7 typically reflect either the municipal demand for which the system was designed or the estimated safe yield of the esker and may not reflect the maximum safe yield of the aquifer; in fact, these water uses would be bias to remain below the maximum safe yield of the aquifers they exploit. For example, the reported withdrawal limit for the Vars municipal groundwater system is 2,290 m^3/day, whereas the supply feasibility study (WESA, 1992) proposed a safe perennial yield of 3,606 m^3/day and a 20-year theoretical yield of 6,009 m^3/day. Additionally, SN-GSC-UO (2007) indicates that wells installed within the Vars-Winchester esker commonly exceed 2,725 m^3/day, although the Crysler-Finch esker is anticipated to be smaller and more discontinuous. Nonetheless, available information suggests that two or more distanced wells would be required to meet the proposed water demand of Casselman, with additional backup wells for redundancy.

4.1.2 Water Quality

The water quality of the Crysler-Finch esker remains uncertain but may be expected to be susceptible to surface water impacts in locations where Basin Muds pinch out or have been eroded, exposing the more conductive sand or gravel of the esker formation.

The water qualities were variable between the municipal source water supplies reviewed as they were distributed over a large spatial extent. Results frequently indicated possible surface water influences in the municipal supply wells (i.e., nitrates, organic nitrogen, total coliform, DOC, and variable turbidity). All supplies reviewed were treatable to meet ODWQS; however, different treatment systems were employed depending on the perceived risk of surface water impacts, aesthetic issues with the source water, and volume throughput.

Water quality data within a five-kilometre radius of Casselman was reviewed from the Provincial Groundwater Monitoring Network, Ambient Groundwater Geochemistry Project, and public well records. Water quality regularly indicated the potential for surface water influences in the tested wells and excessive boron concentrations (may be attributable to drilling muds). Interface and deep bedrock well water presented as significantly mineralized. Sulphur and saline water conditions were near-exclusively associated with bedrock or bedrock interface wells. Numerous exceedances of health-based, aesthetic, and operational standards were noted and would require consideration during well construction, well siting, and design of treatment systems.

4.1.3 Potential Sources of Groundwater Contamination

Several possible indicators of surface water influences were identified in the review of local water quality data and other municipal systems. Therefore, it is reasonable to expect that overburden and shallow bedrock systems surrounding Casselman may be susceptible to surface water influences depending on the local conditions. A preliminary review of potential sources of contamination in proximity of the Crysler-Finch esker (Figure A.1) was undertaken and noted:

- Agricultural land uses (e.g., livestock, crops, and machine storage);
- Commercial and industrial land-uses (e.g., vehicle service garages, gas stations, sewage works, pesticide storage, and golf course);
- Runoff from roadways, ditches, and highways entraining vehicle contamination and road salt;
- Landfill facilities (e.g., Casselman Landfill and GFL Environmental Incorporated);
- Railway;
- Drilling muds;
- Existing groundwater wells and septic systems; and
- Surface water features (e.g., tributaries to the South Nation River, agricultural drains, storage lagoons, and wetlands).

The potential sources of contamination listed above is non-exhaustive and is meant to illustrate source water protection measures that would need to be considered when identifying potential communal water supply well locations and policies.

5.0 FINAL REMARKS

It is anticipated that the process of confirming and ultimately accessing the most appropriate water source to meet the growing demands of Casselman will be a multi-year process with input from a diverse range of stakeholders. This desktop study of groundwater resources has identified the Crysler-Finch esker as the most likely aquifer capable of supplying groundwater at a municipal scale. Some possible constraints and future work requirements associated with the use of the Crysler-Finch esker as a municipal supply for Casselman include:

1. It is likely that no part of the esker is located within the municipal boundaries of Casselman, necessitating land-use arrangements or land procurement.

2. Intrusive borehole and pumping test investigations would be required to confirm water quality and quantity.

    a. For comparison, the Vars-Winchester Esker, a larger and more extensive regional esker system in the area, has reported individual safe well yields of at approximately 969 to 3,606 m^3/day.

    b. Multiple test wells completed in the proposed water supply aquifer would be required to support technical studies, including at least 72-hour constant rate pumping tests. An Environmental Activity Sector Registry (EASR) is required for pumping tests withdrawing more than 50,000 litres per day.

    c. The volume and quantity of water available from the Crysler-Finch esker is uncertain and may not be able to meet future demands independently. Multiple supply wells may be required to meet future demand requirements.

    d. The Crysler-Finch esker may be a groundwater supply under the influence of surface water, necessitating additional treatment control measures and monitoring. Further, treatment for aesthetic parameters (e.g., iron, hydrogen sulphide, TDS) will likely be required based on available data.

3. A wellhead protection delineation study and land-use inventory would be required.

4. Potential for well interference with existing users and groundwater contamination would need to be assessed.

5. There are several established commercial, municipal, and industrial land-uses surrounding the esker that may conflict with wellhead protection measures. The feasibility of instituting land-use policies to protect the aquifer would need to be assessed.

6. Changing the water chemistry of the source water significantly would need to be assessed with respect to possible effects on the distribution system. Changes in mineral content, oxidation reduction potential, temperature, etc. can have temporary effects on water quality within the distribution system.

7. New treatment facilities would likely be required to treat a groundwater supply.

Detailed assessment of the relative cost of developing a groundwater municipal supply system using the preferred aquifer, or performance of a cost-benefit analysis of the preferred aquifer in comparison to other available options was outside of the scope of this investigation. For consideration, the timeline for the completion of a preliminary hydrogeological assessment of the Crysler-Finch aquifer is expected to be a multi-year process to allow for test well siting and drilling, hydraulic testing, preliminary wellhead delineation studies and regulatory approvals.

6.0 CLOSURE

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.

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misrepresentations. or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

10. **Investigation Limitations:** Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions but even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions.

    The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies. Accordingly, GEMTEC does not warrant or guarantee the exactness of of the subsurface descriptions.

    Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

    In addition, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

11. **Sample Disposal:** GEMTEC will dispose of all uncontaminated soil and/or rock samples 60 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fill materials or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

12. **Follow-Up and Construction Services:** All details of the design were not known at the time of submission of GEMTEC's report. GEMTEC should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of GEMTEC's report.

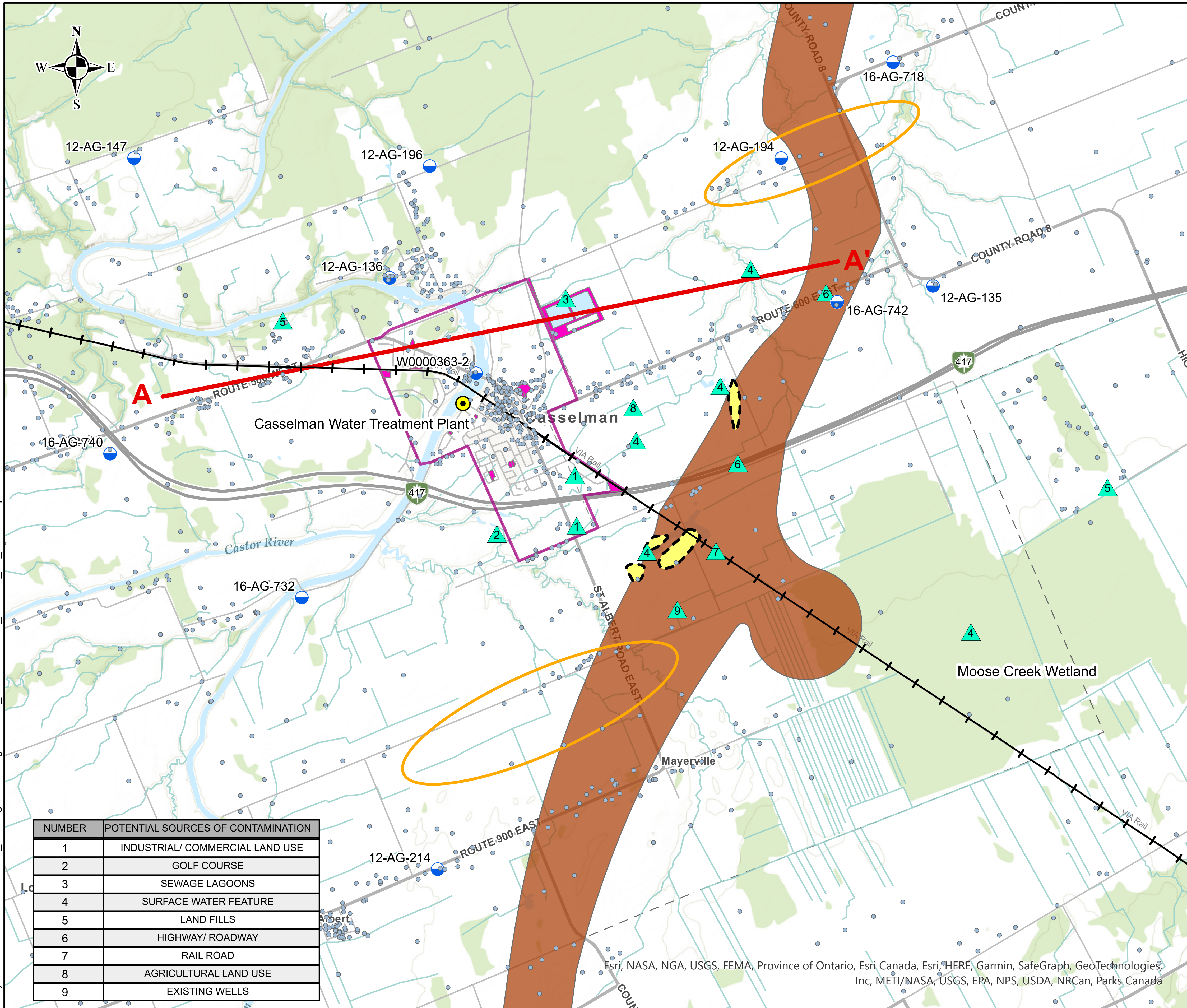
    During construction, GEMTEC should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of GEMTEC's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in GEMTEC's report. Adequate field review, observation and testing during construction are necessary for GEMTEC to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, GEMTEC's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

13. **Changed Conditions:** Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that GEMTEC be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that GEMTEC be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

14. **Drainage:** Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. GEMTEC takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX A

Project Figures



NUMBER	POTENTIAL SOURCES OF CONTAMINATION
1	INDUSTRIAL/ COMMERCIAL LAND USE
2	GOLF COURSE
3	SEWAGE LAGOONS
4	SURFACE WATER FEATURE
5	LAND FILLS
6	HIGHWAY/ ROADWAY
7	RAIL ROAD
8	AGRICULTURAL LAND USE
9	EXISTING WELLS

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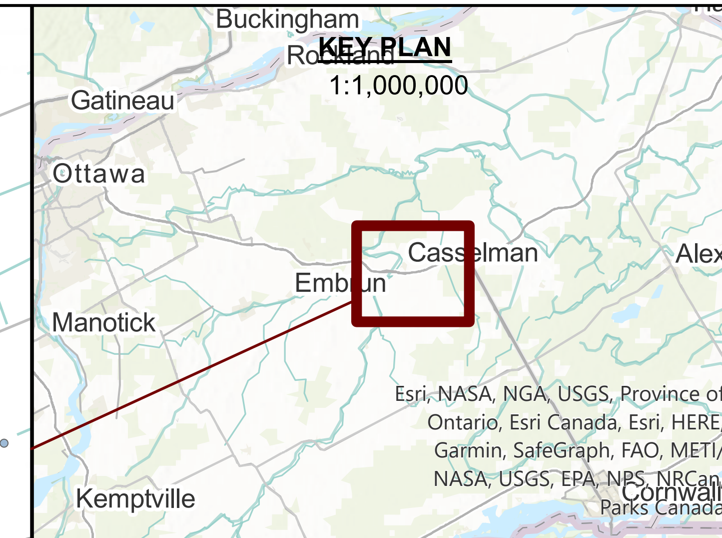


LEGEND

- MECP WELL
- CASSELMAN WATER TREATMENT PLANT
- WATER QUALITY SAMPLE LOCATIONS
- POTENTIAL SOURCES OF CONTAMINATION
- RAIL LINE
- 2-D TRANSECT LINE
- APPROXIMATE LOCATION OF SEISMIC PROFILE STUDY BY LOGAN ET AL. (2009)
- ESKER OUTCROP4
- MUNICIPALLY OWNED LAND
- CASSELMAN MUNICIPAL BOUNDARY
- CRYSLER-FINCH ESKER

NOTES:
1. Coordinate system: NAD83/ UTM zone 18N.
2. Geographic dataset source: Ontario GeoHub.
3. Contains information licensed under the Open Government Licence – Ontario.
4. Esker mapping is a rough approximation based on Gorrel (1991)

Scale:
1:50,000
0 650 1,300 2,600 3,900 Meters

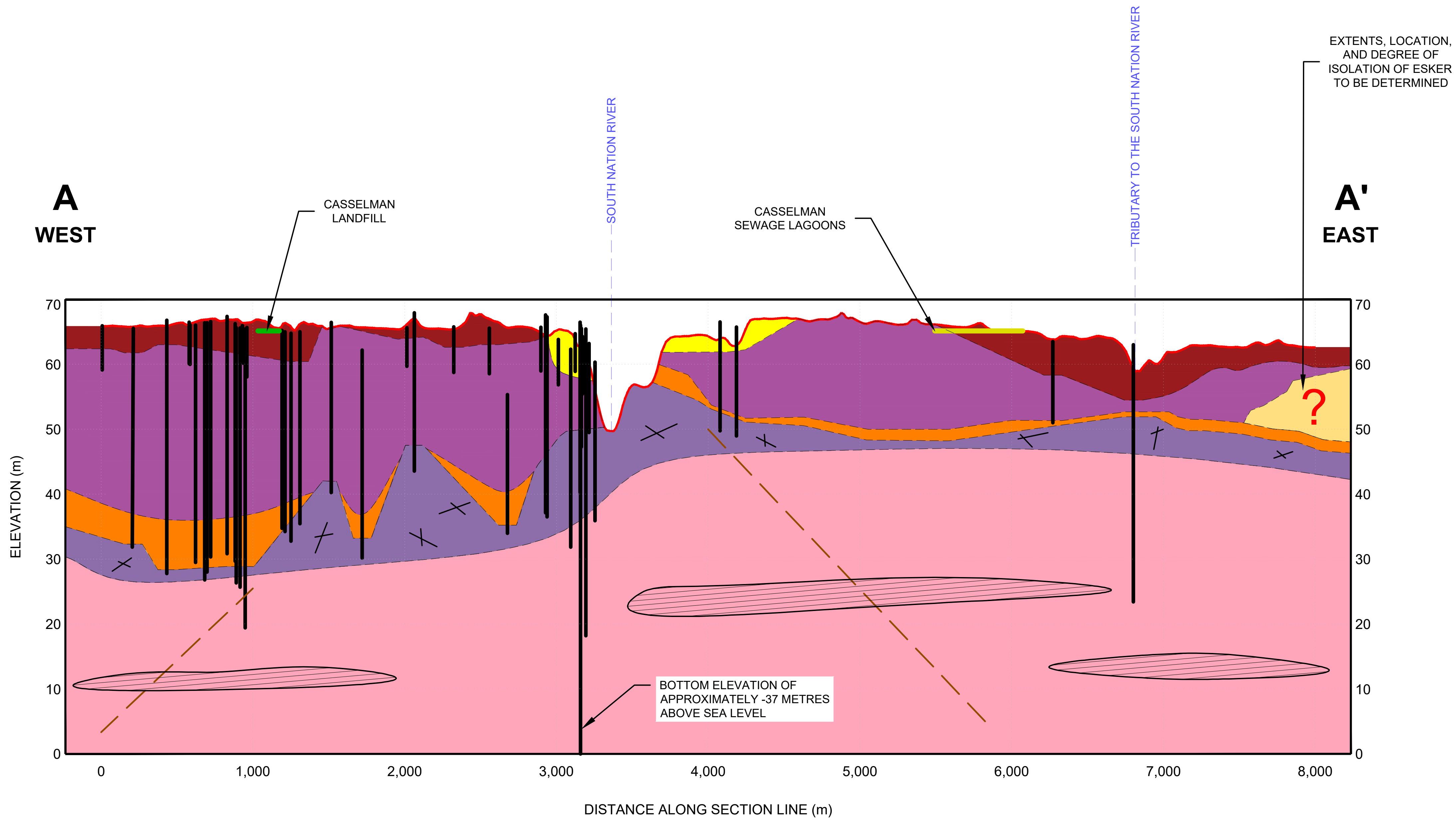
Drawing
WATER SUPPLY SYSTEMS AND ESKER FORMATIONS

Client:
J. L. RICHARDS AND ASSOCIATES LIMITED

Project
DESKTOP REVIEW OF WATER SUPPLY FEASIBILITY
VILLAGE OF CASSELMAN, ONTARIO

Drwn By:	S.L.	Chkd By:	J.KA.
Project No.	100117.050	Revision No.	0
Date	DECEMBER 2023		FIGURE A.1

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS
32 Steacie Drive
Ottawa, ON, K2K 2A9
Tel: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca



LEGEND

- ONTARIO DEM GROUND SURFACE
- INFERRED STRATIGRAPHIC BOUNDARY
- FAULT
- GROUNDWATER WELL

STRATIGRAPHY

- RIVER DEPOSIT
- BASIN SAND
- BASIN MUD
- CRYSLER FINCH ESKER
- GLACIAL TILL
- LIMESTONE WITH SHALE INTERBEDS (HIGHLY FRACTURED)
- LIMESTONE WITH SHALE INTERBEDS

NOTES:

1. SEE FIGURE A.1 FOR LOCATION OF TRANSECT.
2. THE BOREHOLE LOGS ARE LOCATED WITHIN 500 METERS OF THE MAPPED TRANSECT IN FIGURE.
3. THIS FIGURE IS ONLY A ROUGH APPROXIMATION OF GEOLOGICAL CONDITIONS BASED ON WELL RECORDS, MAPPING, AND REVIEWED REPORTS.

HORIZONTAL SCALE
1:30,000
0 0.5 1 1.5 2km

VERTICAL SCALE
43x HORIZONTAL SCALE

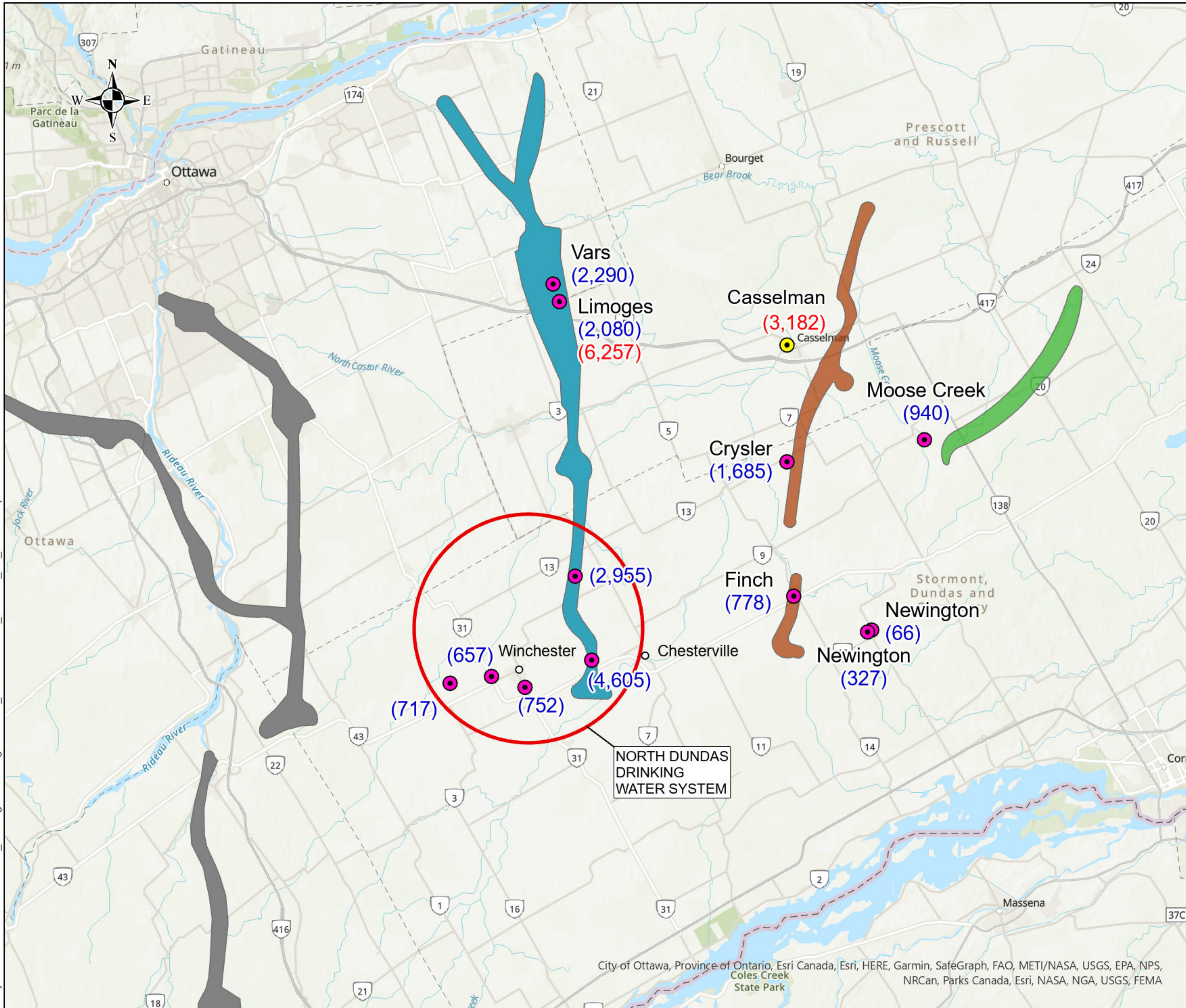
DRAWING
CONCEPTUAL CROSS SECTION A - A'

CLIENT
J. L. RICHARDS AND ASSOCIATES LIMITED

PROJECT
DESKTOP REVIEW OF WATER SUPPLY FEASIBILITY
VILLAGE OF CASSELMAN, ONTARIO

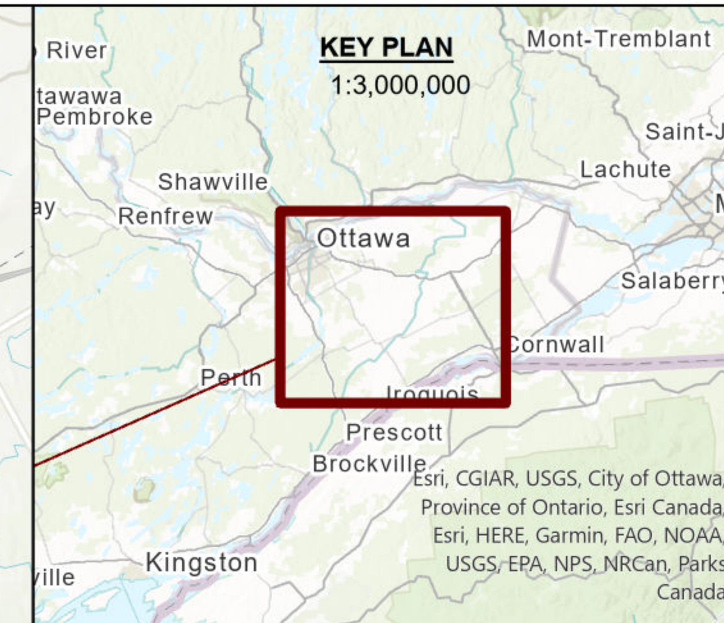
DRAWN BY	CHECKED BY
SL	JKA
PROJECT NO.	REVISION NO.
100117.050	0
DATE	FIGURE NO.
DECEMBER 2023	**FIGURE A.2**

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS
32 Steacie Drive
Ottawa, ON, K2K 2A9
Tel: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca



KEY PLAN

1:3,000,000



LEGEND

(X,XXX) GROUNDWATER CAPACITY, m^3 PER DAY
(X,XXX) SURFACE WATER CAPACITY, m^3 PER DAY
CASSELMAN WATER TREATMENT PLANT
MUNICIPAL SUPPLY WELL LOCATIONS

ESKER FORMATIONS
CRYSLER-FINCH ESKER
DUNVEGAN-MAXVILLE-WARINA ESKER
VARS-WINCHESTER ESKER
OTHER ESKER FORMATIONS

NOTES:
1. Coordinate system: NAD83/ UTM zone 18N.
2. Geographic dataset source: Ontario GeoHub.
3. Contains information licensed under the Open Government Licence – Ontario.
4. Esker mapping is a rough approximation based on Gorrel (1991)

Scale:
1 : 300,000
0 6,000 12,000 24,000 Meters

Drawing
WATER SUPPLY SYSTEMS AND ESKER FORMATIONS

Client:
J. L. RICHARDS AND ASSOCIATES LIMITED

Project
DESKTOP REVIEW OF WATER SUPPLY FEASIBILITY
VILLAGE OF CASSELMAN, ONTARIO

Drwn By:	S.L.	Chkd By:	J.KA.
Project No.	100117.050	Revision No.	0
Date	DECEMBER 2023		**FIGURE A.3**

GEMTEC
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Tel: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

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APPENDIX B

MECP Public Well Records Summary Table

MECP Online Well Database Summary (2-km Radius)

ID	Township	Completion Date (yyyy-mm-dd)	Water Use	Well Depth (m)	Bedrock Depth (m)	Minimum Casing Depth (m)	Static Water Levels (m)	Water Types and Bearing Zone Depths (ft)	Stratigraphic Layers (ft)
7046391	CAMBRIDGE TOWNSHIP 05 015	2007-07-06	DO	6.5		6.5	2.4	FR 0008	BLCK LOAM 0001 YLLW SAND 0005 GREY SAND 0010 BLUE CLAY 0021
7050360	CASSELMAN VILLAGE 08	2007-08-17	DO	19.8	13.7	15.5		FR 0060	BRWN CLAY 0012 GREY GRVL STNS SAND 0045 GREY SHLE 0065
7052082	CAMBRIDGE TOWNSHIP 05 010	2007-11-02	DO	6.5		6.5	2.7	FR 0009	BLCK LOAM 0001 YLLW SAND 0006 GREY SAND 0011 BLUE CLAY 0021
5201985	ALFRED TOWNSHIP CON 06 005	1984-11-10	DO	12.5		12.5	3.0	FR 0041	RED CLAY 0017 BLUE CLAY 0040 BLCK GRVL 0041
5600086	CASSELMAN VILLAGE	1956-04-03	DO	15.2	13.1	13.1	2.1	FR 0050	CLAY 0020 HPAN 0040 GRVL 0043 LMSN 0050
5600087	CASSELMAN VILLAGE	1954-08-15	DO	12.8	12.2	12.2	3.0	FR 0030	LOAM MSND 0006 BLUE CLAY 0035 HPAN 0040 SHLE 0042
5600088	CASSELMAN VILLAGE	1956-04-04	DO	15.2	14.0	14.0	2.4	FR 0047	CLAY 0036 HPAN 0046 LMSN 0050
5600089	CASSELMAN VILLAGE	1953-11-20	DO	14.0		14.0	3.7	FR 0038	LOAM MSND 0005 BLUE CLAY 0040 GRVL 0046
5600090	CASSELMAN VILLAGE	1957-03-26	DO	13.7		13.7	6.7	FR 0045	RED CLAY 0008 BLUE CLAY 0034 MSND 0043 GRVL 0045
5600091	CASSELMAN VILLAGE	1949-08-06	DO	11.0		11.0	8.8	FR 0036	CLAY 0010 GRVL MSND 0036
5600092	CASSELMAN VILLAGE	1953-10-08	DO	13.4		12.8	5.8	FR 0042	BLUE CLAY 0020 HPAN CLAY 0025 GREY QSND 0042 GRVL 0044
5600093	CASSELMAN VILLAGE	1964-02-12	DO	18.0	15.2	15.2	4.6	SU 0053	YLLW LOAM 0007 BLUE CLAY 0035 MSND 0045 GRVL 0050 GREY ROCK 0059
5600094	CASSELMAN VILLAGE	1962-09-07	DO	18.3	12.2	12.2	3.0	FR 0055	CLAY 0018 HPAN 0040 LMSN 0060

AC = Cooling and A/C
CO = Commercial
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IN = Industrial
IR = Irrigation
MN = Municipal
MO = Monitoring
MT = Monitoring and Test Hole
NU = Not Used
OT = Other
PS = Public
ST = Livestock
TH = Test Hole

ID	Township	Completion Date (yyyy-mm-dd)	Water Use	Well Depth (m)	Bedrock Depth (m)	Minimum Casing Depth (m)	Static Water Levels (m)	Water Types and Bearing Zone Depths (ft)	Stratigraphic Layers (ft)
5600095	CASSELMAN VILLAGE	1963-09-23	DO	15.2		15.2	6.1	FR 0050	RED CLAY 0021 HPAN 0047 GRVL MSND 0050
5600096	CASSELMAN VILLAGE	1963-10-17	DO	18.3	14.3	14.3	9.1	FR 0047	LOAM MSND 0010 HPAN 0040 MSND 0047 LMSN 0060
5600097	CASSELMAN VILLAGE	1962-09-15	CO	32.9	14.0	14.0	5.5	FR 0105	GREY LOAM 0020 HPAN 0046 GREY ROCK 0108
5600098	CASSELMAN VILLAGE	1960-07-25	DO	15.8	15.2	15.2	4.6	FR 0052	RED CLAY 0005 BLUE CLAY 0022 CLAY STNS 0030 HPAN 0047 GRVL 0050 ROCK 0052
5600099	CASSELMAN VILLAGE	1962-11-03	DO	17.7		17.7	6.1	FR 0058	GREY LOAM 0005 BLUE CLAY 0020 HPAN 0050 MSND 0058
5600100	CASSELMAN VILLAGE	1963-04-02	DO	16.2	15.2	16.2	2.1	FR 0050	RED CLAY 0010 BLUE CLAY 0040 GRVL 0050 GREY ROCK 0053
5600006	CAMBRIDGE TOWNSHIP CON 05 010	1960-09-27	ST DO	25.9	22.9	22.9	19.8	SU 0085	LOAM MSND 0010 CLAY 0065 HPAN 0075 GREY ROCK 0085
5600007	CAMBRIDGE TOWNSHIP CON 05 010	1957-04-12	DO	12.2		12.2	11.0	FR 0040	LOAM 0035 GRVL 0040
5600009	CAMBRIDGE TOWNSHIP CON 05 011	1949-06-16	DO	27.1		27.1	21.0	FR 0089	LOAM 0080 CLAY 0087 MSND 0089
5600016	CAMBRIDGE TOWNSHIP CON 06 005	1955-10-26	ST DO	15.2		15.2	4.9	FR 0045	MSND 0010 BLUE CLAY 0030 QSND 0045 GRVL 0050
5600017	CAMBRIDGE TOWNSHIP CON 06 006	1957-04-05	DO	7.6		7.6	1.8	SU 0025	RED CLAY 0010 BLUE CLAY 0022 GRVL 0025
5600018	CASSELMAN VILLAGE	1964-03-25	DO	9.8	9.1	9.1	2.7	FR 0032	YLLW LOAM 0012 BLUE CLAY 0025 GRVL 0030 GREY ROCK 0032
5600019	CASSELMAN VILLAGE	1968-04-18	CO	16.5	13.4	13.4	2.4	FR 0052	LOAM MSND 0003 RED CLAY 0015 MSND CLAY 0030 HPAN 0038 GRVL MSND 0044 LMSN 0054

AC = Cooling and A/C | CO = Commercial | DE = Dewatering | DO = Domestic | IN = Industrial
IR = Irrigation | MN = Municipal | MO = Monitoring | MT = Monitoring and Test Hole | NU = Not Used
OT = Other | PS = Public | ST = Livestock | TH = Test Hole

MECP Online Well Database Summary (2-km Radius)

ID	Township	Completion Date (yyyy-mm-dd)	Water Use	Well Depth (m)	Bedrock Depth (m)	Minimum Casing Depth (m)	Static Water Levels (m)	Water Types and Bearing Zone Depths (ft)	Stratigraphic Layers (ft)
5600020	CASSELMAN VILLAGE	1968-08-07	DO	15.2	12.5	12.5	2.7	FR 0049	RED CLAY 0005 BLUE CLAY MSND 0015 HPAN 0038 MSND GRVL 0041 GREY LMSN 0050
5600021	CASSELMAN VILLAGE	1968-05-15	DO	18.3	9.4	9.4	9.1	FR 0055	LOAM MSND 0005 RED CLAY 0020 BLUE CLAY MSND 0028 MSND GRVL 0031 GREY LMSN 0060
5600022	CASSELMAN VILLAGE	1967-07-20	DO	18.9	17.1	17.1	6.1	FR 0060	MSND 0005 BLUE CLAY 0022 HPAN STNS 0054 GRVL 0056 LMSN 0062
5600023	CASSELMAN VILLAGE	1968-06-07	DO	18.3	17.4	17.4	9.1	FR 0060	LOAM MSND 0003 BRWN CLAY 0020 HPAN 0055 MSND GRVL 0057 GREY LMSN 0060
5600024	CASSELMAN VILLAGE	1968-07-25	CO	16.5	13.4	13.4	9.1	FR 0052	LOAM MSND 0005 BLUE MSND CLAY 0040 HPAN 0044 GREY LMSN 0054
5600025	CASSELMAN VILLAGE	1968-07-20	CO DO	21.3	17.4	17.4	10.7	FR 0068	BRWN CLAY 0006 RED CLAY 0014 BLUE CLAY 0020 HPAN 0050 MSND GRVL 0057 GREY LMSN 0070
5600026	CASSELMAN VILLAGE	1965-06-01	NU	30.5	11.0	11.6			CLAY 0030 HPAN 0036 ROCK 0100
5600027	CASSELMAN VILLAGE	1963-04-26	DO	20.7		20.7	7.6	FR 0048	CLAY 0055 HPAN 0063 GRVL 0068
5600028	CASSELMAN VILLAGE	1967-09-16	NU	91.4		16.5			CLAY 0045 GRVL 0052 STNS 0300
5600033	CASSELMAN VILLAGE	1964-04-13	DO	12.8	11.6	11.6	2.4	FR 0042	YLLW LOAM 0012 BLUE CLAY 0035 GRVL 0038 GREY ROCK 0040 UNKN UNKN UNKN 0042
5600034	CASSELMAN VILLAGE	1953-10-01	DO	13.4	12.8	12.8	2.4	SU 0044	HPAN 0042 LMSN 0044
5600035	CASSELMAN VILLAGE	1961-11-06	ST DO	21.9	20.4	20.4	6.1	SU 0070	BLUE CLAY 0030 HPAN 0065 GRVL 0067 GREY ROCK 0072
5600039	CAMBRIDGE TOWNSHIP CON 08 007	1950-12-20	DO	12.2		12.2	1.5	FR 0030	HPAN 0030 GRVL 0040

AC = Cooling and A/C
IR = Irrigation
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CO = Commercial
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NU = Not Used

ID	Township	Completion Date (yyyy-mm-dd)	Water Use	Well Depth (m)	Bedrock Depth (m)	Minimum Casing Depth (m)	Static Water Levels (m)	Water Types and Bearing Zone Depths (ft)	Stratigraphic Layers (ft)
5600040	CAMBRIDGE TOWNSHIP CON 08 009	1950-07-01	PS	15.8	11.9	11.9	0.3	FR 0051	CLAY 0038 GRVL 0039 ROCK 0052
5600041	CAMBRIDGE TOWNSHIP CON 08 010	1957-10-26	ST DO	18.6	15.5	15.2	4.3	FR 0060	CLAY 0047 GRVL 0051 GREY LMSN 0061
5600101	CASSELMAN VILLAGE	1963-10-12	DO	14.9		14.9	9.1	FR 0049	LOAM MSND 0010 CLAY 0045 GRVL 0049
5600102	CASSELMAN VILLAGE	1962-08-09	DO	15.2	9.7	10.4	9.8	FR 0045	YLLW GRVL 0010 BLUE CLAY 0025 HPAN 0032 BLCK ROCK 0050
5600103	CASSELMAN VILLAGE	1952-04-26	DO	28.3	13.7	13.7	2.4	FR	CLAY 0045 ROCK 0093
5600104	CASSELMAN VILLAGE	1963-09-19	PS	16.8	11.9	11.9	1.8	FR 0053	GREY LOAM 0010 BLUE CLAY 0027 HPAN 0035 GRVL 0039 ROCK 0055
5600105	CASSELMAN VILLAGE	1960-06-18	DO	16.2	15.2	15.2	1.8	FR 0050	BRWN LOAM 0030 QSND 0050 LMSN 0053
5600106	CASSELMAN VILLAGE	1954-03-10	DO	14.3		12.2	2.1	FR 0047	HPAN 0012 HPAN CLAY 0036 GRVL 0047
5600107	CASSELMAN VILLAGE	1961-11-08	DO	8.2	6.1	7.3	3.0	FR 0027	GREY CLAY 0010 BLUE CLAY 0015 GRVL 0020 GREY LMSN 0027
5600108	CASSELMAN VILLAGE	1961-04-28	DO	18.0	17.7	17.7	6.1	FR 0058	BRWN LOAM 0020 BLUE CLAY 0040 CSND 0058 GREY LMSN 0059
5600110	CASSELMAN VILLAGE	1954-11-12	CO	14.6	13.4	13.4	11.0	FR 0048	BLUE CLAY 0020 HPAN 0044 LMSN 0048
5600111	CASSELMAN VILLAGE	1949-04-07	DO	11.6		11.6	5.2	FR 0017	LOAM 0032 MSND 0038
5600112	CASSELMAN VILLAGE	1959-12-03	CO	17.4	15.8	15.8	6.1	FR 0057	PRDG 0018 HPAN 0035 MSND 0038 HPAN 0050 GRVL 0052 LMSN 0057

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MECP Online Well Database Summary (2-km Radius)

ID	Township	Completion Date (yyyy-mm-dd)	Water Use	Well Depth (m)	Bedrock Depth (m)	Minimum Casing Depth (m)	Static Water Levels (m)	Water Types and Bearing Zone Depths (ft)	Stratigraphic Layers (ft)
5600113	CASSELMAN VILLAGE	1949-10-01	DO	14.6	13.1	13.1	2.1	FR 0043	LOAM 0038 MSND 0043 ROCK 0048
5600114	CASSELMAN VILLAGE	1949-10-19	DO	13.4		13.4	10.7	FR 0044	LOAM 0038 MSND 0044
5600115	CASSELMAN VILLAGE	1949-08-15	DO	11.9		11.9	8.8	FR 0039	CLAY 0010 GRVL MSND 0039
5600116	CASSELMAN VILLAGE	1954-11-06	DO	12.2		12.2	3.7	FR 0028	BLUE CLAY 0025 HPAN 0035 GRVL 0040
5600117	CASSELMAN VILLAGE	1954-11-23	DO	11.9		11.9	4.6	FR 0024	BRWN CLAY 0010 BLUE CLAY 0025 MSND 0034 GRVL 0039
5600118	CASSELMAN VILLAGE	1961-10-19	DO	14.0	13.4	13.4	5.5	FR 0045	HPAN 0020 QSND 0027 HPAN STNS 0042 GRVL 0044 LMSN 0046
5600119	CASSELMAN VILLAGE	1961-07-07	PS	21.9	18.6	18.3	9.1	FR 0070	LOAM MSND 0005 BLUE CLAY 0025 HPAN 0059 GRVL 0061 GREY LMSN 0072
5600120	CASSELMAN VILLAGE	1961-05-12	PS	22.9	16.5	16.5	9.1	FR 0054 FR 0070	LOAM MSND 0005 BLUE CLAY 0025 HPAN 0053 GRVL 0054 GREY LMSN 0075
5600121	CASSELMAN VILLAGE	1960-09-22	PS	18.0	16.5	16.5	9.1	FR 0054	BRWN LOAM 0010 GREY CLAY 0020 MSND 0054 LMSN 0059
5600122	CASSELMAN VILLAGE	1960-04-30	PS	62.2	13.4	13.4	1.2	SU 0200	BRWN LOAM 0020 BLUE CLAY 0040 MSND 0044 GREY LMSN 0204
5600123	CASSELMAN VILLAGE	1954-08-05	DO	14.0		14.0	4.6	FR 0046	YLLW LOAM 0005 BLUE CLAY 0035 HPAN 0041 GRVL 0046
5600124	CASSELMAN VILLAGE	1949-03-15	DO	14.6	13.1	13.1	2.4	FR 0048	HPAN 0020 CLAY 0035 HPAN 0040 GRVL 0043 ROCK 0048
5600125	CASSELMAN VILLAGE	1952-11-12	DO	12.8		12.8	1.8	FR 0025	HPAN BLDR 0010 BLUE CLAY 0025 GREY MSND 0042

AC = Cooling and A/C | CO = Commercial | DE = Dewatering | DO = Domestic | IN = Industrial
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5600126	CASSELMAN VILLAGE	1952-10-08	DO	12.5	11.9	12.5	7.6	FR 0041	CLAY 0030 GRVL 0039 ROCK 0041
5600127	CASSELMAN VILLAGE	1952-07-29	DO	20.7		20.7	8.5	FR 0028	MSND 0005 CLAY 0025 HPAN 0046 GRVL 0068
5600128	CASSELMAN VILLAGE	1953-11-03	DO	14.9	14.3	14.3	3.7	FR 0049	CLAY 0015 HPAN 0040 GRVL 0047 ROCK 0049
5600129	CASSELMAN VILLAGE	1953-09-17	DO	17.7	15.2	15.2	3.7	FR 0042	CLAY 0030 GREY CLAY HPAN BLDR 0042 GRVL 0050 LMSN 0058
5600130	CASSELMAN VILLAGE	1953-09-17	DO	9.8	9.4	9.1	4.9	FR 0031	BLUE CLAY 0022 GREY CLAY STNS HPAN 0030 GRVL 0031 GREY LMSN 0032
5600131	CASSELMAN VILLAGE	1953-12-24	DO	12.2		12.2	4.9	FR 0034	YLLW MSND 0005 CLAY 0030 HPAN 0038 GRVL 0040
5600132	CASSELMAN VILLAGE	1953-12-17	DO	30.8	14.3	14.3	12.2	FR 0101	LOAM MSND 0010 BLUE CLAY 0040 HPAN 0047 GREY ROCK 0101
5600133	CASSELMAN VILLAGE	1957-09-18	DO	16.8	14.6	14.6	6.1	FR 0053	LOAM MSND 0006 CLAY 0040 HPAN 0048 GREY LMSN 0055
5600134	CASSELMAN VILLAGE	1957-08-21	DO	15.8		15.8	6.1	FR 0052	LOAM MSND 0008 CLAY 0040 HPAN 0050 STNS 0052
5600135	CASSELMAN VILLAGE	1957-03-29	DO	14.3		14.3	8.5	SU 0047	BRWN CLAY 0008 BLUE CLAY 0034 MSND 0045 GRVL 0047
5600136	CASSELMAN VILLAGE	1958-06-09	DO	12.8	12.5	12.5	6.7	FR 0042	CLAY 0025 HPAN 0041 LMSN 0042
5600137	CASSELMAN VILLAGE	1959-04-24	DO	16.2		16.2	7.6	FR 0053	CLAY 0020 BLUE CLAY 0040 HPAN 0052 GRVL 0053
5600138	CASSELMAN VILLAGE	1959-08-27	DO	17.7		17.7	5.8	SU 0058	BRWN LOAM 0020 BLUE CLAY 0040 MSND 0058

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5600139	CASSELMAN VILLAGE	1959-09-20	NU	102.7	11.3	11.3			BRWN LOAM 0010 BLUE CLAY 0027 HPAN 0037 LMSN 0337
5600140	CASSELMAN VILLAGE	1956-06-27	DO	15.8	7.3	7.3	3.7	FR 0050	CLAY 0020 HPAN 0024 LMSN 0052
5600141	CASSELMAN VILLAGE	1959-10-10	DO	16.5	16.1	16.2	5.5	FR 0054	RED CLAY 0010 BLUE CLAY 0030 HPAN 0050 GRVL 0053 LMSN 0054
5600142	CASSELMAN VILLAGE	1962-09-05	DO	21.6	20.1	20.1	3.0	FR 0070	YLLW LOAM 0010 BLUE CLAY 0050 HPAN 0060 GRVL 0066 GREY ROCK 0071
5600143	CASSELMAN VILLAGE	1949-07-22	DO	12.2		12.2	6.1	FR 0040	CLAY LOAM 0005 HPAN 0040
5600144	CASSELMAN VILLAGE	1948-06-03	DO	17.1		17.1	4.6	FR 0015	MSND 0004 BRWN CLAY MSND 0025 MSND 0055 GRVL 0056
5600146	CASSELMAN VILLAGE	1964-12-03	DO	20.7	11.6	17.7	7.6	FR 0045	LOAM MSND 0005 CLAY 0036 GRVL 0038 LMSN 0068
5600147	CASSELMAN VILLAGE	1949-05-15	DO	12.5		12.5	3.0	FR 0041	HPAN 0020 CLAY 0035 GRVL 0041
5600148	CASSELMAN VILLAGE	1949-05-28	DO	18.0		18.0	9.1	FR 0049	LOAM 0010 CLAY 0042 MSND 0059
5600149	CASSELMAN VILLAGE	1949-04-16	DO	13.7		13.7	1.8	FR 0006	LOAM 0018 FILL 0040 MSND 0045
5600150	CASSELMAN VILLAGE	1950-12-30	ST DO	4.9	3.0	3.0	1.8	FR 0014	BRWN LOAM 0010 GREY LMSN 0016
5600151	CASSELMAN VILLAGE	1950-08-11	NU	38.1	0.0	38.1			ROCK 0125
5600152	CASSELMAN VILLAGE	1952-03-24	DO	14.9	13.4	14.9	2.4	FR 0049	CLAY 0020 SILT 0044 ROCK 0049

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5600153	CASSELMAN VILLAGE	1952-04-04	DO	14.9		14.9	7.6	FR 0046	LOAM 0001 BLUE CLAY 0046 GRVL 0049
5600154	CASSELMAN VILLAGE	1952-12-28	DO	18.0		18.0	5.5	SU 0058	CLAY 0010 HPAN 0050 MSND 0059
5600155	CASSELMAN VILLAGE	1952-04-22	PS	10.4		10.4	2.7	FR	CLAY 0020 MSND 0030 GRVL 0034
5600156	CASSELMAN VILLAGE	1952-04-14	PS	15.2		15.2	7.6	MN	BLUE CLAY 0045 MSND GRVL 0050
5600157	CASSELMAN VILLAGE	1955-06-09	DO	15.5	14.3	14.3	3.0	FR 0040	YLLW LOAM 0010 BLUE CLAY 0020 HPAN 0045 GRVL 0047 GREY LMSN 0051
5600159	CASSELMAN VILLAGE	1956-04-09	DO	15.2	12.5	12.8	1.5	FR 0048	HPAN 0025 MSND 0037 GRVL 0041 LMSN 0050
5600160	CASSELMAN VILLAGE	1957-04-24	ST DO	15.2		15.2	14.0	FR 0050	RED CLAY 0020 BLUE CLAY 0045 GRVL 0050
5600161	CASSELMAN VILLAGE	1953-07-18	DO	14.3		14.3	9.1	SU 0030	HPAN 0045 GRVL 0047
5600162	CASSELMAN VILLAGE	1952-03-14	DO	7.9	7.3	7.9	3.0	FR 0026	CLAY 0020 SILT 0024 ROCK 0026
5600163	CASSELMAN VILLAGE	1953-07-22	DO	13.4		13.4	9.1	SU 0042	HPAN 0042 GRVL 0044
5600164	CASSELMAN VILLAGE	1953-10-02	DO	14.6		14.6	7.6	SU 0048	GRVL 0048
5600165	CASSELMAN VILLAGE	1964-09-07	DO	13.1	12.5	12.5	1.8	FR 0041	YLLW LOAM 0010 BLUE CLAY 0032 GRVL 0041 GREY ROCK 0043
5600166	CASSELMAN VILLAGE	1964-10-14	DO	16.2	6.1	7.6	3.7	FR 0050	GREY LOAM 0020 GREY ROCK 0053

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5600167	CASSELMAN VILLAGE	1964-09-15	DO	17.4	16.8	16.8	3.0	FR 0055	PRDG 0021 BLUE CLAY 0042 HPAN 0052 GRVL 0055 GREY ROCK 0057
5600168	CASSELMAN VILLAGE	1964-08-14	CO	15.5		15.5	9.1	FR 0050	LOAM MSND 0008 CLAY 0022 HPAN 0045 GRVL 0051
5600169	CASSELMAN VILLAGE	1964-05-01	DO	30.5	12.8	12.8	12.2	FR 0060	MSND 0009 CLAY 0033 HPAN 0042 LMSN 0100
5600170	CASSELMAN VILLAGE	1964-10-05	DO	15.2	9.7	9.8	9.8	FR 0032	BRWN CLAY 0010 BLUE CLAY 0025 HPAN 0032 LMSN 0050
5600171	CASSELMAN VILLAGE	1965-05-15	NU	15.8		15.8			LOAM MSND 0006 HPAN 0030 CLAY STNS 0052
5600172	CASSELMAN VILLAGE	1965-09-27	DO	17.1	14.6	14.3	3.4	FR 0052	LOAM MSND 0006 HPAN 0045 GRVL MSND 0048 LMSN 0056
5600173	CASSELMAN VILLAGE	1965-05-28	PS	19.8	18.3	11.9	3.7	FR 0040	MSND GRVL 0020 BLDR HPAN 0060 LMSN 0065
5600174	CASSELMAN VILLAGE	1965-06-01	DO	15.2		11.6	6.1	FR 0038	CLAY 0012 HPAN 0050
5600175	CASSELMAN VILLAGE	1965-06-09	DO	13.7	10.7	10.7	9.1	FR 0038	LOAM MSND 0010 MSND CLAY 0033 QSND 0035 LMSN 0045
5600176	CASSELMAN VILLAGE	1965-06-16	DO	12.2	7.9	7.9	7.6	FR 0035	LOAM MSND 0006 RED CLAY 0015 HPAN 0024 GRVL MSND 0026 LMSN 0040
5600177	CASSELMAN VILLAGE	1965-06-18	CO	17.4		17.4	9.8	SU 0057	LOAM MSND 0020 BLUE CLAY 0040 HPAN STNS 0055 GRVL MSND 0057
5600178	CASSELMAN VILLAGE	1965-06-24	CO	19.8	16.2	16.2	7.6	SU 0055	MSND 0005 BLUE CLAY 0035 HPAN 0050 GRVL MSND 0053 LMSN 0065
5600179	CASSELMAN VILLAGE	1965-06-26	DO	14.9	13.1	13.1	4.6	FR 0048	LOAM MSND 0020 CLAY MSND 0030 HPAN 0040 GRVL 0043 LMSN 0049

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5600180	CASSELMAN VILLAGE	1965-06-21	DO	18.3	14.0	14.0	10.7	FR 0055	PRDG 0036 HPAN GRVL 0046 LMSN 0060
5600181	CASSELMAN VILLAGE	1965-06-07	DO	15.5	13.4	13.4	7.6	FR 0047	LOAM MSND 0008 RED CLAY 0012 HPAN 0040 MSND GRVL 0044 LMSN 0051
5600182	CASSELMAN VILLAGE	1965-05-26	DO	12.2	9.8	9.8	4.6	FR 0035	MSND 0005 RED CLAY 0015 BLUE CLAY 0025 HPAN 0030 GRVL MSND 0032 LMSN 0040
5600183	CASSELMAN VILLAGE	1966-10-18	DO	22.9	17.4	17.4	10.7	SU 0070	LOAM MSND 0005 RED CLAY 0010 BLUE CLAY 0040 HPAN 0055 GRVL MSND 0057 LMSN 0075
5600184	CASSELMAN VILLAGE	1966-05-11	DO	22.9	17.1	17.1	6.7	FR 0070	LOAM MSND 0005 RED CLAY 0010 CLAY 0030 HPAN 0045 MSND GRVL 0056 LMSN 0075
5600185	CASSELMAN VILLAGE	1966-03-09	DO	14.6	12.5	12.5	3.7	FR 0048	MSND LOAM 0004 RED CLAY 0012 BLUE CLAY MSND 0035 HPAN 0041 LMSN 0048
5600186	CASSELMAN VILLAGE	1967-05-23	DO	21.6	20.1	20.1	9.1	SU 0068	YLLW GRVL 0010 BLUE CLAY 0035 HPAN 0060 GRVL 0066 GREY ROCK 0071
5600187	CASSELMAN VILLAGE	1968-04-18	CO	16.5	13.4	13.4	2.4	FR 0052	LOAM MSND 0003 RED CLAY 0015 MSND CLAY 0030 HPAN 0038 GRVL MSND 0044 LMSN 0054
5601209	CASSELMAN VILLAGE	1970-08-27	DO	18.3	10.1	10.1	9.1	FR 0058	BRWN LOAM 0001 RED CLAY 0006 BLUE CLAY MSND 0025 GREY HPAN 0033 GREY LMSN 0060
5601211	CASSELMAN VILLAGE	1970-08-03	DO	22.9	16.2	16.2	9.1	FR 0074	BRWN LOAM 0002 RED CLAY 0008 BLUE CLAY MSND 0050 GREY MSND GRVL 0053 GREY LMSN 0075
5601468	CAMBRIDGE TOWNSHIP CON 06 011	1973-08-13	DO			11.0	13.1	FR 0050	
5601797	CAMBRIDGE TOWNSHIP CON 06 008	1975-06-16	DO	12.2	9.8	9.8	2.4	FR 0040	BRWN LOAM 0012 BLUE CLAY 0032 GREY ROCK 0040
5601800	CAMBRIDGE TOWNSHIP CON 05 011	1975-10-27	DO	32.0	31.1	31.1	19.8	FR 0104	BRWN LOAM 0006 BRWN FSND 0018 BRWN CLAY 0102 BLCK ROCK 0105

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5601802	CASSELMAN VILLAGE	1975-10-29	DO	21.3	15.5	15.5	4.6	FR 0068	BRWN LOAM 0006 BRWN HPAN 0051 GREY LMSN 0070
5601969	CAMBRIDGE TOWNSHIP CON 07 011	1976-10-28	DO	22.9	21.9	21.9	7.9	FR 0074	BRWN LOAM SNDY 0002 BRWN CLAY FSND 0040 GREY HPAN 0061 GREY SAND GRVL 0072 GREY LMSN 0075
5601971	CAMBRIDGE TOWNSHIP CON 06 007	1976-09-21	DO	14.9	13.4	13.4	2.7	FR 0045	RED CLAY 0004 BLUE CLAY 0044 BLCK SHLE 0049
5601066	CAMBRIDGE TOWNSHIP CON 08 009	1968-08-28	ST DO	10.7	7.6	7.6	3.7	FR 0030	RED CLAY 0015 GRVL 0025 LMSN 0035
5601067	CAMBRIDGE TOWNSHIP CON 07 013	1968-08-22	ST DO	21.0	20.4	20.4	5.5	FR 0067	RED CLAY 0020 BLUE CLAY 0060 GRVL 0067 LMSN 0069
5601068	CASSELMAN VILLAGE	1968-12-03	PS	15.8	10.7	10.7	7.9	FR 0050	RED CLAY 0010 HPAN 0030 GRVL 0035 LMSN 0052
5601099	CASSELMAN VILLAGE	1969-02-15	DO	15.5	14.6	14.6	1.2	FR 0050	LOAM MSND 0003 BRWN CLAY 0016 HPAN 0048 LMSN 0051
5601106	CASSELMAN VILLAGE	1969-03-21	DO	14.3	11.9	11.9	9.1	FR 0045	LOAM 0002 BRWN CLAY 0018 BLUE CLAY 0030 HPAN 0039 BRWN LMSN 0047
5601112	CASSELMAN VILLAGE	1969-06-12	ST DO	16.8	11.9	11.9	3.7	FR 0054	BRWN LOAM 0002 RED CLAY 0010 BLUE CLAY 0030 GREY HPAN 0039 GREY LMSN 0055
5601114	CASSELMAN VILLAGE	1969-04-08	DO	14.0	12.8	12.8	7.6	FR 0045	LOAM 0002 QSND 0020 BLUE CLAY 0035 HPAN 0042 LMSN 0046
5601116	CASSELMAN VILLAGE	1969-06-04	NU	21.6	15.5	15.8	5.8	FR 0055	GREY CLAY LOAM 0003 GREY CLAY GRVL MSND 0019 GREY CLAY MSND GRVL 0051 GREY LMSN 0071
5601117	CAMBRIDGE TOWNSHIP CON 07 010	1969-06-23	NU	27.7	17.7		6.1	FR 0058 FR 0070 FR 0075	BRWN LOAM MSND 0002 GREY CLAY MSND GRVL 0031 GREY CLAY BLDR MSND 0057 GREY GRVL MSND CLAY 0058 GREY LMSN 0091
5601118	CAMBRIDGE TOWNSHIP CON 07 009	1969-07-04	NU	14.3	6.4		6.1	FR 0046	BRWN LOAM CLAY 0002 GREY CLAY 0004 GREY CLAY BLDR GRVL 0021 GREY LMSN 0047

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5601119	CAMBRIDGE TOWNSHIP CON 07 008	1969-07-15	NU	16.8	10.1				BRWN LOAM 0002 GREY CLAY 0028 GREY CLAY GRVL MSND 0033 GREY LMSN 0055
5601122	CAMBRIDGE TOWNSHIP CON 07 006	1969-07-04	DO	16.8	13.4	13.4	2.4	FR 0053	BRWN LOAM 0002 RED CLAY 0007 BRWN CLAY 0010 BLUE CLAY 0040 BRWN MSND GRVL 0044 GREY LMSN 0055
5601133	CAMBRIDGE TOWNSHIP CON 08 010	1969-09-10	DO	12.8	10.1	10.1	3.0	FR 0040	BRWN LOAM 0002 BLUE CLAY 0025 BLCK MSND GRVL 0033 GREY LMSN 0042
5601134	CASSELMAN VILLAGE	1969-10-01	NU	39.6	10.4	10.4			LOAM 0002 MSND CLAY 0028 HPAN 0034 GREY LMSN 0130
5601137	CAMBRIDGE TOWNSHIP CON 07 008	1970-11-13	DO	17.7	5.8	5.8	3.0	FR 0056	BRWN LOAM 0002 RED CLAY MSND 0019 GREY LMSN 0058
5601139	CAMBRIDGE TOWNSHIP CON 08 010	1969-10-23	DO	18.9	13.1	13.1	3.0	FR 0058	RED CLAY 0015 BLUE CLAY 0035 GREY HPAN 0042 GREY GRVL 0043 BLUE ROCK 0049 GREY LMSN 0062
5601152	CAMBRIDGE TOWNSHIP CON 07 010	1969-06-17	DO	15.2	14.3	14.3	2.4	FR 0050	BRWN LOAM 0002 RED CLAY 0012 GREY HPAN STNS 0025 BRWN HPAN 0047 GREY LMSN 0050
5601156	CASSELMAN VILLAGE	1970-01-07	CO	18.3	12.2	14.6	9.1	FR 0058	BRWN LOAM 0002 GREY CLAY 0004 RED CLAY 0010 BLUE CLAY MSND 0020 GREY HPAN 0040 BLCK SHLE 0048 GREY LMSN 0060
5601163	CAMBRIDGE TOWNSHIP CON 07 010	1970-04-24	ST DO	15.2	12.8	12.8	3.0	FR 0048	BRWN LOAM 0002 GREY CLAY MSND 0030 GREY HPAN 0042 GREY LMSN 0050
5601167	CASSELMAN VILLAGE	1970-06-13	DO	14.3		14.3	9.1	FR 0040	BRWN LOAM 0002 YLLW GRVL 0006 RED CLAY 0008 BLUE CLAY MSND 0035 GREY HPAN 0046 BLCK GRVL 0047
5601168	CAMBRIDGE TOWNSHIP CON 08 010	1970-05-11	DO	21.0		21.0	4.6	FR 0068	BRWN LOAM 0002 RED CLAY 0006 BLUE CLAY MSND 0035 GREY CLAY MSND 0065 BLCK GRVL 0069
5601178	CASSELMAN VILLAGE	1970-07-15	DO	18.3	17.4	17.4	10.7	FR 0058	BRWN CLAY MSND 0024 GREY HPAN 0050 GREY MSND GRVL STNS 0057 GREY LMSN 0060
5601182	CAMBRIDGE TOWNSHIP CON 07 007	1970-05-05	DO	15.8	14.0	14.0	2.1	FR 0051	BLCK LOAM 0001 BRWN CLAY 0003 RED CLAY 0007 BLUE CLAY 0025 GREY HPAN STNS 0042 GREY MSND GRVL 0046 GREY LMSN 0052

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5601183	CASSELMAN VILLAGE	1970-06-19	DO	18.9	18.3	18.3	9.1	FR 0061	BRWN LOAM 0002 BRWN MSND CLAY 0004 RED CLAY 0009 BLUE CLAY MSND 0030 GREY HPAN 0055 GREY STNS GRVL 0060 GREY LMSN 0062
5601206	CAMBRIDGE TOWNSHIP CON 06 013	1970-08-04	ST DO	26.2	24.1	24.1	3.7	FR 0085	BRWN LOAM 0001 BRWN CLAY 0020 BLUE CLAY FSND 0066 GREY HPAN 0079 GREY LMSN 0086
5601228	CASSELMAN VILLAGE	1970-10-07	DO	13.7	11.6	11.6	3.7	FR 0044	BRWN LOAM 0002 GREY HPAN STNS 0038 GREY LMSN 0045
5601230	CAMBRIDGE TOWNSHIP CON 07 008	1970-09-25	ST	20.1	16.1	16.2	3.0	FR 0065	BRWN LOAM 0001 BRWN CLAY FSND 0018 GREY CLAY MSND 0040 GREY HPAN 0051 GREY FSND 0053 GREY LMSN 0066
5601237	CAMBRIDGE TOWNSHIP CON 07 006	1970-09-24	ST DO	17.7	16.5	16.5	3.4	FR 0057	BRWN LOAM 0002 BRWN CLAY 0052 GREY MSND GRVL 0054 GREY LMSN 0058
5601249	CAMBRIDGE TOWNSHIP CON 06 010	1970-12-22	DO	61.0	6.7	6.7	6.4	FR 0112	BRWN CLAY 0015 HPAN 0022 GREY LMSN 0200
5601310	CAMBRIDGE TOWNSHIP CON 07 006	1971-01-15	DO	13.1		13.1	3.0	FR	BRWN LOAM 0002 GREY CLAY FSND 0016 GREY HPAN 0042 BLCK GRVL 0043
5601316	CASSELMAN VILLAGE	1971-04-28	DO	18.3	16.5	16.5	3.7	FR 0057	BRWN LOAM 0003 RED CLAY 0021 GREY HPAN 0054 BLCK ROCK 0060
5601317	CASSELMAN VILLAGE	1971-04-27	DO	18.3	17.1	17.1	3.0	FR 0059	BRWN LOAM 0003 RED CLAY 0021 GREY HPAN 0056 BLCK ROCK 0060
5601318	CAMBRIDGE TOWNSHIP CON 06 008	1971-05-24	DO	7.6	3.0	3.0	1.5	FR	BRWN LOAM 0002 GREY HPAN 0010 GREY LMSN 0025
5601331	CASSELMAN VILLAGE	1971-06-09	DO	16.2	14.9	14.9	3.0	FR 0052	RED CLAY 0005 GREY HPAN BLDR 0045 GREY GRVL 0049 GREY ROCK 0053
5601344	CASSELMAN VILLAGE	1971-06-24	DO	16.8	11.6	16.8	4.6	FR 0054	GREY HPAN STNS 0037 BLCK GRVL 0038 GREY LMSN 0055
5601346	CASSELMAN VILLAGE	1971-06-29	DO	19.5		19.2	4.6	FR 0062	BRWN LOAM 0002 BLUE CLAY FSND 0040 GREY HPAN 0060 BLCK GRVL 0064

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5601358	CAMBRIDGE TOWNSHIP CON 06 010	1971-09-26	ST DO	25.9	15.2		4.3	FR 0084	PRDG 0050 GREY LMSN 0085
5601362	CAMBRIDGE TOWNSHIP CON 07 011	1971-10-12	DO	19.2	18.0	18.0	7.9	FR 0060	RED CLAY 0015 BLUE CLAY 0035 GREY GRVL SAND 0056 GREY GRVL 0059 WHIT LMSN 0063
5601384	CAMBRIDGE TOWNSHIP CON 07 009	1971-10-26	DO	19.8	12.8	12.8	6.1	FR 0045	BRWN LOAM 0003 BLUE CLAY 0025 SAND 0042 GREY LMSN 0065
5601385	CAMBRIDGE TOWNSHIP CON 06 009	1971-10-21	DO	18.0	10.7	10.7	3.0	FR 0050	BRWN SAND 0005 BLUE CLAY 0025 BLCK GRVL 0035 GREY LMSN 0059
5601405	CAMBRIDGE TOWNSHIP CON 07 009	1971-10-25	CO	10.7	9.1	7.6	1.8	FR 0025	RED CLAY 0015 BLUE CLAY 0025 GREY GRVL SAND 0030 GREY LMSN 0035
5601421	CASSELMAN VILLAGE	1970-06-18	CO	19.2	17.7	17.7	9.1	FR 0062	BRWN LOAM 0002 RED CLAY 0006 BRWN CLAY 0030 GREY HPAN 0058 GREY LMSN 0063
5601424	CAMBRIDGE TOWNSHIP CON 07 013	1972-05-01	ST DO	20.1		19.8	6.1	FR 0065	BRWN LOAM 0002 RED CLAY 0018 BLUE CLAY QSND 0054 GREY HPAN 0064 BLCK GRVL 0066
5601434	CASSELMAN VILLAGE	1972-06-15	DO	18.3	17.7	17.7	12.2	FR 0058	BRWN LOAM 0006 BRWN CLAY 0015 BLUE CLAY 0032 BLCK GRVL HPAN 0058 GREY LMSN 0060
5601435	CASSELMAN VILLAGE	1972-06-08	DO	19.2	17.4	17.4	4.9	SU 0060	BRWN LOAM 0004 BRWN CLAY 0025 BLUE CLAY 0043 GREY HPAN BLDR 0057 GREY LMSN 0063
5601447	CAMBRIDGE TOWNSHIP CON 06 010	1972-11-08	DO	17.4	15.5	15.5	3.4	FR 0057	RED CLAY 0015 GREY BLDR 0020 GREY GRVL 0051 GREY LMSN 0057
5601452	CASSELMAN VILLAGE	1972-08-30	DO	18.3	9.7	9.8	7.6	FR 0060	YLLW LOAM 0005 RED CLAY 0022 GREY HPAN 0032 GREY LMSN 0060
5601454	CASSELMAN VILLAGE	1972-07-08	DO	15.8	14.0	14.3	9.1	FR 0050	YLLW OBDN 0005 CLAY 0016 HPAN 0046 LMSN 0052
5601456	CAMBRIDGE TOWNSHIP CON 06 012	1972-09-20	DO	24.4	20.4	20.4	15.2	FR 0075	PRDG 0012 BRWN CLAY SAND 0066 BLCK GRVL 0067 BRWN LMSN 0080

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5601486	CASSELMAN VILLAGE	1973-04-18	DO	16.8	15.2	15.2	6.1	FR 0053	RED CLAY 0016 BLUE CLAY 0035 GREY GRVL 0050 WHIT LMSN 0055
5601495	CAMBRIDGE TOWNSHIP CON 06 014	1973-07-13	DO	36.6	36.0	36.0		SA 0120	LOAM 0010 GREY CLAY 0070 SAND 0118 LMSN 0120
5601496	CAMBRIDGE TOWNSHIP CON 05 014	1973-06-21	DO	36.6		36.6	-16.2	FR 0118	YLLW SAND 0016 BLUE CLAY 0071 GREY SAND GRVL 0120
5601498	CAMBRIDGE TOWNSHIP CON 06 011	1973-06-02	DO	21.9	21.0	21.0	7.6	FR 0069	RED CLAY 0020 BLUE CLAY 0061 GREY UNKN HARD 0069 GREY LMSN 0072
5601499	CAMBRIDGE TOWNSHIP CON 05 015	1973-06-28	DO	39.0	38.4	38.4	-12.2	FR 0126	BRWN LOAM 0004 BRWN SAND 0012 BLUE CLAY 0059 GREY SAND BLDR 0126 GREY LMSN 0128
5601507	CAMBRIDGE TOWNSHIP CON 05 011	1973-07-20	DO	21.3	20.1	20.1	10.7	FR 0069	YLLW LOAM SOFT 0015 BLUE CLAY SOFT 0064 GREY GRVL HARD 0066 WHIT LMSN HARD 0070
5601517	CAMBRIDGE TOWNSHIP CON 06 009	1973-08-29	DO			12.8	3.0	FR 0050	
5601529	CASSELMAN VILLAGE	1972-09-09	MN	18.6	14.0	14.0	3.0	FR 0060	LOAM 0005 CLAY 0018 HPAN 0046 LMSN 0061
5601533	CASSELMAN VILLAGE	1972-11-16	CO	18.3	5.5	5.5	1.5	FR 0058	LOAM 0002 GREY HPAN STNS 0018 GREY LMSN 0060
5601539	CASSELMAN VILLAGE	1972-07-12	DO	26.8	12.2	12.2	3.4	FR 0078	BRWN LOAM 0002 GREY HPAN 0030 GREY QSND 0040 GREY LMSN 0088
5601619	CAMBRIDGE TOWNSHIP CON 07 007	1974-03-11	ST DO	15.2	13.1	13.1	3.7	FR 0048	PRDG 0005 BLUE CLAY FSND 0043 GREY LMSN 0050
5601623	CAMBRIDGE TOWNSHIP CON 08 009	1974-04-16	DO	12.8	8.2	8.2	3.0	SA 0042	LOAM 0010 GREY SAND 0020 QSND 0027 LMSN 0042
5601628	CASSELMAN VILLAGE	1974-05-08	DO	20.1	19.5	19.5	4.6	FR 0065	BRWN LOAM 0009 BLUE CLAY 0034 GREY HPAN 0064 GREY LMSN 0066
5601629	CAMBRIDGE TOWNSHIP CON 08 008	1974-05-02	ST DO	42.1	23.5	23.5	3.0	FR 0118	BRWN LOAM SNDY 0003 BRWN CLAY FSND 0010 GREY HPAN BLDR 0077 BLCK LMSN 0138
5601651	CAMBRIDGE TOWNSHIP CON 05 011	1974-09-01	DO	36.6	29.3	29.3	21.3	SU 0120	BRWN LOAM 0003 RED CLAY 0021 BLUE CLAY 0092 BLCK GRVL SAND BLDR 0096 GREY LMSN 0120
5601655	CAMBRIDGE TOWNSHIP CON 07 011	1974-08-21	DO	22.9	20.7	21.0	13.7	FR 0070	BRWN LOAM 0007 GREY CLAY 0032 HPAN 0068 LMSN 0069 UNKN 0075
5601656	CAMBRIDGE TOWNSHIP CON 05 011	1974-09-30	DO	25.6	23.8	23.8	19.8	UK 0079	BRWN LOAM 0003 BLUE CLAY 0077 BLCK GRVL SAND 0078 GREY LMSN 0084

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5601657	CAMBRIDGE TOWNSHIP CON 05 010	1974-09-15	DO	25.9	17.7	17.7	14.6	FR 0082	BRWN LOAM SNDY 0002 GREY CLAY FSND 0056 GREY SAND GRVL 0058 GREY LMSN 0085
5601672	CAMBRIDGE TOWNSHIP CON 05 010	1974-10-28	DO	25.3	22.2	22.3	16.2	FR 0082	YLLW LOAM 0012 BLUE CLAY 0068 BLCK GRVL 0073 GREY LMSN 0083
5601673	CAMBRIDGE TOWNSHIP CON 05 010	1974-10-29	DO	25.9	21.9	21.9	18.3	FR 0084	YLLW LOAM 0010 BLUE CLAY 0070 GREY GRVL 0072 GREY LMSN 0085
5601677	CAMBRIDGE TOWNSHIP CON 06 006	1974-07-04	DO	13.7	12.2	12.2	2.7	FR 0045	PRDG 0009 GREY CLAY 0030 GREY GRVL 0040 GREY LMSN 0045
5601678	CAMBRIDGE TOWNSHIP CON 07 011	1974-07-08	DO	21.9	21.9	21.9	12.8	FR 0072	BRWN LOAM 0012 BLUE CLAY 0034 GREY HPAN 0068 BLCK GRVL 0069 GREY HPAN 0072 LMSN 0072
5601722	CAMBRIDGE TOWNSHIP CON 07 008	1975-06-25	DO	9.1	3.3	3.4	2.1	SA 0025	BRWN LOAM 0005 GREY HPAN 0011 GREY SHLE 0030
5601723	CAMBRIDGE TOWNSHIP CON 07 008	1975-06-25	DO	9.1	4.0	4.0	2.1	FR 0025	BRWN LOAM 0005 GREY HPAN 0013 BLCK SHLE 0030
5601724	CASSELMAN VILLAGE	1975-06-18	PS	22.6	15.5	15.5	9.1	SU 0069	RED CLAY 0011 GREY SAND BLDR GRVL 0051 GREY LMSN 0074
5601742	CASSELMAN VILLAGE	1974-05-30	CO	21.6	15.5	15.5	8.2	SU 0069	BRWN LOAM 0004 RED CLAY 0013 BLUE CLAY 0042 GREY SAND GRVL 0051 GREY LMSN 0071
5601746	CAMBRIDGE TOWNSHIP CON 05 011	1974-07-09	DO	23.8	22.2	22.3	12.2	FR 0075	BRWN LOAM 0018 BLUE CLAY 0070 BLCK GRVL 0073 GREY LMSN 0078
5601753	CAMBRIDGE TOWNSHIP CON 07 008	1974-06-12	DO	27.4	3.0	3.0	3.4	FR 0089	BRWN LOAM 0002 RED CLAY 0010 GREY LMSN 0090
5601764	CAMBRIDGE TOWNSHIP CON 05 015	1975-06-15	DO	33.8	33.2	33.2	12.2	FR 0110	YLLW LOAM SOFT 0012 BLUE CLAY SOFT 0087 GREY SAND HARD 0102 GREY GRVL HARD 0109 BLCK ROCK HARD 0111
5601782	CAMBRIDGE TOWNSHIP CON 05 010	1975-07-25	DO	24.1	18.6	18.6	18.0	FR 0078	BRWN LOAM 0007 BLUE CLAY 0054 BLCK GRVL SAND 0061 GREY LMSN 0079

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5601803	CASSELMAN VILLAGE	1975-10-25	DO	18.9	14.0	14.0	4.6	FR 0060	BRWN LOAM 0005 BRWN HPAN 0046 GREY LMSN 0062
5601812	CASSELMAN VILLAGE	1975-10-01	DO	16.2	13.1	13.1	5.5	FR 0051	PRDG 0012 BRWN CLAY FSND 0038 BLCK GRVL 0043 GREY LMSN 0053
5601884	CAMBRIDGE TOWNSHIP CON 06 007	1976-05-17	DO	11.3		11.3	0.9	FR 0037	RED CLAY 0005 BLUE CLAY 0033 BLCK SAND GRVL 0037
5601928	CASSELMAN VILLAGE	1976-06-24	CO	31.4	5.5	5.5	2.4	FR 0045	BRWN LOAM 0003 RED CLAY 0018 GREY LMSN 0103
5601943	CAMBRIDGE TOWNSHIP CON 07 007	1976-08-25	DO	8.8	6.4	6.4	2.4	FR 0026	BRWN LOAM 0004 BLUE CLAY 0021 GREY LMSN 0029
5602305	CAMBRIDGE TOWNSHIP CON 07 009	1979-09-05	CO DO	10.7	5.8	5.8	2.1	FR 0035	BRWN CLAY FSND 0010 GREY HPAN STNS 0019 GREY LMSN 0020 UNKN 0035
5602825	CAMBRIDGE TOWNSHIP CON 05 011	1983-10-28	DO	38.1	20.7	20.7	18.3	FR 0068	YLLW SAND 0005 BLUE CLAY 0056 BLCK GRVL SAND 0068 GREY LMSN 0125
5603508	CAMBRIDGE TOWNSHIP CON 05 015	1988-02-23	CO	38.1		38.1	17.7	FR 0125	BRWN SAND 0012 BLUE CLAY 0083 GREY SAND 0122 BLCK GRVL 0125
5602004	CAMBRIDGE TOWNSHIP CON 05 010	1977-04-12	DO	23.8	18.6	18.6	12.8	FR 0075	YLLW SAND SOFT 0009 BLUE CLAY SOFT 0056 GREY GRVL HARD 0061 BLUE ROCK HARD 0078
5602008	CAMBRIDGE TOWNSHIP CON 06 010	1975-12-17	DO	47.2	9.1	10.7	10.4	FR 0155	RED CLAY 0020 BLUE CLAY 0030 GREY LMSN 0100 GREY SNDS 0155
5602018	CAMBRIDGE TOWNSHIP CON 09 012	1977-07-08	DO	16.5	14.3	14.3	3.0	FR 0050	PRDG 0015 BLUE CLAY 0040 GREY GRVL 0047 GREY LMSN 0054
5602019	CAMBRIDGE TOWNSHIP CON 06 009	1977-07-18	DO	21.6	16.8	16.8	5.5	FR 0065	BRWN LOAM SNDY 0010 GREY HPAN BLDR SOFT 0055 GREY LMSN 0071
5602038	CAMBRIDGE TOWNSHIP CON 05 006	1977-06-30	DO	25.0	23.5	23.5	7.3	FR 0080	GREY LOAM SNDY 0004 GREY SAND CLAY 0042 BLUE CLAY 0060 BLCK SAND GRVL 0077 GREY LMSN STNS 0082

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5602040	CAMBRIDGE TOWNSHIP CON 07 005	1977-07-20	DO	17.1	16.5	16.5	4.3	SU 0055	BRWN LOAM 0002 RED CLAY 0018 GREY CLAY FSND 0044 GREY HPAN SAND 0054 GREY LMSN 0056
5602086	CAMBRIDGE TOWNSHIP CON 07 007	1977-10-19	DO	9.1	5.8	5.8	2.7	FR 0027	BRWN LOAM 0002 RED CLAY 0014 GREY SAND 0019 GREY LMSN 0030
5602122	CAMBRIDGE TOWNSHIP CON 07 007	1978-05-09	DO	18.0	6.7	9.8	4.6	FR 0055	RED CLAY SOFT 0016 BLDR 0022 WHIT LMSN 0059
5602150	CAMBRIDGE TOWNSHIP CON 07 007	1978-06-28	DO	10.7	8.2	8.2	1.8	FR 0034	BRWN LOAM 0002 BRWN CLAY 0020 GREY HPAN 0027 GREY LMSN 0035
5602155	CAMBRIDGE TOWNSHIP CON 07 007	1978-07-25	DO	12.8	10.1	10.1	3.7	FR 0041	BRWN LOAM 0004 RED CLAY 0032 BLCK GRVL SAND 0033 GREY LMSN 0042
5602164	CAMBRIDGE TOWNSHIP CON 05 010	1978-07-25	DO	21.3		20.1	15.2	FR 0068	RED CLAY SOFT 0025 BLUE CLAY SOFT 0062 GREY GRVL HARD 0066 GREY STNS HARD 0070
5602196	CAMBRIDGE TOWNSHIP CON 08 007	1978-10-10	ST	39.9	27.4	27.4	12.2	FR 0093	RED CLAY 0024 BRWN SAND BLDR 0090 GREY LMSN 0131
5602237	CAMBRIDGE TOWNSHIP CON 05 010	1979-05-23	ST DO	25.0	21.9	21.9	7.9	FR 0080	RED CLAY SOFT 0015 BLUE CLAY SOFT 0071 GREY GRVL HARD 0072 WHIT LMSN HARD 0082
5602240	CAMBRIDGE TOWNSHIP CON 08 008	1979-05-21	DO	13.4	11.3	11.3	1.5	FR 0042	RED CLAY SOFT 0008 BLUE CLAY SOFT 0037 GREY LMSN HARD 0044
5602255	CAMBRIDGE TOWNSHIP CON 05 010	1979-05-24	DO	26.2	21.9	21.9	12.2	FR 0084	YLLW SAND 0006 BLUE CLAY 0067 BRWN HPAN 0072 GREY LMSN 0086
5602275	CAMBRIDGE TOWNSHIP CON 07 010	1979-08-31	DO	21.3	16.8	16.8	5.5	FR 0069	RED CLAY SOFT 0010 BLUE CLAY SOFT 0042 GREY SAND GRVL PCKD 0055 GREY LMSN 0070
5602276	CAMBRIDGE TOWNSHIP CON 08 013	1979-07-11	ST	16.5		14.0	2.7	FR 0052	RED CLAY SOFT 0011 BLUE CLAY SOFT 0044 GREY GRVL HARD 0046 GREY STNS HARD 0054
5602280	CAMBRIDGE TOWNSHIP CON 05 006	1979-08-22	DO	16.5	14.3	14.3	4.6	FR 0052	RED CLAY SOFT 0007 BLUE CLAY SOFT 0042 GREY GRVL HARD 0047 WHIT LMSN HARD 0054

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5602358	CAMBRIDGE TOWNSHIP CON 06 016	1980-01-23	DO	28.0	27.4	27.4	10.7	SU 0091	RED CLAY SOFT 0011 BLUE CLAY SOFT 0082 GREY GRVL HARD 0090 BRWN SHLE HARD 0092
5602364	CAMBRIDGE TOWNSHIP CON 07 011	1980-05-12	DO	23.8	21.6	21.6	6.1	FR 0075	RED CLAY SOFT 0011 BLUE CLAY SOFT 0065 GREY GRVL HARD 0071 WHIT LMSN HARD 0078
5602396	CASSELMAN VILLAGE 029	1980-07-25	CO DO	12.5	7.6	7.6	2.4	FR 0039	GREY LOAM CLAY SNDY 0016 GREY HPAN STNS 0025 GREY LMSN STNS 0041
5602444	CAMBRIDGE TOWNSHIP CON 07 009	1980-11-18	CO	19.5	13.1	13.1	2.4	FR 0060	YLLW SAND 0007 GREY CLAY 0022 BRWN HPAN 0043 GREY LMSN 0064
5602486	CAMBRIDGE TOWNSHIP CON 05 010	1981-04-16	DO	29.3	21.9	21.9	16.2	FR 0094	BRWN SAND 0009 BLUE CLAY 0068 BLCK GRVL SAND 0072 GREY LMSN 0096
5602488	CAMBRIDGE TOWNSHIP CON 07 007	1981-04-03	DO	12.8	11.6	11.6	0.9	FR 0041	BRWN LOAM 0004 BLUE CLAY 0035 BLCK GRVL SAND 0038 GREY LMSN 0042
5602492	CAMBRIDGE TOWNSHIP CON 07 006	1981-05-07	ST	17.1	12.2	12.2	4.0	FR 0054	RED CLAY 0005 BLUE CLAY 0036 BLCK GRVL SAND 0040 GREY LMSN 0056
5602493	CAMBRIDGE TOWNSHIP CON 07 012	1981-05-23	DO	21.3	20.1	20.1	1.2	FR 0068	RED CLAY 0023 GREY SAND GRVL 0066 GREY LMSN 0070
5602494	CAMBRIDGE TOWNSHIP CON 07 012	1981-06-02	DO	35.7	28.3	28.3	5.5	FR 0108	BRWN LOAM 0004 RED CLAY 0019 BLUE CLAY 0033 BLCK SAND GRVL 0093 GREY LMSN 0117
5602505	CAMBRIDGE TOWNSHIP CON 07 009	1981-04-07	DO	14.0	12.2	12.2	1.8	FR 0044	BRWN FILL 0002 GREY CLAY 0028 GREY HPAN 0039 BLCK GRVL 0040 GREY LMSN 0046
5602565	CAMBRIDGE TOWNSHIP CON 05 010	1982-03-18	DO	25.9	21.3	21.3	13.7	FR 0083	YLLW SAND 0007 BLUE CLAY 0061 BLCK GRVL SAND 0070 GREY LMSN 0085
5602572	CAMBRIDGE TOWNSHIP CON 05 010	1982-06-22	DO	25.9	21.6	21.6	18.3	FR 0082	YLLW SAND 0009 BLUE CLAY 0062 BLCK GRVL SAND 0071 GREY LMSN 0085
5602574	CAMBRIDGE TOWNSHIP CON 05 014	1982-06-24	CO	36.3	35.4	35.4	13.7	SU 0119	GREY LOAM SNDY 0012 GREY CLAY 0070 BLUE CLAY 0102 GREY CLAY FSND 0105 GREY HPAN FSND 0116 GREY LMSN STNS 0119

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5602592	CAMBRIDGE TOWNSHIP CON 05 013	1982-08-07	PS	29.6	29.0	29.0	16.5	FR 0097	YLLW SAND SOFT 0018 BLUE CLAY SOFT 0090 GREY GRVL HARD 0095 WHIT LMSN HARD 0097
5602610	CAMBRIDGE TOWNSHIP CON 05 011	1982-09-15	DO	51.8	21.3	21.3	17.7	FR 0082	BRWN LOAM 0008 BLUE CLAY 0059 BLCK SAND GRVL 0070 GREY LMSN 0170
5602660	CAMBRIDGE TOWNSHIP CON 05 008	1982-11-17	ST	15.5		15.5	13.1	FR 0050	YLLW LOAM 0009 BLUE CLAY 0039 BLCK GRVL 0051
5602663	CAMBRIDGE TOWNSHIP CON 07 014	1982-12-21	DO	26.8		25.3	10.7	FR 0087	YLLW SAND SOFT 0012 BLUE CLAY SOFT 0069 GREY SAND GRVL HARD 0083 GREY STNS HARD 0088
5602802	CAMBRIDGE TOWNSHIP CON 06 008	1983-09-10	ST	13.4		13.4	4.6	FR 0043	RED CLAY 0012 BLUE CLAY 0038 BLCK GRVL 0044
5602803	CAMBRIDGE TOWNSHIP CON 05 011	1983-10-01	DO	33.5	21.3		21.3	FR 0080	PRDR 0070 GREY LMSN STNS 0110
5602867	CAMBRIDGE TOWNSHIP CON 08 010	1984-03-30	DO	11.3	11.0	11.0	2.1	FR 0036	RED CLAY 0009 BLUE CLAY 0029 BLCK GRVL 0036 GREY LMSN 0037
5602912	CAMBRIDGE TOWNSHIP CON 05 010	1984-07-07	DO	19.5	18.3	19.5	15.5	FR 0064	YLLW SAND 0004 BLUE CLAY 0056 BLCK GRVL 0060 GREY LMSN 0064
5602970	CAMBRIDGE TOWNSHIP CON 05 014	1984-09-12	DO	30.5		30.5	11.6	FR 0100	YLLW SAND 0006 BLUE CLAY 0087 BLCK GRVL 0100
5602972	CAMBRIDGE TOWNSHIP CON 06 014	1984-08-21	DO	25.0	24.7	24.7	10.7	SU 0081	YLLW SAND 0006 BLUE CLAY 0081 GREY LMSN 0082
5603002	CAMBRIDGE TOWNSHIP CON 05 013	1984-12-02	DO	30.8	29.9	29.9	14.6	FR 0101	YLLW SAND 0013 BLUE CLAY 0094 BLCK GRVL 0098 GREY LMSN 0101
5603023	CAMBRIDGE TOWNSHIP CON 05 011	1985-04-02	DO	51.8	21.0	21.0	17.4	FR 0136	BRWN SAND 0013 BLUE CLAY 0067 BLCK GRVL 0069 GREY LMSN 0170
5603038	CAMBRIDGE TOWNSHIP CON 06 005	1984-11-10	ST	12.5		12.5	3.0	FR 0041	RED CLAY 0017 BLUE CLAY 0040 BLCK GRVL 0041

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5603055	CAMBRIDGE TOWNSHIP CON 05 015	1985-03-19	DO	36.3	35.4	35.4	9.1	FR 0116	UNKN 0012 GREY CLAY 0075 BRWN SAND 0085 GREY SAND GRVL 0116 GREY LMSN 0119
5603057	CAMBRIDGE TOWNSHIP CON 05 008	1985-06-21	DO	41.1	15.2	15.8	14.6	FR 0128	BRWN LOAM 0007 BLUE CLAY 0048 BLCK GRVL 0050 GREY LMSN 0052 UNKN 0135
5603097	CAMBRIDGE TOWNSHIP CON 05 014	1985-07-09	DO	36.0	35.7	35.7	18.3	FR 0118	BRWN SAND 0015 BLUE CLAY 0099 BLCK GRVL FGVL 0117 GREY LMSN 0118
5603114	CAMBRIDGE TOWNSHIP CON 08 012	1985-10-02	DO	15.2	13.4	13.4	2.7	UK 0048	RED CLAY SOFT 0011 BLUE CLAY SOFT 0043 GREY GRVL HPAN 0044 GREY ROCK HARD 0050
5603123	CAMBRIDGE TOWNSHIP CON 06 012	1985-09-03	DO	21.3		21.3	5.2	FR 0070	BRWN LOAM 0003 RED CLAY 0023 BLUE CLAY 0063 BLCK GRVL CGVL 0070
5603208	CAMBRIDGE TOWNSHIP CON 06 014	1985-10-16	DO	31.7	31.1	31.1	14.6	FR 0104	RED CLAY 0019 BLUE CLAY 0100 BLCK GRVL 0102 BLCK SHLE 0104
5603214	CAMBRIDGE TOWNSHIP	1985-10-31	CO	11.9	11.0	11.0	3.7	SU 0038	BRWN LOAM 0006 BLUE CLAY 0036 BLCK SHLE 0039
5603217	CAMBRIDGE TOWNSHIP CON 06 016	1985-11-15	DO	34.7	34.4	34.4	15.2	FR 0113	BRWN SAND 0018 RED CLAY 0060 BLUE CLAY 0112 GREY GRVL 0113 GREY LMSN 0114
5603270	CAMBRIDGE TOWNSHIP CON 08 009	1986-04-05	DO	20.1	0.0	14.6	12.2	FR 0058	RED SHLE 0048 BLCK SHLE 0066
5603287	CAMBRIDGE TOWNSHIP CON 05 015	1986-04-21	DO	35.4	34.7	34.7	12.2	FR 0115	BRWN SAND 0012 GREY CLAY 0048 BLUE CLAY 0100 GREY GRVL SAND 0114 GREY LMSN ROCK 0116
5603333	CAMBRIDGE TOWNSHIP	1986-08-02	CO	38.1	15.5	15.5	6.1	FR 0099 SU 0120	YLLW SAND 0013 GREY CLAY SAND 0038 BLUE CLAY 0049 BLCK SILT 0051 BLCK SHLE SOFT 0125
5603337	CAMBRIDGE TOWNSHIP CON 08 009	1986-11-01	DO	13.4	11.6	13.7	3.0	FR 0043	GREY SAND FILL 0003 RED CLAY 0006 GREY CLAY QSND 0034 GREY HPAN SAND 0038 BLCK SHLE 0044
5603338	CAMBRIDGE TOWNSHIP 06	1986-11-25	DO	16.8	13.4	13.4	3.0	FR 0054	BRWN CLAY SAND 0006 GREY CLAY 0028 GREY HPAN 0042 GREY GRVL SAND 0044 GREY LMSN 0055

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5603351	CAMBRIDGE TOWNSHIP CON 06 009	1985-12-03	DO	14.9	12.2	12.2	1.8	FR 0047	BRWN SAND 0011 BRWN HPAN 0040 GREY LMSN 0049
5603352	CAMBRIDGE TOWNSHIP CON 05 011	1986-12-12	DO	27.4	20.1	20.1	19.2	FR 0088	BRWN SAND 0005 RED CLAY 0035 BLUE CLAY 0055 GREY TILL GRVL 0066 GREY LMSN 0090
5603367	CAMBRIDGE TOWNSHIP CON 07 005	1987-01-08	DO	14.9		14.9	3.4	FR 0049	BRWN LOAM 0004 BLUE CLAY 0041 BLCK GRVL CGVL 0049
5603383	CAMBRIDGE TOWNSHIP CON 05 011	1987-07-19	DO	28.0	18.0	18.0	18.3	FR 0087	RED CLAY SOFT 0012 BLUE CLAY BLDR SOFT 0059 GREY ROCK HPAN 0092
5603408	CAMBRIDGE TOWNSHIP	1987-07-23	DO	11.3	6.4	6.4	2.7	SU 0033	BRWN HPAN 0021 BLUE SHLE 0037
5603410	CAMBRIDGE TOWNSHIP CON 06 005	1987-08-05	DO	17.4	16.2	16.5	2.7	FR 0053	RED CLAY HARD 0013 BRWN SAND HARD 0052 GREY GRVL HARD 0053 GREY ROCK HARD 0057
5603424	CAMBRIDGE TOWNSHIP	1987-08-11	DO	26.5		26.5	3.4	SA 0087	BRWN SAND 0014 BLUE CLAY 0078 BLCK GRVL SAND 0087
5603434	CAMBRIDGE TOWNSHIP CON 08 005	1987-11-14	DO ST	30.8	27.4	30.8	2.4	SU 0100	BRWN CLAY 0004 GREY CLAY FSND 0020 GREY SAND GRVL 0090 GREY ROCK 0101
5603495	CAMBRIDGE TOWNSHIP CON 05 011	1987-12-08	DO	27.4	24.4	24.4	9.1	FR 0085	GREY CLAY 0065 BLUE CLAY 0080 GREY LMSN 0090
5603554	CAMBRIDGE TOWNSHIP CON 05 008	1988-07-26	DO	41.1	15.8	15.8	13.7	FR 0090	YLLW LOAM SOFT 0005 RED CLAY SOFT 0012 BLUE CLAY SOFT 0045 GREY GRVL BLDR HARD 0052 GREY ROCK HARD 0135
5603572	CAMBRIDGE TOWNSHIP CON 05	1988-08-04	DO	32.0	29.0	29.0	9.1	UK 0100	GREY CLAY 0080 BRWN GRVL 0095 BRWN LMSN 0105
5603596	CAMBRIDGE TOWNSHIP CON 05 011	1988-09-15	DO	64.0	25.9		19.8	FR 0150	UNKN 0085 GREY LMSN 0210
5603617	CAMBRIDGE TOWNSHIP	1988-10-08	DO	13.7		13.7	2.7	FR 0045	BRWN LOAM 0003 RED CLAY 0019 GREY HPAN GRVL 0044 GREY GRVL CGVL 0045

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5603620	CAMBRIDGE TOWNSHIP CON 05 014	1988-10-18	DO	34.7		34.7	17.1	FR 0114	BRWN SAND 0006 BLUE CLAY 0101 GREY SAND FSND 0109 BLCK GRVL CGVL 0114
5603661	CAMBRIDGE TOWNSHIP CON 08 009	1989-02-16	CO	17.4		17.4	3.7	FR 0057	BRWN SAND 0008 BLUE CLAY 0043 GREY SAND FSND 0054 BLCK GRVL 0057
5603835	CAMBRIDGE TOWNSHIP CON 05 014	1989-12-06	DO	39.9	36.6	36.6	13.7	FR 0125	RED CLAY SOFT 0009 BLUE CLAY SOFT 0056 GREY SAND GRVL HARD 0120 BLCK ROCK HARD 0131
5604922	CAMBRIDGE TOWNSHIP CON 08 009	1994-08-22	DO	12.5	10.7	11.3	3.0	FR 0041	BRWN CLAY 0011 GREY CLAY 0034 GREY GRVL 0035 GREY LMSN 0041
5605074	CAMBRIDGE TOWNSHIP CON 05 010	1996-05-16	DO	5.5		5.5		FR 0018	BRWN SAND 0005 GREY CLAY FSND 0018
5603688	CAMBRIDGE TOWNSHIP CON 05 011	1989-04-24	DO	28.0	23.5	23.5	19.5	FR 0089	BRWN SAND 0013 BLUE CLAY 0071 GREY HPAN GRVL BLDR 0077 GREY LMSN 0092
5603715	CASSELMAN VILLAGE 063	1989-06-20	DO	22.9	19.8	19.8	7.6	FR 0073	BRWN CLAY 0010 GREY CLAY 0025 GREY GRVL 0065 GREY LMSN 0075
5603772	CAMBRIDGE TOWNSHIP	1989-08-29	CO	19.8	9.1	10.4	3.0	FR 0062	BRWN CLAY SAND HPAN 0030 BLCK LMSN 0065
5603773	CAMBRIDGE TOWNSHIP	1989-08-29	CO	18.3	9.7		4.3	FR 0057	BRWN CLAY STNS HPAN 0032 BLCK LMSN 0060
5603807	CAMBRIDGE TOWNSHIP	1989-10-28	CO	11.6		11.6	2.1	SU 0038	BRWN CLAY 0018 BLUE CLAY 0033 GREY SAND 0038
5603808	CAMBRIDGE TOWNSHIP	1989-10-27	CO	26.2	11.6	11.6	1.5	FR 0038	BRWN CLAY 0017 BLUE CLAY 0038 BLUE SHLE 0086
5603842	CAMBRIDGE TOWNSHIP CON 06 007	1989-11-01	DO	14.9	14.3	14.3	3.4	FR 0047	BRWN CLAY 0019 BLUE CLAY 0043 BLCK GRVL 0047 GREY LMSN 0049
5603858	CAMBRIDGE TOWNSHIP	1990-02-16	DO	18.9	11.0	11.0	5.2	SU 0046	BRWN HPAN FILL 0006 BRWN CLAY 0036 BLUE SHLE 0062

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5603878	CAMBRIDGE TOWNSHIP CON 06 013	1990-04-23	DO	22.6		22.6	10.7	SU 0074	BRWN SAND 0004 BLUE CLAY 0068 BLCK GRVL 0074
5603882	CAMBRIDGE TOWNSHIP	1990-04-29	CO	38.1	14.0	14.0	3.7	FR 0085	RED CLAY SOFT 0009 BLUE CLAY SOFT 0032 GREY GRVL HARD 0046 GREY ROCK HARD 0125
5603883	CAMBRIDGE TOWNSHIP	1990-04-27	CO	19.8	14.3	14.3	3.7	FR 0062	RED CLAY SOFT 0012 BLUE CLAY SOFT 0032 GREY GRVL HARD 0047 GREY ROCK HARD 0065
5603891	CAMBRIDGE TOWNSHIP CON 05 011	1990-05-30	DO	33.8	27.4	27.4	15.2	FR 0110	BRWN SAND 0010 GREY CLAY FSND 0070 BLUE CLAY FSND 0090 GREY LMSN 0111
5603941	CAMBRIDGE TOWNSHIP	1990-06-13	CO	50.3	19.8		2.4	FR 0160	PRDR 0065 GREY LMSN 0165
5603999	CAMBRIDGE TOWNSHIP CON 06 013	1989-07-17	DO	26.8	26.5	26.5	4.6	FR 0088	YLLW LOAM SAND DNSE 0010 GREY SAND DNSE 0015 BLUE CLAY LOOS 0087 GREY LMSN LYRD 0088
5604001	CAMBRIDGE TOWNSHIP	1990-11-22	DO	38.1	3.3	6.7	4.6	FR 0122	BRWN STNS HPAN 0011 BRWN SHLE 0018 BRWN LMSN 0125
5604034	CAMBRIDGE TOWNSHIP CON 05 011	1991-01-14	DO	39.6	18.3	18.3	16.8	FR 0126	BRWN LOAM 0004 BLUE CLAY 0060 GREY LMSN 0130
5604088	CAMBRIDGE TOWNSHIP CON 06 008	1991-07-05	DO	5.5	4.6	4.6	2.1	FR 0017	BRWN CLAY 0015 GREY LMSN 0018
5604117	CAMBRIDGE TOWNSHIP CON 07	1991-07-18	DO	14.6	13.4	13.4	6.1	FR 0048	BRWN CLAY 0004 GREY CLAY 0042 GREY GRVL SAND 0044 GREY ROCK 0048
5604121	CAMBRIDGE TOWNSHIP	1991-08-07	DO	19.5	14.0	14.0	7.3	FR 0059	BRWN LOAM 0004 BRWN CLAY 0027 GREY SAND BLDR 0046 GREY LMSN 0064
5604138	CAMBRIDGE TOWNSHIP	1991-07-26	NU	105.2	49.7	49.7	16.8	FR 0325	BRWN SAND LOOS 0015 GREY SILT LOOS 0150 GREY TILL PCKD 0163 BRWN SHLE SOFT 0345
5604157	CAMBRIDGE TOWNSHIP	1991-11-08	AC	17.4		17.4	6.4	FR 0057	BRWN CLAY 0023 BRWN HPAN 0036 BLCK GRVL CGVL 0057

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5604208	CAMBRIDGE TOWNSHIP	1992-01-24	DO	9.1	7.6	7.6	1.2	FR 0030	BRWN SAND 0003 BRWN CLAY 0021 BLCK GRVL 0025 GREY LMSN 0030
5604229	CAMBRIDGE TOWNSHIP CON 08 010	1992-06-18	DO	10.7		10.7	4.3	FR 0035	BRWN CLAY 0023 BRWN HPAN BLDR 0034 GREY GRVL CGVL 0035
5604311	CAMBRIDGE TOWNSHIP CON 05 011	1992-07-16	DO	41.8	19.5	19.5		UK	BRWN LOAM 0003 GREY CLAY 0047 BLUE CLAY 0064 GREY LMSN 0137
5604358	CASSELMAN VILLAGE	1992-09-09	NU	15.2	5.8	6.7	2.1	FR 0048	BRWN LOAM CLAY SNDY 0005 BRWN GRVL STNS HPAN 0019 BRWN LMSN ROCK HARD 0050
5604461	CAMBRIDGE TOWNSHIP CON 05 013	1992-11-26	DO	40.8	39.6	39.6	21.3	SA 0134	YLLW SAND SOFT 0006 GREY SAND SOFT 0023 GREY CLAY SAND SOFT 0080 BLUE CLAY SOFT 0130 BRWN SHLE HARD 0134
5604482	CAMBRIDGE TOWNSHIP CON 08 011	1993-04-28	ST	22.3	18.9	18.9	2.4	FR 0070	RED CLAY SOFT 0015 BLUE CLAY SOFT 0051 GREY GRVL PCKD HARD 0062 GREY LMSN HARD 0073
5604497	CAMBRIDGE TOWNSHIP CON 06 013	1993-05-13	DO	25.9	21.0	21.3	17.1	FR 0082	BRWN SAND 0008 GREY CLAY 0046 BLUE CLAY 0068 GREY GRVL CLAY 0069 GREY LMSN 0085
5604534	CAMBRIDGE TOWNSHIP 011	1993-07-22	DO	21.3		21.3	7.6	FR 0070	YLLW SAND SOFT 0005 RED CLAY SOFT 0015 GREY CLAY SAND SOFT 0025 BLUE CLAY SOFT 0060 BRWN SAND SOFT 0065 BRWN SAND GRVL SOFT 0069 BLCK GRVL SOFT 0070
5604596	CAMBRIDGE TOWNSHIP CON 08 009	1993-10-15	DO	18.0	13.4	13.4	1.2	FR 0057	RED CLAY SOFT 0010 BLUE CLAY SOFT 0043 GREY GRVL HARD 0044 GREY ROCK HARD 0059
5604625	CAMBRIDGE TOWNSHIP CON 05 011	1993-10-07	DO	28.3	23.2	23.2	18.3	FR 0080	BRWN LOAM SOFT 0001 YLLW SAND SOFT 0013 GREY CLAY SOFT 0040 BLUE CLAY SOFT 0073 BLCK GRVL SOFT 0076 BLCK SHLE HARD 0093
5604626	CAMBRIDGE TOWNSHIP CON 05 011	1993-11-24	DO	21.0	20.7	20.7	12.2	FR 0068	YLLW SAND SOFT 0012 GREY CLAY SOFT 0045 BLUE CLAY SOFT 0067 BLCK GRVL HARD 0068 BRWN SHLE HARD 0069
5604627	CAMBRIDGE TOWNSHIP CON 05 011	1993-11-25	DO	27.4	27.1	27.1	13.7	FR 0089	YLLW SAND SOFT 0020 GREY CLAY SOFT 0050 BLCK CLAY SOFT 0088 BLCK GRVL HARD 0089 BLCK SHLE HARD 0090
5604644	CAMBRIDGE TOWNSHIP	1994-01-14	MN	21.3	9.1	9.8		FR 0068	YLLW SAND SOFT 0008 BLUE CLAY SOFT 0030 GREY ROCK HARD 0032 GREY ROCK HARD 0070

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5604645	CAMBRIDGE TOWNSHIP	1994-01-14	MN	27.4		12.2		FR 0087	YLLW SAND SOFT 0008 BLUE CLAY SOFT 0040 GREY HPAN 0090
5604867	CAMBRIDGE TOWNSHIP	1994-03-16	MN	25.3		6.1	3.0		YLLW FSND 0010 BRWN GRVL SILT 0015 SAND GRVL 0020 GRVL BLDR 0030 SAND BLDR 0033 GRVL 0040 GREY GRVL MGVL CSND 0045 GRVL CSND 0050 CSND 0060 CSND MSND 0065 GRVL MSND SNDY 0080 GRVL CSND GRVL 0083
5604886	CAMBRIDGE TOWNSHIP CON 08 008	1994-08-02	DO	16.8	14.6	15.5	3.0	FR 0052	BRWN CLAY 0008 GREY CLAY 0041 GREY SAND 0048 GREY LMSN 0055
5604909	CAMBRIDGE TOWNSHIP CON 05 011	1994-07-14	DO	6.1		6.1	1.5	FR 0006	BRWN LOAM 0001 RED SAND 0003 GREY SAND 0006 BLUE CLAY 0020
5604945	CAMBRIDGE TOWNSHIP CON 06 009	1994-11-04	DO	21.3	6.1	6.7	3.7	FR 0068	BRWN LOAM SNDY CLAY 0006 GREY CLAY 0018 GREY GRVL SAND ROCK 0020 GREY LMSN ROCK 0070
5604947	CAMBRIDGE TOWNSHIP CON 05 010	1994-10-11	DO	29.3	23.5	23.5	18.3	UK 0094	BRWN SAND 0014 GREY CLAY 0073 GREY GRVL SHLE SAND 0077 GREY LMSN ROCK 0096
5604954	CAMBRIDGE TOWNSHIP 005	1994-09-08	DO	27.7	25.6	25.6	9.4	SU 0084	BRWN LOAM 0003 BRWN CLAY SOFT 0018 GREY CLAY SOFT 0068 BLCK SAND GRVL SOFT 0083 BLCK GRVL PCKD 0084 BLCK SHLE SOFT 0091
5604960	CAMBRIDGE TOWNSHIP CON 05 011	1994-10-14	DO	25.3	18.3	18.3	15.2	FR 0077	YLLW SAND SOFT 0009 GREY CLAY SAND SOFT 0040 BLUE CLAY SOFT 0060 GREY LMSN HARD 0083
5604980	CAMBRIDGE TOWNSHIP CON 06 016	1995-02-01	DO	28.7	28.3	28.3	6.1	FR 0093	BRWN CLAY PCKD 0015 GREY CLAY SOFT 0075 GREY GRVL LOOS 0093 GREY LMSN LYRD 0094
5604983	CAMBRIDGE TOWNSHIP CON 05 011	1995-03-14	DO	24.4	19.5	19.5	16.8	FR 0070	BRWN SAND PCKD 0012 BRWN CLAY DNSE 0050 GREY CLAY SOFT 0064 GREY LMSN ROCK HARD 0080
5604991	CAMBRIDGE TOWNSHIP	1994-11-09	DO	7.3		6.1	5.5	FR 0009 FR 0016	BRWN LOAM 0001 YLLW SAND 0003 GREY SAND 0012 BLUE SAND 0024
5605008	CAMBRIDGE TOWNSHIP	1995-05-24	CO	7.3		7.3	0.9	FR 0007	BRWN SAND 0024
5605014	CAMBRIDGE TOWNSHIP CON 07 007	1995-06-18	DO	13.7	11.6	12.8	3.0	FR 0042	RED CLAY SOFT 0007 GREY CLAY SOFT 0022 BLUE CLAY SOFT 0038 BRWN SHLE PORS 0042 BRWN SHLE HARD 0045

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5605024	CAMBRIDGE TOWNSHIP CON 05 011	1995-08-10	DO	25.6	19.5	19.5	13.7	FR 0080	BRWN SAND PCKD 0005 BLUE CLAY SOFT 0064 GREY ROCK HARD 0084
5605031	CAMBRIDGE TOWNSHIP CON 06 013	1995-06-30	DO	6.1		6.1	1.8	FR 0018	BRWN LOAM 0001 BRWN SAND 0004 GREY SAND 0018 GREY CLAY FSND 0020
5605032	CAMBRIDGE TOWNSHIP CON 08 007	1995-03-16	DO	37.2	29.9	29.9	3.0	SU 0115	BRWN CLAY 0022 GREY HPAN STNS 0098 GREY LMSN ROCK 0122
5605040	CAMBRIDGE TOWNSHIP CON 05 013	1995-09-25	DO	6.1		7.0	3.4	FR 0010	LOAM 0006 YLLW SAND 0009 GREY SAND 0010 CLAY 0020
5605062	CASSELMAN VILLAGE 684	1996-03-27	DO	19.8	13.4	13.4	7.6	FR 0062	RED CLAY SOFT 0008 BLUE CLAY SOFT 0040 GREY GRVL HARD 0044 GREY LMSN HARD 0065
5605239	CAMBRIDGE TOWNSHIP CON 05 015	1997-11-07	DO	5.5		5.5			BRWN LOAM 0001 BRWN SAND 0004 GREY SAND 0014 GREY CLAY SNDY 0018
5605708	CAMBRIDGE TOWNSHIP CON 08 010	2002-08-15	DO	20.4	13.7		7.6	FR 0046	BRWN SAND CLAY 0012 GREY CLAY 0027 GREY GRVL SAND 0045 GREY SHLE 0067
5605095	CAMBRIDGE TOWNSHIP CON 06 015	1996-09-05	DO	6.1		6.1		FR 0018	BRWN SAND 0003 GREY SAND 0012 BLUE CLAY 0020
5605117	CAMBRIDGE TOWNSHIP	1996-09-17	DO	8.2		7.3		UK 0008	BLUE LOAM 0001 YLLW SAND 0003 GREY SAND 0008 BLUE CLAY 0027
5605118	CAMBRIDGE TOWNSHIP CON 07 011	1996-09-22	DO	21.9	21.3	21.3	6.1	FR 0070	RED CLAY SOFT 0006 BRWN CLAY SOFT 0019 GREY CLAY SOFT 0026 BLUE CLAY SOFT 0068 BLCK SAND GRVL SOFT 0070 GREY LMSN HARD 0072
5605126	CAMBRIDGE TOWNSHIP CON 07 012	1996-10-23	DO	25.6	21.3	21.3	7.6	FR 0078	BRWN CLAY SNDY LOAM 0005 RED CLAY 0008 GREY CLAY 0045 BLUE CLAY 0058 GREY CLAY FSND 0070 GREY LMSN 0084
5605143	CAMBRIDGE TOWNSHIP CON 05 011	1996-12-03	DO	26.8	21.3	22.3	15.2	FR 0085	BRWN LOAM SNDY 0005 GREY SAND 0012 GREY CLAY 0060 GREY CLAY SAND GRVL 0070 GREY SHLE ROCK 0072 GREY LMSN ROCK 0088
5605186	CAMBRIDGE TOWNSHIP CON 05 014	1997-07-30	DO	7.3		6.7	1.5	FR 0016	BRWN LOAM SNDY 0002 GREY SAND 0018 GREY CLAY 0024

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5605190	CAMBRIDGE TOWNSHIP CON 11 005	1997-08-27	DO	30.5	21.3		19.8	FR 0100	PRDR 0070 GREY LMSN ROCK 0100
5605192	CAMBRIDGE TOWNSHIP	1997-06-09	DO	7.3		7.3		FR 0018	BRWN LOAM 0001 BRWN SAND 0003 GREY SAND 0014 GREY CLAY 0024
5605207	CAMBRIDGE TOWNSHIP CON 05 014	1997-08-29	DO	6.1				FR 0012	BRWN LOAM 0001 BRWN SAND 0003 GREY SAND 0020
5605258	CAMBRIDGE TOWNSHIP CON 05 011	1998-06-18	DO	6.1		6.1		UK 0014	BRWN LOAM 0001 BRWN SAND 0003 GREY SAND 0012 GREY CLAY 0020
5605265	CAMBRIDGE TOWNSHIP	1997-08-25	DO	5.2		5.2		FR 0003	BRWN LOAM SNDY CLN 0001 BRWN SILT SAND CLN 0002 GREY SILT CLAY CLN 0017
5605266	CAMBRIDGE TOWNSHIP	1997-06-03	DO	5.8		5.8		FR	BRWN LOAM SNDY CLN 0001 YLLW SILT SAND 0008 GREY SILT CLAY FSND 0019
5605272	CAMBRIDGE TOWNSHIP	1998-06-19	DO	35.1		35.1		FR 0115	YLLW SAND SOFT 0015 GREY CLAY SOFT 0045 BLUE CLAY SOFT 0100 GREY GRVL SOFT 0115
5605273	CAMBRIDGE TOWNSHIP	1998-06-23	DO	27.4	22.9	22.9	6.1	FR 0075	YLLW SAND SOFT 0011 GREY CLAY SOFT 0040 BLUE CLAY GRVL SOFT 0075 GREY LMSN HARD 0090
5605287	CAMBRIDGE TOWNSHIP	1998-08-18	DO	61.9	34.7	36.6	8.5	FR 0120	YLLW SAND SOFT 0004 GREY CLAY SOFT 0050 BLUE CLAY SOFT 0114 GREY LMSN HARD 0203
5605288	CAMBRIDGE TOWNSHIP	1998-08-06	DO	12.2	11.3	11.3	3.7	FR 0037	RED CLAY SOFT 0008 GREY CLAY SOFT 0032 GREY GRVL SOFT 0037 GREY LMSN HARD 0040
5605293	CAMBRIDGE TOWNSHIP CON 05 011	1998-10-15	DO	33.5	18.3	18.3	16.8	FR 0090 FR 0105	BRWN SAND LOAM 0006 GREY CLAY 0055 GREY HPAN CLAY 0060 GREY LMSN ROCK HARD 0110
5605313	CASSELMAN VILLAGE 07 008	1998-10-24	NU						
5605314	CASSELMAN VILLAGE 07 008	1998-10-24	NU						

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5605318	CAMBRIDGE TOWNSHIP	1998-11-16	DO	15.2		12.2	6.1	FR 0037	BRWN UNKN LOOS 0006 BRWN UNKN 0017 UNKN 0037 BRWN UNKN LOOS 0050
5605323	CAMBRIDGE TOWNSHIP	1999-05-10	DO	7.0		6.4	6.1	UK 0012	BRWN LOAM 0001 YLLW SAND 0008 BLUE SILT 0023
5605354	CASSELMAN VILLAGE 009	1999-08-15	DO	27.4	13.7	13.7	12.2	FR 0080	BRWN CLAY 0022 GREY CLAY 0045 BLCK LMSN ROCK 0074 GREY LMSN ROCK 0090
5605379	CAMBRIDGE TOWNSHIP CON 05 010	1999-09-10	DO ST	27.4	21.3	21.3	18.3	FR 0088	BRWN SAND CLAY 0012 BRWN CLAY 0040 GREY CLAY 0065 GREY CLAY SAND 0070 GREY LMSN ROCK 0090
5605380	CAMBRIDGE TOWNSHIP CON 07 012	1999-09-06	DO	22.9		22.6	4.6	FR 0074	BRWN CLAY HARD 0015 BLUE CLAY 0060 GREY SAND GRVL CLAY 0074 GREY UNKN 0075
5605398	CAMBRIDGE TOWNSHIP	1999-12-15	DO	14.6		7.9	2.2	FR	LOAM 0010 BLUE CLAY 0026 BRWN SAND 0048
5605414	CAMBRIDGE TOWNSHIP CON 06 005	2000-03-24	ST	14.9		14.9	4.6	FR 0049	YLLW GRVL SOFT 0006 RED CLAY PCKD 0015 GREY GRVL PCKD 0049
5605417	CAMBRIDGE TOWNSHIP	1999-05-31	DO	5.5		5.5			SAND 0006 BRWN LOAM SNDY 0012 CLAY SLTY SAND 0018
5605420	CAMBRIDGE TOWNSHIP	1998-06-26	DO	5.5		5.5		FR	SAND SLTY 0008 BRWN LOAM 0012 CLAY SLTY 0018
5605436	CAMBRIDGE TOWNSHIP CON 08 007	2000-05-23	DO	7.6	6.7	6.7	1.5	FR 0022	BRWN TILL 0002 GREY CLAY 0010 GREY HPAN 0022 BRWN ROCK 0025
5605461	CAMBRIDGE TOWNSHIP CON 08 009	2000-08-16	DO	15.8	13.7			FR 0045 FR 0051	BRWN SAND 0004 BRWN CLAY SAND 0018 GREY CLAY 0030 GREY GRVL 0042 GREY SAND GRVL 0045 BLCK SHLE ROCK 0052
5605477	CAMBRIDGE TOWNSHIP CON 012	2000-10-04	DO	24.4	23.8		7.6	FR 0079	RED CLAY SOFT 0012 BLUE CLAY SOFT 0076 GREY GRVL 0078 GREY ROCK LMSN LYRD 0080
5605478	CAMBRIDGE TOWNSHIP CON 05 011	2000-09-19	DO	33.5	19.2		18.3	FR 0105	BRWN UNKN SNDY 0012 GREY CLAY 0060 GREY SAND CLAY 0063 GREY LMSN ROCK 0110
5605509	CAMBRIDGE TOWNSHIP CON 08 009	2000-10-25	DO	20.4	15.8			SU 0065	BRWN CLAY 0016 GREY CLAY 0040 GREY CLAY SAND 0046 GREY SAND GRVL 0052 GREY LMSN ROCK 0067
5605517	CAMBRIDGE TOWNSHIP CON 06 006	2001-04-04	DO	18.3	12.5		6.1	FR 0052	RED CLAY SOFT 0008 BLUE CLAY SOFT 0041 GREY LMSN LYRD 0060

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5605544	CAMBRIDGE TOWNSHIP CON 05 015	2001-06-12	DO	3.7			1.5	FR 0006	BLCK LOAM 0002 GREY SAND 0009 GREY CLAY 0012
5605545	CAMBRIDGE TOWNSHIP CON 07 008	2001-05-21	DO	15.2	8.5		3.0	FR 0040	BRWN LOAM CLAY 0003 GREY CLAY 0022 GREY GRVL SAND 0028 BRWN LMSN ROCK 0050
5605581	CAMBRIDGE TOWNSHIP CON 06 012	2001-10-23	DO	45.7	14.0		12.2	FR 0140	YLLW SAND SOFT 0010 BLUE CLAY SOFT 0037 GREY GRVL BLDR PCKD 0046 GREY LMSN LYRD 0150
5605620	CAMBRIDGE TOWNSHIP CON 05 011	2001-11-01	DO	30.5	24.4		21.3	FR 0090	BRWN UNKN SNDY 0018 GREY CLAY SAND 0080 GREY ROCK 0100
5605642	CAMBRIDGE TOWNSHIP CON 07 010	2002-04-19	DO	26.2	25.0		4.6	FR 0082	RED CLAY DNSE 0030 BLUE CLAY SOFT 0080 GREY GRVL PCKD 0082 GREY LMSN LYRD 0086
5605650	CAMBRIDGE TOWNSHIP CON 07 008	2002-02-05	DO	10.1	4.3		2.4	FR 0025	BRWN CLAY 0002 BRWN HPAN STNS 0014 GREY ROCK 0016 GREY ROCK 0033
5605651	CAMBRIDGE TOWNSHIP CON 07 008	2002-02-12	NU						
5605674	CAMBRIDGE TOWNSHIP CON 05 015	2002-06-06	DO MN	32.0	29.9		7.6	SU 0102	BRWN SAND PCKD 0008 GREY CLAY DNSE 0014 GREY CLAY SOFT 0094 GREY GRVL SAND LOOS 0098 GREY SHLE LMSN ROCK 0105
5605675	CAMBRIDGE TOWNSHIP	2001-09-12	DO	5.5				FR 0005	BRWN LOAM FSND LOOS 0001 YLLW FSND VERY SLTY 0005 GREY FSND SLTY PCKD 0018
5605676	CAMBRIDGE TOWNSHIP	2001-09-28	DO	4.3				FR 0004	BRWN LOAM SNDY 0001 YLLW SILT VERY FSND 0006 GREY SAND SLTY 0014
5605677	CAMBRIDGE TOWNSHIP	2001-01-17	DO	5.5				FR 0005	BRWN LOAM SNDY 0001 BRWN FSND SNDY 0005 YLLW SAND SLTY 0018
5605735	CAMBRIDGE TOWNSHIP CON 07 012	2002-09-12	DO	24.4	23.5		6.1	SA 0077	RED CLAY SOFT 0010 GREY CLAY GRVL SOFT 0055 GREY GRVL BLDR LOOS 0077 GREY LMSN HARD 0080
5605766	CAMBRIDGE TOWNSHIP CON 07 012	2002-12-30	DO	24.4	24.1	24.1	4.6	SA 0079	RED CLAY SOFT 0012 GREY CLAY SOFT 0055 GREY GRVL SOFT 0079 GREY SHLE PORS 0080
5605816	CAMBRIDGE TOWNSHIP CON 06 011	2003-02-21	MO	24.4	4.3	6.1	3.0	FR 0075	BRWN LOAM PCKD 0001 BRWN CLAY DNSE 0004 BLCK CLAY LOOS 0013 GREY TILL PCKD 0014 GREY LMSN LYRD 0080
5605817	CAMBRIDGE TOWNSHIP CON 06 011	2003-02-21	MO	4.6		1.5		FR 0014	BRWN LOAM PCKD 0001 BRWN CLAY HARD 0004 BRWN SAND DNSE 0008 BLUE CLAY DNSE 0013 GREY GRVL PCKD 0015

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5605865	CAMBRIDGE TOWNSHIP CON 08 009	2003-07-15	DO	19.8	9.4		4.6	FR 0040 FR 0063	RED CLAY 0018 GREY CLAY 0028 GREY SAND GRVL 0031 GREY SHLE 0065
5605866	CAMBRIDGE TOWNSHIP CON 05 009	2003-06-17	DO	41.5	16.8		15.2	FR 0060	BRWN HPAN STNS 0005 BRWN CLAY 0018 GREY CLAY 0052 GREY GRVL SAND 0055 GREY LMSN 0136
5606014	CAMBRIDGE TOWNSHIP CON 05 011	2004-08-20	DO	6.1		6.1	1.9	FR 0006	BLCK LOAM 0001 YLLW SAND 0006 BLUE CLAY 0020
5606021	CAMBRIDGE TOWNSHIP CON 08 010	2004-10-09	NU						
5606044	CASSELMAN VILLAGE 07 010	2004-11-01	DO	51.0	36.0	39.0	3.8		BRWN SAND LOAM CLAY 0013 GREY CLAY 0052 GREY HPAN SAND GRVL 0118 GREY ROCK 0167
5606089	CASSELMAN VILLAGE 07 009	2005-05-03	NU						
5606091	CAMBRIDGE TOWNSHIP CON 08 010	2005-04-22	DO ST						
5606092	CAMBRIDGE TOWNSHIP CON 08 010	2005-04-22	DO ST						
5606093	CAMBRIDGE TOWNSHIP CON 08	2005-04-05	DO	19.8	11.3	14.6	3.0	FR 0060	BRWN SAND LOAM CLAY 0001 BRWN CLAY 0012 GREY HPAN STNS GRVL 0037 BRWN SHLE 0065
5606128	CASSELMAN VILLAGE 07 009	2005-06-08	NU						
5606129	CAMBRIDGE TOWNSHIP CON 05 010	2005-07-13	DO	6.6		6.6	2.3	FR 0007	BLCK LOAM 0001 YLLW SAND 0005 GREY SAND 0008 BLUE CLAY 0022
5606173	CAMBRIDGE TOWNSHIP CON 05 005	2005-09-16	DO	27.8	24.8	24.8	10.5	FR 0081	YLLW SAND SOFT 0005 GREY CLAY SOFT 0022 BLUE CLAY SOFT 0058 GREY GRVL SAND SHLE 0081 GREY LMSN HARD 0091
5606187	CAMBRIDGE TOWNSHIP CON 05 011	2005-10-14	DO	6.1		6.1	1.7	FR 0006	BLCK LOAM 0001 YLLW SAND 0005 GREY SAND 0012 BLUE CLAY 0020

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5606198	CAMBRIDGE TOWNSHIP CON 05 011	2005-09-21	DO	68.6	34.1			FR	0112 BRWN ROCK 0225
5606199	CASSELMAN VILLAGE 06 009	2005-09-29	DO	24.4	16.2	16.8	1.3	FR 0060	BRWN CLAY 0013 GREY GRVL SAND STNS 0053 GREY LMSN 0080
5606200	CAMBRIDGE TOWNSHIP CON 05 011	2005-09-23	DO	6.7		6.7		FR 0018	BRWN SAND 0007 GREY SAND 0009 GREY CLAY 0022
5606203	CAMBRIDGE TOWNSHIP CON 05 011	2005-09-23	DO	7.3		7.3		0015	BRWN SAND 0005 GREY SAND 0007 GREY CLAY SAND 0009 GREY CLAY 0024
5606243	CAMBRIDGE TOWNSHIP CON 05 011	2006-03-27	DO	6.5			2.1	FR 0007	BLCK LOAM 0001 YLLW SAND 0008 GREY SAND 0011 BLUE CLAY 0021
5606302	CAMBRIDGE TOWNSHIP CON 05 002	2006-07-22	DO	6.6		6.6	2.5	FR 0008	BLCK LOAM 0001 YLLW SAND 0006 GREY SAND 0010 BLUE CLAY 0022
5606304	CAMBRIDGE TOWNSHIP CON 05 011	2006-07-24	DO	6.6		6.6	2.7	FR 0009	BLCK LOAM 0001 YLLW SAND 0007 GREY SAND 0011 BLUE CLAY 0022
5606307	CAMBRIDGE TOWNSHIP CON 05 012	2006-08-26	DO	6.5		6.5	3.0	FR 0010	BLCK LOAM 0001 YLLW SAND 0006 GREY SAND 0010 BLUE CLAY 0021
5606315	CASSELMAN VILLAGE 06 010	2006-09-25	DO	6.7		6.7	1.6	FR 0005	BLCK LOAM 0001 YLLW SAND 0004 GREY SAND 0007 BLUE CLAY 0022
7039376	CASSELMAN VILLAGE 06	2006-09-26	MN	10.4	4.3	4.3			GREY HPAN STNS CLAY 0014 GREY ROCK 0034
7039377	CASSELMAN VILLAGE 06	2006-09-26	MN	9.4	2.4	2.9		0028	GREY HPAN STNS CLAY 0008 GREY ROCK 0031
7039398	CAMBRIDGE TOWNSHIP 05 010	2006-10-19	DO	29.0	21.3	21.9	15.6	FR 0095	BRWN CLAY 0018 GREY CLAY 0052 GREY SAND CLAY 0060 GREY SAND GRVL 0070 GREY ROCK 0095
7100275	CASSELMAN VILLAGE 7 8	2007-11-26	NU	97.5					0190 0320

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7101183	CAMBRIDGE TOWNSHIP CON 05 014	2007-07-17	MO	5.9		3.3			BRWN FSND SILT 0006 GREY CLAY SILT 0019
7101183	CAMBRIDGE TOWNSHIP CON 05 014	2007-07-17	MO	5.9		3.3			BRWN FSND SILT 0006 GREY CLAY SILT 0019
7101183	CAMBRIDGE TOWNSHIP CON 05 014	2007-07-17	MO	5.9		3.3			BRWN FSND SILT 0006 GREY CLAY SILT 0019
7101183	CAMBRIDGE TOWNSHIP CON 05 014	2007-07-17	MO	5.9		3.3			BRWN FSND SILT 0006 GREY CLAY SILT 0019
7101183	CAMBRIDGE TOWNSHIP CON 05 014	2007-07-17	MO	5.9		3.3			BRWN FSND SILT 0006 GREY CLAY SILT 0019
7101183	CAMBRIDGE TOWNSHIP CON 05 014	2007-07-17	MO	5.9		3.3			BRWN FSND SILT 0006 GREY CLAY SILT 0019
7101183	CAMBRIDGE TOWNSHIP CON 05 014	2007-07-17	MO	5.9		3.3			BRWN FSND SILT 0006 GREY CLAY SILT 0019
7101183	CAMBRIDGE TOWNSHIP CON 05 014	2007-07-17	MO	5.9		3.3			BRWN FSND SILT 0006 GREY CLAY SILT 0019
7101183	CAMBRIDGE TOWNSHIP CON 05 014	2007-07-17	MO	5.9		3.3			BRWN FSND SILT 0006 GREY CLAY SILT 0019
7101554	08 010	2008-01-15	DO	7.8		7.8	3.5	FR 0012	BLCK LOAM 0001 RED CLAY 0009 BLUE CLAY 0026
7106241	CASSELMAN VILLAGE 06	2008-05-22	PS DO	6.1		6.1		FR 0015	BRWN LOAM 0002 BRWN SAND 0004 GREY CLAY 0007 0020
7106242	CASSELMAN VILLAGE 05 001	2008-06-01	ST	32.0	21.6	22.1	5.1	FR 0095	GRVL 0002 BRWN SAND CLAY 0006 GREY CLAY 0026 BLUE CLAY 0068 GREY GRVL SAND 0071 GREY ROCK HARD 0105
7106243	05 001	2008-01-10	NU						

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7110378	CASSELMAN VILLAGE 08 011	2008-03-03	MO	22.8			1.5		BRWN FSND LYRD 0016 BRWN GRVL 0021 GREY ---- 0030 BRWN FSND 0049 GREY ---- 0059 GREY BLDR ROCK FCRD 0075
7110378	CASSELMAN VILLAGE 08 011	2008-03-03	MO	22.8			1.5		BRWN FSND LYRD 0016 BRWN GRVL 0021 GREY ---- 0030 BRWN FSND 0049 GREY ---- 0059 GREY BLDR ROCK FCRD 0075
7110378	CASSELMAN VILLAGE 08 011	2008-03-03	MO	22.8			1.5		BRWN FSND LYRD 0016 BRWN GRVL 0021 GREY ---- 0030 BRWN FSND 0049 GREY ---- 0059 GREY BLDR ROCK FCRD 0075
7113288	CASSELMAN VILLAGE 05 011	2008-10-03	DO	6.6		6.6	2.4	FR 0008	BLCK LOAM 0001 YLLW SAND 0006 GREY SAND 0012 BLUE CLAY 0022
7113948	CASSELMAN VILLAGE 04 010	2008-10-02	DO	39.6	38.1	38.1	21.1	FR 0128	BRWN SAND SOFT 0020 GREY CLAY SOFT 0118 GREY GRVL PCKD 0125 GREY SHLE LYRD 0130
7113955	CASSELMAN VILLAGE 05	2008-10-02	DO	30.5	21.2	22.0	20.8	FR 0098	RED CLAY DNSE 0010 BLUE CLAY SOFT 0069 GREY GRVL PCKD 0070 GREY LMSN 0100
7114223	CASSELMAN VILLAGE 05 011	2008-10-20	DO	6.0		6.0	2.1	FR 0009	BLCK LOAM 0001 YLLW SAND 0006 GREY SAND 0012 BLUE CLAY 0020
7114301	CASSELMAN VILLAGE 05 011	2008-10-20	NU						
7115459	CAMBRIDGE TOWNSHIP CON 05 002	2008-11-15	DO	7.3		7.3	2.6	FR 0008	BLCK LOAM 0001 YLLW SAND 0006 GREY SAND 0010 BLUE CLAY 0024
7116657	CAMBRIDGE TOWNSHIP 06	2008-10-02	DO	12.2	7.0	7.9	1.2	FR 0020	BRWN CLAY 0008 GREY CLAY 0016 GREY GRVL SAND 0023 GREY LMSN 0040
7116663	CAMBRIDGE TOWNSHIP CON 05 014	2008-11-17	NU	4.9		4.9			0016
7116664	CAMBRIDGE TOWNSHIP CON 05 014	2008-12-18	NU	1.8		1.8			0006
7117292	CAMBRIDGE TOWNSHIP CON 06 006	2008-12-22	ST			9.5			

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7117297	CAMBRIDGE TOWNSHIP CON 06 006	2008-12-19	ST	24.3	14.7	14.7	3.0	FR 0066	BRWN CLAY SOFT 0011 GREY CLAY SOFT 0044 GREY GRVL PCKD 0048 GREY LMSN LYRD 0080
7118424	CAMBRIDGE TOWNSHIP	2008-08-13	MO	14.9	14.0	0.3			FILL 0001 RED CLAY SILT 0033 RED CLAY SILT 0033 FSND SILT CLAY 0046 LMSN SHLE 0049
7118426	CAMBRIDGE TOWNSHIP	2008-08-01	MO	25.8	16.0	1.2			LOAM SAND SLTY 0001 GREY CLAY SILT 0007 GREY FSND SILT GRVL 0031 TILL STNS SILT 0052 ROCK LMSN SAND 0085
7119308	CAMBRIDGE TOWNSHIP CON 06 012	2009-02-10	DO	6.9		6.9	2.2	FR 0007	BLCK LOAM 0001 YLLW SAND 0005 GREY SAND 0008 BLUE CLAY 0023
7124270	CAMBRIDGE TOWNSHIP CON 07 007	2009-01-27	CO	21.3	17.7	18.6	1.3	FR 0068	BRWN CLAY 0006 BRWN CLAY SAND GRVL 0020 GREY GRVL SAND 0047 GREY SAND GRVL 0058 BRWN SHLE SOFT 0070
7124574	CAMBRIDGE TOWNSHIP CON 08 010	2009-05-30	CO	19.2	17.6	17.6	3.9	FR 0062	BRWN CLAY SOFT 0010 BLUE CLAY SOFT 0043 GREY CSND BLDR PCKD 0058 GREY LMSN LYRD 0063
7125699	CAMBRIDGE TOWNSHIP CON 05 013	2009-06-11	DO	37.3	36.5	36.5	18.9	FR 0121	BRWN SAND SOFT 0010 GREY SAND SOFT 0015 GREY CLAY SOFT 0105 GREY GRVL PCKD 0120 GREY SHLE LYRD 0122
7127232	CAMBRIDGE TOWNSHIP CON 08 009	2009-03-23	MO	12.7	10.1	0.9			BRWN MUCK 0013 BRWN MUCK 0013 GREY SAND 0025 GREY 0033 GREY 0033 LMSN 0042 LMSN 0042 LMSN 0042 LMSN 0042
7129632	CAMBRIDGE TOWNSHIP CON 06 010	2009-08-06	PS			16.8			
7130717	CAMBRIDGE TOWNSHIP CON 05 011	2009-09-24	DO	7.3		7.3	2.9		BLCK LOAM 0001 YLLW SAND 0007 BLUE SAND 0011 BLUE CLAY 0024
7135921	CAMBRIDGE TOWNSHIP CON 07 009	2009-06-11	PS			8.0			
7135922	CAMBRIDGE TOWNSHIP CON 07 009	2009-06-11	PS			8.0			
7146859	CAMBRIDGE TOWNSHIP CON 07 009	2010-06-01	NU						

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7149321	CAMBRIDGE TOWNSHIP CON 05 010	2010-07-26	DO	6.7		6.7	2.4	FR 0008	BLCK LOAM 0001 YLLW SAND 0005 GREY SAND 0007 BLUE CLAY 0022
7150496	CAMBRIDGE TOWNSHIP CON 05 011	2010-08-19	DO	7.3		7.3	2.0	FR 0007	BLCK LOAM 0002 YLLW SAND 0006 GREY SAND 0011 BLUE CLAY 0024
7157547	CAMBRIDGE TOWNSHIP CON 08 009	2010-12-10	DO	18.3	13.1	14.6	0.9	FR 0055	BRWN CLAY 0011 GREY CLAY 0031 GREY GRVL SAND 0043 GREY LMSN SOFT 0060
7157564	CAMBRIDGE TOWNSHIP CON 05 013	2010-12-22	DO	6.2		6.6	1.2	FR	BLCK LOAM 0001 YLLW SAND 0004 GREY SAND 0010 BLUE CLAY 0020
7158192	CAMBRIDGE TOWNSHIP CON 06 012	2010-12-20	DO			19.3			
7158206	CAMBRIDGE TOWNSHIP CON 06 011	2009-09-16	DO	7.0		7.0		FR 0011	BRWN CLAY LOAM PCKD 0001 GREY CLAY PCKD 0010 GREY CLAY PCKD 0023
7162484	CAMBRIDGE TOWNSHIP CON 05 010	2011-04-28	DO	6.2		6.7	1.9	FR 0006	BLCK LOAM 0001 YLLW SAND 0006 GREY SAND 0010 BLUE CLAY 0020
7162825	CAMBRIDGE TOWNSHIP CON 07 005	2011-04-13	DO	18.2	16.7	16.7	3.7	UT 0056	BRWN CLAY HARD 0012 GREY CLAY SOFT 0048 GREY GRVL PCKD 0055 GREY SHLE LYRD 0060
7164612	CAMBRIDGE TOWNSHIP	2011-05-04	DO	38.4	33.5	34.4	6.1	UT 0120	BRWN SAND 0014 GREY CLAY 0072 GREY SAND GRVL 0110 GREY LMSN 0126
7168578	CAMBRIDGE TOWNSHIP CON 07 013	2011-08-09	DO	33.3	26.7	26.7	8.7	FR 0088	BRWN CLAY SOFT 0015 GREY CLAY SOFT 0065 BLUE CLAY SOFT 0075 GREY GRVL SAND SOFT 0088 GREY LMSN HARD 0109
7170600	CAMBRIDGE TOWNSHIP CON 05 011	2011-10-24	DO	6.5		7.2	2.1	FR 0007	BLCK LOAM 0001 YLLW SAND 0006 GREY SAND 0011 BLUE CLAY 0021
7170737	CAMBRIDGE TOWNSHIP CON 05 012	2011-10-24	DO	7.0		7.3	1.7	FR 0006	BLCK LOAM 0001 YLLW SAND 0006 GREY SAND 0010 BLUE CLAY 0023
7173628	CAMBRIDGE TOWNSHIP CON 05 012	2011-12-12	DO	6.3			2.6	FR 0009	BLCK LOAM 0001 YLLW SAND 0004 GREY SAND 0016 BLUE CLAY 0021

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7174032	CAMBRIDGE TOWNSHIP CON 05 010	2011-12-19	DO	6.5		6.5	0.8	0002	BLCK LOAM 0001 YLLW SAND 0005 GREY SAND 0010 BLUE CLAY 0021
7174040	CAMBRIDGE TOWNSHIP CON 05 010	2011-12-19	DO	7.3		7.3	1.1	FR 0004	BLCK LOAM 0001 YLLW SAND 0007 GREY SAND 0010 BLUE CLAY 0021 0024
7174041	CAMBRIDGE TOWNSHIP CON 05 010	2011-12-19	DO	7.3		7.3	1.1	UK 0004	BLCK LOAM 0001 YLLW SAND 0004 GREY SAND 0010 BLUE CLAY 0021 0024
7179351	CAMBRIDGE TOWNSHIP CON 07 011	2012-04-09	NU	22.3					FILL 0073
7187552	CAMBRIDGE TOWNSHIP CON 06 010	2012-08-13	MO	8.9	5.6	6.0			0018 LMSN SHLE 0029
7189092	CAMBRIDGE TOWNSHIP CON 07 007	2012-09-12	DO	15.1	5.8	6.1	5.1	FR	BRWN CLAY SOFT 0015 GREY GRVL SHLE SOFT 0019 GREY LMSN HARD 0050
7189236	CAMBRIDGE TOWNSHIP CON 05 012	2012-09-24	DO	31.2	30.3	30.6	20.9	FR 0100	YLLW SAND SOFT 0009 GREY CLAY SOFT 0060 BLUE CLAY SOFT 0099 GREY SHLE PORS 0102
7189532	CAMBRIDGE TOWNSHIP CON 06 010	2012-09-17	DO	30.5	17.0	18.2	17.7	UT 0066	BRWN CLAY SILT HARD 0008 GREY CLAY HARD 0053 GREY GRVL PCKD 0056 GREY LMSN LYRD 0100
7190824	CAMBRIDGE TOWNSHIP CON 05 011	2012-10-16	DO	28.8	23.9	23.9	21.9	FR 0085	YLLW SAND SOFT 0005 GREY SAND SOFT 0025 GREY CLAY SOFT 0060 BLUE CLAY SOFT 0074 GREY GRVL SOFT 0079 GREY LMSN HARD 0094
7196546	CAMBRIDGE TOWNSHIP	2012-10-16	NU						
7202521	CAMBRIDGE TOWNSHIP	2013-05-02	DO	42.7	36.0	36.6	0.9	UT 0130	BRWN CLAY 0020 GREY SAND STNS GRVL 0118 GREY LMSN 0140
7206171	CAMBRIDGE TOWNSHIP	2013-07-04	TH	39.4	37.6	37.6	19.4	SU 0011	BRWN CLAY SOFT 0003 BRWN SAND CLAY SOFT 0030 GREY CLAY SOFT 0119 GREY GRVL SOFT 0123 GREY SHLE LYRD 0129
7207453	CAMBRIDGE TOWNSHIP CON 08 010	2013-08-27	NU						

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7207455	CAMBRIDGE TOWNSHIP CON 08 010	2013-08-23	DO	24.8	15.2	15.1	3.9	FR 0017 FR 0019	BRWN CLAY SOFT 0015 BLUE CLAY SOFT 0025 GREY SAND GRVL SOFT 0050 GREY LMSN HARD 0081
7210184	CAMBRIDGE TOWNSHIP	2013-08-19	DO	35.1	26.8	27.4	1.0	SU 0110	BRWN CLAY 0011 GREY CLAY 0026 GREY SAND CLAY 0088 GREY LMSN 0115
7210653	CAMBRIDGE TOWNSHIP CON 05 010	2013-10-08	TH	33.3	30.3	30.3	20.3	FR 0006	BRWN CLAY SOFT 0006 BRWN SAND SOFT 0012 GREY CLAY SOFT 0094 GREY GRVL SOFT 0099 GREY LMSN HARD 0109
7210654	CAMBRIDGE TOWNSHIP CON 05 010	2013-10-09	TH	30.9	25.1	25.1	20.7	FR 0091	BRWN CLAY SOFT 0002 BRWN SAND SOFT 0012 GREY CLAY SAND SOFT 0077 GREY GRVL SOFT 0083 GREY LMSN SHLE HARD 0101
7212486	CAMBRIDGE TOWNSHIP CON 05 012	2013-11-28	DO	6.0		6.5	1.7	FR 0006	BLCK LOAM 0001 YLLW SAND 0004 GREY SAND 0006 BLUE CLAY 0020
7213297	CAMBRIDGE TOWNSHIP CON 05 012	2013-12-07	DO	6.5		6.5	2.0	0007	BLCK LOAM 0001 YLLW SAND 0005 GREY SAND 0014 BLUE CLAY 0021
7213298	CAMBRIDGE TOWNSHIP CON 05 010	2013-12-12	DO	6.1		6.1	2.3	FR 0008	BLCK 0001 YLLW SAND 0005 GREY SAND 0020
7216087	CAMBRIDGE TOWNSHIP	2013-12-09	MT	3.3		1.2			GREY GRVL HARD 0001 GREY GRVL SILT 0003 GREY CLAY HARD 0011
7216088	CAMBRIDGE TOWNSHIP	2013-12-09	MT	3.3		1.2			GREY GRVL HARD 0001 GREY GRVL SILT 0003 GREY CLAY HARD 0011
7216089	CAMBRIDGE TOWNSHIP	2013-12-09	MT	4.6		1.2			GREY GRVL HARD 0001 GREY GRVL LOOS 0003 GREY CLAY HARD 0015
7216090	CAMBRIDGE TOWNSHIP	2013-12-06	MT	4.6		1.5			BRWN FILL GRVL LOOS 0002 BRWN CLAY SILT SOFT 0005 GREY CLAY SILT SOFT 0015
7216091	CAMBRIDGE TOWNSHIP	2013-12-06	MT	3.1		1.2			BRWN FILL GRVL LOOS 0002 BRWN CLAY SILT SOFT 0005 GREY CLAY SILT SOFT 0010
7216092	CAMBRIDGE TOWNSHIP	2013-12-06	MT	4.9		1.8			BRWN FILL GRVL LOOS 0002 BRWN CLAY SILT SOFT 0006 GREY CLAY SILT SOFT 0016

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7216093	CAMBRIDGE TOWNSHIP	2013-12-06	MT	6.1		3.1			BRWN FILL GRVL LOOS 0002 BRWN CLAY SILT SOFT 0010 GREY CLAY SILT SOFT 0020
7216094	CASSELMAN VILLAGE	2013-12-06	MT	6.1		3.1			BRWN FILL GRVL LOOS 0002 BRWN SILT SAND SOFT 0005 BRWN CLAY SILT SOFT 0010 GREY CLAY SILT SOFT 0020
7216095	CAMBRIDGE TOWNSHIP	2013-12-05	MT	5.2		2.1			BRWN FILL GRVL LOOS 0002 BRWN SILT SAND SOFT 0005 BRWN CLAY SILT SOFT 0007 GREY CLAY SILT SOFT 0017
7216096	CAMBRIDGE TOWNSHIP	2013-12-05	MT	4.6		1.5			BRWN FILL GRVL LOOS 0002 BRWN SILT SAND SOFT 0010 GREY CLAY SILT SOFT 0015
7216097	CASSELMAN VILLAGE	2013-12-05	MT	4.6		1.5			BRWN FILL GRVL LOOS 0002 BRWN SILT SAND SOFT 0010 GREY CLAY SILT SOFT 0015
7215564	CAMBRIDGE TOWNSHIP CON 06 012	2013-12-21	DO	36.6	26.0	26.7	8.8	UT 0098	BRWN CLAY SILT HARD 0013 GREY CLAY SOFT 0083 GREY GRVL STNS PCKD 0085 GREY LMSN LYRD 0120
7216305	CAMBRIDGE TOWNSHIP CON 06 015	2013-12-19	DO	46.1	36.7	36.7	20.3	FR 0005	YLLW SAND SOFT 0012 BRWN SAND SOFT 0027 GREY CLAY SOFT 0091 GREY GRVL BLDR SOFT 0120 GREY LMSN HARD 0151
7216307	CAMBRIDGE TOWNSHIP CON 06 015	2013-12-10	DO	39.4	35.2	35.2	20.4	FR 0115	YLLW SAND SOFT 0012 BRWN SAND SOFT 0018 GREY CLAY SOFT 0066 BRWN CLAY SOFT 0084 GREY GRVL SOFT 0115 GREY LMSN HARD 0129
7220939	CAMBRIDGE TOWNSHIP CON 08 006	2013-05-28							
7221349	CAMBRIDGE TOWNSHIP	2013-10-16	NU						
7225236	CAMBRIDGE TOWNSHIP	2014-07-10	DO	28.8	21.2	21.2	6.6	FR 0004	RED CLAY SOFT 0011 GREY CLAY SOFT 0061 GREY GRVL SAND SOFT 0070 GREY LMSN HARD 0094
7228283	CAMBRIDGE TOWNSHIP	2014-09-09	NU						
7233003	CAMBRIDGE TOWNSHIP CON 05 011	2014-11-29	DO	67.3	19.1	19.1	19.3	FR 0075	BRWN SAND SOFT 0011 BLUE CLAY SOFT 0030 GREY CLAY SOFT 0062 GREY GRVL SHLE SOFT 0063 GREY LMSN HARD 0221

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7233765	CAMBRIDGE TOWNSHIP	2014-11-04	MT	4.3		1.2			BRWN FILL SAND SOFT 0006 GREY CLAY SILT SOFT 0010 GREY CLAY SOFT 0014
7233766	CAMBRIDGE TOWNSHIP	2014-11-04	MT	4.3		1.2			BRWN FILL SAND SOFT 0005 GREY CLAY SILT SOFT 0010 GREY CLAY SOFT 0014
7233767	CAMBRIDGE TOWNSHIP	2014-11-04	MT	9.1		7.6			BRWN FILL SAND SOFT 0005 GREY CLAY SILT SOFT 0010 GREY CLAY SOFT 0020 GREY CLAY SOFT 0030
7233768	CAMBRIDGE TOWNSHIP	2014-11-05	MT	4.3		1.2			BRWN FILL SAND SOFT 0004 GREY CLAY SILT SOFT 0010 GREY CLAY SOFT 0014
7233769	CAMBRIDGE TOWNSHIP	2014-11-04	MT	4.3		1.2			BRWN FILL SAND SOFT 0005 GREY CLAY SILT SOFT 0010 GREY CLAY SOFT 0014
7233770	CAMBRIDGE TOWNSHIP	2014-11-04	MT	4.3		1.2			BRWN FILL SAND SOFT 0005 GREY CLAY SILT SOFT 0010 GREY CLAY SOFT 0014
7234592	CAMBRIDGE TOWNSHIP CON 06 008	2014-10-06	DO	12.2	6.1	6.7	1.1	UT 0028	BRWN SAND 0003 BRWN CLAY SAND 0008 GREY CLAY SAND 0014 GREY GRVL SAND STNS 0020 GREY ROCK 0040
7234595	CASSELMAN VILLAGE	2014-12-03							
7235157	CAMBRIDGE TOWNSHIP CON 06 015	2014-12-15	DO	40.0	35.8	36.1	20.6	FR 0020	BRWN CLAY SOFT 0005 BRWN SAND SOFT 0017 GREY CLAY SOFT 0097 GREY SAND GRVL SOFT 0117 GREY SHLE SOFT 0118 GREY LMSN HARD 0131
7240713	CAMBRIDGE TOWNSHIP CON 08 010	2015-04-01	DO	16.8	11.3	12.8	5.2	UT 0046	BRWN CLAY SILT HARD 0009 GREY CLAY SOFT 0030 GREY GRVL SAND STNS 0037 BRWN SHLE LYRD 0055
7241827	CAMBRIDGE TOWNSHIP	2015-03-31	NU						
7241828	CAMBRIDGE TOWNSHIP	2015-03-31	NU						
7242486	CAMBRIDGE TOWNSHIP	2014-01-24							

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7242590	CAMBRIDGE TOWNSHIP CON 05 013	2015-04-30	NU						
7246058	CAMBRIDGE TOWNSHIP	2015-01-09	MT	7.6		4.6			BRWN SAND FILL DRY 0005 BRWN CLAY SILT 0016 GREY CLAY SILT WBRG 0025
7246059	CAMBRIDGE TOWNSHIP	2015-01-09	MT	7.0		4.0			BLCK SAND FILL SOFT 0005 BRWN CLAY SILT SOFT 0011 BRWN CLAY SILT SOFT 0018 GREY CLAY SILT SOFT 0023
7246060	CAMBRIDGE TOWNSHIP	2015-07-09	MT	5.8		2.7			BRWN SAND SOFT 0006 BRWN CLAY SILT SOFT 0013 GREY CLAY SILT SOFT 0019
7246061	CAMBRIDGE TOWNSHIP	2015-07-09	MT	5.8		2.7			BRWN FILL HARD DRY 0004 BRWN CLAY SILT SOFT 0010 GREY CLAY SILT SOFT 0016 BRWN SAND GRVL HARD 0019
7246062	CAMBRIDGE TOWNSHIP	2015-07-09	MT	4.9		1.8			BRWN CLAY SILT SOFT 0010 GREY CLAY SILT WBRG 0016
7246063	CAMBRIDGE TOWNSHIP	2015-07-09	MT	6.1		3.1			GREY GRVL FILL HARD 0004 BRWN CLAY SILT SOFT 0012 GREY CLAY SILT SOFT 0020
7246064	CAMBRIDGE TOWNSHIP	2015-07-08	MT	5.8		2.8			BRWN SAND SOFT DRY 0002 BRWN SILT CLAY SOFT 0014 BRWN SILT CLAY SOFT 0019
7247457	CAMBRIDGE TOWNSHIP	2015-07-22	NU						
7250093	CAMBRIDGE TOWNSHIP CON 07 011	2015-08-06	NU						
7254734	CAMBRIDGE TOWNSHIP CON 07 006	2015-10-22	NU						
7263452	CASSELMAN VILLAGE	2015-07-08	MT	4.9		1.8			BRWN FILL LOOS 0005 BRWN SAND SILT LOOS 0016
7264618	CAMBRIDGE TOWNSHIP CON 05 010	2016-05-18	DO	32.7	21.2	21.2	19.0	FR 0097	BRWN CLAY SOFT 0006 GREY SAND SOFT 0018 GREY CLAY SOFT 0069 GREY GRVL BLDR HARD 0070 GREY LMSN HARD 0107

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7270088	CAMBRIDGE TOWNSHIP CON 05 010	2016-08-11	NU						
7272762	CASSELMAN VILLAGE	2016-08-08	NU						
7272769	CAMBRIDGE TOWNSHIP CON 05	2016-09-16	DO	77.9	21.2	21.2			BRWN CLAY SAND SOFT 0007 GREY CLAY SOFT 0066 GREY GRVL SOFT 0070 GREY LMSN HARD 0255
7273296	CAMBRIDGE TOWNSHIP	2016-09-20	MT	5.3					BLCK GRVL LOOS 0001 BRWN SAND SILT SOFT 0005 BRWN CLAY SOFT 0014 GREY CLAY SOFT 0017
7273297	CAMBRIDGE TOWNSHIP	2016-09-20	MT	4.3					GREY GRVL SAND LOOS 0001 GREY SAND SILT SOFT 0005 BRWN CLAY SOFT 0010 GREY CLAY SOFT 0014
7273298	CAMBRIDGE TOWNSHIP	2016-09-20	MT	4.6					BLCK GRVL LOOS 0001 BRWN SAND SOFT 0005 BRWN CLAY SAND SOFT 0010 BRWN CLAY SOFT 0015
7273299	CAMBRIDGE TOWNSHIP	2016-09-09	MT	4.6					BLCK GRVL LOOS 0002 BRWN SAND SOFT 0008 GREY CLAY SOFT 0015
7273300	CAMBRIDGE TOWNSHIP	2016-09-19	MT	4.3					BLCK GRVL LOOS 0001 BRWN SAND SILT SOFT 0006 GREY CLAY SOFT 0014
7273301	CAMBRIDGE TOWNSHIP	2016-09-19	MT	4.3					BLCK GRVL LOOS 0002 BLCK SILT SAND SOFT 0004 BRWN SAND SLTY SOFT 0006 GREY CLAY SOFT 0014
7274536	CASSELMAN VILLAGE CON 06 011	2016-10-24	NU						
7276556	CAMBRIDGE TOWNSHIP CON 05 011	2016-11-10	DO	34.8	23.3	23.3	20.7	FR 0089	BRWN SAND SOFT 0007 GREY CLAY SOFT 0077 GREY LMSN HARD 0114
7278385	CASSELMAN VILLAGE	2016-09-16							
7285652	CAMBRIDGE TOWNSHIP CON 05 010	2016-06-22	DO	6.0		6.0		FR 0007	BRWN LOAM 0001 FSND SLTY 0005 SAND SLTY 0010 SAND SLTY 0016 CLAY SLTY 0020

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7288001	CAMBRIDGE TOWNSHIP CON 07 012	2017-05-15	DO	25.6	20.1	20.1	5.1	UT 0072	BRWN CLAY SILT HARD 0012 GREY CLAY SOFT 0058 GREY GRVL SAND STNS 0066 GREY LMSN LYRD 0084
7289474	CAMBRIDGE TOWNSHIP								
7289694	CASSELMAN VILLAGE CON 07 008	2017-05-19	DO	15.2	10.7	11.3	0.8	UT 0040	BRWN CLAY 0011 GREY CLAY 0028 GREY GRVL SAND 0035 GREY ROCK 0050
7290825	CAMBRIDGE TOWNSHIP CON 05 010	2017-07-09	DO						
7293967	CAMBRIDGE TOWNSHIP CON 05 007	2017-08-23	DO	16.8	12.2	12.2	5.0	UT 0049	BRWN CLAY SILT HARD 0013 GREY CLAY SILT SOFT 0040 YLLW LMSN LYRD 0055
7294647	CAMBRIDGE TOWNSHIP CON 07 012	2017-08-26	DO	27.4	18.8	19.5	5.1	FR 0085	BRWN CLAY SILT HARD 0014 GREY CLAY SILT SOFT 0062 GREY LMSN LYRD 0090
7294920	CASSELMAN VILLAGE	2017-08-22	DO	30.9	24.8	24.8	19.1	FR 0021	BRWN SAND SOFT 0006 GREY CLAY SOFT 0068 GREY GRVL SOFT 0081 GREY LMSN HARD 0101
7299831	CAMBRIDGE TOWNSHIP CON 08 007	2017-10-31	DO	16.8	14.3	14.3	2.8	UT 0052	BRWN CLAY HARD 0015 GREY CLAY SOFT 0040 GREY GRVL PCKD 0047 GREY LMSN LYRD 0055
7299843	CASSELMAN VILLAGE	2017-11-10	NU						
7306234	CASSELMAN VILLAGE	2017-12-09							
7313925	CAMBRIDGE TOWNSHIP CON 06 008	2018-06-01	DO	15.1	5.8	6.1	3.7	FR 0007	BRWN SAND GRVL SOFT 0019 GREY LMSN SHLE HARD 0050
7314891	CAMBRIDGE TOWNSHIP CON 06 014	2018-06-19	DO	30.5	24.7	25.3	8.4	UT 0081 UT 0095	BRWN CLAY 0008 GREY CLAY 0045 BLUE CLAY 0067 GREY SAND 0077 GREY GRVL SAND 0081 GREY ROCK 0100
7314892	CASSELMAN VILLAGE	2018-06-15	DO	17.4	15.8	16.5	4.4	UT 0055	BRWN CLAY 0012 GREY CLAY 0035 GREY GRVL SAND 0052 GREY ROCK 0057

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7314893	CAMBRIDGE TOWNSHIP CON 07 007	2018-06-13	DO	17.4	15.8	16.5	4.2	UT 0055	BRWN CLAY 0012 GREY CLAY 0035 GREY GRVL SAND 0052 GREY ROCK 0057
7315350	CAMBRIDGE TOWNSHIP CON 08 009	2018-03-20	NU						
7319952	CAMBRIDGE TOWNSHIP	2018-08-29	DO	28.9	25.6	25.6	21.3	UT 0089	BRWN SAND SILT HARD 0018 GREY CLAY 0081 GREY CLAY GRVL PCKD 0084 GREY SHLE 0095
7319953	CAMBRIDGE TOWNSHIP	2018-08-30	DO	28.9	27.1	27.1	21.1	UT 0089	BRWN SAND SILT 0014 GREY CLAY SOFT 0083 GREY CLAY GRVL SILT 0089 GREY SHLE 0095
7319958	CAMBRIDGE TOWNSHIP	2018-08-24	DO	33.5	28.0	28.0	21.4	UT	BRWN SAND SILT 0012 GREY CLAY SOFT 0092 GREY LMSN 0110
7320157	CAMBRIDGE TOWNSHIP CON 06 015	2018-10-04	DO	36.6	33.8	34.7	20.8	UT 0115	BRWN SAND 0008 GREY CLAY SAND 0070 GREY GRVL SAND STNS 0111 GREY ROCK 0120
7325495	CAMBRIDGE TOWNSHIP CON 05 010	2018-12-05	DO	36.6	26.4	27.4	20.6	UT	BRWN SAND SILT HARD 0018 GREY CLAY SOFT 0078 GREY GRVL SAND PCKD 0087 GREY SHLE LYRD 0120
7326129	CAMBRIDGE TOWNSHIP CON 07 013	2018-10-02	DO	6.1		6.1	14.0	UT 0020	BRWN LOAM 0001 BRWN CLAY 0012 GREY CLAY 0020
7331235	CAMBRIDGE TOWNSHIP CON 06 015	2018-03-29	DO	39.6	33.2	34.1	19.8	UT 0109 UT 0128	BRWN LOAM 0001 YLLW SAND 0013 GREY CLAY 0071 GREY GRVL SAND 0109 GREY ROCK 0130
7332472	CAMBRIDGE TOWNSHIP CON 05 014	2019-03-19	DO	7.6		8.2	2.9	UT 0003	BRWN LOAM 0001 BRWN SAND 0005 GREY SAND 0009 GREY CLAY 0025
7335343	CASSELMAN VILLAGE	2019-05-30	DO						
7335344	CASSELMAN VILLAGE	2019-05-29	DO	17.4	17.1	17.7	2.7	0056	BRWN CLAY 0008 BRWN SAND GRVL 0056 GREY ROCK 0057
7335345	CASSELMAN VILLAGE	2019-05-09	NU						

AC = Cooling and A/C
IR = Irrigation
OT = Other
CO = Commercial
MN = Municipal
PS = Public
DE = Dewatering
MO = Monitoring
ST = Livestock
DO = Domestic
MT = Monitoring and Test Hole
TH = Test Hole
IN = Industrial
NU = Not Used

MECP Online Well Database Summary (2-km Radius)

ID	Township	Completion Date (yyyy-mm-dd)	Water Use	Well Depth (m)	Bedrock Depth (m)	Minimum Casing Depth (m)	Static Water Levels (m)	Water Types and Bearing Zone Depths (ft)	Stratigraphic Layers (ft)
7338005	CAMBRIDGE TOWNSHIP CON 06 008	2019-06-27	TH						
7339965	CASSELMAN VILLAGE	2019-06-14	DO						
7340432	CAMBRIDGE TOWNSHIP CON 07 013	2019-08-19	DO	9.1		9.1	4.3	GS 0020	BRWN LOAM 0001 BRWN CLAY 0012 GREY CLAY 0030
7340433	CAMBRIDGE TOWNSHIP CON 06 008	2019-08-01	TH						
7347963	CAMBRIDGE TOWNSHIP CON 04 010	2019-11-27	DO	6.6		6.6	3.3	FR 0011	BLCK LOAM 0001 YLLW SAND 0007 GREY SAND 0011 BLUE CLAY 0022
7350346	CAMBRIDGE TOWNSHIP CON 05 012	2019-12-17	DO	5.5		5.5	3.0	FR 0010	BLCK LOAM 0001 YLLW SAND 0009 BLUE CLAY 0018
7360934	CAMBRIDGE TOWNSHIP CON 06 05	2020-06-11	NU						
7372477	CAMBRIDGE TOWNSHIP CON 05 010	2020-10-20	DO	29.0	27.1	27.1	21.1	UT 0092	BROWN SILT CLAY SAND 0010 GREY CLAY 0078 GREY SAND STNS GRAVEL 0089 GREY LMSN 0095
7409064	CASSELMAN VILLAGE	2021-11-02							
7413821	CASSELMAN VILLAGE	2021-12-22							
7413942	CAMBRIDGE TOWNSHIP	2021-12-16							
7415255	CAMBRIDGE TOWNSHIP	2021-12-17							
7418126	CASSELMAN VILLAGE	2022-04-22							

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APPENDIX C

Water Quality Monitoring Program Data

Provincial Groundwater Monitoring Network
W0000363-2 Exceedances

Parameter Name	Sample Date	Value	Units	Qualifiers	Comments	Lab Name	Sample Number	ODWQS (in parameter unit)	ODWQS Objective Type	Exceedance (Yes/No)
Alkalinity; total fixed endpt	2007-09-21	456	mg/L CaCO3	5	Ionic balance > 5%, use with caution	CEL	B07-29104-23	500	OG	No
Alkalinity; total fixed endpt	2008-10-28	463	mg/L CaCO3		Ionic balance > 5%, use with caution	MOE	C164172-0006	500	OG	No
Alkalinity; total fixed endpt	2009-10-20	463	mg/L CaCO3			MOE	C172419-0011	500	OG	No
Alkalinity; total fixed endpt	2010-12-08	470	mg/L CaCO3		Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	500	OG	No
Alkalinity; total fixed endpt	2011-11-10	469	mg/L CaCO3			MOE	C190404-0011	500	OG	No
Alkalinity; total fixed endpt	2012-06-12	480	mg/L CaCO3		Ionic balance > 5%, use with caution	MOE	C194707-0001	500	OG	No
Alkalinity; total fixed endpt	2012-10-25	464	mg/L CaCO3		Ionic balance > 5%, use with caution	MOE	C198481-0009	500	OG	No
Alkalinity; total fixed endpt	2013-10-21	466	mg/L CaCO3			MOE	C207284-0002	500	OG	No
Alkalinity; total fixed endpt	2014-11-05	469	mg/L CaCO3			MOE	C216232-0002	500	OG	No
Alkalinity; total fixed endpt	2015-11-24	455	mg/L CaCO3			MOE	C225762-0002	500	OG	No
Alkalinity; total fixed endpt	2016-11-23	428	mg/L CaCO3			MOE	C234976-0005	500	OG	No
Alkalinity; total fixed endpt	2017-10-18	303	mg/L CaCO3		Use with caution - Inconsistent with other results	MOE	C243643-0003	500	OG	No
Alkalinity; total fixed endpt	2018-11-01	410	mg/L CaCO3			MOE	C253968-0003	500	OG	No
Alkalinity; total fixed endpt	2019-09-25	391	mg/L CaCO3			MOE	C261214-0001	500	OG	No
Aluminum	2007-09-21	30	µg/L	10	Ionic balance > 5%, use with caution	CEL	B07-29104-23	100	OG	No
Aluminum	2008-10-28	10.3	µg/L	+/-1.10	Ionic balance > 5%, use with caution	MOE	C164172-0006	100	OG	No
Aluminum	2009-10-20	10.6	µg/L	+/-0.90		MOE	C172419-0011	100	OG	No
Aluminum	2010-12-08	8.4	µg/L	+/-1.40	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	100	OG	No
Aluminum	2011-11-10	9.3	µg/L	+/-1.60		MOE	C190404-0011	100	OG	No
Aluminum	2012-06-12	8.7	µg/L	+/-1.50	Ionic balance > 5%, use with caution	MOE	C194707-0001	100	OG	No
Aluminum	2012-10-25	8.2	µg/L	+/-1.40	Ionic balance > 5%, use with caution	MOE	C198481-0009	100	OG	No
Aluminum	2013-10-21	9.4	µg/L	+/-1.60		MOE	C207284-0002	100	OG	No
Aluminum	2014-11-05	16.2	µg/L	+/-2.70		MOE	C216232-0002	100	OG	No
Aluminum	2015-11-24	8.1	µg/L	+/-1.30		MOE	C225762-0002	100	OG	No
Aluminum	2016-11-23	8	µg/L	+/-1.30		MOE	C234976-0005	100	OG	No
Aluminum	2017-10-18	15.6	µg/L	+/-2.60	Use with caution - Inconsistent with other results	MOE	C243643-0003	100	OG	No
Aluminum	2018-11-01	8.7	µg/L	+/-1.40		MOE	C253968-0003	100	OG	No
Aluminum	2019-09-25	8	µg/L	+/-2.40		MOE	C261214-0001	100	OG	No
Aluminum	2021-11-11	19	µg/L	DL=5µg/L		LaSB	3759001	100	OG	No
Antimony	2007-09-21		µg/L	<0.1	Ionic balance > 5%, use with caution	CEL	B07-29104-23	6	IMAC	No
Antimony	2008-10-28	0.69	µg/L	+/-0.17	Ionic balance > 5%, use with caution	MOE	C164172-0006	6	IMAC	No
Antimony	2009-10-20	0.6	µg/L	+/-0.18		MOE	C172419-0011	6	IMAC	No
Antimony	2010-12-08	0.8	µg/L	+/-0.18	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	6	IMAC	No
Antimony	2011-11-10	0.6	µg/L	+/-0.18		MOE	C190404-0011	6	IMAC	No
Antimony	2012-06-12	0.6	µg/L	+/-0.18	Ionic balance > 5%, use with caution	MOE	C194707-0001	6	IMAC	No
Antimony	2012-10-25	0.5	µg/L	+/-0.20	Ionic balance > 5%, use with caution	MOE	C198481-0009	6	IMAC	No
Antimony	2013-10-21	0.7	µg/L	+/-0.20		MOE	C207284-0002	6	IMAC	No
Antimony	2014-11-05	0.5	µg/L	+/-0.20		MOE	C216232-0002	6	IMAC	No
Antimony	2015-11-24	0.5	µg/L	+/-0.20		MOE	C225762-0002	6	IMAC	No
Antimony	2016-11-23	0.6	µg/L	+/-0.20		MOE	C234976-0005	6	IMAC	No
Antimony	2017-10-18	0.4	µg/L	+/-0.20	Use with caution - Inconsistent with other results	MOE	C243643-0003	6	IMAC	No
Antimony	2018-11-01	0.5	µg/L	+/-0.20		MOE	C253968-0003	6	IMAC	No
Antimony	2019-09-25	0.4	µg/L	+/-0.20		MOE	C261214-0001	6	IMAC	No
Antimony	2021-11-11	0.5	µg/L	DL=0.5µg/L		LaSB	3759001	6	IMAC	No
Arsenic	2007-09-21	10	µg/L	0.1	Ionic balance > 5%, use with caution;	CEL	B07-29104-23	25	IMAC	No
Arsenic	2008-10-28	4.34	µg/L	+/-0.38	Ionic balance > 5%, use with caution;	MOE	C164172-0006	25	IMAC	No
Arsenic	2009-10-20	8.4	µg/L	+/-1.00		MOE	C172419-0011	25	IMAC	No
Arsenic	2010-12-08	5.1	µg/L	+/-1.00	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	25	IMAC	No
Arsenic	2011-11-10	9.4	µg/L	+/-1.80		MOE	C190404-0011	25	IMAC	No
Arsenic	2012-06-12	6.1	µg/L	+/-1.20	Ionic balance > 5%, use with caution	MOE	C194707-0001	25	IMAC	No
Arsenic	2012-10-25	8.2	µg/L	+/-1.60	Ionic balance > 5%, use with caution	MOE	C198481-0009	25	IMAC	No
Arsenic	2013-10-21	6.9	µg/L	+/-1.30		MOE	C207284-0002	25	IMAC	No
Arsenic	2014-11-05	6.1	µg/L	+/-1.20		MOE	C216232-0002	25	IMAC	No
Arsenic	2015-11-24	7.6	µg/L	+/-1.50		MOE	C225762-0002	25	IMAC	No
Arsenic	2016-11-23	2.2	µg/L	+/-0.60		MOE	C234976-0005	25	IMAC	No
Arsenic	2017-10-18	7.1	µg/L	+/-1.40	Use with caution - Inconsistent with other results	MOE	C243643-0003	25	IMAC	No
Arsenic	2018-11-01	8.1	µg/L	+/-1.60		MOE	C253968-0003	25	IMAC	No
Arsenic	2019-09-25	8.1	µg/L	+/-2.40		MOE	C261214-0001	25	IMAC	No
Arsenic	2021-11-11	5	µg/L	DL=1µg/L		LaSB	3759001	25	IMAC	No
Barium	2007-09-21	132	µg/L	1	Ionic balance > 5%, use with caution	CEL	B07-29104-23	1000	MAC	No
Barium	2008-10-28	141	µg/L	+/-11.00	Ionic balance > 5%, use with caution	MOE	C164172-0006	1000	MAC	No
Barium	2009-10-20	99.5	µg/L	+/-8.00		MOE	C172419-0011	1000	MAC	No

Parameter Name	Sample Date	Value	Units	Qualifiers	Comments	Lab Name	Sample Number	ODWQS (in parameter unit)	ODWQS Objective Type	Exceedance (Yes/No)
Barium	2010-12-08	93.9	µg/L	+/-15.10	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	1000	MAC	No
Barium	2011-11-10	88.5	µg/L	+/-14.30		MOE	C190404-0011	1000	MAC	No
Barium	2012-06-12	79.5	µg/L	+/-12.80	Ionic balance > 5%, use with caution	MOE	C194707-0001	1000	MAC	No
Barium	2012-10-25	94.1	µg/L	+/-15.20	Ionic balance > 5%, use with caution	MOE	C198481-0009	1000	MAC	No
Barium	2013-10-21	92.5	µg/L	+/-15.00		MOE	C207284-0002	1000	MAC	No
Barium	2014-11-05	89.3	µg/L	+/-14.50		MOE	C216232-0002	1000	MAC	No
Barium	2015-11-24	89.2	µg/L	+/-14.50		MOE	C225762-0002	1000	MAC	No
Barium	2016-11-23	85.2	µg/L	+/-13.80		MOE	C234976-0005	1000	MAC	No
Barium	2017-10-18	251	µg/L	+/-41.00	Use with caution - Inconsistent with other results	MOE	C243643-0003	1000	MAC	No
Barium	2018-11-01	136	µg/L	+/-22.00		MOE	C253968-0003	1000	MAC	No
Barium	2019-09-25	132	µg/L	+/-31.00		MOE	C261214-0001	1000	MAC	No
Barium	2021-11-11	82.7	µg/L	DL=0.5µg/L		LaSB	3759001	1000	MAC	No
Boron	2007-09-21	78	µg/L	5	Ionic balance > 5%, use with caution	CEL	B07-29104-23	5000	IMAC	No
Boron	2008-10-28	76.2	µg/L	+/-11.60	Ionic balance > 5%, use with caution	MOE	C164172-0006	5000	IMAC	No
Boron	2009-10-20	81.3	µg/L	+/-9.80		MOE	C172419-0011	5000	IMAC	No
Boron	2010-12-08	74.2	µg/L	+/-13.60	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	5000	IMAC	No
Boron	2011-11-10	74.6	µg/L	+/-13.70		MOE	C190404-0011	5000	IMAC	No
Boron	2012-06-12	66.6	µg/L	+/-12.30	Ionic balance > 5%, use with caution	MOE	C194707-0001	5000	IMAC	No
Boron	2012-10-25	76	µg/L	+/-14.00	Ionic balance > 5%, use with caution	MOE	C198481-0009	5000	IMAC	No
Boron	2013-10-21	71	µg/L	+/-13.00		MOE	C207284-0002	5000	IMAC	No
Boron	2014-11-05	72	µg/L	+/-13.00		MOE	C216232-0002	5000	IMAC	No
Boron	2015-11-24	85	µg/L	+/-16.00		MOE	C225762-0002	5000	IMAC	No
Boron	2016-11-23	74	µg/L	+/-14.00		MOE	C234976-0005	5000	IMAC	No
Boron	2017-10-18	116	µg/L	+/-21.00	Use with caution - Inconsistent with other results	MOE	C243643-0003	5000	IMAC	No
Boron	2018-11-01	87	µg/L	+/-16.00		MOE	C253968-0003	5000	IMAC	No
Boron	2019-09-25	64	µg/L	+/-24.00		MOE	C261214-0001	5000	IMAC	No
Boron	2021-11-11	81	µg/L	DL=10µg/L		LaSB	3759001	5000	IMAC	No
Cadmium	2007-09-21		µg/L	<5	Ionic balance > 5%, use with caution	CEL	B07-29104-23	5	MAC	No
Cadmium	2008-10-28	0.02	µg/L	+/-0.02	Ionic balance > 5%, use with caution	MOE	C164172-0006	5	MAC	No
Cadmium	2009-10-20	0	µg/L	+/-0.13		MOE	C172419-0011	5	MAC	No
Cadmium	2010-12-08	0	µg/L	+/-0.13	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	5	MAC	No
Cadmium	2011-11-10	0	µg/L	+/-0.13		MOE	C190404-0011	5	MAC	No
Cadmium	2012-06-12	0	µg/L	+/-0.13	Ionic balance > 5%, use with caution	MOE	C194707-0001	5	MAC	No
Cadmium	2012-10-25	0	µg/L	+/-0.10	Ionic balance > 5%, use with caution	MOE	C198481-0009	5	MAC	No
Cadmium	2013-10-21	0	µg/L	+/-0.10		MOE	C207284-0002	5	MAC	No
Cadmium	2014-11-05	0	µg/L	+/-0.10		MOE	C216232-0002	5	MAC	No
Cadmium	2015-11-24	0	µg/L	+/-0.10		MOE	C225762-0002	5	MAC	No
Cadmium	2016-11-23	0	µg/L	+/-0.10		MOE	C234976-0005	5	MAC	No
Cadmium	2017-10-18	0	µg/L	+/-0.10	Use with caution - Inconsistent with other results	MOE	C243643-0003	5	MAC	No
Cadmium	2018-11-01	0	µg/L	+/-0.10		MOE	C253968-0003	5	MAC	No
Cadmium	2019-09-25	0	µg/L	+/-0.17		MOE	C261214-0001	5	MAC	No
Cadmium	2021-11-11		µg/L	DL=0.5µg/L		LaSB	3759001	5	MAC	No
Carbon; dissolved organic	2008-10-28	9.2	mg/L		Ionic balance > 5%, use with caution	MOE	C164172-0006	5	AO	Yes
Carbon; dissolved organic	2009-10-20	8.7	mg/L			MOE	C172419-0011	5	AO	Yes
Carbon; dissolved organic	2010-12-08	9.3	mg/L		Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	5	AO	Yes
Carbon; dissolved organic	2011-11-10	7.9	mg/L			MOE	C190404-0011	5	AO	Yes
Carbon; dissolved organic	2012-06-12	8.3	mg/L		Ionic balance > 5%, use with caution	MOE	C194707-0001	5	AO	Yes
Carbon; dissolved organic	2012-10-25	8.1	mg/L		Ionic balance > 5%, use with caution	MOE	C198481-0009	5	AO	Yes
Carbon; dissolved organic	2013-10-21	8.1	mg/L			MOE	C207284-0002	5	AO	Yes
Carbon; dissolved organic	2014-11-05	8	mg/L			MOE	C216232-0002	5	AO	Yes
Carbon; dissolved organic	2015-11-24	9.6	mg/L			MOE	C225762-0002	5	AO	Yes
Carbon; dissolved organic	2016-11-23	6.5	mg/L			MOE	C234976-0005	5	AO	Yes
Carbon; dissolved organic	2017-10-18	10.4	mg/L		Use with caution - Inconsistent with other results	MOE	C243643-0003	5	AO	Yes
Carbon; dissolved organic	2018-11-01	8.5	mg/L			MOE	C253968-0003	5	AO	Yes
Carbon; dissolved organic	2019-09-25	7.3	mg/L			MOE	C261214-0001	5	AO	Yes
Carbon; dissolved organic	2021-11-11	7.93	mg/L	DL=0.2mg/L		LaSB	3759001	5	AO	Yes
Chloride	2007-09-21	110	mg/L	1	Ionic balance > 5%, use with caution;	CEL	B07-29104-23	250	AO	No
Chloride	2008-10-28	98.6	mg/L		Ionic balance > 5%, use with caution;	MOE	C164172-0006	250	AO	No
Chloride	2009-10-20	104	mg/L			MOE	C172419-0011	250	AO	No
Chloride	2010-12-08	51.3	mg/L		Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	250	AO	No
Chloride	2011-11-10	105	mg/L			MOE	C190404-0011	250	AO	No

Parameter Name	Sample Date	Value	Units	Qualifiers	Comments	Lab Name	Sample Number	ODWQS (in parameter unit)	ODWQS Objective Type	Exceedance (Yes/No)
Chloride	2012-06-12	62	mg/L		Ionic balance > 5%, use with caution	MOE	C194707-0001	250	AO	No
Chloride	2012-10-25	129	mg/L		Ionic balance > 5%, use with caution	MOE	C198481-0009	250	AO	No
Chloride	2013-10-21	73	mg/L			MOE	C207284-0002	250	AO	No
Chloride	2014-11-05	95.4	mg/L			MOE	C216232-0002	250	AO	No
Chloride	2015-11-24	40.8	mg/L			MOE	C225762-0002	250	AO	No
Chloride	2016-11-23	156	mg/L			MOE	C234976-0005	250	AO	No
Chloride	2017-10-18	695	mg/L		Use with caution - Inconsistent with other results	MOE	C243643-0003	250	AO	Yes
Chloride	2018-11-01	375	mg/L			MOE	C253968-0003	250	AO	Yes
Chloride	2019-09-25	413	mg/L			MOE	C261214-0001	250	AO	Yes
Chloride	2021-11-11	173	mg/L	DL=1.5mg/L		LaSB	3759001	250	AO	No
Chromium	2007-09-21		µg/L	<2	Ionic balance > 5%, use with caution	CEL	B07-29104-23	50	MAC	No
Chromium	2008-10-28	0.3	µg/L	+/-0.50	Ionic balance > 5%, use with caution	MOE	C164172-0006	50	MAC	No
Chromium	2009-10-20	0.9	µg/L	+/-0.34		MOE	C172419-0011	50	MAC	No
Chromium	2010-12-08	0.5	µg/L	+/-0.34	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	50	MAC	No
Chromium	2011-11-10	0.4	µg/L	+/-0.34		MOE	C190404-0011	50	MAC	No
Chromium	2012-06-12	0.4	µg/L	+/-0.34	Ionic balance > 5%, use with caution	MOE	C194707-0001	50	MAC	No
Chromium	2012-10-25	0.4	µg/L	+/-0.20	Ionic balance > 5%, use with caution	MOE	C198481-0009	50	MAC	No
Chromium	2013-10-21	1	µg/L	+/-0.20		MOE	C207284-0002	50	MAC	No
Chromium	2014-11-05	0.4	µg/L	+/-0.20		MOE	C216232-0002	50	MAC	No
Chromium	2015-11-24	0.5	µg/L	+/-0.20		MOE	C225762-0002	50	MAC	No
Chromium	2016-11-23	0.7	µg/L	+/-0.20		MOE	C234976-0005	50	MAC	No
Chromium	2017-10-18	0.8	µg/L	+/-0.20	Use with caution - Inconsistent with other results	MOE	C243643-0003	50	MAC	No
Chromium	2018-11-01	1	µg/L	+/-0.20		MOE	C253968-0003	50	MAC	No
Chromium	2019-09-25	0	µg/L	+/-1.67		MOE	C261214-0001	50	MAC	No
Chromium	2021-11-11		µg/L	DL=5µg/L		LaSB	3759001	50	MAC	No
Copper	2007-09-21		µg/L	<2	Ionic balance > 5%, use with caution	CEL	B07-29104-23	1000	AO	No
Copper	2008-10-28	2.1	µg/L	+/-0.50	Ionic balance > 5%, use with caution	MOE	C164172-0006	1000	AO	No
Copper	2009-10-20	0.4	µg/L	+/-0.20		MOE	C172419-0011	1000	AO	No
Copper	2010-12-08	0.7	µg/L	+/-0.20	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	1000	AO	No
Copper	2011-11-10	0.4	µg/L	+/-0.20		MOE	C190404-0011	1000	AO	No
Copper	2012-06-12	0.3	µg/L	+/-0.20	Ionic balance > 5%, use with caution	MOE	C194707-0001	1000	AO	No
Copper	2012-10-25	0.4	µg/L	+/-0.10	Ionic balance > 5%, use with caution	MOE	C198481-0009	1000	AO	No
Copper	2013-10-21	0.6	µg/L	+/-0.10		MOE	C207284-0002	1000	AO	No
Copper	2014-11-05	0.6	µg/L	+/-0.10		MOE	C216232-0002	1000	AO	No
Copper	2015-11-24	0.4	µg/L	+/-0.10		MOE	C225762-0002	1000	AO	No
Copper	2016-11-23	0.6	µg/L	+/-0.10		MOE	C234976-0005	1000	AO	No
Copper	2017-10-18	1.1	µg/L	+/-0.20	Use with caution - Inconsistent with other results	MOE	C243643-0003	1000	AO	No
Copper	2018-11-01	1.1	µg/L	+/-0.20		MOE	C253968-0003	1000	AO	No
Copper	2019-09-25	0	µg/L	+/-1.67		MOE	C261214-0001	1000	AO	No
Copper	2021-11-11		µg/L	DL=5µg/L		LaSB	3759001	1000	AO	No
Fluoride	2007-09-21		mg/L	<0.1	Ionic balance > 5%, use with caution	CEL	B07-29104-23	1.5	MAC	No
Fluoride	2008-10-28	0.12	mg/L		Ionic balance > 5%, use with caution	MOE	C164172-0006	1.5	MAC	No
Fluoride	2009-10-20	0.05	mg/L			MOE	C172419-0011	1.5	MAC	No
Fluoride	2010-12-08	0.16	mg/L		Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	1.5	MAC	No
Fluoride	2011-11-10	0.22	mg/L			MOE	C190404-0011	1.5	MAC	No
Fluoride	2012-06-12	0.15	mg/L		Ionic balance > 5%, use with caution	MOE	C194707-0001	1.5	MAC	No
Fluoride	2012-10-25	0.21	mg/L		Ionic balance > 5%, use with caution	MOE	C198481-0009	1.5	MAC	No
Fluoride	2013-10-21	0.2	mg/L			MOE	C207284-0002	1.5	MAC	No
Fluoride	2014-11-05	0.13	mg/L			MOE	C216232-0002	1.5	MAC	No
Fluoride	2015-11-24	0.2	mg/L			MOE	C225762-0002	1.5	MAC	No
Fluoride	2016-11-23	0.08	mg/L			MOE	C234976-0005	1.5	MAC	No
Fluoride	2017-10-18	0.28	mg/L		Use with caution - Inconsistent with other results	MOE	C243643-0003	1.5	MAC	No
Fluoride	2018-11-01	0.3	mg/L			MOE	C253968-0003	1.5	MAC	No
Fluoride	2019-09-25	0.04	mg/L	<T		MOE	C261214-0001	1.5	MAC	No
Fluoride	2021-11-11	0.09	mg/L	DL=0.01mg/		LaSB	3759001	1.5	MAC	No
Hardness	2007-09-21	389	mg/L	1	Ionic balance > 5%, use with caution	CEL	B07-29104-23	500	OG[1]	No
Hardness	2008-10-28	355	mg/L		Ionic balance > 5%, use with caution	MOE	C164172-0006	500	OG[1]	No
Hardness	2009-10-20	417	mg/L			MOE	C172419-0011	500	OG[1]	No
Hardness	2010-12-08	361	mg/L		Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	500	OG[1]	No
Hardness	2011-11-10	420	mg/L			MOE	C190404-0011	500	OG[1]	No
Hardness	2012-06-12	380	mg/L		Ionic balance > 5%, use with caution	MOE	C194707-0001	500	OG[1]	No
Hardness	2012-10-25	410	mg/L		Ionic balance > 5%, use with caution	MOE	C198481-0009	500	OG[1]	No
Hardness	2013-10-21	400	mg/L			MOE	C207284-0002	500	OG[1]	No
Hardness	2014-11-05	410	mg/L			MOE	C216232-0002	500	OG[1]	No
Hardness	2015-11-24	419	mg/L			MOE	C225762-0002	500	OG[1]	No
Hardness	2016-11-23	470	mg/L			MOE	C234976-0005	500	OG[1]	No
Hardness	2017-10-18	900	mg/L		Use with caution - Inconsistent with other results	MOE	C243643-0003	500	OG[1]	Yes

Parameter Name	Sample Date	Value	Units	Qualifiers	Comments	Lab Name	Sample Number	ODWQS (in parameter unit)	ODWQS Objective Type	Exceedance (Yes/No)
Hardness	2018-11-01	640	mg/L			MOE	C253968-0003	500	OG[1]	Yes
Hardness	2019-09-25	640	mg/L			MOE	C261214-0001	500	OG[1]	Yes
Hardness	2021-11-11	376	mg/L	DL=0.2mg/L		LaSB	3759001	500	OG[1]	No
Iron	2007-09-21	11100	µg/L	5	Ionic balance > 5%, use with caution	CEL	B07-29104-23	300	AO	Yes
Iron	2008-10-28	7420	µg/L	+/-460.00	Ionic balance > 5%, use with caution	MOE	C164172-0006	300	AO	Yes
Iron	2009-10-20	15000	µg/L	+/-2700.00		MOE	C172419-0011	300	AO	Yes
Iron	2010-12-08	13000	µg/L	+/-3600.00	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	300	AO	Yes
Iron	2011-11-10	16700	µg/L	+/-4600.00		MOE	C190404-0011	300	AO	Yes
Iron	2012-06-12	14400	µg/L	+/-4000.00	Ionic balance > 5%, use with caution	MOE	C194707-0001	300	AO	Yes
Iron	2012-10-25	15900	µg/L	+/-3900.00	Ionic balance > 5%, use with caution	MOE	C198481-0009	300	AO	Yes
Iron	2013-10-21	13900	µg/L	+/-3400.00		MOE	C207284-0002	300	AO	Yes
Iron	2014-11-05	16100	µg/L	+/-3900.00		MOE	C216232-0002	300	AO	Yes
Iron	2015-11-24	17300	µg/L	+/-4200.00		MOE	C225762-0002	300	AO	Yes
Iron	2016-11-23	17800	µg/L	+/-4300.00		MOE	C234976-0005	300	AO	Yes
Iron	2017-10-18	38700	µg/L	+/-9400.00	Use with caution - Inconsistent with other results	MOE	C243643-0003	300	AO	Yes
Iron	2018-11-01	21700	µg/L	+/-5300.00		MOE	C253968-0003	300	AO	Yes
Iron	2019-09-25	28100	µg/L	+/-12200		MOE	C261214-0001	300	AO	Yes
Iron	2021-11-11	12200	µg/L	DL=30µg/L		LaSB	3759001	300	AO	Yes
Lead	2007-09-21		µg/L	<0.02	Ionic balance > 5%, use with caution	CEL	B07-29104-23	10	MAC[2]	No
Lead	2008-10-28	0.1	µg/L	+/-0.10	Ionic balance > 5%, use with caution	MOE	C164172-0006	10	MAC[2]	No
Lead	2009-10-20	0	µg/L	+/-0.16		MOE	C172419-0011	10	MAC[2]	No
Lead	2010-12-08	0	µg/L	+/-0.16	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	10	MAC[2]	No
Lead	2011-11-10	0.1	µg/L	+/-0.16		MOE	C190404-0011	10	MAC[2]	No
Lead	2012-06-12	0	µg/L	+/-0.16	Ionic balance > 5%, use with caution	MOE	C194707-0001	10	MAC[2]	No
Lead	2012-10-25	0.1	µg/L	+/-0.10	Ionic balance > 5%, use with caution	MOE	C198481-0009	10	MAC[2]	No
Lead	2013-10-21	0.1	µg/L	+/-0.10		MOE	C207284-0002	10	MAC[2]	No
Lead	2014-11-05	0	µg/L	+/-0.10		MOE	C216232-0002	10	MAC[2]	No
Lead	2015-11-24	0	µg/L	+/-0.10		MOE	C225762-0002	10	MAC[2]	No
Lead	2016-11-23	0.1	µg/L	+/-0.10		MOE	C234976-0005	10	MAC[2]	No
Lead	2017-10-18	0.2	µg/L	+/-0.10	Use with caution - Inconsistent with other results	MOE	C243643-0003	10	MAC[2]	No
Lead	2018-11-01	0	µg/L	+/-0.10		MOE	C253968-0003	10	MAC[2]	No
Lead	2019-09-25	0	µg/L	+/-0.17		MOE	C261214-0001	10	MAC[2]	No
Lead	2021-11-11		µg/L	DL=0.5µg/L		LaSB	3759001	10	MAC[2]	No
Manganese	2007-09-21	6490	µg/L	1	Ionic balance > 5%, use with caution	CEL	B07-29104-23	50	AO	Yes
Manganese	2008-10-28	5850	µg/L	+/-440.00	Ionic balance > 5%, use with caution;	MOE	C164172-0006	50	AO	Yes
Manganese	2009-10-20	4700	µg/L	+/-470.00		MOE	C172419-0011	50	AO	Yes
Manganese	2010-12-08	5210	µg/L	+/-490.00	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	50	AO	Yes
Manganese	2011-11-10	4960	µg/L	+/-460.00		MOE	C190404-0011	50	AO	Yes
Manganese	2012-06-12	4740	µg/L	+/-440.00	Ionic balance > 5%, use with caution	MOE	C194707-0001	50	AO	Yes
Manganese	2012-10-25	5000	µg/L	+/-470.00	Ionic balance > 5%, use with caution	MOE	C198481-0009	50	AO	Yes
Manganese	2013-10-21	4980	µg/L	+/-470.00		MOE	C207284-0002	50	AO	Yes
Manganese	2014-11-05	5250	µg/L	+/-490.00		MOE	C216232-0002	50	AO	Yes
Manganese	2015-11-24	5380	µg/L	+/-510.00		MOE	C225762-0002	50	AO	Yes
Manganese	2016-11-23	5080	µg/L	+/-480.00		MOE	C234976-0005	50	AO	Yes
Manganese	2017-10-18	11800	µg/L	+/-1100.00	Use with caution - Inconsistent with other results	MOE	C243643-0003	50	AO	Yes
Manganese	2018-11-01	6830	µg/L	+/-640.00		MOE	C253968-0003	50	AO	Yes
Manganese	2019-09-25	7100	µg/L	+/-1810.00		MOE	C261214-0001	50	AO	Yes
Manganese	2021-11-11	4150	µg/L	DL=0.5µg/L		LaSB	3759001	50	AO	Yes
Nitrogen; nitrate+nitrite	2008-10-28	0.39	mg/L		Ionic balance > 5%, use with caution	MOE	C164172-0006	10	MAC	No
Nitrogen; nitrate+nitrite	2009-10-20	0.05	mg/L	<=W		MOE	C172419-0011	10	MAC	No
Nitrogen; nitrate+nitrite	2010-12-08	0.05	mg/L	<=W	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	10	MAC	No
Nitrogen; nitrate+nitrite	2011-11-10	0.06	mg/L	<T		MOE	C190404-0011	10	MAC	No
Nitrogen; nitrate+nitrite	2012-06-12	0.18	mg/L	<T	Ionic balance > 5%, use with caution	MOE	C194707-0001	10	MAC	No
Nitrogen; nitrate+nitrite	2012-10-25	1.1	mg/L	<TE	Ionic balance > 5%, use with caution	MOE	C198481-0009	10	MAC	No
Nitrogen; nitrate+nitrite	2013-10-21	0.105	mg/L			MOE	C207284-0002	10	MAC	No
Nitrogen; nitrate+nitrite	2014-11-05	0.043	mg/L	<T		MOE	C216232-0002	10	MAC	No
Nitrogen; nitrate+nitrite	2015-11-24	0.253	mg/L			MOE	C225762-0002	10	MAC	No
Nitrogen; nitrate+nitrite	2016-11-23	0.02	mg/L	<=W		MOE	C234976-0005	10	MAC	No
Nitrogen; nitrate+nitrite	2017-10-18	0.02	mg/L	<=W	Use with caution - Inconsistent with other results	MOE	C243643-0003	10	MAC	No
Nitrogen; nitrate+nitrite	2018-11-01	0.02	mg/L	<=W		MOE	C253968-0003	10	MAC	No
Nitrogen; nitrate+nitrite	2019-09-25	0.084	mg/L	<T		MOE	C261214-0001	10	MAC	No
Nitrogen; nitrate+nitrite	2021-11-11	0.06	mg/L	DL=0.04mg/		LaSB	3759001	10	MAC	No

Provincial Groundwater Monitoring Network
W0000363-2 Exceedances

Parameter Name	Sample Date	Value	Units	Qualifiers	Comments	Lab Name	Sample Number	ODWQS (in parameter unit)	ODWQS Objective Type	Exceedance (Yes/No)
Nitrogen; nitrite	2007-09-21		mg/L	<0.1	Ionic balance > 5%, use with caution	CEL	B07-29104-23	1	MAC	No
Nitrogen; nitrite	2008-10-28	0.047	mg/L		Ionic balance > 5%, use with caution	MOE	C164172-0006	1	MAC	No
Nitrogen; nitrite	2009-10-20	0.005	mg/L	<=W		MOE	C172419-0011	1	MAC	No
Nitrogen; nitrite	2010-12-08	0.02	mg/L	<T	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	1	MAC	No
Nitrogen; nitrite	2011-11-10	0.055	mg/L			MOE	C190404-0011	1	MAC	No
Nitrogen; nitrite	2012-06-12	0.027	mg/L		Ionic balance > 5%, use with caution	MOE	C194707-0001	1	MAC	No
Nitrogen; nitrite	2012-10-25	0.15	mg/L	<TE	Ionic balance > 5%, use with caution	MOE	C198481-0009	1	MAC	No
Nitrogen; nitrite	2013-10-21	0.019	mg/L			MOE	C207284-0002	1	MAC	No
Nitrogen; nitrite	2014-11-05	0.008	mg/L			MOE	C216232-0002	1	MAC	No
Nitrogen; nitrite	2015-11-24	0.026	mg/L			MOE	C225762-0002	1	MAC	No
Nitrogen; nitrite	2016-11-23	0.012	mg/L			MOE	C234976-0005	1	MAC	No
Nitrogen; nitrite	2017-10-18	0.012	mg/L		Use with caution - Inconsistent with other results	MOE	C243643-0003	1	MAC	No
Nitrogen; nitrite	2018-11-01	0.011	mg/L			MOE	C253968-0003	1	MAC	No
Nitrogen; nitrite	2019-09-25	0.003	mg/L	<T		MOE	C261214-0001	1	MAC	No
Nitrogen; nitrite	2021-11-11	0.011	mg/L	DL=0.001mg		LaSB	3759001	1	MAC	No
Selenium	2007-09-21	0.9	µg/L	0.2	Ionic balance > 5%, use with caution	CEL	B07-29104-23	10	MAC	No
Selenium	2008-10-28	0	µg/L	+/-1.00	Ionic balance > 5%, use with caution	MOE	C164172-0006	10	MAC	No
Selenium	2009-10-20	0.4	µg/L	+/-0.50		MOE	C172419-0011	10	MAC	No
Selenium	2010-12-08	0.2	µg/L	+/-0.50	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	10	MAC	No
Selenium	2011-11-10	0.3	µg/L	+/-0.50		MOE	C190404-0011	10	MAC	No
Selenium	2012-06-12	0.2	µg/L	+/-0.50	Ionic balance > 5%, use with caution	MOE	C194707-0001	10	MAC	No
Selenium	2012-10-25	1	µg/L	+/-0.40	Ionic balance > 5%, use with caution	MOE	C198481-0009	10	MAC	No
Selenium	2013-10-21	0.2	µg/L	+/-0.40		MOE	C207284-0002	10	MAC	No
Selenium	2014-11-05	0.7	µg/L	+/-0.40		MOE	C216232-0002	10	MAC	No
Selenium	2015-11-24	0.2	µg/L	+/-0.40		MOE	C225762-0002	10	MAC	No
Selenium	2016-11-23	0.2	µg/L	+/-0.40		MOE	C234976-0005	10	MAC	No
Selenium	2017-10-18	0.3	µg/L	+/-0.40	Use with caution - Inconsistent with other results	MOE	C243643-0003	10	MAC	No
Selenium	2018-11-01	0.2	µg/L	+/-0.40		MOE	C253968-0003	10	MAC	No
Selenium	2019-09-25	0	µg/L	+/-1.67		MOE	C261214-0001	10	MAC	No
Selenium	2021-11-11		µg/L	DL=5µg/L		LaSB	3759001	10	MAC	No
Sodium	2007-09-21	68.2	mg/L	0.2	Ionic balance > 5%, use with caution	CEL	B07-29104-23	200	AO[3]	No
Sodium	2008-10-28	74.1	mg/L		Ionic balance > 5%, use with caution	MOE	C164172-0006	200	AO[3]	No
Sodium	2009-10-20	71	mg/L			MOE	C172419-0011	200	AO[3]	No
Sodium	2010-12-08	61.7	mg/L		Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	200	AO[3]	No
Sodium	2011-11-10	73	mg/L	+/-11		MOE	C190404-0011	200	AO[3]	No
Sodium	2012-06-12	63.5	mg/L	+/-9.5	Ionic balance > 5%, use with caution	MOE	C194707-0001	200	AO[3]	No
Sodium	2012-10-25	74	mg/L	+/-7.4	Ionic balance > 5%, use with caution	MOE	C198481-0009	200	AO[3]	No
Sodium	2013-10-21	69.8	mg/L	+/-7.0		MOE	C207284-0002	200	AO[3]	No
Sodium	2014-11-05	72.9	mg/L	+/-7.3		MOE	C216232-0002	200	AO[3]	No
Sodium	2015-11-24	60	mg/L			MOE	C225762-0002	200	AO[3]	No
Sodium	2016-11-23	80.5	mg/L	+/-8.1		MOE	C234976-0005	200	AO[3]	No
Sodium	2017-10-18	204	mg/L	+/-20	Use with caution - Inconsistent with other results	MOE	C243643-0003	200	AO[3]	Yes
Sodium	2018-11-01	158	mg/L	+/-16		MOE	C253968-0003	200	AO[3]	No
Sodium	2019-09-25	160	mg/L	+/-16		MOE	C261214-0001	200	AO[3]	No
Sodium	2021-11-11	137	mg/L	DL=0.02mg/L		LaSB	3759001	200	AO[3]	No
Sulphate	2007-09-21	8	mg/L	1	Ionic balance > 5%, use with caution	CEL	B07-29104-23	500	AO[4]	No
Sulphate	2008-10-28	14.8	mg/L		Ionic balance > 5%, use with caution	MOE	C164172-0006	500	AO[4]	No
Sulphate	2009-10-20	7.6	mg/L			MOE	C172419-0011	500	AO[4]	No
Sulphate	2010-12-08	22.3	mg/L		Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	500	AO[4]	No
Sulphate	2011-11-10	10.1	mg/L			MOE	C190404-0011	500	AO[4]	No
Sulphate	2012-06-12	19.9	mg/L		Ionic balance > 5%, use with caution	MOE	C194707-0001	500	AO[4]	No
Sulphate	2012-10-25	15.9	mg/L		Ionic balance > 5%, use with caution	MOE	C198481-0009	500	AO[4]	No
Sulphate	2013-10-21	28.5	mg/L			MOE	C207284-0002	500	AO[4]	No
Sulphate	2014-11-05	17	mg/L			MOE	C216232-0002	500	AO[4]	No
Sulphate	2015-11-24	30.5	mg/L			MOE	C225762-0002	500	AO[4]	No
Sulphate	2016-11-23	21.2	mg/L			MOE	C234976-0005	500	AO[4]	No
Sulphate	2017-10-18	122	mg/L		Use with caution - Inconsistent with other results	MOE	C243643-0003	500	AO[4]	No
Sulphate	2018-11-01	83.9	mg/L			MOE	C253968-0003	500	AO[4]	No
Sulphate	2019-09-25	44.4	mg/L			MOE	C261214-0001	500	AO[4]	No
Sulphate	2021-11-11	26.5	mg/L	DL=0.1mg/L		LaSB	3759001	500	AO[4]	No
Uranium	2007-09-21	1.06	µg/L	0.05	Ionic balance > 5%, use with caution	CEL	B07-29104-23	20	MAC	No
Uranium	2008-10-28	1.75	µg/L	+/-0.14	Ionic balance > 5%, use with caution	MOE	C164172-0006	20	MAC	No
Uranium	2009-10-20	0.5	µg/L	+/-0.18		MOE	C172419-0011	20	MAC	No
Uranium	2010-12-08	0.7	µg/L	+/-0.18	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	20	MAC	No

Parameter Name	Sample Date	Value	Units	Qualifiers	Comments	Lab Name	Sample Number	ODWQS (in parameter unit)	ODWQS Objective Type	Exceedance (Yes/No)
Uranium	2011-11-10	0.5	µg/L	+/-0.18		MOE	C190404-0011	20	MAC	No
Uranium	2012-06-12	0.6	µg/L	+/-0.18	Ionic balance > 5%, use with caution	MOE	C194707-0001	20	MAC	No
Uranium	2012-10-25	0.6	µg/L	+/-0.20	Ionic balance > 5%, use with caution	MOE	C198481-0009	20	MAC	No
Uranium	2013-10-21	0.7	µg/L	+/-0.20		MOE	C207284-0002	20	MAC	No
Uranium	2014-11-05	0.6	µg/L	+/-0.20		MOE	C216232-0002	20	MAC	No
Uranium	2015-11-24	0.4	µg/L	+/-0.20		MOE	C225762-0002	20	MAC	No
Uranium	2016-11-23	0.6	µg/L	+/-0.20		MOE	C234976-0005	20	MAC	No
Uranium	2017-10-18	0.4	µg/L	+/-0.20	Use with caution - Inconsistent with other results	MOE	C243643-0003	20	MAC	No
Uranium	2018-11-01	0.3	µg/L	+/-0.20		MOE	C253968-0003	20	MAC	No
Uranium	2019-09-25	0.3	µg/L	+/-0.17		MOE	C261214-0001	20	MAC	No
Uranium	2021-11-11		µg/L	DL=0.5µg/L		LaSB	3759001	20	MAC	No
Zinc	2007-09-21		µg/L	<5	Ionic balance > 5%, use with caution	CEL	B07-29104-23	5000	AO	No
Zinc	2008-10-28	5.5	µg/L	+/-0.40	Ionic balance > 5%, use with caution	MOE	C164172-0006	5000	AO	No
Zinc	2009-10-20	3.5	µg/L	+/-0.49		MOE	C172419-0011	5000	AO	No
Zinc	2010-12-08	1.5	µg/L	+/-0.49	Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	5000	AO	No
Zinc	2011-11-10	1.3	µg/L	+/-0.49		MOE	C190404-0011	5000	AO	No
Zinc	2012-06-12	1.1	µg/L	+/-0.49	Ionic balance > 5%, use with caution	MOE	C194707-0001	5000	AO	No
Zinc	2012-10-25	2.3	µg/L	+/-0.70	Ionic balance > 5%, use with caution	MOE	C198481-0009	5000	AO	No
Zinc	2013-10-21	3.3	µg/L	+/-0.70		MOE	C207284-0002	5000	AO	No
Zinc	2014-11-05	3.5	µg/L	+/-0.70		MOE	C216232-0002	5000	AO	No
Zinc	2015-11-24	1.1	µg/L	+/-0.70		MOE	C225762-0002	5000	AO	No
Zinc	2016-11-23	1	µg/L	+/-0.70		MOE	C234976-0005	5000	AO	No
Zinc	2017-10-18	7	µg/L	+/-0.90	Use with caution - Inconsistent with other results	MOE	C243643-0003	5000	AO	No
Zinc	2018-11-01	3.5	µg/L	+/-0.70		MOE	C253968-0003	5000	AO	No
Zinc	2019-09-25	0.5	µg/L	+/-0.67		MOE	C261214-0001	5000	AO	No
Zinc	2021-11-11	2	µg/L	DL=2µg/L		LaSB	3759001	5000	AO	No
pH	2007-09-21	6.8	none	0	Ionic balance > 5%, use with caution	CEL	B07-29104-23	6.5-8.5	OG	No
pH	2008-10-28	7.62	none		Ionic balance > 5%, use with caution	MOE	C164172-0006	6.5-8.5	OG	No
pH	2009-10-20	7.43	none			MOE	C172419-0011	6.5-8.5	OG	No
pH	2010-12-08	7.78	none		Ionic balance > 5%, use with caution; Calcium, Chloride suspect	MOE	C182252-0003	6.5-8.5	OG	No
pH	2011-11-10	8.32	none			MOE	C190404-0011	6.5-8.5	OG	No
pH	2012-06-12	7.22	none		Ionic balance > 5%, use with caution	MOE	C194707-0001	6.5-8.5	OG	No
pH	2012-10-25	7.36	none		Ionic balance > 5%, use with caution	MOE	C198481-0009	6.5-8.5	OG	No
pH	2013-10-21	7.67	none			MOE	C207284-0002	6.5-8.5	OG	No
pH	2014-11-05	7.52	none			MOE	C216232-0002	6.5-8.5	OG	No
pH	2015-11-24	7.45	none			MOE	C225762-0002	6.5-8.5	OG	No
pH	2016-11-23	7.78	none			MOE	C234976-0005	6.5-8.5	OG	No
pH	2017-10-18	7.54	none		Use with caution - Inconsistent with other results	MOE	C243643-0003	6.5-8.5	OG	No
pH	2018-11-01	7.22	none			MOE	C253968-0003	6.5-8.5	OG	No
pH	2019-09-25	7.5	none			MOE	C261214-0001	6.5-8.5	OG	No
pH	2021-11-11	7.16	none	DL=N/A		LaSB	3759001	6.5-8.5	OG	No
1,2-dichlorobenzene	2012-06-12	0.05	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	200	MAC	No
1,2-dichloroethane	2012-06-12	0.05	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	5	IMAC	No
1,4-dichlorobenzene	2012-06-12	0.25	µg/L	<T	Ionic balance > 5%, use with caution	MOE	C194707-0001	5	MAC	No
2,3,4,6-tetrachlorophenol	2012-06-12	0.05	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	100	MAC	No
2,4,6-trichlorophenol	2012-06-12	0.05	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	5	MAC	No
2,4-dichlorophenol	2012-06-12	0.1	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	900	MAC	No
Alachlor	2012-06-12	100	ng/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	5000	IMAC	No
Alkalinity	2021-11-11	437	mg/L as Ca	DL=1mg/L Ca		LaSB	3759001	500	OG	No
Azinphos-methyl	2012-06-12	0.1	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	20	MAC	No
Benzene	2012-06-12	0.05	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	1	MAC	No
Bromoxynil	2012-06-12	0.05	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	5	IMAC	No
Carbaryl	2012-06-12	0.2	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	90	MAC	No
Carbofuran	2012-06-12	0.5	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	90	MAC	No
Carbon tetrachloride	2012-06-12	0.2	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	2	MAC	No
Chlorpyrifos	2012-06-12	0.1	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	90	MAC	No
Diazinon	2012-06-12	0.5	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	20	MAC	No
Dicamba	2012-06-12	0.05	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	120	MAC	No
Dichloromethane	2012-06-12	0.2	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	50	MAC	No
Diclofop-methyl	2012-06-12	0.05	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	9	MAC	No
Dimethoate	2012-06-12	0.5	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	20	IMAC	No
Dinoseb	2012-06-12	0.05	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	1	MAC	No

Provincial Groundwater Monitoring Network
W0000363-2 Exceedances

Parameter Name	Sample Date	Value	Units	Qualifiers	Comments	Lab Name	Sample Number	ODWQS (in parameter unit)	ODWQS Objective Type	Exceedance (Yes/No)
Diquat	2012-06-12	0.1	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	70	MAC	No
Diuron	2012-06-12	0.5	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	150	MAC	No
Ethylbenzene	2012-06-12	0.05	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	2.4	AO	No
Glyphosate	2012-06-12	2	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	280	IMAC	No
Heptachlor	2012-06-12	1	ng/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	3000	MAC	No
Heptachlor epoxide	2012-06-12	2	ng/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	3000	MAC	No
Malathion	2012-06-12	1	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	190	MAC	No
Methoxychlor	2012-06-12	5	ng/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	900000	MAC	No
Metolachlor	2012-06-12	100	ng/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	50000	IMAC	No
Metribuzin	2012-06-12	100	ng/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	80000	MAC	No
Nitrate	2021-11-11	0.04	mg/L	DL=0.04mg/L		LaSB	3759001	10	MAC	No
PCB; total	2012-06-12	20	ng/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	3000	IMAC	No
Paraquat	2012-06-12	0.1	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	10	IMAC	No
Pentachlorophenol	2012-06-12	0.05	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	60	MAC	No
Phorate	2012-06-12	0.1	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	2	IMAC	No
Picloram	2012-06-12	0.05	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	190	IMAC	No
Prometryne	2012-06-12	20	ng/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	1000	IMAC	No
Simazine	2012-06-12	50	ng/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	10000	IMAC	No
Temephos	2012-06-12	0.1	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	280	IMAC	No
Terbufos	2012-06-12	0.2	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	1	IMAC	No
Tetrachloroethene	2012-06-12	0.05	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	30	MAC	No
Toluene	2012-06-12	0.05	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	24	AO	No
Triallate	2012-06-12	1	µg/L	<MDL	Ionic balance > 5%, use with caution	MOE	C194707-0001	230	MAC	No
Trichloroethene	2012-06-12	0.05	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	5	MAC	No
Trifluralin	2012-06-12	5	ng/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	45	IMAC	No
Trihalomethanes; total	2012-06-12	0.5	µg/L	<=W	Ionic balance > 5%, use with caution	MOE	C194707-0001	100	MAC[5]	No
Colour, apparent	2007-09-21	32	TCU	2	Ionic balance > 5%, use with caution	CEL	B07-29104-23	5	AO	Yes
Turbidity	2007-09-21	15500	NTU	0.2	Ionic balance > 5%, use with caution	CEL	B07-29104-23	5	AO[6]	Yes

Notes:
ODWQS: Ontario Drinking Water Quality Standards
MOE: Ministry of the Environment
CEL: Caduceon Environmental Laboratories
AO: Aesthetic Objective
MAC: Maximum Acceptable Concentration
IMAC: Interim Maximum Acceptable Concentration
OG: Operational Guidelines
DL: Detection Limit
MDL: Method Detection Limit
NA: Results not available
< : Actual result is less than reported value
<T: A measurable trace amount: interpret with caution
<TE: A measurable trace after dilution/ concentration: caution
<W: No measurable response [zero]; <Reported value
<=W: No measurable response (zero): <Reported value
ng/L: Nanograms per litre
µg/L: Micrograms per litre
mg/L: milograms per litre
1 - OG for hardness levels are between 80 and 100 mg/L. Hardness in excess of 500 mg/L in drinking water is unaccaptable for most domestic purposes
2 - Standard applies to water at the point of consumption. Since lead is a component in some plumbing systems, first flush water may contain higher concentrations of lead than water that has been flushed for five minutes
3 - The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets
4 - When sulphate levels exceed 500 mg/L, water may have a laxative effect on some people
5 - This standard is expressed as a running annual average of quarterly samples measured at point reflecting the maximum residence time in the distribution system
6 - Applicable for all waters at the point of consumption

Ambient Groundwater Geochemistry Summary - Casselman
(OGS, 2021)

Parameter	Units	ODWQS	ODWQS Type						
Station ID				12-AG-135	12-AG-136	12-AG-136	12-AG-147	12-AG-194	12-AG-196
Sample ID				12-AG-135	12-AG-136	12-AG-139	12-AG-147	12-AG-194	12-AG-196
Easting[4]				498400	491600	491600	488400	496500	492100
Northing[4]				5019300	5019400	5019400	5020900	5020900	5020800
Representative Aquifer				Lindsay (interface)	Overburden	Overburden	Overburden	Lindsay (interface)	Overburden
Well Type				Drilled	Dug	Dug	Bored	Drilled	Bored
DEM Elevation (mASL)				63.5	65.4	65.4	69.2	63.2	66.2
Rock Elevation (mASL)				42	34	34	29	39	43
Local Drift Thickness (m)				21.2	23.9	23.9	36.6	24.8	59.3
MOE Well ID				5200937	5606304	5606304	-	5601642	-
Well Depth (m)				21.3	6.1	6.1	4.9	25.6	5.2
Static Water Level (mbgs)				≥ 4.9	2	2	0.21	3.55	0.3
Sample Date				2012-06-20	2012-06-20	2012-06-20	2012-06-18	2012-07-08	2012-07-08
Charge Balance				0.6	5.9	4.7	8.3	-2.2	-2.9
Alkalinity	mg/L as $CaCO_3$	30-500	OG	**544**	283	296	118.5	367	259
Temperature	ºC	15	AO	-	9.95	-	9.48	-	9.06
pH	pH Units	6.5-8.5	OG	7.82	6.66	-	7.16	7.79	6.89
Sulphide	mg/L H2S	0.05	AO	<0.01	0	0	**0.2**	**0.07**	0
Sodium[1]	mg/L	200	AO	**245.4**	35.2	36.1	3.7	94.9	72.1
Sulphate[2]	mg/L	500	AO	0.1	65.4	66.5	13.1	15.7	27.4
Chloride	mg/L	250	AO	74.0	48.6	48.6	1.3	10.2	158.3
Nitrate	mg/L as N	10	MAC	<0.002	**11.100**	**11.300**	<0.002	3.190	3.230
Nitrite	mg/L as N	1	MAC	<0.003	<0.003	<0.003	<0.003	<0.003	0.010
Organic Nitrogen	mg/L as N	0.15	OG	**0.32**	<0.05	<0.05	**1.45**	**0.33**	**0.23**
Dissolved Organic Carbon	mg/L	5	AO	**10.4**	2.3	2.6	2.4	4.6	**7**
Boron	mg/L	5	IMAC	**711**	**65**	**65**	**9**	**371**	**7**
Iron	mg/L	0.3	AO	**100.3**	<3	<3	**662.8**	**143.2**	<3
Total Coliform	Counts/100mL	0 (ND)	MAC	0	**18**	**4**	0	0	**13**
Fecal Coliform	Counts/100mL	-	NS	0	0	0	0	0	0
Lab Colour	TCU	5	AO	-	-	-	-	-	-
Methane	L/m^3	3	AO	**9.2**	0	0	0.4	0.6	0
TDS	mg/L	500	AO	**699.8**	484.9	495.5	153.5	414.5	**541.4**
Aluminum	µg/L	100	OG	<5	<5	<5	<5	<5	<5
Arsenic	µg/L	25	IMAC	0.337	0.205	0.197	0.679	0.08	0.4115
Barium	µg/L	1000	MAC	145.9	97.9	95.4	41.0	508.0	61.1
Cadmium	µg/L	5	MAC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	µg/L	50	MAC	0.187	0.133	0.131	0.078	0.279	0.2995
Copper	µg/L	1000	AO	<0.2	5.71	6.48	0.25	<0.2	18.29
Mercury	ng/L	1000	MAC	1.9	1.7	1.9	3	<1.5	<1.5
Manganese	µg/L	50	AO	7.6	<3	<3	**899.1**	5.3	<3
Lead[3]	µg/L	10	MAC	0.003	0.149	0.158	0.016	0.003	0.208
Antimony	µg/L	6	IMAC	0.038	0.212	0.218	0.010	0.012	0.031
Selenium	µg/L	10	MAC	0.271	<0.1	0.104	0.657	<0.1	0.131
Uranium	µg/L	20	MAC	0.004	0.350	0.349	0.196	0.003	0.947
Zinc	µg/L	5000	AO	<1	3.7	4.4	5.3	<1	7.8

Notes:
ODWQS: Ontario Drinking Water Quality Standards
TDS: Total Dissolved Solids
AO: Aesthetic Objective
MAC: Maximum Acceptable Concentration
IMAC: Interim Maximum Acceptable Concentration
OG: Operational Guidelines
-: No information
NS: No Standard
ng/L: Nanograms per litre
µg/L: Micrograms per litre
mg/L: milograms per litre
ºC: Degrees Celsius
1 - The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets
2 - When sulphate levels exceed 500 mg/L, water may have a laxative effect on some people
3 - This standard applies to water at the point of consumption. Since lead is a component in some plumbing systems, first flush water may contain higher concentrations of lead than water that has been flushed for five minutes.
4 - NAD83 UTM Zone 18
Bold + Underlined: Exceeds ODWQS MAC, IMAC, OG, or AO

Ambient Groundwater Geochemistry Summary - Casselman
(OGS, 2021)

Station ID				12-AG-214	16-AG-718	16-AG-732	16-AG-740	16-AG-742
Sample ID				12-AG-214	16-AG-718	16-AG-732	16-AG-740	16-AG-742
Easting[4]				492200	497900	490500	488100	497200
Northing[4]				5012000	5022100	5015400	5017200	5019100
Representative Aquifer				Lindsay (subcrop)	Lindsay (subcrop)	Lindsay (subcrop)	Lindsay (interface)	Lindsay (interface)
Well Type				Drilled	Drilled	Drilled	Drilled	Drilled
DEM Elevation (mASL)				71.8	63.6	63.4	66.6	63
Rock Elevation (mASL)				67	43	42	43	48
Local Drift Thickness (m)				3.6	21.2	20.6	24.2	18.2
MOE Well ID				7172613	5204259	-	-	5606164
Well Depth (m)				18.2	46	24.4	26.2	19.5
Static Water Level (mbgs)				2.7	≈12	5.565	15.315	6.01
Sample Date				2012-07-12	2016-07-24	2016-07-27	2016-08-02	2016-08-02
Charge Balance				-10.9	-7.7	-5.6	0.2	-0.4
Parameter	**Units**	**ODWQS**	**ODWQS Type**					
Alkalinity	mg/L as $CaCO_3$	30-500	OG	**<u>732</u>**	**<u>546</u>**	**<u>547</u>**	**<u>946</u>**	421.6
Temperature	ºC	15	AO	-	9.53	10.38	10.03	9.66
pH	pH Units	6.5-8.5	OG	**<u>6.47</u>**	8.14	8.29	8.02	7.84
Sulphide	mg/L H2S	0.05	AO	0	**<u>0.2</u>**	<0.01	<0.01	**<u>0.1</u>**
Sodium[1]	mg/L	200	AO	**<u>927.7</u>**	177.1	**<u>273.5</u>**	**<u>1164.4</u>**	82.3
Sulphate[2]	mg/L	500	AO	94.1	0.5	3.4	0.3	1.5
Chloride	mg/L	250	AO	**<u>1822.9</u>**	38.5	135.0	**<u>1265.0</u>**	8.6
Nitrate	mg/L as N	10	MAC	0.081	<0.002	<0.006	<0.002	<0.002
Nitrite	mg/L as N	1	MAC	<0.003	<0.003	<0.003	<0.003	<0.003
Organic Nitrogen	mg/L as N	0.15	OG	**<u>5.89</u>**	<0.05	**<u>0.54</u>**	<0.05	0.11
Dissolved Organic Carbon	mg/L	5	AO	**<u>27</u>**	**<u>6</u>**	**<u>7</u>**	**<u>10</u>**	4
Boron	mg/L	5	IMAC	**<u>76.5</u>**	**<u>667.5</u>**	**<u>855.5</u>**	**<u>1288.4</u>**	**<u>395.5</u>**
Iron	mg/L	0.3	AO	**<u>1356.3</u>**	**<u>120.5</u>**	**<u>14.6</u>**	**<u>25.3</u>**	**<u>91.2</u>**
Total Coliform	Counts/100mL	0 (ND)	MAC	0	-	-	-	-
Fecal Coliform	Counts/100mL	-	NS	0	-	-	-	-
Lab Colour	TCU	5	AO	-	**<u>39</u>**	**<u>41</u>**	**<u>40</u>**	**<u>11</u>**
Methane	L/m³	3	AO	0	**<u>7.1</u>**	**<u>7.4</u>**	**<u>9.5</u>**	1.1
TDS	mg/L	500	AO	**<u>3564.2</u>**	**<u>598.9</u>**	**<u>774.9</u>**	**<u>3081.5</u>**	440.9
Aluminum	µg/L	100	OG	<5	<5	<5	<5	<5
Arsenic	µg/L	25	IMAC	0.221	0.17	0.347	0.203	0.061
Barium	µg/L	1000	MAC	259.1	247.7	166.2	486.9	417.5
Cadmium	µg/L	5	MAC	0.022	<0.01	<0.01	<0.01	<0.01
Chromium	µg/L	50	MAC	0.119	0.177	0.229	0.242	0.046
Copper	µg/L	1000	AO	15.03	0.22	0.23	0.36	<0.2
Mercury	ng/L	1000	MAC	<1.5	1.5	<1.5	1.9	1.8
Manganese	µg/L	50	AO	**<u>384.1</u>**	3.4	<3	<3	7.3
Lead[3]	µg/L	10	MAC	0.400	0.004	0.005	0.007	<0.002
Antimony	µg/L	6	IMAC	0.044	0.023	0.029	0.020	<0.01
Selenium	µg/L	10	MAC	0.441	0.203	0.194	0.171	0.280
Uranium	µg/L	20	MAC	3.640	0.004	0.002	0.006	0.004
Zinc	µg/L	5000	AO	9	<1	<1	<1	7.7

Notes:
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2 - When sulphate levels exceed 500 mg/L, water may have a laxative effect on some people
3 - This standard applies to water at the point of consumption. Since lead is a component in some plumbing systems, first flush water may contain higher concentrations of lead than water that has been flushed for five minutes.
4 - NAD83 UTM Zone 18
<u>Bold + Underlined:</u> Exceeds ODWQS MAC, IMAC, OG, or AO

APPENDIX D

Public Well Records for Reviewed Municipal Systems

Vars Well 1

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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

11 | 1528046 | MUNICIP. 15011 | CON. CON | 05

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
Carleton	Cumberland	5	26

OWNER (SURNAME FIRST): Regional Municipality of Ottawa-Carleton.
ADDRESS: 111 Lisgar St., Ottawa, Ont. K2P 2L7
DATE COMPLETED: DAY 27 MO 04 YR 94

21 | ZONE | EASTING | NORTHING | RC | ELEVATION | RC | BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
Yellow	Sand		Oxydised fine sand	0	10
Brown	Gravel	Silt	Brown gravel silt	10	15
	Sand	Gravel	Sand & gravel	15	20
	Gravel	Boulders	Gravel & boulders	20	30
	Sand	Boulders	Sand & boulders	30	33
	Gravel		Gravel	30	40
Grey	Gravel		Grey gravel	40	50
	Sand	Gravel	Sand & gravel	50	55
	Gravel	Sand & boulders	Sand gravel & boulders	55	60
	Gravel		Gravel (well sorted)	60	70
	Gravel	Sand	Sand & gravel	70	78
	Sand	Silt	Fine sand & silt	78	80

31
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
	1 ☑ FRESH 3 ☑ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
10"	1 ☑ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	.375	0	63
20"	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	.375	0	63
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER	LENGTH
250	10 INCHES	15 FEET

MATERIAL AND TYPE: S.S. 304
DEPTH TO TOP OF SCREEN: 63'-78' FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
0	24'	Cement Grout

71 PUMPING TEST

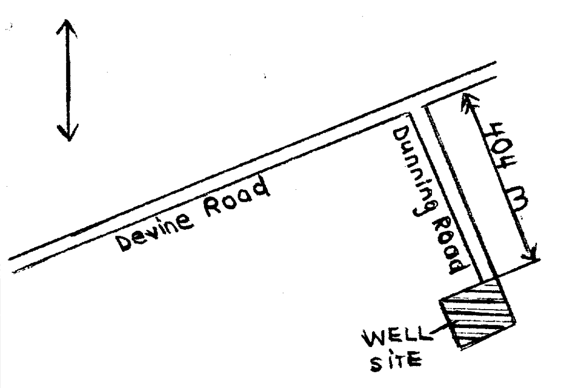
PUMPING TEST METHOD: 1 ☑ PUMP 2 ☐ BAILER
PUMPING RATE: 400 imp. GPM
DURATION OF PUMPING: 72 HOURS 0 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
From Top 10.92 FEET	15.06 FEET	12.23 FEET	12.37 FEET	12.50 FEET	12.60 FEET

WATER LEVELS DURING: 1 ☑ PUMPING 2 ☐ RECOVERY
IF FLOWING, GIVE RATE: GPM
PUMP INTAKE SET AT: 45.92 FEET
WATER AT END OF TEST: 1 ☑ CLEAR 2 ☐ CLOUDY
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☐ DEEP
RECOMMENDED PUMP SETTING: 50 FEET
RECOMMENDED PUMPING RATE: GPM

LOCATION OF WELL

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



DRILLERS REMARKS: 147693

FINAL STATUS OF WELL

1 ☑ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☐ UNFINISHED
☐ DEWATERING

WATER USE

1 ☐ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☑ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☑ CABLE TOOL
2 ☐ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☐ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING
☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: Coop Envirotecheau
WELL CONTRACTOR'S LICENCE NUMBER: 12636
ADDRESS: 2251 Chemin St. François, Dorval. H9R-4K3
NAME OF WELL TECHNICIAN: Benoit Bouchard
WELL TECHNICIAN'S LICENCE NUMBER: 1756
SIGNATURE OF TECHNICIAN/CONTRACTOR: J. G. Tremblay
SUBMISSION DATE: DAY 27 MO. 04 YR. 94

OFFICE USE ONLY

DATA SOURCE: | CONTRACTOR: 6826 | DATE RECEIVED: JUL 19 1994
DATE OF INSPECTION: | INSPECTOR:
REMARKS: CSS.ES

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

Vars Well 2

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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

11 | 1527906 | MUNICIP. 15011 | CON. CON 05

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
Carleton	Cumberland	5	26

OWNER (SURNAME FIRST): Regional Municipality of ~~Ottawa Carleton~~
ADDRESS: 111 Lisgar St. Ottawa, Ont. K2P 2L7
DATE COMPLETED: DAY 27 MO 04 YR 94

21 | ZONE | EASTING | NORTHING | RC | ELEVATION | RC | BASIN CODE

PW2

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
Yellow	Sand		Oxydised fine sand	0	10
Brown	Gravel	Silt	Brown gravel silt	10	15
	Sand	Gravel	Sand & gravel	15	20
	Gravel	Boulders	Gravel & Boulders	20	30
	Sand	Boulders	Sand & Boulders	30	33
	Gravel		Gravel	30	40
Grey	Gravel		Grey gravel	40	50
	Sand	Gravel	Sand & gravel	50	55
	Gravel	Sand & Boulders	Sand gravel & Boulders	55	60
	Gravel		Gravel (well sorted)	60	70
	Gravel	Sand	Sand & Gravel	70	78
	Sand	Silt	Fine Sand & Silt	78	80

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
	1 ☑ FRESH 3 ☑ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
10"	1 ☑ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	.375	0	63
20"	1 ☑ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	.375	0	63
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER	LENGTH
250	10 INCHES	15 FEET

MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN
S.S. 304	63' - 78' FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
0	24	Cement Grout

71 PUMPING TEST

PUMPING TEST METHOD	1 ☑ PUMP 2 ☐ BAILER
PUMPING RATE	400 imp. GPM
DURATION OF PUMPING	72 HOURS 0 MINS
STATIC LEVEL	From top 10.92 FEET
WATER LEVEL END OF PUMPING	15.06 FEET
WATER LEVELS DURING	1 ☑ PUMPING 2 ☐ RECOVERY
15 MINUTES	12.23
30 MINUTES	12.37
45 MINUTES	12.50 FEET
60 MINUTES	12.60 FEET
IF FLOWING, GIVE RATE	GPM
PUMP INTAKE SET AT	45.92 FEET
WATER AT END OF TEST	1 ☑ CLEAR 2 ☐ CLOUDY
RECOMMENDED PUMP TYPE	☐ SHALLOW ☑ DEEP
RECOMMENDED PUMP SETTING	50 FEET
RECOMMENDED PUMPING RATE	GPM

FINAL STATUS OF WELL

1 ☑ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☐ UNFINISHED
☐ DEWATERING

WATER USE

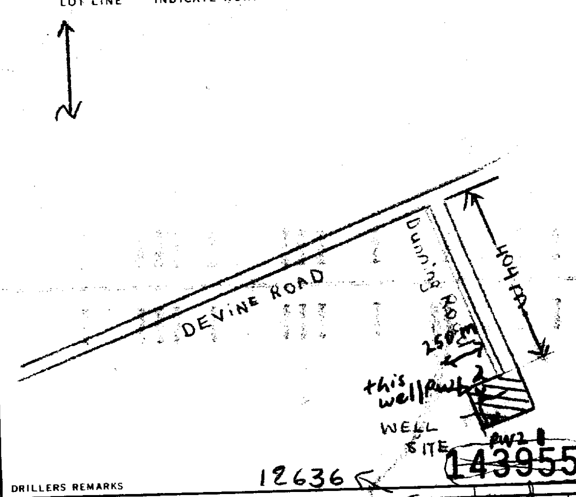
1 ☐ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☑ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☑ CABLE TOOL
2 ☐ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☐ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING
☐ DIGGING
☐ OTHER

LOCATION OF WELL

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



143955

CONTRACTOR

NAME OF WELL CONTRACTOR: Coop. Envirotecheau
WELL CONTRACTOR'S LICENCE NUMBER: 1757
ADDRESS: 2251 Chemin St. François, Dorval.
NAME OF WELL TECHNICIAN: Benoit Bouchard
WELL TECHNICIAN'S LICENCE NUMBER: 6826
SIGNATURE OF TECHNICIAN/CONTRACTOR: [signature]
SUBMISSION DATE: DAY 27 MO 04 YR 94

DRILLERS REMARKS

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 6826 | DATE RECEIVED: transferred from licensee MAY 18 1994
DATE OF INSPECTION | INSPECTOR
REMARKS

CSS.GS

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

Moose Creek Well 1 (abandoned)

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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

11 | 5803471 | MUNICIP 58004 | CON. CON 06

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
Stormont	Roxborough	Con. # 6	19

OWNER (SURNAME FIRST)	ADDRESS	DATE COMPLETED
Village of Moose Creek	Moose Creek Ontario	DAY 20 MO 11 YR 91

PW-1 WATER WELL — ZONE / EASTING / NORTHING / RC / ELEVATION / RC / BASIN CODE / II / III / IV

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
Brown	Topsoil		Loose	0'	2'
Grey	Clay	Silt sand	Packed	2'	40'
Black	Shale		Fractured	40'	41'6"
Black	Shale		Layered	41'6"	100'

31
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
65'	☒ FRESH ☒ SULPHUR
95'	☒ SULPHUR

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
20"	☒ STEEL / ☒ OPEN HOLE		0'	20'
16"	☒ STEEL	.250	+3'	41'6"
8"	☒ STEEL	.312	+4'	100'

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER	LENGTH
80	8" INCHES	2x5' FEET

MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN
Stainless Steel	65' FEET

61 PLUGGING & SEALING RECORD

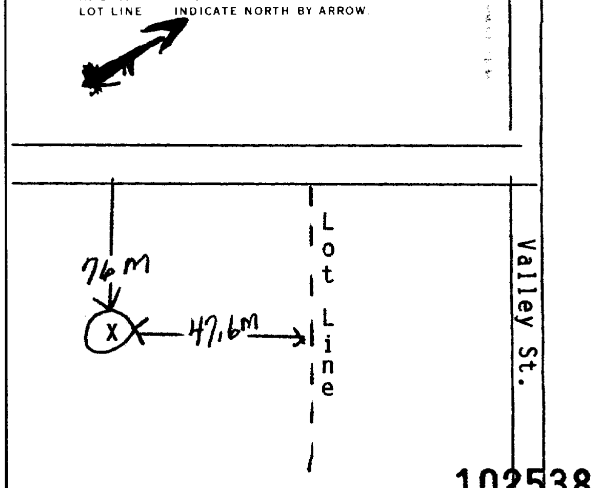
DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
0'	20'	Cement Grout 15 sacks of High Early Cement

71 PUMPING TEST

PUMPING TEST METHOD	☒ PUMP ☐ BAILER
PUMPING RATE	50 GPM
DURATION OF PUMPING	72 HOURS
STATIC LEVEL	12' FEET
WATER LEVEL END OF PUMPING	60' FEET
WATER LEVELS DURING	☐ PUMPING ☐ RECOVERY
15 MINUTES	19' FEET
30 MINUTES	20' FEET
45 MINUTES	30' FEET
60 MINUTES	45' FEET
IF FLOWING GIVE RATE	GPM
PUMP INTAKE SET AT	88' FEET
WATER AT END OF TEST	☒ CLEAR ☐ CLOUDY
RECOMMENDED PUMP TYPE	☐ SHALLOW ☒ DEEP
RECOMMENDED PUMP SETTING	85' FEET
RECOMMENDED PUMPING RATE	50 GPM

LOCATION OF WELL

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



102538

DRILLERS REMARKS

FINAL STATUS OF WELL: ☒ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL ☐ ABANDONED, INSUFFICIENT SUPPLY ☐ ABANDONED, POOR QUALITY ☐ UNFINISHED ☐ DEWATERING

WATER USE: ☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER ☐ COMMERCIAL ☒ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED

METHOD OF CONSTRUCTION: ☒ CABLE TOOL ☐ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☐ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR	OLYMPIC DRILLING CO. LIMITED
WELL CONTRACTOR'S LICENCE NUMBER	4006
ADDRESS	Box 9180 OTTAWA, Ont. KIG 3T9
NAME OF WELL TECHNICIAN	JODIE RENWICK
WELL TECHNICIAN'S LICENCE NUMBER	T0-460
SIGNATURE OF TECHNICIAN/CONTRACTOR	J.D. Renwick (Sec.)
SUBMISSION DATE	DAY 02 MO 12 YR 91

OFFICE USE ONLY

DATA SOURCE	
CONTRACTOR	4006
DATE RECEIVED	DEC 10 1991
DATE OF INSPECTION	
INSPECTOR	
REMARKS	

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

Moose Creek Well 2

Ministry of the Environment

Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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

11 | 5803463 | MUNICIP 58004 | CON. CON. | 06

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
Stormont	Roxborough	Con. 6	PL-19

OWNER (SURNAME FIRST)	ADDRESS	DATE COMPLETED
Jacques Whitford Ltd.	Unit C20-2285 St.Laurent Blv.Ottawa	DAY 23 MO 08 YR 91

21 Well #2 | ZONE | EASTING | NORTHING | RC | ELEVATION | RC | BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
Brown	Topsoil	Sand	Loose	0'	2'
Grey	Clay	Silt	packed	2'	43'
Grey	Shaley-Limestone		Layered	43'	101'

31

32

41 WATER RECORD

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

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
16"	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC	.375	+2'	43'
16"	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☒ OPEN HOLE ☒ PLASTIC		43'	101'
8"	☒ STEEL ☒ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC	.209	+3'	101'

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER	LENGTH
50	8" INCHES	10' FEET

MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN
Stainless Steel	69' FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
0'	20'	Cement Grout
		10 sacks of
		High Early Cement

71 PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
☒ PUMP ☐ BAILER	50 GPM	72 HOURS __ MINS

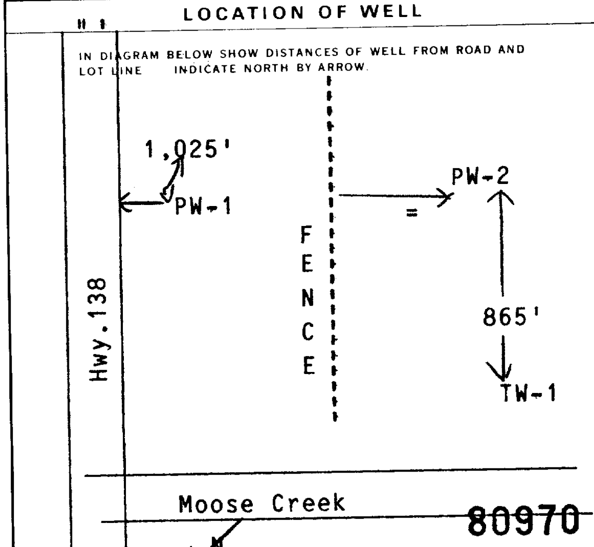
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING ☐ PUMPING ☐ RECOVERY: 15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
8' FEET	66' FEET	30' FEET	42' FEET	51' FEET	61' FEET

IF FLOWING, GIVE RATE: ___ GPM | PUMP INTAKE SET AT: 90' FEET | WATER AT END OF TEST: ☒ CLEAR ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP | RECOMMENDED PUMP SETTING: 90' FEET | RECOMMENDED PUMPING RATE: 40 GPM

LOCATION OF WELL

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



DRILLERS REMARKS: 80970

FINAL STATUS OF WELL

☒ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL ☐ ABANDONED, INSUFFICIENT SUPPLY ☐ ABANDONED, POOR QUALITY ☐ UNFINISHED ☐ DEWATERING

WATER USE

☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER ☐ COMMERCIAL ☒ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED

METHOD OF CONSTRUCTION

☒ CABLE TOOL ☒ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☐ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING ☐ DIGGING ☐ OTHER

NAME OF WELL CONTRACTOR	WELL CONTRACTOR'S LICENCE NUMBER
Olympic DrillingCo.Ltd.	4006

ADDRESS: 9180 OTTAWA, Ont.KIG 3T9

NAME OF WELL TECHNICIAN	WELL TECHNICIAN'S LICENCE NUMBER
Renwick	T0-460

SIGNATURE OF TECHNICIAN/CONTRACTOR (Sec.) | SUBMISSION DATE: DAY 10 MO. 10 YR. 91

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 4006 | DATE RECEIVED OCT 21 1991

DATE OF INSPECTION | INSPECTOR

REMARKS

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

Moose Creek Well 3

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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

11 | 5803393 | MUNICIP 58004 | CON. CON | 06

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON, BLOCK, TRACT, SURVEY, ETC	LOT
Stormont	Roxborough	Con. 6	PL-19

OWNER (SURNAME FIRST)	ADDRESS	DATE COMPLETED
Jacques Whitford Ltd.	Unit C20-2285 St.Laurent Blv.OTTAWA	DAY 16 MO 04 YR 91

21 | 6" X 8" GRAVEL PACK WELL (MOOSE CREEK ONT.)

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
Black	Top Soil			0'	2'
Grey	Quick Sand			2'	41'
Black	Fracture bedrock shales			41'	53'
Dark Grey	Shales			53'	105'

31
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
45'	☒ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS
85'	☒ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
17½"	☒ OPEN HOLE, ☒ PLASTIC		0'	53'
16"	☒ OPEN HOLE, ☒ PLASTIC		53'	105'
8"	☒ STEEL, ☒ GALVANIZED, ☒ CONCRETE, ☒ OPEN HOLE	.188	+ 2'	105'

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER	LENGTH
100 slot	8" INCHES	10' FEET

MATERIAL AND TYPE: Stainless Steel Screen | DEPTH TO TOP OF SCREEN: 5' @ 82' / 5' @ 100' FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
☒ PUMP ☐ BAILER	50 GPM	72 HOURS MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
1.41m FEET	26.10m FEET	22.75m FEET	23.39m FEET	23.78m FEET	23.89m FEET

WATER LEVELS DURING: ☐ PUMPING ☐ RECOVERY

IF FLOWING, GIVE RATE: GPM | PUMP INTAKE SET AT: 96' FEET | WATER AT END OF TEST: ☒ CLEAR ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP | RECOMMENDED PUMP SETTING: 96' FEET | RECOMMENDED PUMPING RATE: 50 GPM

FINAL STATUS OF WELL

☒ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL ☐ ABANDONED, INSUFFICIENT SUPPLY ☐ ABANDONED, POOR QUALITY ☐ UNFINISHED ☐ DEWATERING

WATER USE

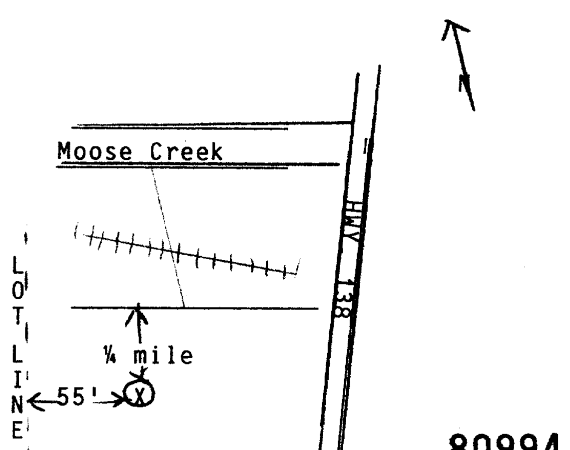
☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER ☒ COMMERCIAL ☐ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED

METHOD OF CONSTRUCTION

☐ CABLE TOOL ☐ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☒ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING ☐ DIGGING ☐ OTHER

LOCATION OF WELL

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



80994

DRILLERS REMARKS

CONTRACTOR

NAME OF WELL CONTRACTOR: OLYMPIC DRILLING CO.LTD. | WELL CONTRACTOR'S LICENCE NUMBER: 4006

ADDRESS: Box 9180 OTTAWA, Ont. KIG 3T9

NAME OF WELL TECHNICIAN: WAYNE RENWICK | WELL TECHNICIAN'S LICENCE NUMBER: T0-327

SIGNATURE OF TECHNICIAN/CONTRACTOR: W.D. Renwick (Sec.) | SUBMISSION DATE: DAY 22 MO. 04 YR 91

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 4006 | DATE RECEIVED MAY 08 1991

DATE OF INSPECTION | INSPECTOR

REMARKS

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

Finch Well 1

MINISTRY OF THE ENVIRONMENT

The Ontario Water Resources Act

WATER WELL RECORD

Ontario

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

11 | 5801326 | MUNICIP. 58701 | CON.

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
STORMONT	FINCH		

OWNER (SURNAME FIRST)	ADDRESS	DATE COMPLETED
VILLAGE of FINCH	FINCH	DAY 12 MO. 07 YR. 72

21 | ZONE 18 | EASTING 493000 | NORTHING 4998760 | RC. 4 | ELEVATION 0270 | RC. 5 | BASIN CODE 25

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
	fill			0	5
	gravel			5	11
	limestone	SHALE	(OTTAWA FORMATION)	11	189

FINCH WELL No 1/72

31 | 0005 01 | 0011 11 | 0189 1517

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0026	☒ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERAL
0079	☒ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERAL
0130 (~~130-140~~)	☒ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERAL
0150 (~~150-165~~)	☒ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERAL
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
08	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE	1/4	0	0028 (~~27.5~~)
08	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☒ OPEN HOLE		0028 (27.5)	0189
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.) | DIAMETER INCHES | LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

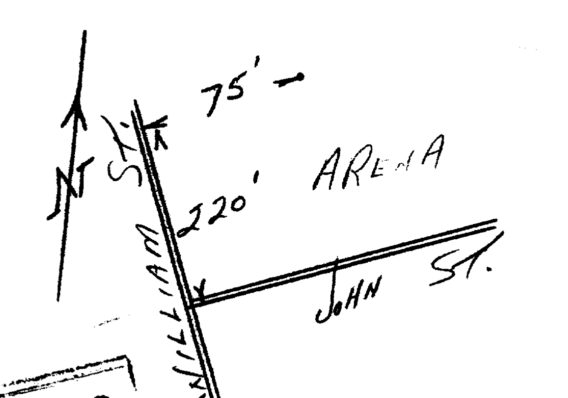
71 PUMPING TEST

PUMPING TEST METHOD: ☒ PUMP ☐ BAILER	PUMPING RATE 0120 GPM	DURATION OF PUMPING 72 HOURS 00 MINS				
STATIC LEVEL 016 (~~104~~) FEET	WATER LEVEL END OF PUMPING 052 FEET	WATER LEVELS DURING ☒ PUMPING ☐ RECOVERY: 15 MINUTES 029 FEET	30 MINUTES 029 FEET	45 MINUTES 031 FEET	60 MINUTES 031 FEET	
IF FLOWING, GIVE RATE GPM	PUMP INTAKE SET AT FEET	WATER AT END OF TEST ☒ CLEAR ☐ CLOUDY				
RECOMMENDED PUMP TYPE ☐ SHALLOW ☒ DEEP	RECOMMENDED PUMP SETTING 080 (~~100~~) FEET	RECOMMENDED PUMPING RATE 0110 GPM				

50-53: 002.8

LOCATION OF WELL

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



DRILLERS REMARKS:

FINAL STATUS OF WELL: ☒ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL ☐ ABANDONED, INSUFFICIENT SUPPLY ☐ ABANDONED, POOR QUALITY ☐ UNFINISHED

WATER USE 06: ☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER ☐ COMMERCIAL ☒ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED

METHOD OF DRILLING: ☒ CABLE TOOL ☐ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☐ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR	LICENCE NUMBER
RAMON H. CASSELMAN	1505

ADDRESS: WILLIAMSBURG

NAME OF DRILLER OR BORER | LICENCE NUMBER

SIGNATURE OF CONTRACTOR | SUBMISSION DATE DAY ___ MO. ___ YR. ___

OFFICE USE ONLY

DATA SOURCE	CONTRACTOR	DATE RECEIVED
1	1505	190973

DATE OF INSPECTION | INSPECTOR

REMARKS:

MINISTRY OF THE ENVIRONMENT COPY

FORM 7 07-091

Finch Well 2

MINISTRY OF THE ENVIRONMENT

The Ontario Water Resources Act

Ontario

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
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11 | 5801327 | MUNICIP. 58704 | CON.

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT 25-27
STORMONT	FINCH		

OWNER (SURNAME FIRST) 28-47	ADDRESS	DATE COMPLETED 48-53
VILLAGE of Finch	FINCH	DAY 19 MO. ~~Jan~~ 01 YR. 72

21 | ZONE 18 | EASTING 493000 | NORTHING 4998250 | RC 4 | ELEVATION 0270 | RC 5 | BASIN CODE 25

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
	gravel	clay fill		0	5
	gravel			5	11
	limestone		Solid	11	99
	"	broken		99	104
	"		solid	104	189
	FINCH	WELL	No 2/72		

31 | 0005 01/1005 0011 1/1 0189 15

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0064 ~~64-78~~	1 ☒ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
08	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	1/4	0	0028 ~~27~~
08	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		0028 (27)	~~189~~ 0189
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.) | DIAMETER INCHES | LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER

PUMPING RATE: 0120 GPM

DURATION OF PUMPING: 06 HOURS 00 MINS

STATIC LEVEL: 011 (~~14~~) FEET

WATER LEVEL END OF PUMPING: 025 FEET

WATER LEVELS DURING: 1 ☒ PUMPING 2 ☐ RECOVERY

15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
019 FEET	020 FEET	020 FEET	020 FEET

IF FLOWING, GIVE RATE: GPM

PUMP INTAKE SET AT: FEET

WATER AT END OF TEST: 1 ☐ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP

RECOMMENDED PUMP SETTING: 080 FEET

RECOMMENDED PUMPING RATE: 0110 GPM

50-53: 008.6

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☐ UNFINISHED

WATER USE

06

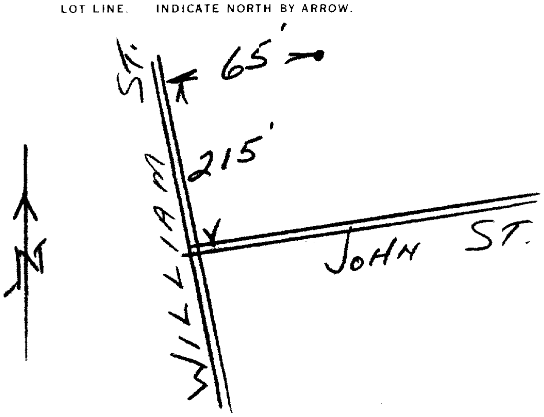
1 ☐ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☒ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF DRILLING

1 ☒ CABLE TOOL
2 ☐ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☐ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING

LOCATION OF WELL

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



DRILLERS REMARKS:

CONTRACTOR

NAME OF WELL CONTRACTOR: RAMON H. CASSELMAN | LICENCE NUMBER: 1505

ADDRESS: WILLIAMSBURG

NAME OF DRILLER OR BORER | LICENCE NUMBER

SIGNATURE OF CONTRACTOR | SUBMISSION DATE DAY ___ MO. ___ YR. ___

OFFICE USE ONLY

DATA SOURCE: 1 | CONTRACTOR: 1505 | DATE RECEIVED: 190973

DATE OF INSPECTION | INSPECTOR

REMARKS:

FORM 7 07-091

Newington Well 2

Ministry of the Environment
Ontario

The Ontario Water Resources Act
WATER WELL RECORD

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11 | 5802247 | MUNICIP. 58003 | CON. CON 08

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
STORMONT	OSNABRUCK	8	007

OWNER (SURNAME FIRST): STORMONT AGRI. SOC. / STORMONT AGRICULTURE SOCIETY
ADDRESS: NEWINGTON
DATE COMPLETED: DAY 11 MO 08 YR 79

21 | ZONE 18 | EASTING 498799 | NORTHING 4996299 | RC 5 | ELEVATION 0325 | RC 5 | BASIN CODE 26

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
BROWN	SAND			0	8
GREY	HARD PAN	STONES		8	42
" "	LIMESTONE		LAYERED	42	112

31 | 0008628 | 0042214112 | 0112157411
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0062	☒ FRESH
0080	☒ FRESH
0105	☒ FRESH

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
06 (6 1/4")	☒ STEEL	188	0	0042
6"				

SCREEN: SIZE(S) OF OPENING (SLOT NO.) / DIAMETER / LENGTH / MATERIAL AND TYPE / DEPTH TO TOP OF SCREEN

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

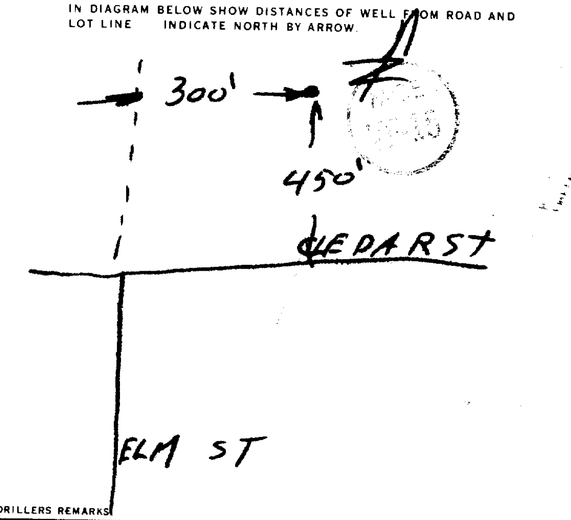
PUMPING TEST METHOD: ☒ PUMP ☐ BAILER
PUMPING RATE: 0012 GPM
DURATION OF PUMPING: 06 HOURS 00 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
015 FEET	080 FEET	045 FEET	060 FEET	070 FEET	080 FEET

WATER LEVELS DURING: ☒ PUMPING ☐ RECOVERY
IF FLOWING, GIVE RATE: GPM
PUMP INTAKE SET AT: 112 FEET
WATER AT END OF TEST: ☒ CLEAR ☐ CLOUDY
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP
RECOMMENDED PUMP SETTING: 100 FEET
RECOMMENDED PUMPING RATE: 0012 GPM

LOCATION OF WELL

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



DRILLERS REMARKS:

FINAL STATUS OF WELL: 1 — ☒ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL ☐ ABANDONED, INSUFFICIENT SUPPLY ☐ ABANDONED, POOR QUALITY ☐ UNFINISHED

WATER USE: 16 — ☒ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER ☐ COMMERCIAL ☒ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED

METHOD OF DRILLING: 4 — ☐ CABLE TOOL ☐ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☒ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING

CONTRACTOR
NAME OF WELL CONTRACTOR: Roy's Machine Shop Ltd — LICENCE NUMBER 4609
ADDRESS: Cornwall
NAME OF DRILLER OR BORER: R A ROY — LICENCE NUMBER
SIGNATURE OF CONTRACTOR: [signature]
SUBMISSION DATE: DAY MO YR

OFFICE USE ONLY
DATA SOURCE: 1 | CONTRACTOR: 4609 | DATE RECEIVED: 20 1279
DATE OF INSPECTION | INSPECTOR
REMARKS:

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506-4-77

Chesterville Well 5 or 6

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

DUNDAS

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

11 | 1803511 | MUNICIP. 18004 | CON. CON 05

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
~~STORMONT~~ DUNDAS	CHESTERVILLE, ONTARIO	Con. 5	12

OWNER (SURNAME FIRST)	ADDRESS	DATE COMPLETED
Town of Chesterville	CHESTERVILLE Ont. K0C 1H0	DAY 23 MO 01 YR 89

21 PRODUCTION WELL — ZONE / EASTING / NORTHING / RC / ELEVATION / RC / BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
Brown	Sand	Gravel Stones	Packed	0'	22'
Grey	Gravel	Stones sand clay	Layered	22'	30'
Multi color	Gravel	Stones , Cobbles	Loose	30'	40'

31
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
30'	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
40'	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
30"	3 ☒ CONCRETE		0'	20'
20"	1 ☒ STEEL	.375	0'	30'
10"	1 ☒ STEEL	.302	0'	30'

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER	LENGTH
100	10" INCHES	10' FEET

MATERIAL AND TYPE: Stainless Steel — DEPTH TO TOP OF SCREEN: 30' FEET

61 PLUGGING & SEALING RECORD

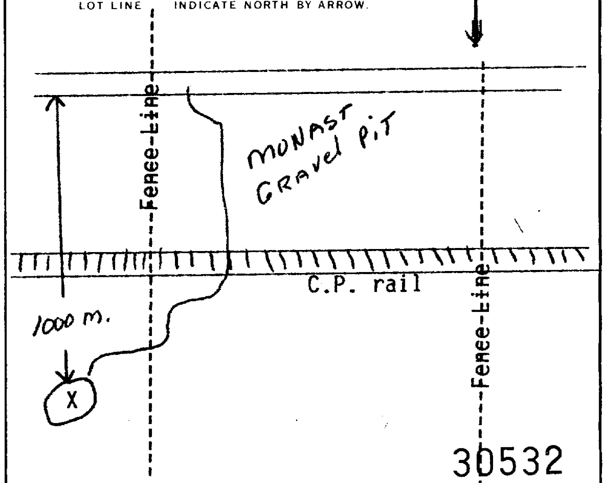
DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
0'	21'	Cement grout 20 sacks of High Early Cement

71 PUMPING TEST

PUMPING TEST METHOD	1 ☒ PUMP 2 ☐ BAILER
PUMPING RATE	300 GPM
DURATION OF PUMPING	72 HOURS __ MINS
STATIC LEVEL	31' FEET
WATER LEVEL END OF PUMPING	16' 2" FEET
WATER LEVELS DURING	1 ☐ PUMPING 2 ☐ RECOVERY
15 MINUTES	16' 1" FEET
30 MINUTES	15' 7" FEET
45 MINUTES	15' 4" FEET
60 MINUTES	15' 8" FEET
IF FLOWING, GIVE RATE	GPM
PUMP INTAKE SET AT	39' FEET
WATER AT END OF TEST	1 ☒ CLEAR 2 ☐ CLOUDY
RECOMMENDED PUMP TYPE	☐ SHALLOW ☒ DEEP
RECOMMENDED PUMP SETTING	29' FEET
RECOMMENDED PUMPING RATE	300 GPM

LOCATION OF WELL

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



DRILLERS REMARKS

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☐ UNFINISHED
9 ☐ DEWATERING

WATER USE

1 ☐ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☒ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☒ CABLE TOOL
2 ☐ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☐ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING
☐ DIGGING
☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: OLYMPIC DRILLING CO. LTD. — WELL CONTRACTOR'S LICENCE NUMBER: 4006

ADDRESS: Box 9180 OTTAWA, Ontario KIG 3T9

NAME OF WELL TECHNICIAN: JODIE RENWICK — WELL TECHNICIAN'S LICENCE NUMBER: T-0460

SIGNATURE OF TECHNICIAN/CONTRACTOR: J. D. Renwick — SUBMISSION DATE: DAY 23 MO 01 YR 89

OFFICE USE ONLY

DATA SOURCE — CONTRACTOR 4006 — DATE RECEIVED FEB 06 1989

DATE OF INSPECTION — INSPECTOR

REMARKS: WDE CSS.ES

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

Chesterville Well 5 or 6

Ontario — Ministry of Environment and Energy

The Ontario Water Resources Act

WATER WELL RECORD

Print only in spaces provided.
Mark correct box with a checkmark, where applicable.

11 — 1805088 — Municipality 18004 — Con. CON 05

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot
DUNDAS	WINCHESTER	V	12

Owner's surname / First Name	Address of Well Location	Date completed
TOWNSHIP OF NORTH DUNDAS	CHESTERVILLE	3 day 9 month 03 year

21 — UTM Zone / Easting / Northing / RC / Elevation / RC / Basin Code / ii / iii / iv

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth - feet From	To
	CLAY & GRAVEL	SANDY	PACKED	0	8
	GRAVEL	SAND	FINE TO COARSE	8	24
	SAND & GRAVEL	CLAY & BOULDERS	FINE TO COARSE	24	32

31

32

41 WATER RECORD

Water found at - feet	Kind of water
10-13	☒ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
15-18	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
20-23	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
25-28	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
30-33	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth - feet From	To
24	☒ Steel ☐ Galvanized ☐ Concrete ☐ Open hole ☐ Plastic	0.375	0	16
12	☒ Steel ☐ Galvanized ☐ Concrete ☐ Open hole ☐ Plastic	0.375	+5	17
12	☒ Steel ☐ Galvanized ☐ Concrete ☐ Open hole ☐ Plastic	0.375	27	30

SCREEN

Sizes of opening (Slot No.)	Diameter	Length
50	12 inches	10 feet

Material and type	Depth at top of screen
WW SS	17 feet

61 PLUGGING & SEALING RECORD

☐ Annular space ☐ Abandonment

Depth set at - feet From	To	Material and type (Cement grout, bentonite, etc.)
19	0	CEMENT GROUT.

71 PUMPING TEST

Pumping test method: ☒ Pump ☐ Bailer — Pumping rate 400 GPM — Duration of pumping 72 Hours 0 Mins

Static level	Water level end of pumping	Water levels during: ☒ Pumping ☐ Recovery — 15 minutes	30 minutes	45 minutes	60 minutes
5.5 feet	12.3 feet	8.9 feet	9.1 feet	9.4 feet	9.5 feet

If flowing give rate ___ GPM — Pump intake set at ___ feet — Water at end of test ☐ Clear ☐ Cloudy

Recommended pump type ☐ Shallow ☐ Deep — Recommended pump setting ___ feet — Recommended pump rate ___ GPM

FINAL STATUS OF WELL

☒ Water supply ☐ Observation well ☐ Test hole ☐ Recharge well ☐ Abandoned, insufficient supply ☐ Abandoned, poor quality ☐ Abandoned (Other) ☐ Dewatering ☐ Unfinished ☐ Replacement well

WATER USE

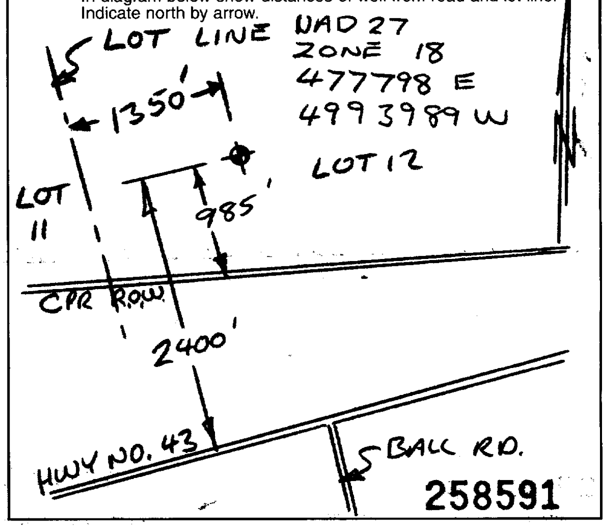
☐ Domestic ☐ Stock ☐ Irrigation ☐ Industrial ☐ Commercial ☒ Municipal ☐ Public supply ☐ Cooling & air conditioning ☐ Not use ☐ Other

METHOD OF CONSTRUCTION

☒ Cable tool ☐ Rotary (conventional) ☐ Rotary (reverse) ☐ Rotary (air) ☐ Air percussion ☐ Boring ☐ Diamond ☐ Jetting ☐ Driving ☐ Digging ☐ Other

LOCATION OF WELL

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



258591

Name of Well Contractor	Well Contractor's Licence No.
INTERNATIONAL WATER SUPPLY	2801
Address: PO BOX 310 BARRIE ON L4M 4T5	
Name of Well Technician: WALTER NOBES	Well Technician's Licence No.: T0115
Signature of Technician/Contractor	Submission date: 25 day 09 mo 03 yr

MINISTRY USE ONLY

Data source	Contractor	Date received
	2801	OCT 22 2003
Date of inspection	Inspector	
Remarks		CSS.ES3

2 - MINISTRY OF ENVIRONMENT AND ENERGY COPY

0506 (06/02) Front Form 9

Winchester Well 1

UTM | | Z | | E
9 R | | N
Elev. 9 R 0 2 5 0
Basin 25

GROUND ... JUL 18 1958 No. 887
ONTARIO WATER RESOURCES COMMISSION

Winchester Well #1
Equipped for 125 Igpm

ONTARIO

The Water-well Drillers Act, 1954
Department of Mines

Water-Well Record

County or Territorial District: Dundas — ~~Township~~, Village, ~~Town or City~~: Winchester
Con. ... Lot ... Street and Number (if in Village, Town or City): Block 8
Owner: Village of Winchester — Address: Winchester Ontario
Date completed: 30 (day) June (month) 58 (year)

Pipe and Casing Record

Casing diameter(s): 8 inch
Length(s): 42 ft.
Type of screen: Nil
Length of screen: Nil

Pumping Test

Bailer Test.

Static level: 10½ ft.
Pumping rate: 35 gpm
Pumping level: 25 ft.
Duration of test: 4 hrs.

Well Log / Water Record

Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	No. of feet water rises	Kind of water (fresh, salty, or sulphur)
Topsoil	0	2			
Clay (hardpan)	2	6			
Sand gravel & clay	6	28			
Dark grey Limestone	28	80	80	66	fresh
" " "	80	156	156	90	"
" " "	156	202			
" " "	202	206	202-206	195½	"
" " "	206	310	306	295½	"

For what purpose(s) is the water to be used? Village Water system
Is water clear or cloudy? Clear
Is well on upland, in valley, or on hillside? Upland
Drilling firm: R. H. Casselman
Address: Williamsburg Ontario

Name of Driller: Garnet Weegar
Address: Williamsburg Ontario

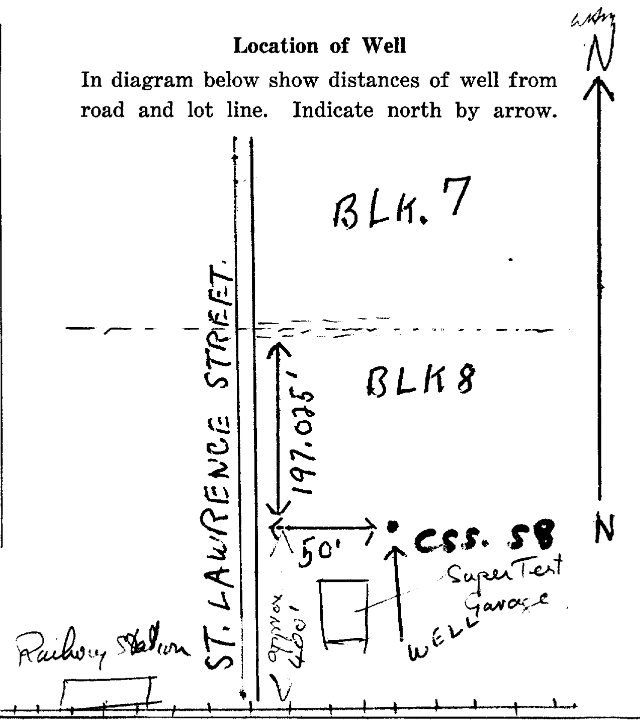
Licence Number: 259

I certify that the foregoing statements of fact are true.

Date: June 30/58 — [signature] Ramon H. Casselman
Signature of Licensee

Location of Well

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



Form 5

Winchester Well 5

31C3W

13

Ontario

MINISTRY OF THE ENVIRONMENT

The Ontario Water Resources Act

WATER WELL RECORD

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

11 | 1801563 | MUNICIP. 18004 | CON. con | 07

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
DUNDAS	WINCHESTER	VII	001

OWNER (SURNAME FIRST)	ADDRESS	DATE COMPLETED
VILLAGE of WINCHESTER	WINCHESTER	DAY 27 MO. 05 (MAY) YR. 72

21 | ZONE 18 | EASTING 470300 | NORTHING 4992700 | RC 4 | ELEVATION 0250 | RC 5 | BASIN CODE 25

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
	sand	gravel		0	8
	hardpan			8	14
grey	dolomite	and limestone		14	92

31 | 0008 28 11 | 0014 14 | 0092 21 15

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0046	☒ FRESH
0064	☒ FRESH
0080	☒ FRESH

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
08	☒ STEEL	.188	0	75 (0015)
08	☒ OPEN HOLE		15	92 (0092)

SCREEN

SIZE(S) OF OPENING (SLOT NO.) | DIAMETER INCHES | LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: ☒ PUMP ☐ BAILER | PUMPING RATE 0100 GPM | DURATION OF PUMPING 54 HOURS 00 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
0014 FEET	023 FEET	015 FEET	016 FEET	017 FEET	018 FEET

WATER LEVELS DURING: ☒ PUMPING ☐ RECOVERY

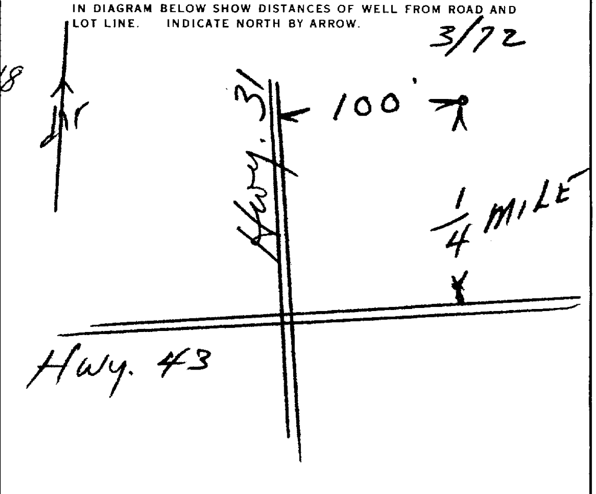
IF FLOWING, GIVE RATE ___ GPM | PUMP INTAKE SET AT 90 FEET | WATER AT END OF TEST ☒ CLEAR ☐ CLOUDY

RECOMMENDED PUMP TYPE ☐ SHALLOW ☒ DEEP | RECOMMENDED PUMP SETTING 090 FEET | RECOMMENDED PUMPING RATE 0125 GPM

0045 GPM./FT. SPECIFIC CAPACITY

LOCATION OF WELL

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



DRILLERS REMARKS:

FINAL STATUS OF WELL: ☒ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL ☐ ABANDONED, INSUFFICIENT SUPPLY ☐ ABANDONED, POOR QUALITY ☐ UNFINISHED

WATER USE 06: ☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER ☐ COMMERCIAL ☒ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED

METHOD OF DRILLING: ☒ CABLE TOOL ☐ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☐ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: RAMOH H. CASSELMAN | LICENCE NUMBER 1505

ADDRESS: WILLIAMSBURG ONT.

NAME OF DRILLER OR BORER: D. GOW | LICENCE NUMBER

SIGNATURE OF CONTRACTOR | SUBMISSION DATE DAY ___ MO. ___ YR. ___

OFFICE USE ONLY

DATA SOURCE 1 | CONTRACTOR 1505 | DATE RECEIVED 020174

DATE OF INSPECTION | INSPECTOR

REMARKS: APL CSS. S8 | P 7/1 | WI

MINISTRY OF THE ENVIRONMENT COPY

FORM 7 07-091

Winchester Well 6

Ministry of the Environment
Ontario

The Ontario Water Resources Act
WATER WELL RECORD

1802800

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK [X] CORRECT BOX WHERE APPLICABLE

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
Dundas	Mountain	7.	20

[redacted] ADDRESS: Test Drilling Contract

DATE COMPLETED: DAY 23 MO Oct.

WELL # 2.

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH FEET FROM	DEPTH FEET TO
Brown	Topsoil		Loose	0	2
[illegible]	Clay	Cobbles	Packed	2	13½
Brown	Sand	Gravel	Cemented	13½	22½
Grey	Limestone	Rock	Hard	22½	52

WATER RECORD

WATER FOUND AT FEET	KIND OF WATER
[illegible] 50	[X] FRESH [ ] SULPHUR [ ] SALTY [ ] MINERAL

CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH FEET FROM	DEPTH FEET TO
[illegible]	[X] STEEL	[illegible]		
	[ ] OPEN HOLE	6.35	0	2[illegible]

SCREEN

SIZE(S) OF OPENING (SLOT NO.) / DIAMETER INCHES / LENGTH FEET / MATERIAL AND TYPE / DEPTH TO TOP OF SCREEN FEET

PLUGGING & SEALING RECORD

DEPTH SET AT – FEET FROM / TO / MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

PUMPING TEST

PUMPING TEST METHOD: [X] PUMP [ ] BAILER — PUMPING RATE: 200 GPM — DURATION OF PUMPING: [illegible] HOURS

STATIC LEVEL: [illegible] FEET — WATER LEVEL END OF PUMPING: [illegible] FEET

WATER LEVELS DURING [ ] PUMPING [ ] RECOVERY: 15 MINUTES FEET, 30 MINUTES FEET, 45 MINUTES FEET, 60 MINUTES FEET

IF FLOWING GIVE RATE GPM — PUMP INTAKE SET AT FEET — WATER AT END OF TEST [ ] CLEAR [ ] CLOUDY

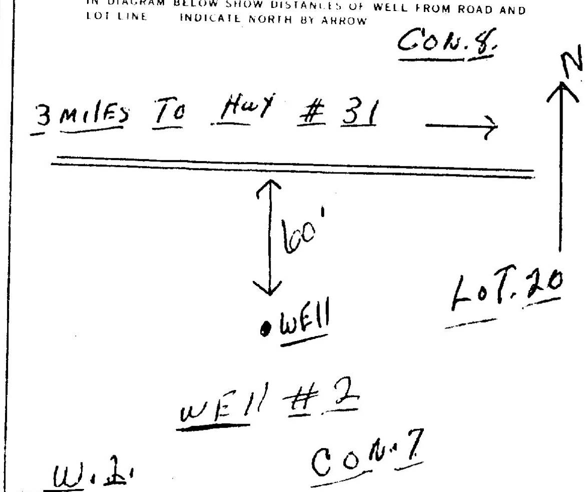
RECOMMENDED PUMP TYPE [ ] SHALLOW [ ] DEEP — RECOMMENDED PUMP SETTING FEET — RECOMMENDED PUMPING RATE GPM

FINAL STATUS OF WELL
[X] WATER SUPPLY [ ] OBSERVATION WELL [ ] TEST HOLE [ ] RECHARGE WELL [ ] ABANDONED, INSUFFICIENT SUPPLY [ ] ABANDONED, POOR QUALITY [ ] UNFINISHED

WATER USE
[ ] DOMESTIC [ ] STOCK [ ] IRRIGATION [ ] INDUSTRIAL [ ] OTHER [ ] COMMERCIAL [X] MUNICIPAL [ ] PUBLIC SUPPLY [ ] COOLING OR AIR CONDITIONING [ ] NOT USED

METHOD OF DRILLING
[ ] CABLE TOOL [ ] ROTARY (CONVENTIONAL) [ ] ROTARY (REVERSE) [X] ROTARY (AIR) [ ] AIR PERCUSSION [ ] BORING [ ] DIAMOND [ ] JETTING [ ] DRIVING

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



DRILLERS REMARKS: W.L.

NAME OF WELL CONTRACTOR: [illegible] — LICENCE NUMBER: [illegible]

ADDRESS: [illegible], Ontario

NAME OF DRILLER OR BORER: [illegible]

SIGNATURE OF CONTRACTOR

OFFICE USE ONLY: [illegible]05 83

CSS.ES

Winchester Well 7B

Ministry of the Environment

Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
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11

1804479

MUNICIP 18004 CON. CON 09

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
DUNDAS	WINCHESTER	Conc. IX Ref: Plan 8R-624 PNE 1/2	15
OWNER: The Corporation of the Village of Winchester	ADDRESS: 54 St-Lawrence street Box 489, Winchester Ontario, KOC 2KO	DATE COMPLETED: DAY 16 MO 05 YR 96	

21 ZONE EASTING NORTHING RC ELEVATION RC BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
	Silt, Sand & Gravel	WELL NO. B	Top Soil, Silt Sand, gravel	0	4 m
Brown	Gravel		Silty gravel	4	6 m
Brown	Gravel		Large sixe gravel well rounded	6	12.5m
Grey			Mixture gravel & grey fine sand	12.5	14.5m
Grey			Gumbo till, grey till	14.5	

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	30"	0	4.8m
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	24"	0	12.6m
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	12"	0	9.1m

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER	LENGTH
250	12" INCHES	15 FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN	FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
0	1.8m	Cimentious grout
0	1.8m	

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER	PUMPING RATE: 300 USgpm GPM	DURATION OF PUMPING: 72 HOURS MINS
STATIC LEVEL / WATER LEVEL END OF PUMPING	WATER LEVELS DURING: Drawdown 50 cm	1 ☐ PUMPING 2 ☐ RECOVERY
15 MINUTES / 30 MINUTES / 45 MINUTES / 60 MINUTES	FEET	
IF FLOWING, GIVE RATE GPM	PUMP INTAKE SET AT FEET	WATER AT END OF TEST: 1 ☐ CLEAR 2 ☐ CLOUDY
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☐ DEEP	RECOMMENDED PUMP SETTING FEET	RECOMMENDED PUMPING RATE GPM

LOCATION OF WELL

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

WELL A

WELL B

WELL C

DRILLERS REMARKS

147696

FINAL STATUS OF WELL

1 ☑ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☐ UNFINISHED
☐ DEWATERING

WATER USE

1 ☐ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☑ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☑ CABLE TOOL
2 ☐ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☐ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING
☐ DIGGING
☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: EA COOPERATIVE SSIROTECHEAU — WELL CONTRACTOR'S LICENCE NUMBER: 14963

ADDRESS: 2251 chemin St-François, Dorval, Qc., H9P 1K3

NAME OF WELL TECHNICIAN: BENOIT BOUCHARD — WELL TECHNICIAN'S LICENCE NUMBER: 20457

SIGNATURE OF TECHNICIAN/CONTRACTOR: Benoit Bouchard — SUBMISSION DATE: DAY 15 MO 10 YR 96

OFFICE USE ONLY

DATA SOURCE — CONTRACTOR 6826 — DATE RECEIVED OCT 28 1996

DATE OF INSPECTION — INSPECTOR

REMARKS

CSS.ES

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FORM NO. 0506 (11/86) FORM 9

Winchester Well 7C

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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

11 | 1804480 | MUNICIP 18004 | CON. CON | 09

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON, BLOCK, TRACT, SURVEY, ETC	LOT
DUNDAS	WINCHESTER	Con IX Ref: Plan 8R-624	15 PNE 1/2 lot

OWNER (SURNAME FIRST)	ADDRESS	DATE COMPLETED
The Corporation of the Of Village of Winchester	54 St-Lawrence street Box 489, Winchester, On	DAY 13 MO 08 YR 96

21 ZONE · EASTING · NORTHING · RC · ELEVATION · RC · BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
Dark Yellow	Silt, Sand & Gravel	Clay (muddy)	Muddy Silty Sandy Gravel	0	4 m
	Gravel		Gravel	4 m	13.90
Grey	Sand Silt Clay		Compact Till	13.90	15 m
	Shale		Bedrock	15 m	
		WELL NO. C			

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	30"	0	4.8 m
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	24"	0	14 m
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	12"	0	10.5m

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER	LENGTH
250	12" INCHES	15 FEET

MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN
Stainless Steel	31.64 FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
0	1.8 m	Cimentious grout

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER

PUMPING RATE: 300 US GPM

DURATION OF PUMPING: 72 HOURS __ MINS

STATIC LEVEL: __ FEET — WATER LEVEL END OF PUMPING: __ FEET

WATER LEVELS DURING: Drawdown 50cm — 1 ☐ PUMPING 2 ☐ RECOVERY

15 MINUTES __ FEET · 30 MINUTES __ FEET · 45 MINUTES __ FEET · 60 MINUTES __ FEET

IF FLOWING, GIVE RATE __ GPM · PUMP INTAKE SET AT __ FEET · WATER AT END OF TEST: 1 ☐ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☐ DEEP · RECOMMENDED PUMP SETTING __ FEET · RECOMMENDED PUMPING RATE __ GPM

LOCATION OF WELL

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

WELL A

WELL B

WELL C

DRILLERS REMARKS: 147697

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☐ UNFINISHED
☐ DEWATERING

WATER USE

1 ☐ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☒ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☒ CABLE TOOL
2 ☐ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☐ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING
☐ DIGGING
☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: LA COOPERATIVE ENVIROTECHEAU — WELL CONTRACTOR'S LICENCE NUMBER: 14963

ADDRESS: 2251 chemin St-François, Dorval, Qc., H9P 1K3

NAME OF WELL TECHNICIAN: BENOIT BOUCHARD — WELL TECHNICIAN'S LICENCE NUMBER: 20457

SIGNATURE OF TECHNICIAN/CONTRACTOR: Benoit Bouchard — SUBMISSION DATE: DAY 15 MO 10 YR 96

OFFICE USE ONLY

DATA SOURCE · CONTRACTOR 6826 · DATE RECEIVED OCT 28 1996

DATE OF INSPECTION · INSPECTOR

REMARKS: CSS.ES

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FORM NO. 0506 (11/86) FORM 9

experience • knowledge • integrity

civil	civil
geotechnical	géotechnique
environmental	environnement
structural	structures
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

expérience • connaissance • intégrité

Appendix C

Meeting Minutes

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Municipality of Casselman **Surface and Groundwater Supply Feasibility Study**
PROJECT INITIATION MEETING (M-2) **Minutes of Meeting No. 2**

Attendance:	Pierre-Paul Beauchamp (PB)	Municipality of Casselman	ppbeauchamp@casselman.ca
	Yves Morrissette (YM)	Municipality of Casselman	ymorrissette@casselman.ca
	Jordan Morrissette (JM)	J.L. Richards & Associates Limited	jmorrissette@jlrichards.ca
	Susan Jingmiao Shi (SS)	J.L. Richards & Associates Limited	sshi@jlrichards.ca
	Kevin Cortez (KC)	J.L. Richards & Associates Limited	kcortez@jlrichards.ca

The meeting commenced at 8:30 a.m. on Friday, September 22, 2023 via Microsoft Teams.

The following summary of the discussions of this meeting has been prepared to record decisions reached and actions required for the project. Please advise the undersigned of any errors or omissions within the next three business days.

ITEM		ACTION BY	DUE BY

1.1 OPENING REMARKS / INTRODUCTION

- JLR introduced the project and stated that the surface and groundwater feasibility study is intended to determine if there is sufficient water supply to support the municipality's future water demand.
- This study will happen concurrently with the piped water supply study, both of which will feed into a Schedule 'B' Water Supply Class EA.

1.2 PROJECT COMMUNICATIONS

- Pierre-Paul Beauchamp is the main point of contact for the Municipality. Yves Morrissette is to be copied on all correspondence.
- Susan Shi is the Project Manager from JLR, supported by Kevin Cortez. Jordan Morrissette is the QA lead and client liaison.

1.3 CONFIRMATION OF PROJECT UNDERSTANDING

- The overall objective of the surface water and groundwater feasibility study is to determine if there is sufficient water available to support the municipality's future demand.
- GEMTEC has been retained as JLR's sub-consultant to complete desktop hydrological and hydrogeological analysis.
- JLR's technical memorandum will be supported by GEMTEC's analysis.
- JLR will include a section in the feasibility study report to document the known surface water and groundwater quality issues in South Nation River and surrounding areas.
- JLR/GEMTEC will provide a high-level review of risk management impacts associated with establishing a new municipal groundwater supply well (i.e., wellhead protection zones).

1.4 REVIEW AND DISCUSSION OF AVAILABLE DOCUMENTATION

- GEMTEC will document and assemble the information for the surface water study.
- GEMTECT will document and assemble regional information for groundwater quantity.

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Municipality of Casselman
Surface and Groundwater Supply Feasibility Study

PROJECT INITIATION MEETING (M-2)
Minutes of Meeting No. 2

ITEM		ACTION BY	DUE BY
	• JLR/GEMTEC will review options to establish a new municipal well on the municipally-owned lands. Municipality has asked JLR/GEMTEC to make general recommendations for a municipal well location outside of the village boundary that will support the future water demand.		
	• Susan Shi will confirm municipally-owned lands and confirm with Pierre-Paul which areas can become available for supply well establishment.	JLR	Oct. 2023
1.5	REVIEW OF WORK PLAN AND PROJECT SCHEDULE		
	• GEMTEC plan to complete the desktop investigation by mid-November.		
	• JLR plan to complete the feasibility study report end of December.		
1.6	OTHER TOPICS/BUSINESS		
	• The following items were discussed related to the piped water feasibility study:		
	○ The Municipality will touch base with the Nation regarding the geotechnical report from their feasibility piped water supply study to Limoges.	MUNICIPALITY	Oct. 2023
	○ The Municipality will touch base with the Nation for the reasoning behind connecting through Limoges and whether they considered watermain sizing.	MUNICIPALITY	Oct. 2023
	○ The Municipality will send the Master Plan to Clarence-Rockland to determine if their system can support Casselman.	MUNICIPALITY	Oct. 2023
	○ JLR will contact South Nation Conservation Authority and schedule a pre-consultation meeting late October.	JLR	Oct. 2023
	○ JLR will send data request for Clearance-Rockland water model.	JLR	Oct. 2023

Meeting adjourned at 9:07 a.m.

Next meeting will be held on TBD

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Municipality of Casselman
Surface and Groundwater Supply Feasibility Study

PROJECT INITIATION MEETING (M-2)
Minutes of Meeting No. 2

Prepared by: Issued on: October 2, 2023

Kevin Cortez, M.Eng., EIT
Environmental Engineering Intern

Reviewed by:

Susan Jingmiao Shi, P.Eng., M.Eng.
Associate, Senior Environmental Engineer

Distribution: All attendees