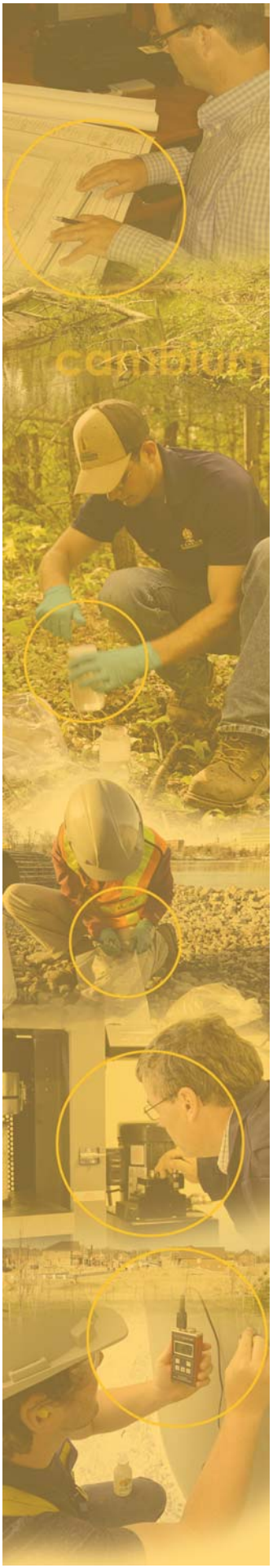
Appendix A
Hydrogeological Investigation Report



Hydrogeological Assessment, Gardens Retirement Residence, 1 Sunnyside Street, Haliburton

Cambium Reference No.: 8786-001

2019-05-08

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Executive Summary

Cambium was retained by Gardens of Haliburton Inc. to complete a hydrogeological assessment at 1 Sunnyside Street, Haliburton, Ontario. The assessment was required to determine if adequate groundwater resources are available on-site to support the proposed development of a retirement residence.

The proposed retirement residence will be built in phases. Phase 1 will include 70 residential units and Phase 2 will include 50 residential units (for a total of 120 units). A Municipal water supply is not available in the area; therefore it is proposed to service the development with an on-site water supply well.

Water supply well (test well PW101-19) was installed on-site and continuously pumped a period of 24 hours at a rate of 50 litres per minute (11 imperial gallons per minute). The data indicates that test well PW101-19 can sustain a daily water withdrawal of 72,000 L and allow for sufficient water level recovery. There was a significant amount of available drawdown remaining at the end of the pumping test, indicating that the well can likely sustain higher water withdrawal rates. Regardless, additional storage may be required to account for peak water usage upon development.

An influence from water withdrawal was not recorded at the monitoring wells. It is possible that test well PW101-19, monitoring well MW101-19 and monitoring well MW102-19 are each installed in hydraulically isolated water bearing fractures. Adjacent water wells are installed at variable depths (according to available records). The hydraulic connection between test well PW101-19 and other adjacent water supply wells is not known; but it is likely that the hydraulic isolation inferred from the testing program is characteristic of other water bearing fractures in the area. In addition, the fracture in which test well PW101-19 has been installed is relatively high capacity and recovers rapidly. If adjacent water supply wells are hydraulically connected to the fracture intercepted by well PW101-19, it is likely that the influence will be minimal to negligible.

The water quality results collected at the end of the pumping test indicate that only hardness exceeded ODWQS criteria. Some other parameters were reported at elevated concentrations,

but not in excess of ODQWS criteria. It is anticipated that continued water withdrawal from test well PW101-19 will improve water quality. Treatment for hardness can be addressed with conventional treatment processes.

In consideration of the above, test well PW101-19 can be used as a viable water supply for the proposed development, and influences on surrounding groundwater users are not anticipated. Supplemental water flow from the existing supply well (labelled as MW102-19) is not required to achieve the daily water demand rate.

Respectfully submitted,

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1.0 Introduction

Cambium Inc. (Cambium) was retained by Gardens of Haliburton Inc. (Client) to undertake a hydrogeological assessment for the water supply for the proposed development located at 1 Sunnyside Street, Haliburton, Ontario (hereafter referred to as the Site).

The Client intends to develop a retirement residence at the Site that will be built in two phases. Phase 1 will include 70 residential units and Phase 2 will include 50 residential units (for a total of 120 units). A Municipal potable water supply is not available in the area; therefore it is proposed to service the development with private, on-site, water supply wells. The purpose of this assessment was to determine if there are adequate groundwater resources on-site that can sustain the water demand of the propose development.

The proposed development will be serviced by the Municipal wastewater infrastructure.

1.1 Site Description and Proposed Development

The legal address of the property is described as Lots 2 & 8 & Part of Lots 1 &7, Block 2, Lots 3 & 4 & Part of Lots 2, 8, 9, & 10, Block 6, Part of Lakeview Street between Blocks 2 & 6, Town of Haliburton, Geographic Township of Dysart, Township of Dysart et al., County of Haliburton. The Site is irregularly shaped and 1.63 hectares (ha). The Site is bound to the south by Sunnyside Street, and to the west by Highway 118. Adjacent Highway 118, to the west, is Head Lake. Residential land use is located to the north, south and east of the Site. Forested areas are located to the northeast of the Site. The regional location of the Site is outlined on Figure 1.

There is one abandoned structure on-site in addition to a storage structure and gazebo. Historically these structures were used as part of Sir Sanford Fleming College. The majority of the Site exists as open grassy areas; however the eastern and northern portions of the Site are forested. The northeastern portion of the Site also exhibits a steep grade. The central and southern portions of the Site are relatively flat.

The proposed development includes the construction of a four storey retirement residence. There will be a total of 120 residential units included as part of the development. A proposed development plan has been included in Appendix A.

There is an existing water supply well located adjacent the northwest corner of the abandoned structure. Presumably the existing well provided a water supply to the Site in the past. The existing well was installed to a depth of 60.06 metres below ground surface (mbgs) and assigned well tag number 2702777. A copy of the water well record for the existing well is included in Appendix B.

2.0 Methodology

This section describes the methodology undertaken to complete the hydrogeological investigation.

2.1 Site Visit and Well Record Review

On March 13, 2019 Cambium staff visited the Site to stake drilling locations of potential test wells. Adjacent property owners were surveyed regarding their private supply well. Water levels and depth of any private supply wells were measured if permission was granted from the owner. The well owners were asked if they would allow Cambium to monitor their supply well during the pumping test (as described in Section 2.4). If the property owner was not present then a letter describing the work program was left at the residence. A copy of the letter has been included in Appendix C. The properties located at the following addresses were visited:

- 7 Sunnyside Street
- 9 Sunnyside Street
- 17 Sunnyside Street
- 24 Sunnyside Street
- 26 Sunnyside Street
- 27 Sunnyside Street
- 29 Sunnyside Street
- 28 Northstar Trail

Only the property owners at 9 Sunnyside Street and 28 Northstar Trail could be contacted. At the time of the initial Site visit (March 13, 2019), both owners gave Cambium permission to monitor their private supply well for the duration of the pumping test. The owners of 28 Northstar Trail indicated at a later date that they did not want to participate in the monitoring program. Further discussion regarding the monitoring wells is included in Section 2.4.2.

A review of water well records located within 500 m of the Site, as per the Ministry of Environment, Conservation and Parks (MECP) Water Well Information System (WWIS), was also completed. The results of the well record review are discussed in Section 3.1. Water well records located within 500 m of the Site are outlined on Figure 2.

2.2 Water Demand

A previous water supply study was completed for the existing on-site water supply well by others in 2010. The report is titled “Groundwater Supply Assessment Report, Watercolours Development, Haliburton, ON” (Trow Associates Inc., 2010).

The report indicated that the existing supply well (well tag number 2702777) can provide water at a rate of 19 L/min for 10 hours per day (total daily yield being 11,400 L/day). The well record of the existing well and pumping test results are included in Appendix B.

There will be a total of 120 units incorporated in the proposed retirement residence development (including Phases 1 and 2). According to the Client there will be between 1.1 and 1.15 persons per unit. Assuming a daily per person flow rate of 450 L/day (as outlined in the document titled “Design Guidelines for Drinking-Water Systems” (Ministry of the Environment, 2008)), the average daily water demand for the proposed development is 62,100 L/day (13,660 imperial gallons per day (igpd)).

As such, the existing well has insufficient yield for the proposed development and an additional well was required.

2.3 Well Installation

On April 3, 2019 a licenced well contractor drilled a test well in the north portion of the Site. The test well was installed with a 0.15 m diameter steel casing. Overburden was 1.5 m in thickness overlying granitic bedrock. The steel casing was advanced to a depth of 7.32 metres below ground surface (mbgs) with the remained portion of the well advanced through an open hole in the bedrock to the final completion depth of 85.37 mbgs. A water bearing fracture was encountered between 65.55 and 67.07 mbgs. The static water level was measured to be 11.52 mbgs. The well tag number of the test well is A252400. A copy of the well record is included in Appendix B.

Upon installation, the driller completed a one hour pumping test. The results indicated that the well yield was greater than 55 litres per minute (Lpm) (12 imperial gallons per minute (igpm)).

The test well will hereafter be referred to as PW101-19. A Site plan, including the location of test well PW101-19 is depicted on Figure 3.

2.4 Hydraulic Pumping Test

On April 10 and 11, 2019 Cambium staff completed a 24 hour pumping test on PW101-19.

A submersible pump was temporarily installed in test well PW101-19 to a depth of 59.45 mbgs. A Solinst™ pressure transducer level logger (logger) was installed in well PW101-19 to monitor the water level. Barometirc pressure was monitored by another logger and used for water level logger compensation purposes.

On April 10, 2019 the pumping test commenced at 10:44. The discharge outlet was placed approximately 30 m to the southwest of PW101-19. The flow rate was set at 50 Lpm (11 igpm) and checked regularly. The pumping test ceased on April 11, 2019 at 10:44.

Water level recovery was monitored until 13:53 on April 11, 2019.

In total, 39,800 L of water was withdrawn on April 10, 2019 and 32,200 L of water was withdrawn on April 11, 2019. Less than 50,000 L of water was withdrawn on each calendar day, therefore a Category 2 Permit To Take Water was not required.

2.4.1 Aquifer Test Analysis

The data produced from the pumping test were processed by AquiferTest Pro™ software. A variety of aquifer properties were derived from the analysis. The results of the AquiferTest Pro™ analysis are included in Appendix D.

2.4.2 Monitoring Wells

The existing on-site supply well and the private supply well that serviced the residence at 9 Sunnyside Street were monitored for the duration of the pumping test. These two wells will hereafter be referred to as monitoring wells MW101-19 and MW102-19, respectively. The static water level and depth of monitoring well MW101-19 was measured to be 3.85 mbgs and

60.94 mbgs. The static water level and depth of monitoring well MW102-19 was measured to be 11.00 mbgs and 38.19 mbgs.

Loggers were installed in both monitoring wells prior to the commencement of the pumping test to monitor water level fluctuations. Water levels were measured manually with a cleaned and disinfected water level tape.

2.4.3 Groundwater Samples

Two water samples were collected from test well PW101-19 during the pumping test. The first sample was collected during the first hour of pumping (at 11:30 on April 10, 2019) while the second sample was collected during the last hour of pumping (at 10:30 on April 11, 2019). The samples were submitted to SGS Canada Inc. in Lakefield (SGS) for analysis of general organic and inorganic chemistry. SGS is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA). Samples were stored at a temperature between 0 °C and 10 °C prior and during transport to Caduceon. The certificates of analysis have been included in Appendix E.

The temperature, pH, conductivity and oxygen reducing potential of the samples were analyzed in the field using handheld instruments. The turbidity of discharge water was tested regularly throughout the pumping test with a portable testing unit. The results of the field analysis testing are included in Appendix F.

2.4.4 Wellhead Elevation Survey

Wellhead elevations of the wells included in the hydraulic testing were surveyed using a Topcon Hyper II RTK survey unit. The benchmark of the survey was a catch basin located adjacent the Site to the south (see Figure 3).

3.0 Geological and Hydrogeological Setting

The Site is located within the Algonquin Highlands physiographic region, as described in Chapman and Putnam (Chapman, L.J. and D.F. Putnam, 1984). The Algonquin Highlands is a physiographic region characterized by hard Precambrian rock overlain by a thin layer of sandy glacial till of variable depth. The Algonquin Highlands are found in Eastern Ontario and cover an area approximately 40,140 km² in size.

According to Map 2556 of the Ontario Geological Survey (Barnett, P.J.,Cowan, W.R. and Henry, A.P., 1991), the Site is within an area where the following surficial deposits are present:

- Ice-contact stratified deposits consisting of sand and gravel, minor silt, clay and till
- Coarse-textured glaciolacustrine deposits consisting of sand, gravel, minor silt and clay (foreshore and basinal deposits)

According to the Bedrock Geology of Ontario, southern sheet; Ontario Geological Survey, Map 2544, scale 1:1 000 000 (Ontario Geological Survey, 1991) the bedrock in the area of the Site is characterized as early felsic plutonic rock granodiorite, tonalite, monzogranite, syenogranite; derived gneisses and migmatite.

3.1 Water Well Records

According to the MECP WWIS, there are 149 water well records within 500 m of the Site. Of these records, 123 describe the installation of drilled bedrock wells and 13 describe the installation of drilled overburden wells. No existing records of dug wells were located (however some records described deepening of dug wells). The remaining 13 well records either outline well abandonments or dry conditions. The wells records located within 500 m of the Site are depicted on Figure 2.

A summary of water well information, including total depth, the static water level and the recommended flow rate, are included below in Embedded Table 1.

Embedded Table 1 Water Well Information Summary

		Depth (mbgs)	Static Water Level (mbgs)	Flow Rate (igpm)
Bedrock Wells Count = 123	Min	7.30	-0.30	0.00
	Max	164.60	36.60	50.00
	Average (1)	57.48	6.63	3.60
Overburden Wells Count = 13	Min	9.40	0.90	3.00
	Max	24.70	7.90	10.00
	Average (1)	14.64	4.35	6.56

1. *The geometric mean of the recommended flow rate was calculated*

The records indicate that the majority (90%) of water wells are installed in fractured bedrock. This is expected due to the generally thin overburden cover in the region.

Overburden wells varied in depth from 9.40 mbgs to 24.70 mbgs and were installed to an average depth of 14.64 mbgs. The static water levels varied from 0.90 to 7.90 mbgs, the average static water level was 4.35 mbgs. The flow rates varied from 0 to 50 igpm, with the geometric mean 3.60 igpm.

Bedrock wells varied in depth from 7.30 mbgs to 164.60 mbgs and were on average 57.48 mbgs deep. The static water levels varied from flowing conditions (i.e. a negative water level of 0.3 m) to 36.60 mbgs. The average static water level was 6.63 mbgs. The flow rates varied from 0 to 50 igpm, the geometric mean being 3.60 igpm.

Most of the water bearing fractures were encountered between the depths of 10 and 60 mbgs. The deepest water bearing fracture was encountered at a depth of approximately 148 mbgs. There was no significant correlation between fracture depth and flow rate. The number of fractures encountered during the installation of bedrock wells, at various depth ranges, were summarized below in Embedded Table 2.

Embedded Table 2 Fracture Depths

Fracture Depth Ranges (mbgs)	Number of Fractures Encountered
0 – 10	10
10 – 20	24
20 – 30	25
30 – 40	19
40 – 50	18
50 – 60	16
60 – 70	4
70 – 80	9
80 – 90	9
90 – 100	2
100 – 110	5
110 – 120	5
120 – 130	2
130 – 140	0
140 - 150	2

1. *These data were generated from a review of 123 bedrock well records located within 500 m of the Site.*

A summary of the six water well records located closest to the Site has been included below in Embedded Table 3.

Embedded Table 3 Water Well Information Summary of Six Closest Water Well Records

WWIS Well Record No.	Depth (mbgs)	Encountered Fractures (mbgs)	Static Water Level (mbgs)	Recommended Pumping Rate
2700166	27.44	-	4.57	3 GPM (1)
2700547	16.77	-	4.57	2 GPM (1)
2701775	No information			
2706191	60.96	25.00 and 59.45	9.76	5 GPM (1)
7046568	91.00	90.00	2.13	23 Lpm
7174472	Abandonment			

1. *Gallons Per Minute (assumed to be US)*
2. *All wells installed in bedrock*

The six wells closest to the Site indicate that the wells were installed at various depths. Water bearing fractures were also encountered at variable depths, which is typical of wells located within 500 m of the Site (see Embedded Table 2). The locations of the six closest water well records have been outlined on Figure 3.

3.2 Hydrogeological Conditions

There are no prevalent overburden aquifers on the Site. Based on the review of the surrounding well records, there are viable bedrock aquifers in the area of the Site; however the

depth and yield of the water bearing fractures is variable which is a typical characteristic of granitic bedrock aquifers.

Overburden was reported to be 1.50 m deep at test well PW101-19 and 7.93 m deep at MW101-19. The previous hydrogeological assessment completed at the Site indicated that a low yielding water bearing zone was encountered at MW101-19 at the overburden/bedrock interface. A low to moderately fractured area was encountered from 54.90 to 56.50 mbgs. (Trow Associates Inc., 2010). The elevation of these fractures ranged from 272.40 to 270.80 metres above sea level (masl).

No water bearing unit was encountered in the shallow overburden at test well PW101-19. A water bearing fractured zone was encountered from 65.55 to 67.07 mbgs. The elevation of the fractures ranged from 263.94 to 262.42 masl. No well record for MW102-19 could be located. The depth of monitoring well MW102-19 was measured be 38.19 mbgs (bottom elevation of 291.13 masl), which is significantly shallower than wells PW101-19 and MW101-19.

Each of the wells included in the assessment were interpreted to have intercepted water bearing fractures that are hydraulically isolated from each other. Hydraulic isolation of supply wells located in the area of the Site is discussed in Section 4.1.1.

Information such as depth, static water level and elevation for each well have been summarized below in Embedded Table 4.

Embedded Table 4 Well Information

Well		PW101-18	MW101-18	MW102-18
Easting [1]		695764	695750	695864
Northing [1]		4991628	4991571	4991529
Top of Pipe (TOP) Elevation (mASL) [2]		330.35	328.13	329.66
Ground Surface Elevation (mASL) [2]		329.49	327.30	329.32
Depth (mBGS) [3]		90.23	60.94	38.19
Stick-up (m)		0.88	0.83	0.34
April 10, 2019	Static Water Level (mTOP) [4]	11.17	4.68	11.34
	Water Level (mBGS) [3]	10.31	3.85	11.00
	Groundwater Elevation (mASL) [2]	319.18	323.45	318.32

1. *Universal Transverse Mercator (Zone 17T)*
2. *Metres Above Sea Level*
3. *Metres Below Ground Surface*
4. *Metres Below Top of Pipe*

4.0 Results

This section discusses the results of the work program.

4.1 Pumping Test

The pumping test commenced at 10:44 on April 10, 2019 and ran continuously for 24 hours. The discharge rate was maintained at 50 Lpm (11 igpm) for the duration of the pumping test. Groundwater elevation responses to water withdrawal are outlined on Figure 4.

From the commencement of the pumping test to 21:00 on April 10, 2019, the water level in test well PW101-19 was drawn down approximately 21.15 m (i.e., ground elevation from 319.18 to 298.03 masl). From 21:00 on April 10 to the end the pumping test on April 11, 2019 the water level lowered an additional 0.36 m (i.e., groundwater elevation decline from 298.03 to 297.67 masl). The total depth of drawdown by the end of the pumping test was 21.51 m.

At the beginning of the pumping test the available drawdown to the top of fracture unit encountered at test well PW101-19 was 55.23 m. At the end of the pumping test the available drawdown to the top of the fracture unit was 33.72 m (which is approximately 61% of the available drawdown). The elevations of the top and bottom of the fracture encountered at PW101-19 are displayed on Figure 4.

Steady state conditions were not achieved during the pumping test.

At 10:44, April 11, 2019 the pumping test ceased and water level recovery was monitored. The water level of test well PW101-19 was monitored until 14:02 April 11, 2019 (a span of 3 hours, 18 minutes). The water level had recovered to 93% of the static water level (a groundwater elevation of 317.67 masl).

Between 10:44 and 24:00 on April 10, 39,800 L of water was withdrawn from test well PW101-19. Between 00:00 and 10:44 on April 11, 32,200 L of water was withdrawn from test well PW101-19. Between the two days of pumping a total of 72,000 L of water was withdrawn.

4.1.1 Monitoring Wells

There was no indication of influence from pumping at test well PW101-19 on the water level in wells MW101-19 and MW102-19. The water elevations monitored in well MW102-19 show an influence from its own domestic use drawing water from the well (Figure 4).

The fractured water bearing zones intercepted by wells PW101-19 and MW101-19 were encountered at similar elevations; however, due to a lack of influence on the water level of MW101-19 during the pumping test, it is unlikely that these water bearing zones are hydraulically connected. Water withdrawal from test well PW101-19 did not influence the water levels reported from monitoring well MW102-19; therefore the fractures encountered by these two wells are likely not hydraulically connected.

The static groundwater elevation reported from well MW101-19 was approximately 5 m higher than the groundwater elevations reported from wells PW101-19 and MW102-19. The water elevation reported from well MW101-19 elevated approximately 0.2 m during the pumping test. The rise in groundwater elevation reported from well MW101-19 was likely caused by meltwater percolating into the subsurface environment. It is probable that the water discharged from well PW101-19 did not influence groundwater elevations at well MW101-19 since the water level fluctuations did not correlate with the time frame of water discharge.

The data suggests that each well intercepted fracture groups that were hydraulically isolated from each other.

In the area of the Site, the bedrock fractures exploited for water supply were encountered between the depths of 10 and 60 mbgs (Embedded Table 2). The water bearing fracture at test well PW101-10 was encountered from approximately 65.55 to 67.07 mbgs, which is just outside the range of depths were most of the groundwater in the area is withdrawn. The pumping test data indicated that water withdrawal from well PW101-19 did not influence shallower water bearing fractures (as evidenced from a lack of water level response at wells MW101-19 and MW102-19).

It is for these reasons (i.e., the hydraulic isolation between the wells included in the assessment, and that the fracture depth at PW101-19 is outside the depth range where most

water resources are drawn) that water withdrawal from well PW101-19 will likely not influence surrounding water wells not included in this assessment.

4.2 Extrapolated Drawdown

To estimate continued water withdrawal from test well PW101-19 the measured drawdown was extrapolated through a 1 year and 20 year time frame. The extrapolations assume that water is continuously withdrawn at a rate of 50 Lpm during the extrapolation period. The extrapolations were plotted against a logarithmic time scale, as shown on Figure 5. The top and bottom of the fracture encountered at well PW101-19 have also been plotted on Figure 5. The results of the extrapolations are summarized below in Embedded Table 5.

Embedded Table 5 Drawdown Extrapolations

Time Frame	Drawdown (m)	Groundwater Elevations (masl)	Available Drawdown to Fracture (m)
End of 24 Hour Pumping Test	21.51	297.67	33.72
1 Year	24.50	294.68	30.74
20 Years	26.00	293.48	29.24

The extrapolated drawdown curves indicate that continued water withdrawal will not likely lower the water level in test well PW101-19 to the fracture. The depth of available drawdown was estimated to reduce from 33.72 m, at the end of the pumping test, to 29.24 m after a 20 year period of continuous pumping. The extrapolated drawdown analysis is considered to be conservative since it assumed continuous pumping with no recovery for a duration of 20 years. Actual water withdrawal from test well PW101-19 will not be continuous through the time frames outlined above.

Due to the conservative nature of the analysis and that there is an ample amount of available drawdown in the well, it is anticipated that the well can likely sustain higher (and possibly peak) water withdrawal rates associated with the proposed development.

4.3 Aquifer Test Analysis

The water level data generated from water withdrawal at test well PW101-19 was processed by AquiferTest Pro™ software.

The water level data generated from the monitoring wells were not processed by AquiferTest Pro™ because there were no influences from pumping. A relatively well matching solution for the Moench Fracture Flow solution (Moench, A. F., 1984) was calculated (attached in Appendix D). A summary of the AquiferTest Pro™ results have been outlined in Embedded Table 6.

Embedded Table 6 Aquifer Test Pro™ Results for PW101-19

Period	T (m^2/day)	Hydraulic Conductivity (m/s)
Drawdown	1.49	1.73×10^{-5}
Recovery	1.07	1.24×10^{-5}

The hydraulic conductivity of the water bearing fracture ranged between 1.73×10^{-5} m/s and 1.24×10^{-5} m/s. Transmissivity ranged between 1.49 m²/day and 1.07 m²/day.

4.4 Water Quality

Two water samples were collected from test well PW101-19. The first sample was collected during the first hour of pumping (at 11:30 on April 10, 2019) and the second sample was collected during the last hour (at 10:30 on April 11, 2019). The samples were submitted to SGS Canada Inc. in Lakefield (SGS) for analysis of general organic and inorganic chemistry. The certificates of analysis have been included in Appendix E.

The water quality results were compared against the Ontario Drinking Water Quality Standards (ODWQS) (Ministry of Environment, 2006). Those parameters that were reported in excess of the ODWQS criteria have been outlined in Embedded Table 7. Parameters reported at elevated concentrations, but not in excess of ODWQS criteria, were also reported in Embedded Table 7.

Embedded Table 7 ODWQS Exceedances and Elevated Parameter Concentrations

ODWQS Exceedances			
Parameter	**Concentration in First Sample (mg/L)**	**Concentration in Second Sample (mg/L)**	**ODWQS Criteria (mg/L)**
Hardness	**162**	**222**	80-100 (2)
Turbidity	**1.13**	0.15	1 (1) or 5 (2)
Elevated Parameter Concentrations			
Parameter	**Concentration in First Sample (mg/L)**	**Concentration in Second Sample (mg/L)**	**ODWQS Criteria (mg/L)**
Fluoride	1.19	1.37	1.5 (1)
Organic Nitrogen	0.08	0.10	0.15 (2)
Manganese	0.0133	0.0361	0.05 (2)
Selenium	0.00879	0.00015	0.01 (1)
Uranium	0.0184	0.00934	0.02 (1)

1. Bold entries indicate exceedances of ODWQS criteria.

The concentration of hardness was reported in excess of ODWQS criteria from both samples. Hardness can be treated with convention treatment systems (i.e. water softening).

Turbidity was reported in excess of ODWQS criteria from the first sample only. The turbidity of the discharge water decreased during the pumping test which is typical in new wells being developed (determined from field sampling, see Appendix F).

The concentrations of several parameters were reported to be elevated, but not in excess of the ODWQS criteria. These parameters included fluoride, organic nitrogen, manganese, selenium and uranium.

Total coliform and E.Coli were not detected in the samples.

4.5 Summary and Interpretation of Results

The pumping test information indicates that well PW101-19 can sustain a 24 water withdrawal at a rate of 50 Lpm with no impact to adjacent well users. The total amount of water withdrawn during the test was 72,000 L, which is greater than the total anticipated daily average water demand rate of 62,100 L. In addition, water does not need to be withdrawn from the existing well (MW101-19) as a supplement to water withdrawal from test well PW101-19 to achieve the average daily water demand for the proposed development.

The peak water withdrawal rates will be greater than the average water withdrawal rate. The water treatment and distribution system may have to include some water storage to account

for peak water usage and for fire suppression, although there was a significant amount of available drawdown during the pumping test to accommodate peak usage.

The water quality was considered to be good with the only ODWQS exceedances being reported for only hardness in the sample collected at the end of the pumping test. Some other parameters were reported at elevated concentrations, but none exceeded ODWQS criteria. It is anticipated that sustained water withdrawal will improve water quality over time.

Monitoring well MW101-19 intercepted fractures at a similar elevation to those intercepted by test well PW101-19; however no hydraulic connection between the two wells was evident. Water withdrawal from test well PW101-19 also did not influence water levels of monitoring wells MW102-19, which is shallower than both PW101-19 and MW101-19.

The pumping test data suggest that the water bearing fracture units encountered in the area of the Site may be hydraulically isolated from each other. Water well records in the area of the Site indicate that water bearing fractures were encountered at various depths. The hydraulic connectivity between the fracture in which well PW101-19 was installed and adjacent wells is not known, but it is likely that the hydraulic isolation which exists between wells PW101-19, MW101-19 and MW102-19 extends off-site to other surrounding water supply wells.

Test well PW101-19 is considered to be relatively high yielding as it can sustain the total daily average water demand rate with ample available drawdown remaining. Furthermore, the rate of recovery following the pumping test was fairly rapid. If any surrounding private wells are hydraulically connected to the fractures that test well PW101-19 has intercepted, it is not likely that a significant influence will occur as the fracture system appears to be high yielding and sustainable.

5.0 Conclusions

Cambium was retained by Gardens of Haliburton Inc. to complete a hydrogeological assessment for the proposed retirement residence development at 1 Sunnyside Street, Haliburton, Ontario. .

Test well PW101-19 was installed on-site and pumped at a rate of 50 Lpm for a continuous period of 24 hours. Upon completion of the testing, a total of 72,000 L of water was withdrawn from test well PW101-19. The well recovered to 93% percent of static water level within several hours after the cessation of pumping. It was concluded that test well PW101-19 can sustain a daily water withdrawal of 72,000 L (which is greater than the average daily water withdrawal rate for the proposed development) and allow for sufficient water level recovery. Supplemental water withdrawal from the existing supply well (MW101-19) was not required to achieve the average daily water withdrawal rate.

Test well PW101-19 was not pumped at the peak water withdrawal rate; however there was a significant amount of available drawdown available at the end of the pumping test. It is likely water can be withdrawn from test well PW101-19 at higher rates. The water distribution system may have to account for peak water usage using storage tanks.

The results of the water quality sample collected at the end of the pumping test indicates that only hardness exceeded the ODWQS criteria which can be treated with conventional treatment systems. Some other parameters were reported at elevated concentrations, but not in excess of ODQWS criteria. It is anticipated that continued water withdrawal from test well PW101-19 will improve water quality.

An influence from water withdrawal was not recorded from the monitoring wells. It is possible that test well PW101-19 and, monitoring wells MW101-19 and MW102-19 are each installed in hydraulically isolated water bearing fractures. Adjacent water wells are installed at variable depths (according to the WWIS). The hydraulic connection between test well PW101-19 and adjacent water supply wells is not known; but it is possible that the hydraulic isolation inferred from the testing program is characteristic of other wells in the area. In addition, the fracture in

which test well PW101-19 has been installed is relatively high capacity aquifer, and recovers rapidly. If adjacent water supply wells are hydraulically connected to the fracture intercepted by well PW101-19, it is likely that the influence will be minimal to negligible.

In consideration of the above, test well PW101-19 can be used as a viable water supply for the proposed development at the Site and off-site influence are anticipated to be negligible.

References

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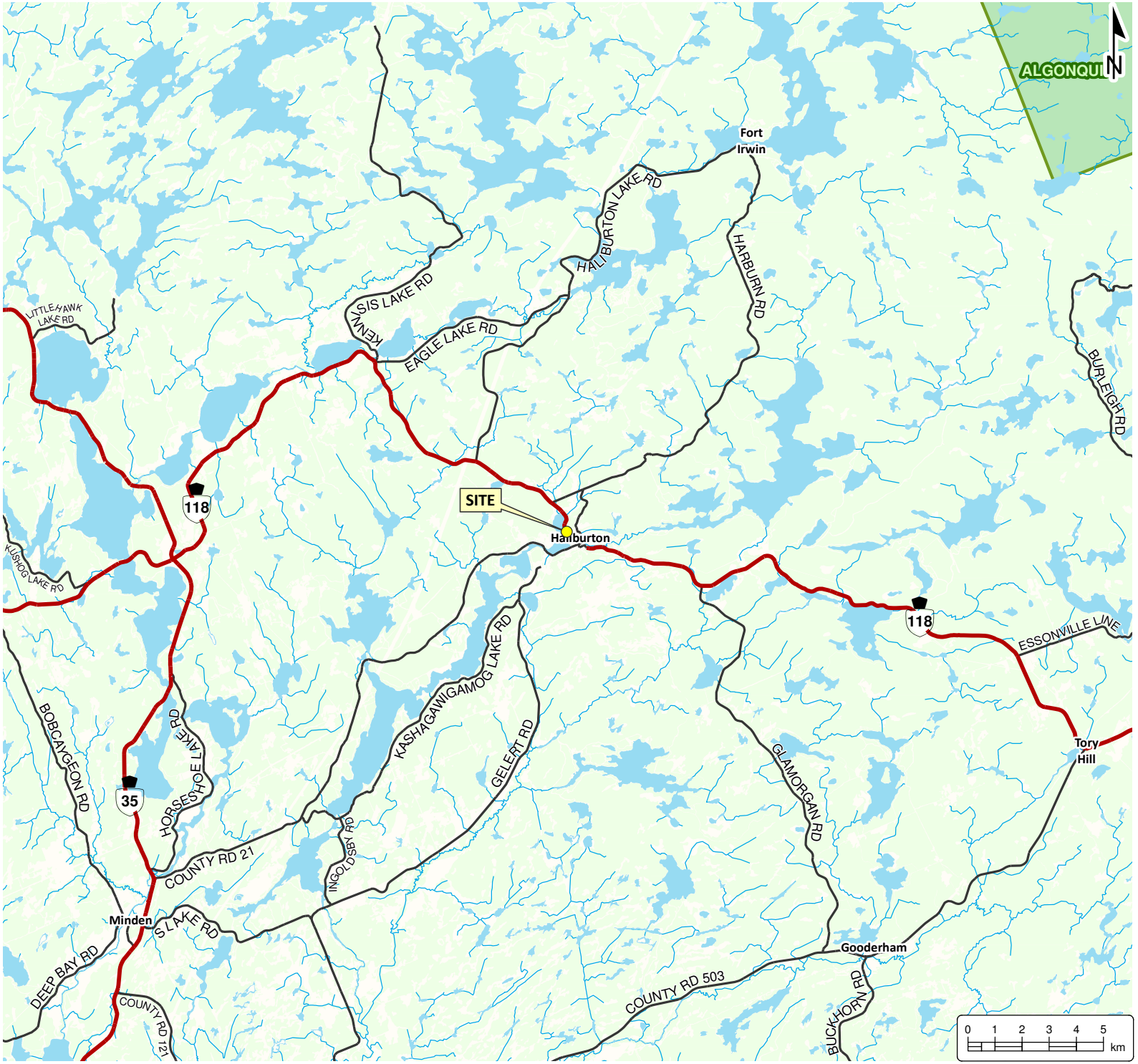
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Appended Figures



HYDROGEOLOGICAL ASSESSMENT

GARDENS RETIREMENT RESIDENCE

1 Sunnyside Street, Haliburton, Ontario

LEGEND

Notes:
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

CAMBIUM

P.O. Box 325, 52 Hunter Street East
Peterborough, Ontario, K9H 1G5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

REGIONAL LOCATION PLAN

Project No.:	8786-001	Date:	April 2019
		Rev.:	
Scale:	1:200,000	Projection:	NAD 1983 UTM Zone 17N
Created by:	TLC	Checked by:	KW
Figure:	1		

O:\GIS\project_MXDs\8700 to 8799\8786-001 Leeswood Construction - Hydrogeological Assessment and Water Treatment - Haliburton Retirement Residence\2019-04-23 FIG 1 - Regional Location Plan.mxd



HYDROGEOLOGICAL ASSESSMENT

GARDENS RETIREMENT RESIDENCE

1 Sunnyside Street,
Haliburton, Ontario

LEGEND

- Water Well Record
- 500m Buffer
- Subject Property (Approximate)

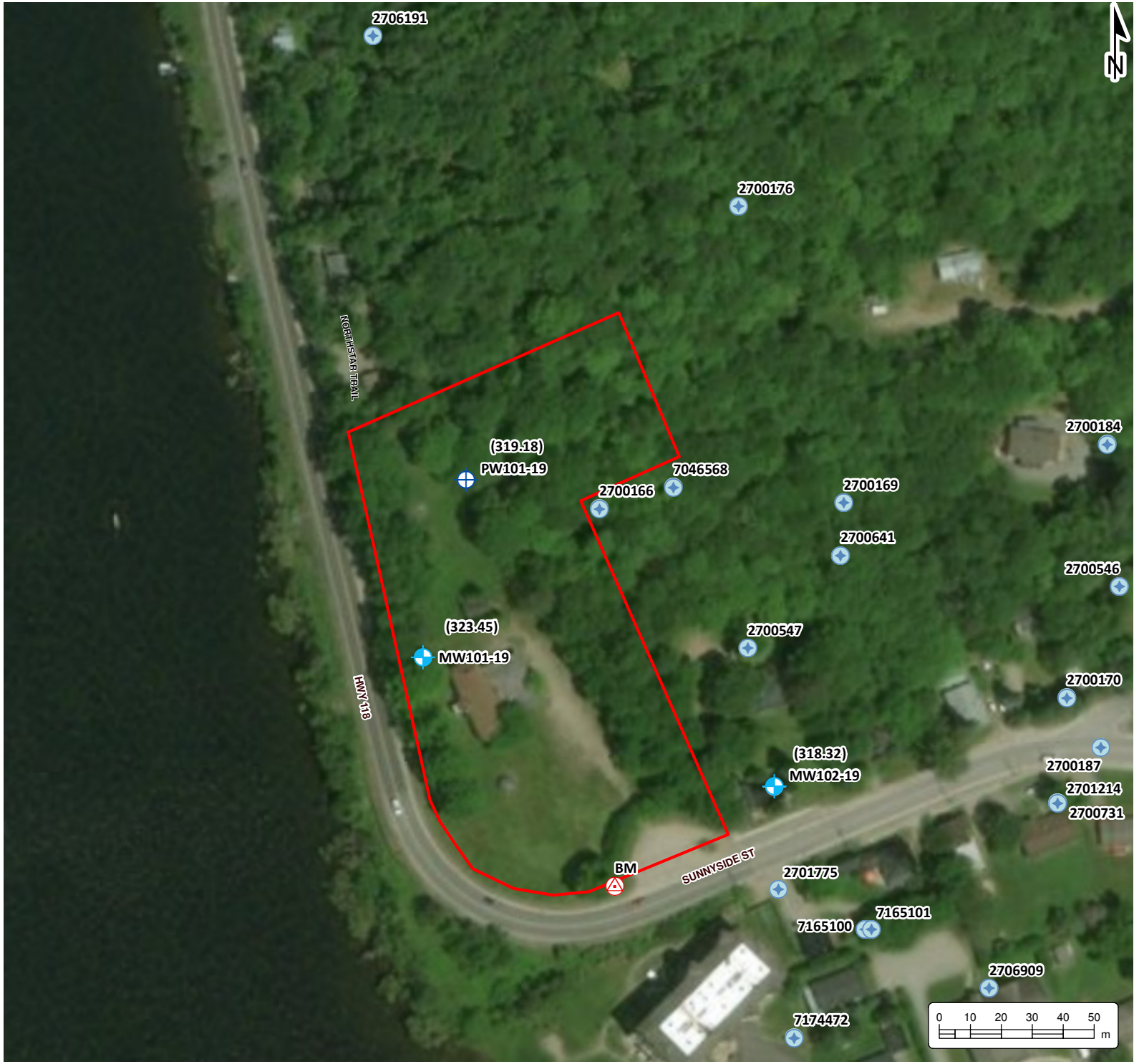
<bol>Notes:</bol>
- Benchmark is a catch basin located on Sunnyside Street and has an assumed elevation of 325.99m, that was obtained from Farid Motamedi Architect Drawing No. A1.1, Job No. FMA-18-139, Site Plan, Site Details & Project Information.
- Subject Property is approximate and was obtained from the County of Haliburton online GIS.
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

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SURROUNDING WATER WELL RECORDS

Project No.:	8786-001	Date: / Rev.:	April 2019
Scale:	1:7,000	Projection:	NAD 1983 UTM Zone 17N
Created by:	TLC	Checked by:	KW
Figure:	2		

O:\GIS\project_MXDs\8700 to 8799\8786-001 Leeswood Construction - Hydrogeological Assessment and Water Treatment - Haliburton Retirement Residence\2019-04-23 FIG 2 - Surrounding Well Records.mxd



HYDROGEOLOGICAL ASSESSMENT

GARDENS RETIREMENT RESIDENCE

1 Sunnyside Street,
Haliburton, Ontario

LEGEND

- Benchmark
- Test Well
- Monitoring Well Location
- Water Well Record
- Subject Property (Approximate)

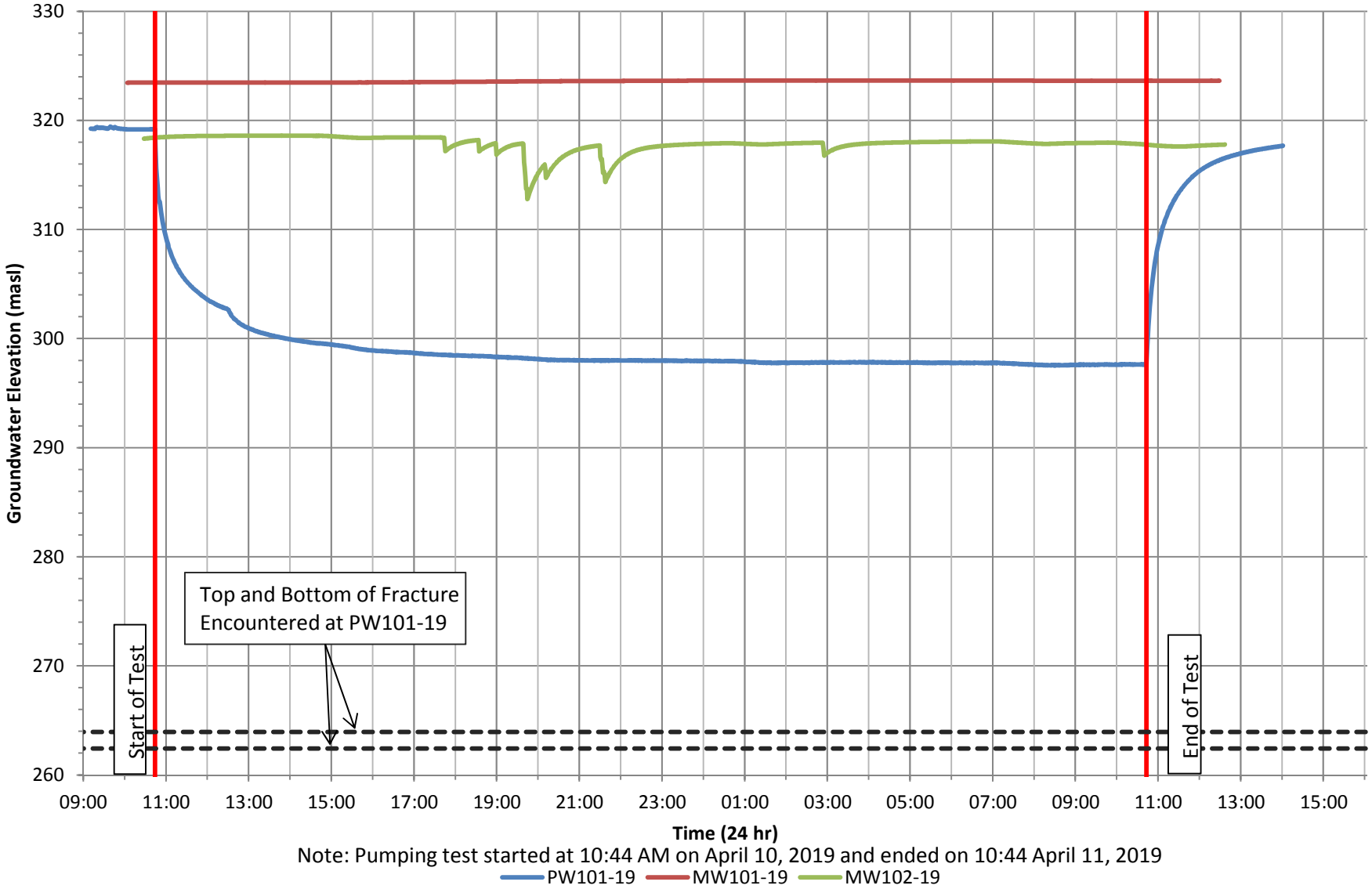
<bol>Notes:</bol>
- Benchmark is a catch basin located on Sunnyside Street and has an assumed elevation of 325.99m, that was obtained from Farid Motamedi Architect Drawing No. A1.1, Job No. FMA-18-139, Site Plan, Site Details & Project Information.
- Subject Property is approximate and was obtained from the County of Haliburton online GIS.
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

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SITE PLAN

Project No.:	8786-001	Date:	April 2019
		Rev.:	
Scale:	1:1,750	Projection:	NAD 1983 UTM Zone 17N
Created by:	TLC	Checked by:	KW
Figure:	3		

O:\GIS\project_MXDs\8700 to 8799\8786-001 Leeswood Construction - Hydrogeological Assessment and Water Treatment - Haliburton Retirement Residence\2019-04-23 FIG 3 - Site Plan.mxd



Note: Pumping test started at 10:44 AM on April 10, 2019 and ended on 10:44 April 11, 2019

Figure 4. Groundwater Elevations

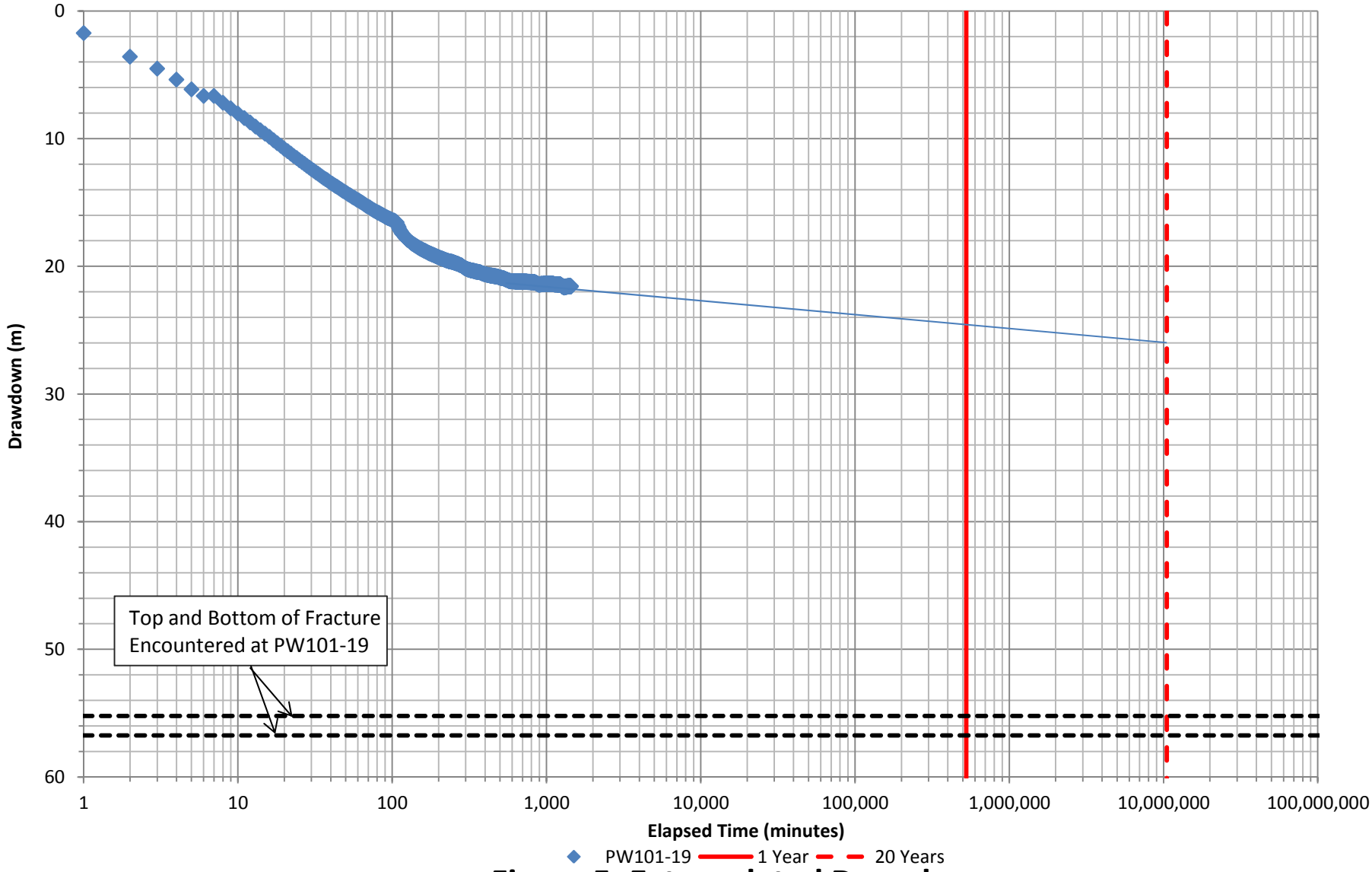


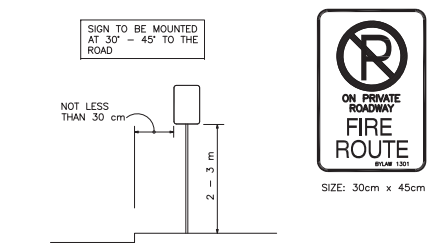
Figure 5. Extrapolated Drawdown

Appendix A
Development Information

FIRE ROUTE SIGN MOUNTING REQUIREMENTS

FIRE ROUTE SIGN (FR) FR

NO PARKING ON PRIVATE ROADWAY,
FIRE ROUTE SIGN PER BY-LAWS OF LOCAL MUNICIPALTY



PAVEMENT DESIGN:

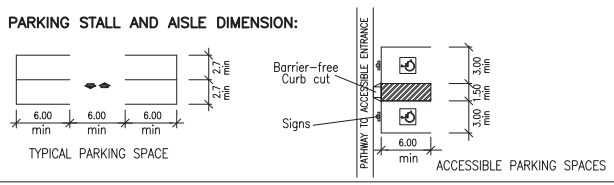
NOTE:
THE FOLLOWING INFORMATION IS TAKEN FROM CHAPTER 6.5 OF GEOTECHNICAL INVESTIGATION PREPARED BY SOILS ENGINEERS LTD. DATED DECEMBER 2018

COURSE	THICKNESS (mm)	OPS SPECIFICATIONS
ASPHALT SURFACE	35	HL-3
ASPHALT BINDER LIGHT-DUTY PARKING HEAVY DUTY AND FIRE ROUTE	40 65	HL-8
GRANULAR BASE	150	GRANULAR "A" OR EQUIVALENTS
GRANULAR SUB-BASE LIGHT-DUTY PARKING HEAVY-DUTY AND FIRE ROUTE	300 450	GRANULAR "B" OR EQUIVALENT

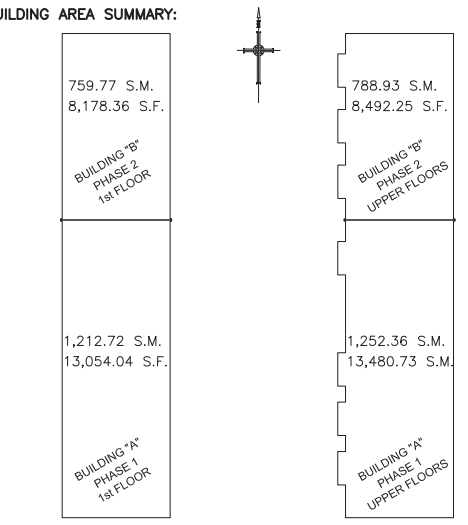
PARKING REQUIREMENTS:

PHASE 1	70 x 0.82 =	58 PARKING SPACES
PHASE 2	50 x 0.82 =	41 PARKING SPACES
TOTAL REQUIRED		99 PARKING SPACES
TOTAL PROVIDED		100 PARKING SPACES

PARKING STALL AND AISLE DIMENSION:



BUILDING AREA SUMMARY:



1ST FLOOR

FOOT PRINT + OVERHANG
TYPICAL FLOOR

ZONING:

ZONING BY-LAW No. 2008 - 63

ZONING BY-LAW:	PERMITTED:	PROPOSED:
PERMITTED USE:	MEDIUM DENSITY DWELLING	MEDIUM DENSITY RETIREMENT HOME

All zone provisions applicable to R3 ZONE, except as follows:

ZONING BY-LAW:	PERMITTED:	PROPOSED:
LOT AREA, MINIMUM:	1.62 HECTARES	1.6289 HECTARES
LOT FRONTAGE, MINIMUM:	60 m	±77 m
DWELLING UNITS PER LOT, MAXIMUM	150	120
SIDE LOT LINE SETBACK, MINIMUM:		
– INTERIOR SIDE:	10.5 m	16.774 m
– EXTERIOR SIDE (HWY 118):	14 m	27.098 m
DWELLING UNIT AREA, MINIMUM:	52 m2	31–72 m2 ✱
STRUCTURE HEIGHT, MAXIMUM:	22.3 m	17 m
PARKING SPACE EQUIPMENT, MINIMUM	1.2 SPACES PER UNIT	0.82 SPACES PER UNIT ✱
PLANTING STRIP, MINIMUM :	NOT DEFINED – PER SPA	3 m
NATURALIZED OPEN SPACE, MINIMUM :	30% OF LOT AREA	71.28%
STREET SETBACK, MINIMUM :	NIL (Front and side lot line setbacks will apply)	N/A
LOT COVERAGE, MAXIMUM :	37%	12.51%
LOADING SPACE REQUIREMENT, MINIMUM :	2	1 ✱
PARKING SPACE DIMENSION, MINIMUM:		
– WIDTH:	2.7 m	2.7 m
– LENGTH:	6 m	6 m
PARKING AISLE WIDTH DIMENSION, MINIMUM :	6 m	6 m

All other provisions of this By-law as applicable to a R3 Zone shall apply:

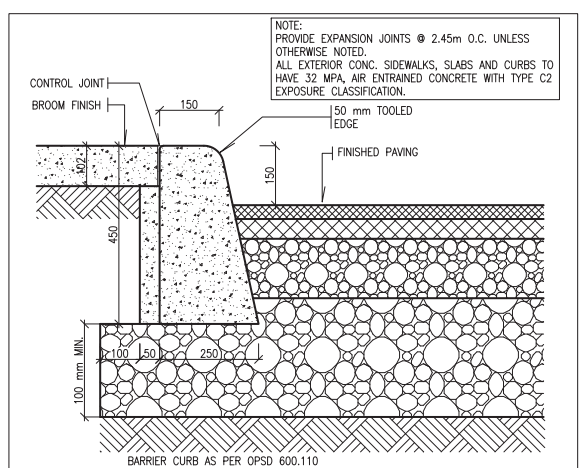
REAR LOT LINE SETBACK, MINIMUM:	7.5 m	27.098 m
PARKING SPACE SETBACK FROM STREET LINE, MINIMUM:	7.5 m	7.5 m
ACCESSIBLE PARKING SPACE DIMENSION, MINIMUM:		
– WIDTH:	4.5 m	4.5 m
– LENGTH:	6 m	6 m

NOTE:
4.5 m WIDTH INCLUDES 1.5 m SHARED SPACE (SHOWN AS PAINTED LINES BETWEEN THE PARKING STALLS)

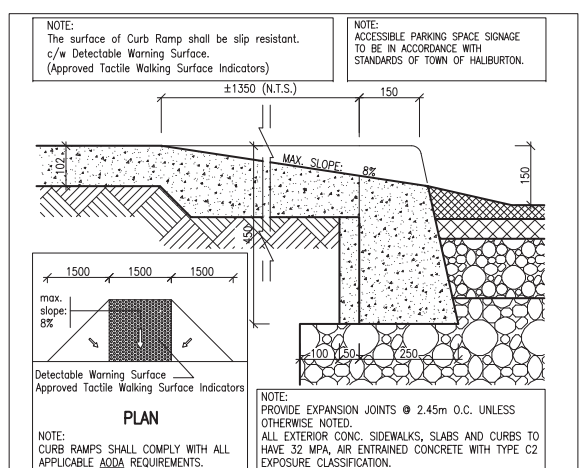
ACCESSIBLE PARKING SPACES REQUIRED: 4 (FOR 51–75) 4 (FOR 58)

PROJECT & SITE STATISTICS:

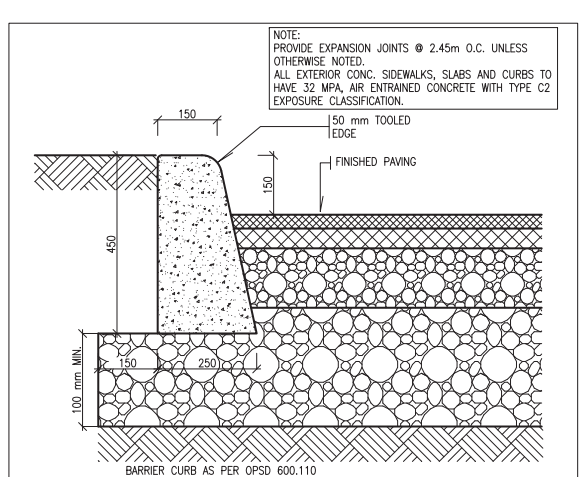
LAND AREA:	16,289	S.M.	±4.02	ACRES
RETIREMENT RESIDENT (PHASE 1): 4 Storey Building				
PHASE 1 – FOOT PRINT AREA	1,212.72	S.M.	13,054.04	S.F.
PHASE 1 – FOOT PRINT+OVERHANG – BUILDING AREA (O.B.C.)	1,252.36	S.M.	13,480.73	S.F.
PHASE 1 – WATER TREATMENT EQUIPMENT ROOM	65.934	S.M.	709.71	S.F.
PHASE 1 – TOTAL FLOOR AREA	5,035.73	S.M.	54,204.19	S.F.
RETIREMENT RESIDENT (PHASE 2): 4 Storey Building				
PHASE 2 – FOOT PRINT AREA	759.77	S.M.	8,178.36	S.F.
PHASE 2 – FOOT PRINT+OVERHANG – BUILDING AREA (O.B.C.)	788.93	S.M.	8,492.25	S.F.
PHASE 2 – TOTAL FLOOR AREA	3,126.56	S.M.	33,655.11	S.F.
TOTAL PROJECT (PHASE 1 + PHASE 2):				
TOTAL BUILDING FOOT PRINT AREA	2,038.33	S.M.	21,940.44	S.F.
TOTAL FLOOR AREA	8,162.29	S.M.	87,858.20	S.F.
LOT COVERAGE (TOTAL BLDG. FOOT PRINT / LOT AREA)	2,038.33 / 16,289		12.51%	
FLOOR SPACE INDEX "FSI" (TOTAL FLOOR AREA / LOT AREA)	8,162.29 / 16,289		50.11%	
TOTAL PAVED AREA	3,439.60 / 16,289		21.11%	
TOTAL LANDSCAPED AREA	10,811.07 / 16,289		66.38%	



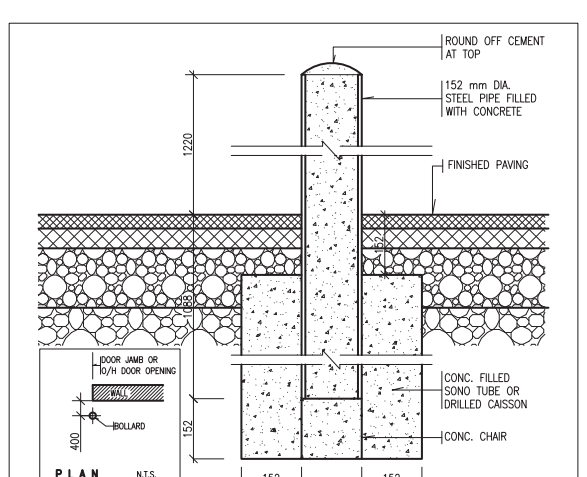
3 / A1.1 CONC. SIDEWALK DETAIL
SCALE 1:10



4 / A1.1 CONC. ACCESSIBLE CURB RAMP
SCALE 1:10



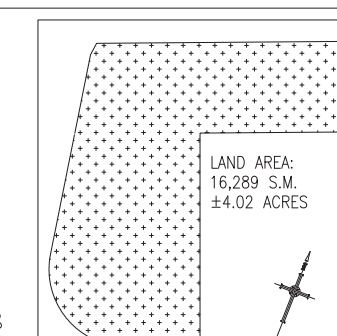
5 / A1.1 CONC. CURB DETAIL
SCALE 1:10



6 / A1.1 STEEL BOLLARD DETAIL
SCALE 1:10



1 / A1.1 SITE PLAN
SCALE 1:400



FARID MOTAMEDI ARCHITECT

ONTARIO ASSOCIATION OF ARCHITECTS
FARID MOTAMEDI
LICENCE
4468
INC.

3 CHASE ROAD
TORONTO, ONTARIO
M2J 2S1 CANADA
TEL: (416) 221-9447
FAX: (416) 221-6533

Certificate of Practice No. : 3502

E-mail: info@fmarchitect.ca
Website: www.fmarchitect.ca

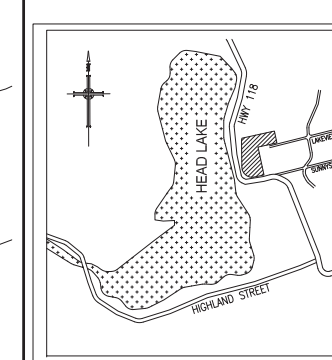
TRUE NORTH | CONSTRUCTION NORTH

NOTES:

1. Verify all dimensions prior to construction.
2. Do not scale drawings.
3. Report all discoveries of errors, omissions or discrepancies to the architect or design engineer as applicable.
4. Use only latest revised drawings or those, that are marked, "Issued for Construction"
5. The drawings are the property of the architect and/or engineer and must be returned on completion of the project. Any unauthorized use is prohibited.
6. All area calculations are approximate.

REVISIONS

No.	DATE	BY	DESCRIPTION
	AUGUST 17, 2018	F.M.	ISSUED FOR COORDINATION
	AUGUST 31, 2018	F.M.	ISSUED FOR COORDINATION
	SEPTEMBER 04, 2018	F.M.	ISSUED FOR COORDINATION
	NOVEMBER 19, 2018	F.M.	ISSUED FOR COORDINATION
	NOVEMBER 27, 2018	F.M.	ISSUED FOR COORDINATION
	DECEMBER 06, 2018	F.M.	ISSUED FOR COORDINATION
	JANUARY 07, 2019	F.M.	ISSUED FOR COORDINATION
	JANUARY 31, 2019	F.M.	ISSUED FOR COORDINATION
	FEBRUARY 25, 2019	F.M.	ISSUED FOR COORDINATION
	FEBRUARY 27, 2019	F.M.	ISSUED FOR COORDINATION



KEY MAP - TOWN OF HALIBURTON N.T.S.

INFORMATION ON THIS DRAWING IS PARTLY TAKEN FROM TOPOGRAPHICAL PLAN OF SURVEY PREPARED BY:
GREG BISHOP ONTARIO LAND SURVEYOR
DATED SEPTEMBER 10, 2007
FILE No: 2007-SSFC

Municipality of Dysart et al

LEGAL ADDRESS:

LOTS 2 & 8 & PART OF LOTS 1 & 7, BLOCK 2
LOTS 3 & 4 & PART OF LOTS 2, 8, 9 & 10, BLOCK 6
PART OF LAKEVIEW STREET BETWEEN BLOCKS 2 & 6
REGISTERED PLAN No. 1, TOWN PLOT OF HALIBURTON
GEOGRAPHIC TOWNSHIP OF DYSART
TOWNSHIP OF DYSART et al
COUNTY OF HALIBURTON

LAND OWNER & APPLICANT:
GARDENS RETIREMENT DEVELOPMENTS INC.
12 Kensington Drive
Richmond Hill, Ontario, L4E 3M9

PROJECT
GARDENS OF HALIBURTON RETIREMENT RESIDENCE
1 SUNNYSIDE STREET, HALIBURTON, ONTARIO

DRAWING
SITE PLAN, SITE DETAILS & PROJECT INFORMATION

DATE	AUGUST 2018
DRAWN BY	B.M.
CHECKED BY	F.M.
SCALE	AS SHOWN
ARCHITECTS JOB No.	FMA-18-139
DRAWING No.	A1.1

FARID MOTAMEDI ARCHITECT INC.
PLOT DATE: February 27, 2019
d:\drawings\Haliburton RR\A1.1

Appendix B
Well Records

Ontario — Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* A252440

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
Bill Mardimae	Gardens Retirement Developments Inc	bill@gardensdevelopments.com	

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
12 Kensington Drive	Richmond Hill	ONT	L4C 3H9	6 1 8 7 2 9 2

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
1 Sunnyside Street	Dysart Et Al	16	8

County/District/Municipality	City/Town/Village	Province	Postal Code
Haliburton	Haliburton	Ontario	K0M 1S0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 8 3	17	695716	4991613	Lot Block 1-2, 7-8 12 Plan 1	

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
brown	soil	boulders	packed	0	5
grey	granite	red granite	hard	5	24
grey	granite	red granite	hard	24	280

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	24	Bentonite hole plug	7.5

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☑ Air percussion
☐ Other, specify

Well Use

☐ Public ☑ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6¼	steel	3/16	+2	24
6⅛	open hole		24	280

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Status of Well

☑ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

Water Details

Water found at Depth (m/ft)	Gas	Kind of Water	Other, specify
215	☐	☐ Fresh ☑ Untested	
	☐	☐ Fresh ☐ Untested	
	☐	☐ Fresh ☐ Untested	

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	24	9
24	280	6⅛

Results of Well Yield Testing

After test of well yield, water was:
☑ Clear and sand free
☐ Other, specify

If pumping discontinued, give reason: n/a

Pump intake set at (m/ft): 250

Pumping rate (l/min / GPM): 12

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 87.8

If flowing give rate (l/min / GPM): n/a

Recommended pump depth (m/ft): 270

Recommended pump rate (l/min / GPM): 12+

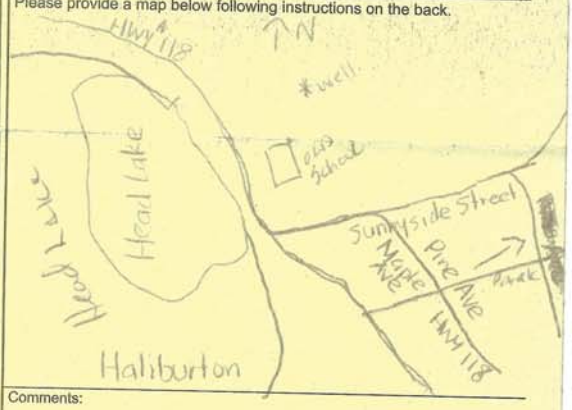
Well production (l/min / GPM): 12

Disinfected? ☑ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	37.8		87.8
1	41.5	1	80.2
2	45	2	76.9
3	48	3	74.2
4	50.5	4	71.8
5	52.8	5	69.8
10	61.2	10	62.2
15	67.1	15	58
20	71.3	20	53.8
25	74.7	25	51.3
30	77.4	30	49.2
40	81.5	40	46.4
50	84.5	50	43.6
60	87.8	60	40.8

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Debler Well Drilling	715012

Business Address (Street Number/Name)	Municipality
2369 Gelert Road	Minden

Province	Postal Code	Business E-mail Address
ONT	K0M 2K0	Svick2033@aol.com

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
7054157114216	Vick Sean

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
31031 9		2019/04/04

Well owner's information package delivered	Date Package Delivered	Ministry Use Only
☑ Yes ☐ No	2019/04/04	Audit No. Z303664
	Date Work Completed: 2019/04/03	Received

0506E (2014/11)

Contractor's Copy

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Ontario Environment

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11 2702777

COUNTY OR DISTRICT: HALIBURTON
TOWNSHIP BOROUGH CITY TOWN VILLAGE: DYSART
CON BLOCK TRACT SURVEY ETC: 0
LOT: PART 16 & 17
OWNER (SURNAME FIRST): [redacted]
ADDRESS: HALIBURTON SCHOOL OF FINE ARTS
DATE COMPLETED: 28 APRIL 88
21 CANADA EASTING: NORTHING: RR# 339 RC SUBDIVISION RC GRID CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH FEET FROM	DEPTH FEET TO
BROWN	SOIL		TOP SOIL	0'	1'
BROWN	CLAY	SAND	LOOSE	1'	18'
GREY	CLAY	STONES	GLACIAL TILL	18'	24'
BROWN	SANDY SILT	BOULDERS	LOOSE & SATURATED	24'	26'
GRAY BLACK	GRANITE	-	FRACTURED	26	30
GRAY	GRANITE	-	TRACE	30	34
GRAY BLACK	GRANITE		TRACE	34	197

31
32

41 WATER RECORD

WATER FOUND AT FEET	KIND OF WATER
16-30	1 ☑ FRESH 5 ☐ SULPHUR; 2 ☐ SALTY 6 ☐ MINERAL
160-16	1 ☑ FRESH 5 ☐ SULPHUR; 2 ☐ SALTY 6 ☐ MINERAL
	1 ☐ FRESH 5 ☐ SULPHUR; 2 ☐ SALTY 6 ☐ MINERAL
	1 ☐ FRESH 5 ☐ SULPHUR; 2 ☐ SALTY 6 ☐ MINERAL
	1 ☐ FRESH 5 ☐ SULPHUR; 2 ☐ SALTY 6 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH FEET FROM	DEPTH FEET TO
6	1 ☑ STEEL; 2 ☐ GALVANIZED; 3 ☐ CONCRETE; 4 ☐ OPEN HOLE	188	0'	26'
6 1/16	1 ☐ STEEL; 2 ☐ GALVANIZED; 3 ☐ CONCRETE; 5 ☑ OPEN HOLE		26'	197
	1 ☐ STEEL; 2 ☐ GALVANIZED; 3 ☐ CONCRETE; 4 ☐ OPEN HOLE			

SCREEN

SLOT NO. OF OPENING | DIAM. | LENGTH
MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN

61 PLUGGING & SEALING RECORD

DEPTH SET AT FEET FROM	TO	MATERIAL AND TYPE
0	21'	BENTAL

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☑ BAILED — AIR
PUMPING RATE: 4½ GPM
DURATION OF PUMPING: 3 HOURS 0 MINUTES

STATIC LEVEL	WATER LEVEL END OF PUMPING
16' FEET	160 FEET

WATER LEVELS DURING: 1 ☑ PUMPING 2 ☐ RECOVERY

10 MINUTES	20 MINUTES	30 MINUTES	40 MINUTES
80 FEET	160 FEET	160 FEET	160 FEET

FLOWING RATE GPM:
PUMP RATE AT END OF TEST: 192 GPM
WATER AT END OF TEST: 1 ☑ CLEAR 2 ☐ CLOUDY
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☑ DEEP
RECOMMENDED PUMP SETTING: 185 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

WATER USE

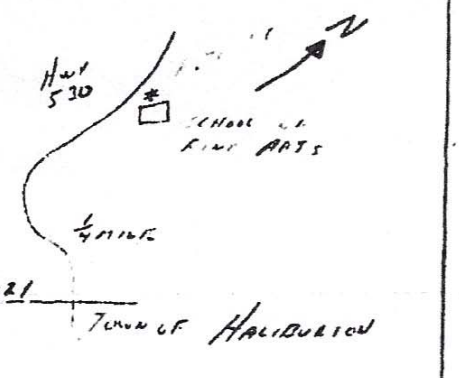
1 ☐ DOMESTIC; 2 ☐ STOCK; 3 ☐ IRRIGATION; 4 ☐ INDUSTRIAL; 5 ☑ COMMERCIAL SCHOOL; 6 ☐ MUNICIPAL; 7 ☐ PUBLIC SUPPLY; 8 ☐ COOLING OR AIR CONDITIONING; OTHER; 9 ☐ NOT USED

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: ALBRATCT'S LINDSAY ONT.
LICENCE NUMBER
ADDRESS
NAME OF DRILLER OR BORER: GORDON BAILEY
LICENCE NUMBER: T-0222
SIGNATURE OF CONTRACTOR
SUBMISSION DATE: DAY 4 MO MAY YR 88

OFFICE USE ONLY

DATA SOURCE: CONTRACTOR
DATE RECEIVED: MAY 02 1988
DATE OF INSPECTION
INSPECTOR
REMARKS

CSS.ES

MINISTRY OF THE ENVIRONMENT COPY

FORM NO 0506-4-77 FORM 7

Dennis Debler Drilling Ltd.
RR 2
Haliburton, Ontario K0M 1S0

JUN 2 4 2008

M.O.E. LICENCED CONTRACTOR
WATER WELL [redacted] EVALUATION

DATE: 12.06.2008	PHONE: 647 477 8463	
CONTACT PERSON: PETER - SYMBOL COMMUNITIES INC.		
LOT #	CONC #	PLAN #
TWP: DYSART	COUNTY: HALIBURTON	
STREET: # 3 SUNNYSIDE STREET		
TOWN/CITY: HALIBURTON		
OWNER:	BUYER:	
ORIGINAL OWNER: Former SR. SANFORD FLEMMING COLLEGE		

ORIGINAL WELL RECORD (If available): N/A		PUMP EQUIPMENT TODAY:			
Date Drilled (M / D / Y):		Type:	Make:		HP:
Diam:	Depth:	Model:			
Static Level:	Flow Rate:	Pit:	Pitless:	Other:	
Pumping Level:		Drop Pipe Dia:	Mat:		Depth:
Screen Length:	Slot #:	Tank Model:	Size:		Type:

TEST PUMP RECORD

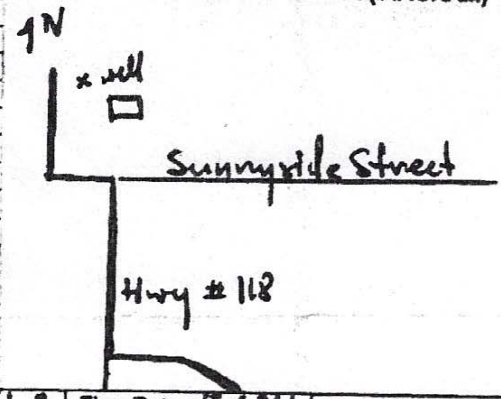
E Time:	Water Level (Pumping)	Water Level (Recovery)
0 Min: static	5.65 m	56.00 m
1:		
2:		
3:		
4:		
5:	9.05 m	49.30 m
6:		
8:		
10:	15.80 m	42.28 m
12:		
15:	24.80 m	35.10 m
20:	33.41 m	31.60 m
25:	41.53 m	27.54 m
30:	48.20 m	23.56 m
40:	60.20 m	13.91 m
50:		12.28 m
60:		7.13 m

EQUIPMENT EVALUATION

Pump	Tank	Well Head	Pipe / Electrical

Key: (G) Good; (F) Fair; (P) Poor; (N) Needs Attention

LOCATION OF WELL (DIAGRAM)



Well Stats Today:	Static: 5.65m	Well Depth: 61.0m	Flow Rate: 5 GPM	Pumping Level: 60.2 m

15,35 LPM

WELL EVALUATION:

To Whom It May Concern:

From the test pumping results of this water well we have determined the following: The water level was 5.65 m. We test pumped at a rate of 44.42 LPM for 40 min and the water level dropped a total of 54.55 m to a pumping level of 60.2 m After stopping the pump, the level recovered to 7.13 m in 60 minutes. From this information, we believe the well can produce 5 GPM (15,35 LPM)

NOTES: Pump intake set at 200' (61 m)
Pumping rate 12 GPM
Pumping discontinued after 40 min (pumping rate too high for well field.)

Assessment Done By: Dennis Debler Signed: 16.06.2008

Appendix C
Property Owner Letter

CAMBIUM

Environmental

Geotechnical

Building Sciences

Construction Monitoring

Telephone
(866) 217.7900
(705) 742.7900

Facsimile
(705) 742.7907

Website
cambium-inc.com

Mailing Address
P.O. Box 325
52 Hunter Street East
Peterborough, ON
K9H 1G5

Locations
Peterborough
Kingston
Barrie
Oshawa

Laboratory
Peterborough

Professional Engineers Ontario

APGO

March 13, 2019

Dear Homeowner,

Cambium Inc. (Cambium) is completing a hydrogeological assessment of the property located at 1 Sunnyside Street (i.e., on the corner of Highway 118). The hydrogeological assessment will be in support of a proposed retirement residence.

The hydrogeological assessment will include drilling at least one additional well at the subject property and completing a 24 hour pumping test on the installed well(s). (A pumping test is completed by pumping water from a well at a constant rate and monitoring for influences at surrounding wells)

To determine if water withdrawal at the subject property influences surrounding groundwater users we would like to include your well in the hydraulic pumping test. With your permission, we will measure the well depth and water levels from your well during the hydraulic pumping test.

Water levels will be measured using cleaned and sterile water level monitoring equipment.

Including your well in the monitoring program is free of charge and the results will be made available to you upon completion.

If you wish to participate in the monitoring program or would like more information please contact Jeremy Tracey at 1-705-742-7900 ext. 226. Alternatively, you can call Cameron MacDougall at 1-705-742-7900 ext. 212.

Thank you.

Best regards,
Cambium Inc.

Cameron MacDougall, P.Geo.
Project Coordinator

P:\8700 to 8799\8786-001 Leeswood Construction - Hydrogeological Assessment and Water Treatment - Haliburton Retirement Residence\Background\2019-03-12 Residential Letter.docx

Appendix D
Aquifer Test Pro Analysis

Cambium Inc.
52 Hunter St. East
Peterborough, Ontatio, Canada
K9H 1G5

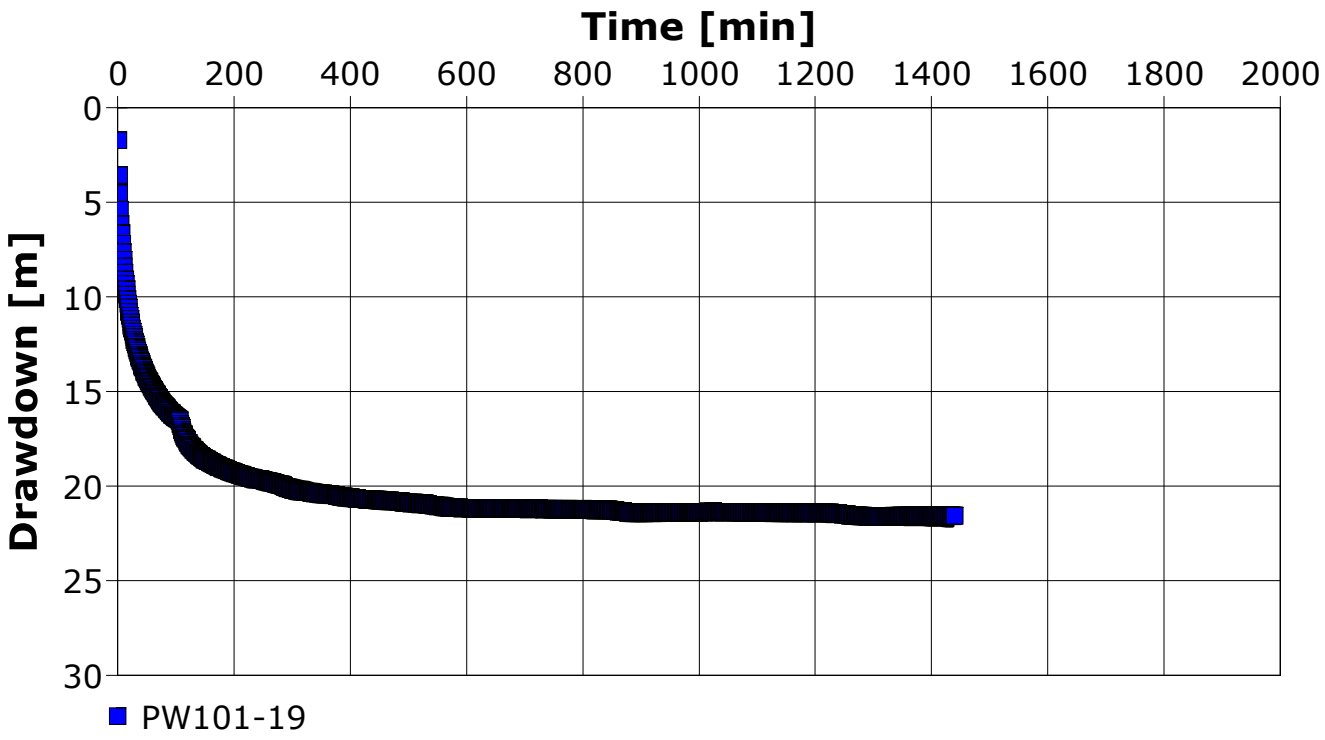
Pumping Test Analysis Report

Project: Hydrogeological Assessment

Number: 8786-001

Client: Leeswood Construction

Location: 1 Sunnyside Street, Haliburton	Pumping Test: PW101-19	Pumping Well: PW101-19
Test Conducted by: J. Tracey, M. Francis		Test Date: 4/10/19
Analysis Performed by: Cam MacDougall	PW101-19 Drawdown	Analysis Date: 4/15/19
Aquifer Thickness: 1.00 m	Discharge Rate: 0.05 [m³/min]	



Calculation using Moench Fracture Flow

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Storage coefficient	Sigma	Gamma	SF	Radial Distance to PW [m]
PW101-19	1.73×10^{-5}	1.73×10^{-5}	9.13×10^{-2}	7.08×10^{0}	2.34×10^{-5}	1.00×10^{-7}	0.16

Cambium Inc.
52 Hunter St. East
Peterborough, Ontatio, Canada
K9H 1G5

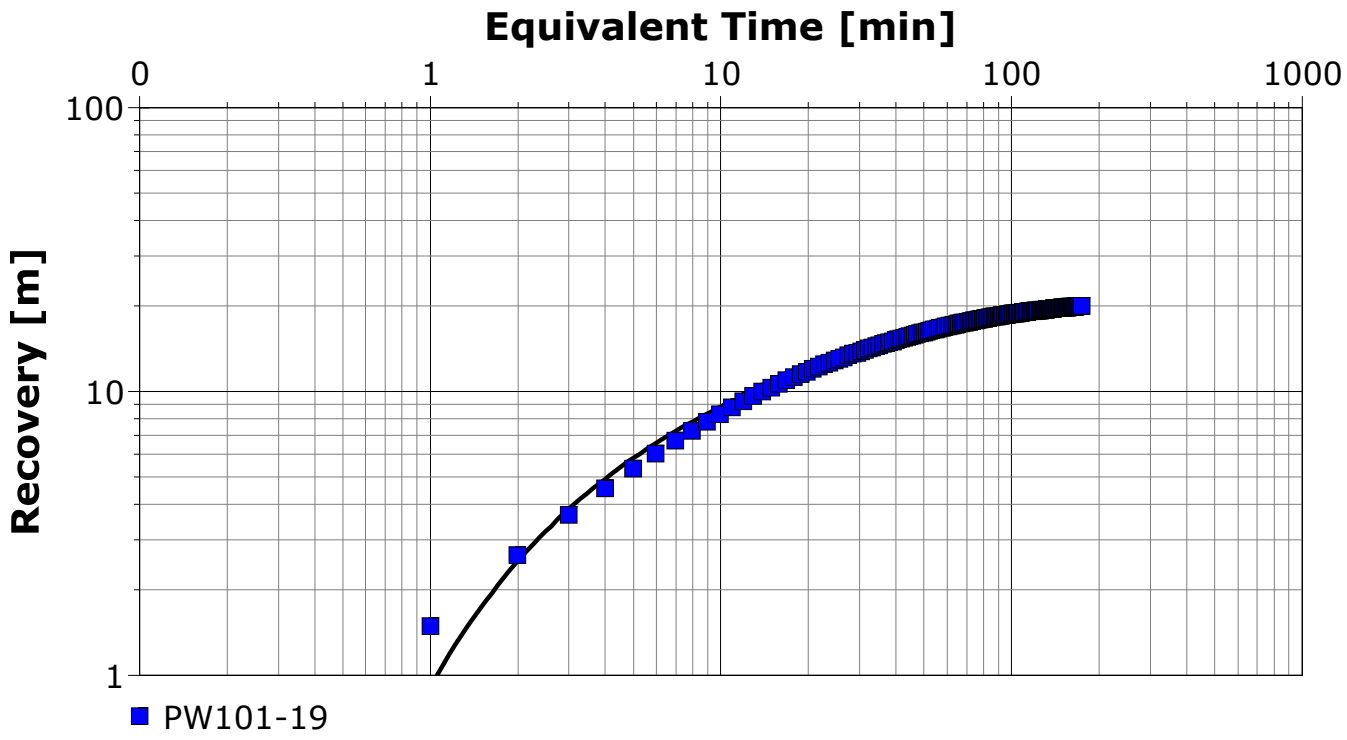
Pumping Test Analysis Report

Project: Hydrogeological Assessment

Number: 8786-001

Client: Leeswood Construction

Location: 1 Sunnyside Street, Haliburton	Pumping Test: PW101-19	Pumping Well: PW101-19
Test Conducted by: J. Tracey, M. Francis		Test Date: 4/10/19
Analysis Performed by: Cam MacDougall	PW101-19 (Recovery)	Analysis Date: 4/15/19
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.05 [m³/min]	



Calculation using AGARWAL + Moench Fracture Flow

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Storage coefficient	Sigma	Gamma	SF	Radial Distance to PW [m]
PW101-19	1.24×10^{-5}	1.24×10^{-5}	1.36×10^{-1}	1.58×10^{0}	1.44×10^{-1}	7.25×10^{-1}	0.16

Appendix E
Certificates of Analysis

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : 8786-001, Hailburton

22-April-2019

Cambium Inc.
Attn : Cameron MacDougall

52 Hunter Street East
Peterborough, ON
K9H 1G5, Canada

Phone: 705-742-7900
Fax:705-742-7907

Date Rec. : 11 April 2019
LR Report: **CA14386-APR19**
Reference: 8786-001, Cameron MacDougall

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Completed Date	4: Analysis Completed Time	5: MAC	6: AO/OG	7: MDL	8: Pump Well-1st Hr	9: Pump Well-Last Hr
Sample Date & Time								10-Apr-19 11:30	11-Apr-19 10:30
Temp Upon Receipt [°C]	---	---	---	---	---	---	---	7.0	7.0
Total Coliform [cfu/100mL]	11-Apr-19	17:00	12-Apr-19	15:24	0			0	0
E.Coli [cfu/100mL]	11-Apr-19	17:00	12-Apr-19	15:24	0			0	0
HPC [cfu/1mL]	11-Apr-19	16:45	15-Apr-19	09:20	---			0	3
TSS [mg/L]	15-Apr-19	10:06	17-Apr-19	11:09			2	10	< 2
UV Transmittance [%T]	12-Apr-19	14:31	15-Apr-19	10:04	---	---		95.8	97.6
Alkalinity [mg/L as CaCO3]	12-Apr-19	10:32	12-Apr-19	15:40	--	30-500		107	107
Temperature @ pH [°C]	12-Apr-19	10:32	12-Apr-19	15:40				24.0	24.1
pH [no unit]	12-Apr-19	10:32	12-Apr-19	15:40	---	6.5-8.5		8.19	8.09
F [mg/L]	12-Apr-19	08:47	15-Apr-19	11:53	---	---	0.06	1.19	1.37
Colour [TCU]	12-Apr-19	10:26	12-Apr-19	14:15	--	5	3	3 <MDL	3 <MDL
Conductivity [uS/cm]	12-Apr-19	10:32	15-Apr-19	15:55	---	---	2	389	457
Turbidity [NTU]	11-Apr-19	21:18	15-Apr-19	10:27	1	5	0.10	1.13	0.15
Organic N [mg/L]	12-Apr-19	17:15	16-Apr-19	15:42	---	0.15	0.01	0.08	0.10
TKN [as N mg/L]	12-Apr-19	17:15	16-Apr-19	15:41	---	---	0.05	0.10	0.12
NH3+NH4 [as N mg/L]	11-Apr-19	20:00	12-Apr-19	09:23	---	---	0.04	< 0.04	< 0.04

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Test method information available upon request. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : 8786-001, Hailburton
LR Report : **CA14386-APR19**

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Completed Date	4: Analysis Completed Time	5: MAC	6: AO/OG	7: MDL	8: Pump Well-1st Hr	9: Pump Well-Last Hr
TOC [mg/L]	11-Apr-19	21:09	15-Apr-19	14:58			1	1	< 1
DOC [mg/L]	11-Apr-19	21:09	15-Apr-19	14:58	--	5	1	< 1	< 1
4AAP-Phenolics [ug/L]	12-Apr-19	10:15	15-Apr-19	15:55	---	---	2	< 2	< 2
H2S [ug/L]	17-Apr-19	09:25	18-Apr-19	08:00			6	< 6	< 6
Sulphide [µg/L]	17-Apr-19	09:25	18-Apr-19	08:00		50	6	< 6	< 6
Cl [mg/L]	16-Apr-19	14:29	17-Apr-19	15:16	--	250	1	17	3
SO4 [mg/L]	16-Apr-19	14:37	17-Apr-19	15:16	--	500	2	59	110
NO2 [as N mg/L]	15-Apr-19	14:01	16-Apr-19	10:32	1	---	0.003	<0.003	<0.003
NO3 [as N mg/L]	15-Apr-19	14:01	16-Apr-19	10:32	10	---	0.006	0.006	<0.006
NO2+NO3 [as N mg/L]	15-Apr-19	14:01	16-Apr-19	10:32	---	---	0.006	0.006	<0.006
Tannin+Lignin [mg phenol/L]	16-Apr-19	08:09	17-Apr-19	22:18	---	---	0.05	0.09	0.16
Hardness (diss) [mg/L as CaCO3]	18-Apr-19	10:35	22-Apr-19	11:08	--	80-100	0.05	162	222
B (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	5	---	---	0.054	0.091
Ca (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	59.3	84.5
Fe (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	0.3	---	0.072	< 0.007
K (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	2.24	1.70
Mg (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	3.42	2.58
Na (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	20*	200	---	9.77	4.84
Sb (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	0.006	---	---	< 0.0009	< 0.0009
As (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	0.025	---	---	0.0003	0.0002
Ba (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	1	---	---	0.03034	0.01874
Be (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	0.000007	< 0.000007
Bi (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	< 0.000007	< 0.000007
Cd (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	0.005	---	---	< 0.000003	< 0.000003
Co (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	0.000056	0.000012
Cr (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	0.05	---	---	0.00017	< 0.00008
Cu (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	1	---	0.0094	0.0020
Mn (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	--	0.05	---	0.0133	0.0361
Mo (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	0.0112	0.00910
Ni (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	0.0002	< 0.0001
P (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	< 0.003	< 0.003

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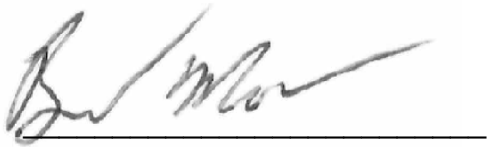
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Test method information available upon request. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Project : 8786-001, Hailburton
LR Report : **CA14386-APR19**

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Completed Date	4: Analysis Completed Time	5: MAC	6: AO/OG	7: MDL	8: Pump Well-1st Hr	9: Pump Well-Last Hr
Pb (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	0.01	---	---	0.00018	0.00007
Se (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	0.01	---	---	0.00879	0.00015
Ag (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	< 0.00005	< 0.00005
Sr (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	2.03	3.50
Tl (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	< 0.000005	< 0.000005
Sn (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	0.00022	0.00008
Ti (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	0.00345	0.00008
U (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	0.02	---	---	0.0184	0.00934
V (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	---	---	---	0.00698	0.00107
Zn (diss) [mg/L]	18-Apr-19	10:35	22-Apr-19	11:08	--	5	---	0.006	0.003
Cation Sum [meq/L]	---	---	---	---	---	---	---	3.77	4.77
Anion Sum [meq/L]	---	---	---	---	---	---	---	3.91	4.58
Anion-Cation Balance [% difference]	---	---	---	---	---	---	---	-1.73	1.94
Ion Ratio	---	---	---	---	---	---	---	0.97	1.04
TDS (calculated) [mg/L]	---	---	---	---	---	---	---	216	272
Conductivity (calc) [uS/cm]	---	---	---	---	---	---	---	384	467
Langelier's Index [@ 4° C]	---	---	---	---	---	---	---	0.05	0.1
Saturation pH [pHs @ 4°C]	---	---	---	---	---	---	---	8.14	7.99



Brad Moore Hon. B.Sc
Project Specialist,
Environment, Health & Safety

OnLine LIMS

0001721937

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Test method information available upon request. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Appendix F
Field Analyses

Field Data

	First Sample	Second Sample
Date Collected	10-Apr-19	11-Apr-19
Time Collected	11:30	10:30
Temperature (°C)	8.7	5.9
pH	8.03	7.98
Conductivity (uS)	420	500
ORP (mV)	98	-

Time	Turbidity
10-Apr-19	
11:30	3.89
14:10	4.87
18:20	0.99
22:50	0.59
11-Apr-19	
01:48	0.56
04:12	0.53
10:30	0.71