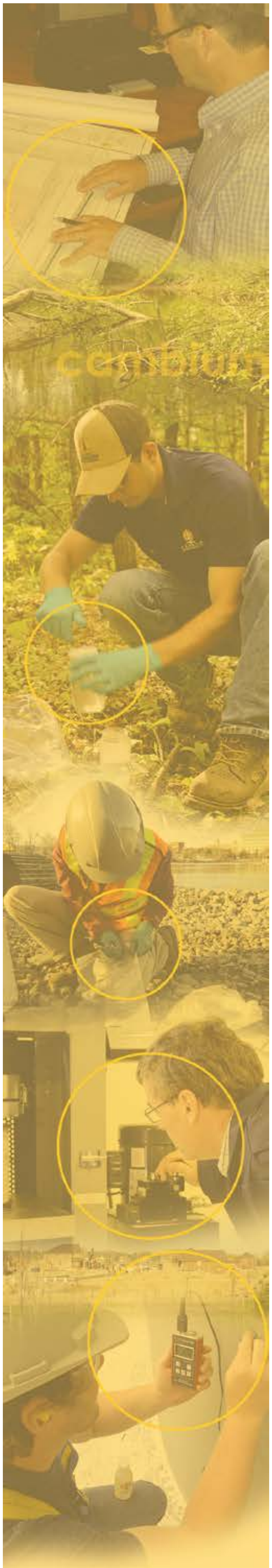


Hydrogeological Assessment - Development at Buffalo Bay

Cambium Reference No.: 3874-001

2016-04-07

Prepared for: Orion Development Properties Inc. c/o EcoVue

CAMBIUM

Cambium Inc.

P.O. Box 325
52 Hunter Street East, Peterborough
Ontario, K9H 1G5

Telephone: (866) 217.7900
Facsimile: (705) 742.7907

cambium-inc.com

EXECUTIVE SUMMARY

Cambium Inc. was retained by Orion Development Properties Inc. (the Client) to complete a hydrogeological assessment of the property located on Lot 17, Concession 14, in the Municipality of Trent Lakes, County of Peterborough (referred to hereafter as the Site). The Client plans to develop the Site and sub-divide the property into 16 residential lots, therefore a hydrogeological assessment, including a D-5-5 assessment and a D-5-4 assessment, were completed.

The work program included the advancement of 11 test pits across the Site from which soils were texturally classified, the depth to bedrock or groundwater measured and samples collected and submitted for grain size analysis.

Three test wells were installed on-site for the purpose of hydraulic testing and groundwater sampling (PW101-16, PW102-16 and PW103-16). Each of the wells were installed in fractured granitic bedrock. One 6-hour pumping test was completed on each of the test wells over the span of three days. At the end of each pumping test a water characterization sample was collected and submitted to SGS Lakefield for analysis. It was determined that the fractures into which PW101-16 and PW102-16 were installed can sustain water withdrawal and yield the minimum water volumes described in Procedure D-5-5. Well PW103-16 could not sustain the minimum required volumes prescribed by Procedure D-5-5 but it can sustain a water withdrawal at a lower rate and will fulfill daily water demands if the system is fitted with a storage system.

The water withdrawal from the three wells did not induce a significant amount of drawdown in the monitoring wells (the two wells not being pumped acted as monitoring wells for the well being pumped) during the duration of each pumping test. Additionally the calculated Zone Of Influence from each well encompassed one or more residential properties, however the distance at which the properties are located from the wells would result in a minimal amount of drawdown.

Aquifer properties were calculated using Aquifer Test software. It was determined that the fractured granitic bedrock aquifer into which the wells have been installed is typical of granitic aquifers and exhibits a low porosity and hydraulic conductivity.

The water quality analysis of the three wells indicated that the water quality was relatively good, however the Heterotrophic Plate Count was considered high in each sample. This indicates that the aquifer is favourable environment for the growth of heterotrophic bacteria. An anti-bacterial treatment system (at a minimum) is recommended to be installed on the water supply of each dwelling.

As per procedure D-5-4 a predictive analysis of the nitrate concentrations migrating off-Site was completed. It was calculated that the concentration of nitrate was less than 10 mg/L. Therefore the proposed number of lots to be built on-Site should be acceptable. A conceptual plan of the Site development indicates that there should be am ample amount of space for the septic systems, dwellings and water supply wells.

Respectfully submitted,

Cambium Inc.

Cameron MacDougall, B.Sc. Hon, G.I.T. Technologist	Kevin Warner, M.Sc. P.Geo. (Ltd) Senior Project Manager

KDW/cjm

Encl.

P:\3800 to 3899\3874-001 EcoVue Consulting Services Inc. - Hydrogeological Assessment for Subdivision - Buffalo Bay Property\Deliverables\REPORT - Hydrogeological Assessment\Final\2016-04-07 Buffalo Bay Hydrogeological Assessment-Edits - Copy.docx

TABLE OF CONTENTS

REFERENCES

LIST OF APPENDED FIGURES

LIST OF APPENDED TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

Cambium Inc. was retained by Orion Development Properties Inc. (the Client) to complete a hydrogeological assessment of the property located on Lot 17, Concession 14, in the Municipality of Trent Lakes, County of Peterborough (referred to hereafter as the Site). The Client plans to develop the Site and sub-divide the property into 16 residential lots; therefore a hydrogeological assessment following Ministry of the Environment and Climate Change (MOECC) Procedures D-5-4 and D-5-5 was undertaken.

1.1 SITE DESCRIPTION

The Site is located on Lot 17, Concession 14, in the Municipality of Trent Lakes, county of Peterborough. The regional location of the Site is depicted on Figure 1. The Site does not currently have a civil address.

The Site encompasses an area approximately 12.8 hectares and surrounds a small waterbody named Buffalo Bay, which is part of Pigeon Lake. The Site is bordered to the east by Nichols Cove Road and is accessed by Fire Route 95. The southwestern portion of the Site borders Fire Route 96B, however there is no direct access to the Site from this road.

A high bedrock ridge is a dominant feature of the landscape in the eastern portion of the Site; the bedrock ridge generally trends north/south. The ridge is found either as exposed bedrock outcrop, or overlain by shallow, sandy soils. In the western and southwestern portions of the Site the soils are generally thicker, however the topography is hummocky and exhibits sporadic bedrock outcrops.

A hydro corridor exists on the Site and extends from Nichols Cove Road northwest through the Site (see Figure 2 for the location of the hydro corridor).

2.0 METHODOLOGY

To complete the hydrogeological assessment eleven test-pits were excavated across the Site, three (3) test wells were installed and six (6) hour pumping tests were completed on each well. The methodology of each of task is described below.

2.1 TEST PIT INVESTIGATION

On November 5, 2015 a test pitting investigation was completed by Cambium to determine the subsurface conditions across the property. W&G Landscaping was contracted to provide a tracked excavator and an operator to complete the work. A total of 11 test pits were excavated across the Site. Test pits were excavated to a maximum depth of 2.3 metres below ground surface (mBGS), to groundwater or to the bedrock contact. The location of each test pits is displayed on Figure 2.

Soil samples were logged for soil type, moisture content and odour. Samples were collected from each test pit is plastic bags and retained for future grain size analysis. Test pit logs are attached as Appendix A.

Three soil samples were submitted for grain size analysis, the results of which are discussed in Section 3.0.

2.2 TEST WELL INSTALLATION

Three (3) test wells were installed across the Site in December of 2015 and January of 2016 (labelled as PW101-16, PW102-16 and PW103-16). The test wells were completed as six (6) inch (0.152 m) diameter drilled wells, advanced with steel casings and installed as open hole wells. The test wells were installed by Burgess Wm & Son Well Drilling (licenced). The logs of the completed test wells are attached as Appendix B.

2.3 PUMPING TESTS

On January 26, 27 and 28 of 2016 Cambium staff were on-Site to complete a six (6) hour pumping test on each of the test wells. A single pumping test was completed each day. During the pumping tests the two (2) wells not being pumped were monitored for any drawdown. To record drawdown Solinst Level Logger (Loggers) pressure transducers were installed in each of the three (3) wells and recorded water levels for the duration of the three pumping tests. Additionally a Logger was utilized for barometric compensation. Manual water level measurements were also taken throughout the testing. Upon completion of the hydraulic pumping tests the wells were allowed to recover to (if possible) to approximately 95% of their original static water level.

2.4 WATER QUALITY SAMPLING

Water characterization sampling was completed on each of the three (3) pumping wells. Samples were collected and analyzed for the parameters outlined in Table 1. One (1) sample was collected from each well within the final

60 minutes of the pumping test. Field analyses were also completed on all samples collected, which included the temperature (°C), pH and conductivity (mS). The results of the analyses are attached as Table 2.

The samples were submitted to SGS Environmental Analytical Laboratory in Lakefield, Ontario (SGS) for analysis. 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 SGS. The Certificates of Analysis are attached as Appendix C.

2.5 AQUIFER TEST ANALYSIS

To determine aquifer properties the data collected from the wells during each of the six (6) hour tests were imported into AquiferTest Pro (Version:2011.1). The model and results of the analysis are discussed in more detail in Section 4.3. The results of the aquifer test analysis have been included as Appendix D.

2.6 PREDICTIVE ANALYSIS

The predictive analysis for nitrate migrating offsite is discussed in detail in Section 5.0.

3.0 GEOLOGICAL AND HYDROGEOLOGICAL SETTING

3.1 TOPOGRAPHY AND DRAINAGE

The topography of the Site varies greatly, as did the subsurface conditions encountered during the test pit investigation. As mentioned in previous sections of this report, a large bedrock ridge exists in the eastern portion of the Site that trends north/south. In several areas the ridge is exposed as a bare bedrock surface. Where the bedrock ridge is not exposed it is covered by a thin, discontinuous layer of organic material. Therefore it has been assumed that there is not a significant degree of surface water percolation in this area of the Site and that the majority of the rain/meltwater is shed as surface water run-off. The ridge generally sheds run-off towards Buffalo Bay, however there is small stream that bisects the bedrock ridge and collects run-off from the eastern slopes of the ridge and discharges it into Buffalo Bay.

In the western/southwestern portion of the Site (considered to be those portions of the Site west of lot 10) the soils are considerably thicker than those encountered in the eastern portion of the Site. The topography in the western and southwestern portions of the Site is hummocky and exhibits sporadic bedrock outcrops. Since the soils in this area of the Site are in general thicker than those encountered in the eastern portion of the Site it is anticipated that a greater depth of infiltration will occur in this area of the Site. However any run-off generated in this area will still be shed towards Buffalo Bay.

According to a survey completed by Coe, Fisher, Cameron, Ontario Land Surveyors, the elevations of the Site ranges between approximately 246.5 metres above sea level (mASL) and 255.0 mASL.

The surrounding properties have either been developed as residences or have been left un-developed.

3.2 GEOLOGICAL CONDITIONS

The bedrock found at the Site and surrounding area are characterized as Neo to Mesoproterozoic and part of the Grenville Supergroup and Flinton Group (classified as mafic to felsic metavolcanic rock: flows, tuffs, breccias, minor iron formation, minor metasedimentary rocks; including reworked pyroclastic units, amphibolite) (Ontario Geological Survey, 1991).

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

Till: Undifferentiated, predominantly sand matrix, extremely stony, boulder and high n total matrix carbonate, often associated with stratifies sediments

Precambrian Bedrock: Undifferentiated igneous and metamorphic rock, exposed at surface or covered by a discontinuous, thin layer of drift

As mentioned previously, the soil encountered at the site varied considerably between the eastern and western portions of the Site.

Test pits TP101, TP102, TP103 and TP104 were all located in an area where a bare bedrock ridge was present. Test pits TP102 and TP103 both intercepted bedrock within 0.35 m of the ground surface. An additional test pit was also advanced at each of these locations in an attempt to locate deeper soils. The only soils encountered at test pits TP102 and TP103 were organic in nature.

Test pits TP101 and TP104 both encountered bedrock at depths of 1.70 mBGS and 0.76 mBGS respectively. Both test pits encountered sand with some large angular boulders. Overlying the sand was organic soil ranging in thickness between 0.15 and 0.25 m.

The remaining test pits (TP105, TP106, TP107, TP108, TP109, TP110 and TP111) were located on the western portion of the Site and, in general, encountered deeper soils. The depth of soil ranged between 1.12 mBGS and greater than 2 mBGS where no assumed bedrock contact was encountered. Shallow soils were encountered at TP110a where bedrock was 0.051 mBGS and at TP108 where bedrock was encountered at 1.12 mBGS. In general the soils encountered in the western portion of the Site consisted primarily of sand and some large angular boulders. Groundwater was only encountered at TP106 at a depth of 2.10 mBGS. Borehole logs are attached as Appendix A.

In total, three (3) soil samples of the brown fine to coarse sand (which was found across the Site) were collected and submitted for grain size analysis. Soil samples from test pits TP101, TP106 and TP110 (b) were submitted for grain size analysis, additionally the sample collected from TP110 (b) was analyzed for silt/clay content. The results of the analyses are presented below:

TP101-1 (0.35 mBGS to1.70 mBGS)

- Classified in the field as a brown fine to medium sand, some boulders, silt and clay were present. 20% to 30% of the in-situ soil was comprised of boulder which could not be sampled. Grain size analysis confirms that the sample was comprised of 12% gravel, 72% sand and 16% silt and clay.

TP106-1 (0.30 mBGS to 2.00 mBGS)

- Classified in the field as a brown fine to coarse sand, some silt and trave gravel. 10% to 15% of the in-situ soil was comprised of boulder which could not be sampled. Grain size analysis confirms that the sample was comprised of 8% gravel, 64% sand and 28% silt and clay.

TP110-1 (b) (0.23 mBGS to 2.30 mBGS)

- Classified in the field as a brown fine to coarse sand, some silt. Grain size analysis confirms that the sample was comprised of 3% gravel, 58% sand and 33% silt and 6% clay.

The samples tested from TP 101 and TP106 were not analyzed for their respective silt and clay content, however since the grain size distribution of the coarser materials are similar between the three (3) samples, it has been assumed that the silt and clay content is also similar. Therefore the overburden soil on-Site (where present) is considered to range between the S.P. and the S.M. classification, and exhibit a range of percolation times between 8 min/cm and 12 min/cm. The results of the grain size analyses are attached as Appendix C.

3.3 HYDROGEOLOGICAL CONDITIONS

Water was only encountered during the advancement of two (2) test-pits during the subsurface investigation. At test pit TP106 groundwater was encountered at 2.10 mBGS and at test pit TP110b groundwater was encountered at 2.30 mBGS.

According to available water well records (retrieved through the MOECC water well database (MOECC, 2016)) there are 11 drilled water supply wells located within approximately 500 m of the Site. Each of the water wells have been installed in granitic bedrock. The depths at which water was found ranged between 3.66 mBGS and 91 mBGS, which is typical for granitic bedrock considering fractures vary greatly in depth, orientation and hydraulic conductivity in this type of bedrock formation.

There are certain areas across the Site where a discontinuous, shallow aquifer is present. It has been confirmed that the shallow receiving aquifer is present in the areas of TP106 and TP110 b (during the excavation of the test pits), however it is also likely to be present near drainage courses and near the shores of Buffalo Bay. It has been assumed that this aquifer varies greatly in areal extent and saturated thickness since it is expected to be recharged primarily from precipitation and/or surface water infiltration.

As evidenced by the surrounding well records and the wells installed on-Site, there is a deeper aquifer found within the granitic bedrock in the area. Pumping wells PW101-16 and PW102-16 were installed in the bedrock aquifer at similar depths (being 30.49 mBGS and 42.68 mBGS, respectively). Pumping well PW103-16 was also installed within the bedrock aquifer, but was installed much deeper than the other two wells at a depth of 97.56 mBGS. The wells installed on-Site are characteristic of the granitic bedrock aquifer into which the surrounding wells have been installed into.

Considering that the shallow aquifer found on-Site had been determined to be unconfined and discontinuous it may act as the primary receiver of effluent generated from septic systems installed on-Site (in certain areas). However in many areas the effluent will percolate through the unsaturated soils, contact the granitic bedrock and (likely) migrate laterally towards Buffalo Bay. This lateral migration will also occur within the shallow discontinuous aquifer where it contacts the granitic bedrock.

4.0 HYDRAULIC PUMPING TESTS – RESULTS AND DISCUSSION

On January 26, 27 and 28 of 2016 Cambium staff were on-Site to undertake three (3) pumping tests, each lasting at least six (6) hours (360 minutes) in duration. One pumping test was completed per day and the tests were completed sequentially on pumping wells PW103-15, PW102-15 and PW101-15 (see Figure 2). The following table outlines the various details of each pumping test and when the tests were started and stopped.

Well	TOP Elevation (mASL)	Static Water Level (mASL)	Depth of Well (mTOP)	Depth of Pump (mTOP)	Date Started (2016)	Time Started	Time Stopped	Duration (mins)	Flow Rate (Lpm)
PW103-15	247.90	244.99	97.56	96.00	January 26	09:04	15:43	399	Variable
PW101-15	251.93	247.88	43.21	36.59	January 27	09:03	15:15	372	25
PW102-15	250.79	247.92	31.02	29.50	January 28	09:37	15:37	360	25

Note: The times outlined in the table above and the rest of this report are in military time.

As per the table above, the pumping test completed on each well was started in the morning of each day. At the end of each pumping test the wells were allowed to recover overnight. The loggers remained installed in the pumping wells for the three (3) days of pumping (and one (1) day after the last pumping test to allow for recovery). The water elevations recorded over the three day period from each of the pumping wells has been plotted on Figure 3.

The table below summarizes the results of each of the pumping tests.

Well	Static Water Level (mTOP)	Water Level at End of Test (mTOP)	Total Drawdown (m)	Available Drawdown (to bottom of well) (m)	Volume of water pumped (L)
PW103-15	2.92	94.45	91.53	3.11	3,241
PW101-15	4.05	10.95	6.90	32.26	9,300
PW102-15	2.87	5.19	2.32	25.83	9,000

4.1 PUMPING TESTS

The pumping tests on wells PW101-16 and PW102-16 and PW103-16 were completed sequentially. Well PW103-16 was tested on January 26, well PW101-16 was tested on January 27 and well PW102-16 was tested on January 28. During each test, the two wells not being pumped were utilized as monitoring wells. The pumping tests are discussed in chronological order in the following sections.

4.1.1 JANUARY 26, 2016 – TEST WELL: PW103-16

On January 26, 2016 Cambium Staff were on-Site to undertake the pumping test on well PW103-16. The test commenced at 09:04. Prior to the commencement of the test the static water level was measured to be 2.92 mTOP (static water elevation was calculated to be 244.98 mASL).

The discharge was arbitrarily set at 3 imperial gallons per minute (ipgm) (13.7 litres per minute (Lpm)).

Within 72 minutes (72 minutes elapsed into the pumping test) approximately 22 m of drawdown had occurred. Since the head in the well had been reduced the discharge naturally lowered to 1.80 ipgm (8.2 Lpm). At this time the discharge rate was increased to 2.5 ipgm (11.4 Lpm). Within 137 minutes (209 minutes elapsed into the test) of the rate change, the pumping rate had naturally lowered to 2 igpm (9.1 Lpm). At this point the water level began to drop rapidly and reliable water level measurements could not be taken since the discharge line was interfering with the relocation of the water level probe. Between 209 and 234 elapsed minutes into the test the discharge rate was lowered to decrease the rate of decline in the pumping level, however the exact rate at which the discharge was lowered to could not be measured. At 234 elapsed minutes into the test, the discharge rate was measured to be 1.5 ipgm (6.8 Lpm). Between 234 elapsed minutes into the test and 399 elapsed minutes (end of test was at 15:43 on January 26, 2016) the pumping level was measured and the flow rate naturally lowered to 1 igpm (4.6 Lpm). At the end of the test 91.53 m of drawdown had occurred in the well. The available drawdown remaining at the end of the pumping test was calculated to be 3.11 m (to the bottom of the well). The drawdown and recovery response of this well has been plotted on Figure 3. Note that the data logger installed in this well only had a capability of recording the change in head for 30 m. The logger was hung at a depth of 24 mTOP (for a degree of safety the logger was not hung at its maximum head depth to accommodate for changes in atmospheric pressure). Therefore the logger could not record any water level below the depth of approximately 24 mTOP (223.80 mASL). Both logger data recordings and the manual water levels have been plotted on Figure 3 to provide a composite recording of the drawdown and recovery response in the well. The well recovered to 95% of the static water level at 04:09 on January 27, 2016 (746 minutes elapsed from the end of the pumping test) and recovered to 100% at 08:48 on the same day (1,025 minutes elapsed from the end of the pumping test).

4.1.1.1 JANUARY 26, 2016 – MONITORING WELL RESPONSE

Pumping wells PW101-16 and PW102-16 were monitored for the duration of the pumping test on January 26, 2015. The water levels in both wells did lower by two (2) to three (3) centimetres each by the end of the test, and continued to lower after the test had completed. The continual drawdown observed at both of the monitoring wells was likely caused by the sustained drawdown cone present from the water withdrawal at PW103-15. The fractures into which PW103-15 has been installed were observed to not be very conductive, therefore a head differential between the pumping well and the monitoring wells was sustained throughout the test.

Considering that the fractures did not provide enough water to facilitate a rapid recovery in the pumping well, the head differential was sustained between the pumping well and the monitoring wells during the recovery period. Therefore the pumping water withdrawal from PW103-15 incurred a minor amount of drawdown in well PW101-16 and PW102-16 during and after the test.

A minor amount of water level fluctuation was observed from the monitoring wells after the pumping test had been completed. These fluctuations could have been caused by natural variations in the bedrock aquifer, or possibly by waves migrating through the bedrock aquifer. In either case, the maximum amount of drawdown observed from monitoring wells PW101-16 and PW102-16 was approximately 0.03 m and 0.01, respectively, neither of which is deemed to be significant considering the depth of the wells. The drawdown responses of the monitoring wells and pumping well have been plotted on Figure 4. The drawdown observed in wells PW101-16 and PW102-16 continued until the start of the pumping test the next day, therefore it is unknown when these wells would have recovered to 95% or 100% of the static water level. However, these drawdown responses are considered relatively insignificant.

4.1.2 JANUARY 27, 2016 – TEST WELL: PW101-16

On January 27, 2016 Cambium Staff were on-Site to complete the pumping test on well PW101-16. The test commenced at 09:03. Prior to the commencement of the test the static water level was measured to be 2.87 mTOP (static water elevation was calculated to be 247.88 mASL).

The discharge rate was arbitrarily set at 5.5 ipgm (25 Lpm) for the duration of the test.

Continuous drawdown was observed throughout the pumping test and steady state conditions were never achieved. The drawdown response from this well has been plotted on Figure 3. At the end of the pumping test a total drawdown of 6.90 m was observed (indicating that there was an available drawdown of 32.26 m to the bottom of the well). The pumping test lasted a total of 372 minutes and was concluded at 15:15 on January 27, 2016. The recovery in the well was recorded overnight and into the next day and reached 94% of the static just before the start of the pumping test at PW102-16 on January 28, 2016 (an elapsed time of 1,104 minutes since the end of the pumping test).

4.1.2.1 JANUARY 27, 2016 – MONITORING WELL RESPONSE

Pumping wells PW102-16 and PW103-16 were monitored for the duration of the pumping test on January 27, 2015. Drawdown was not observed in monitoring well PW103-16 during this pumping test. Monitoring well PW102-16 exhibited a drawdown of approximately 0.17m by the end of the pumping test. Drawdown continued to occur in PW102-15 until approximately 16:19 (64 minutes elapsed from the end of the pumping test) at which time the maximum drawdown was measured to be 0.21 m (a theory of this phenomenon was described in Section 4.1.1.1.). Well PW102-16 was allowed to recover overnight and into the next day and achieved only 77% of static just prior to the pumping on this well on January 28, 2016 (1,040 minutes elapsed from when drawdown ceased in the well). The drawdown responses of these wells (in addition to PW101-16) have been attached as Figure 5.

4.1.3 JANUARY 28, 2016 – TEST WELL: PW102-16

On January 28, 2016 Cambium Staff were on-Site to complete the pumping test on well PW102-16. The test commenced at 09:37. Prior to the commencement of the test the static water level was measured to be 4.05 mTOP (static water elevation was calculated to be 247.92 mASL).

The discharge rate was arbitrarily set at 5.5 ipgm (25 Lpm).

Continuous drawdown was observed throughout the pumping test and steady state conditions were never achieved. The drawdown response from this well has been plotted on Figure 6. At the end of the pumping test a total drawdown of 2.32 m was observed (indicating that there was 25.83 m of available drawdown to the bottom of the well). The pumping test lasted a total of 360 minutes and was concluded at 15:37 on January 28, 2016. The recovery in the well was recorded overnight and into the next day and reached 95% of the static at 0:36 on January 29, 2016 (539 minutes elapsed since the end of the pumping test). The logger was removed from the well (at 8:22 am on January 29, 2016(1,005 elapsed minutes from the end of the pumping test)) the water level had recovered to 98 % of static.

4.1.2.1 JANUARY 28, 2016 – MONITORING WELL RESPONSE

Pumping wells PW101-16 and PW103-16 were monitored for the duration of the pumping test on January 28, 2016. There was no observed drawdown in monitoring well PW103-16 during the pumping test on this day. Monitoring well PW101-16 exhibited a drawdown of approximately 0.045 m at the end of the pumping test. Drawdown continued to occur in PW101-15 until approximately 16:11 (64 minutes elapsed from the end of the pumping test) at which time the maximum drawdown was measured to be 0.048 m (a theory of this phenomenon was described in Section 4.1.1.1.). Well PW101-16 was allowed to recover and achieved 100% of the static water level at 18:14 on January 28, 2016 (123 minutes elapsed since drawdown ceased in the well).

At the start of the pumping test at PW102-16 on January 28, 2016 the water level in PW101-16 was still recovering (see Figure 3) from the previous day's pumping test (the water level had recovered to 94% of static; which equated to a depth of 39 centimetres)). Therefore the drawdown calculated above for PW101-16 was from an artificial static water level that was still undergoing recovery. The actual drawdown that would be incurred from this well from a true static state would likely be slightly greater than the depth outlined above. Even though the true drawdown depth incurred at well PW101-16 would be slightly greater than the observed depth, it is not anticipated that the depth will be significant enough to warrant a concern. The drawdown responses of each well have been attached as Figure 6.

4.2 ZONE OF INFLUENCE

The subsequent sections discuss the zone of influence (ZOI) calculated to determine the area in which water withdrawal from the pumping wells would induce a depression of hydraulic head values in the bedrock aquifer. The ZOI was calculated for each pumping test separately. Each test is discussed chronologically in the following sections.

4.2.1 JANUARY 26, 2016 – ZONE OF INFLUENCE (TEST WELL: PW103-16)

The distances at which each of the monitoring wells are located from PW103-15 were plotted against the drawdown observed at the end of the test (the ZOI). The plot has been attached as Figure 7. As per Figure 7 the drawdown depths of the monitoring wells do not register on the plot since they are relatively small in comparison to the drawdown observed at PW103-15.

The fracture network which was intersected with PW103-16 was rather poor yielding, resulting in significant drawdown in the well during the pumping test (91.53m) at the low rate of 1 igpm. This resulted in an observed minimal drawdown in the two other wells monitored of 0.025 m (PW102-16) and 0.06 m (PW101-16). Considering a distance of 350 m between the two monitoring wells and the pumping well and the pumping level in PW103-16 during the pumping test, this has resulted into a potentially large zone of influence. As such, a straight line correlation between the drawdown in the pumping well PW103-16 and the other wells on-site is likely not accurate, resulting in grossly overestimating the zone of influence at closer distances to the pumping well. The actual zone of influence is likely limited to the poor yielding bedrock fractions near the pumping well and not as extensive as depicted on Figure 7.

4.2.2 JANUARY 27, 2016 – ZONE OF INFLUENCE (TEST WELL: PW101-16)

The ZOI plot for the January 27 pumping test was created in same fashion as was described in Section 4.2.1 (attached as Figure 8). Well PW103-16 was not included on this plot since no drawdown was observed in this well during the test. The following table details what the expected depth of drawdown will at specific distances away from the well after six (6) hours of pumping:

Timeframe	10 metres from well	100 metres from well	Variable
End of Test	2.50 m of drawdown	0.75 m of drawdown	0.0 m of drawdown 200 m from well

4.2.3 JANUARY 28, 2016 – ZONE OF INFLUENCE (TEST WELL: PW102-16)

The ZOI plot for the January 28 pumping test was created in same fashion as was described in Section 4.2.1. (attached as Figure 9). Well PW103-16 was not included on this plot since no drawdown was observed in this well during the test. The following table details what the expected depth of drawdown will at specific distances away from the well after six (6) hours of pumping:

Timeframe	10 metres from well	100 metres from well	Variable
End of Test	0.90 m of drawdown	0.15 m of drawdown	0.0 m of drawdown 200 m from well

4.3 AQUIFER TEST ANALYSIS

As discussed in Section 3.0, pumping wells PW101-16, PW102-16 and PW103-16 have been installed into the granitic bedrock aquifer at depths ranging between 30.49 mBGS and 97.56 mBGS.

To calculate the properties of the granitic bedrock aquifer two (2) analysis methods were utilized. To calculate localized aquifer properties at each of the pumping wells the Agarwal Method was used (Agarwal, 1980). To calculate bulk aquifer properties from each well when they acted as a monitoring well the Double Porosity Method (Moench, 1984) was utilized.

Both of the above mentioned methods calculate aquifer transmissivity (T, m^2/day) and hydraulic conductivity (K, m/day). However, only the Double Porosity Method can be used to calculate the storage coefficient (S, dimensionless). The aquifer properties are described below.

- **Hydraulic Conductivity (K) of the confined aquifer:** The hydraulic conductivity is the net velocity at which water travels through a water bearing unit. It is expressed as m/s (or m/day).
- **Transmissivity (T) of the confined aquifer**: Transmissivity can be described as the amount of water that can be transmitted horizontally through a unit width by the full saturated thickness of the aquifer under a hydraulic gradient of 1. It is expressed as m^2/s (or m^2/day) and is derived from the hydraulic conductivity and the saturated thickness of the aquifer (T = the saturated thickness of the aquifer x K) (Fetter, 2001).
- **Storativity (also referred to as the *storage coefficient*) (S) of the confined aquifer)**: The storage coefficient is described as the volume of water that a permeable unit will absorb or expel from storage per unit surface are per unit change in head. It is a dimensionless quantity, (Fetter, 2001). In an unconfined aquifer S is equal to the specific yield of the water bearing unit. Specific yield is denied as the column of water releases from storage by an unconfined aquifer per unit area of the aquifer per unit decline of the water table (Bear, 1979).

Hydraulic properties were calculated during the drawdown and recovery stages of each pumping and monitoring well during each test (when possible). However, in some instances the drawdown data was could not be used (i.e. the drawdown curve produced from the pumping test at PW103-16), or the recovery curve responded in an unexpected manner (i.e. the recovery curve of PW101-16 upon completion of the pumping test at PW103-16).

Well PW103-16 was not used as a monitoring well since no drawdown was observed in this well during the pumping tests during the pumping tests completed on the other two wells on-Site (PW101-16 and PW102-16). The results of the Aquifer Test analysis are attached as Appendix D and a summary of the calculated aquifer properties are outlined in the table below:

Date	Well Function	Well Label	Data Used	T (m²/d)	K (m/d)	S
January 26	Pumping Well	PW103-16	Recovery	2.03×10^{-1}	2.14×10^{-3}	-
	Monitoring Well	PW101-16	Drawdown	5.98×10^{1}	6.32×10^{-1}	3.48×10^{-5}
		PW102-16	Drawdown	1.32×10^{2}	1.36×10^{0}	9.10×10^{-5}
January 27	Pumping Well	PW101-16	Drawdown	6.50×10^{-1}	1.68×10^{-2}	-
			Recovery	2.32×10^{0}	6.00×10^{-2}	-
	Monitoring Well	PW102-16	Drawdown	3.00×10^{0}	7.76×10^{-2}	3.48×10^{-5}
			Recovery	9.05×10^{-1}	2.34×10^{-2}	3.48×10^{-5}
January 28	Pumping Well	PW102-16	Drawdown	2.05×10^{0}	7.42×10^{-2}	-
			Recovery	1.08×10^{1}	3.91×10^{-1}	-
	Monitoring Well	PW101-16	Drawdown	1.34×10^{1}	4.84×10^{-1}	6.16×10^{-10}
Average aquifer properties have been outlined in this section of the table		PW101-16	-	1.90×10^{1}	2.98×10^{-1}	8.70×10^{-6}
		PW102-16	-	2.98×10^{1}	3.85×10^{-1}	3.21×10^{-5}
		PW103-16	-	2.03×10^{-1}	2.14×10^{-3}	-

As outlined above, the average hydraulic conductivities calculated for each of the wells installed on-Site are relatively low but do however fall within the range of hydraulic conductivities outlined for fractured igneous and metamorphic rock in literature (Domenico, 1990). The transmissivity is also a relatively low value since the saturated thickness of the aquifer was assumed to be the entire water column within each well.

The specific yield of granite has been determined by some to be 0.09 % (dimensionless value of 9.0×10^{-4}) (R.C., 1983). Most of the calculated storage coefficients (specific yield values) are slightly less than what has been reported in literature. The specific yield is dependant of the porosity of the water bearing unit and the capacity of the water bearing unit to retain water. If the granite is relatively competent and exhibits few fractures then the porosity can range almost to 0% (Freeze, 1979). Therefore the calculated values of the storage coefficient outlined above indicate that the bedrock is relatively competent and exhibits a low porosity, since the specific yield is extremely low. Most of the calculated S values fell within 9.10×10^{-5} and 8.70×10^{-6}. However one value for S at monitoring well PW101-15 during the January 28 test was calculated to be 6.16×10^{-10}. This value may have been caused by the variable nature of the aquifer or the fact that the water level recorded on PW101-16 was still recovering from the pumping test on the previous day.

4.4 WATER CHARATERIZATION SAMPLING

One (1) water sample was collected from each pumping well at the end of each test. The samples were collected within the final 60 minutes of each test. Each sample was analyzed for the parameters outlined in Table 1. The results of the analysis have been compiled and attached as Table 2.

The samples collected from each well indicate that the water quality in the area exhibits relatively low concentrations of most parameters (including nitrate and phosphorus which were both reported below the method detection limit) and was slightly basic (the pH ranged between 7.93 and 8.29). No coliforms or E.coli were detected in any of the samples, however the Heterotrophic Plate Count (HPC) was measured to be 380 colony forming units/1ml (CFU/1ml) from PW103-16, 660 CFU/1ml from PW101-16 and 33 CFU/1ml from PW102-16. Although the presence of heterotrophic plates within a water sample does not alone constitute a risk to human health, it does indicate an environment that is favourable for heterotrophic plate growth. Therefore if the dwellings built on the severed lots utilize groundwater as their drinking water source appropriate water treatment and disinfections systems will be required.

4.5 CONCLUSIONS

This section outlines the conclusions drawn from the hydraulic testing, aquifer modelling (using AquiferTest) and the chemical analysis completed on each of the pumping wells.

4.5.1 HYDRAULIC PUMPING TESTS

According to the data generated from the hydraulic pumping test, the granitic bedrock aquifer in the area of wells PW101-16 and PW102-16 should be able to sustain a pumping rate of at least 3 igpm (as required by Procedure D-5-5).

Both PW101-16 and PW102-16 were tested at approximately 5.5 igpm and this testing incurred a relatively minor amount of drawdown in the pumping wells when compared to their depth (available drawdown). Additionally the pumping tests at PW101-16 and PW102-16 did not cause a significant amount of drawdown in the monitoring wells (none in PW103-16) nor was there a significant amount of extrapolated drawdown in the pumping wells or monitoring wells.

Based on available aerial photography, the closest residences are approximately 100 m from the proposed supply well locations. It was determined that the ZOI for PW101-16 and PW102-16 encompasses the closest adjacent residences based on the proposed supply well locations for the development. The calculated depth of drawdown utilizing the worst case scenario ranged between approximately 0.15 m and 0.75 m at the closest residences.

These drawdown depths are not considered to be a cause for concern considering the depths of the surrounding water wells. Most of the surrounding residential wells are installed deep enough to render the additional drawdown of 0.75 meters insignificant.

For example, the shallowest supply well located within 500 m of the Site was installed to a depth of 7.6 mBGS (well record ID# 5105297). The recommended pumping rate is 5 gallons per minute (assumed to igpm) and the recommended pump installation depth is 7.32 mBGS. The static water level upon completion of this well was 1.22 mBGS. If an additional 0.75 m of drawdown were to occur in this well there would still be an ample amount of available drawdown above the pump (5.35 m). Additionally this well can sustain a water withdrawal rate of 5 igpm, therefore any well interference from on-Site pumping is expected to be negligible.

4.5.2 PUMPING WELL PW103-16

The hydraulic testing on PW103-16 indicated that water withdrawal from well PW103-16 would not significantly impact surrounding groundwater users, however the well cannot sustain a continuous water withdrawal rate of 3 igpm. During the test the discharge rate was reduced several times (the lowest recorded of which was 1 igpm) due to a rapid increase in the rate of drawdown. The final discharge rate set was at 1igpm and was established 135 minutes before the end of the test. Even at this rate drawdown continued to occur in the well, therefore the test was terminated at 399 elapsed minutes of pumping. Since higher discharge rates were utilized during the earlier stages of the pumping test it could not be confirmed if the discharge rate of 1 igpm is a sustainable water withdrawal rate for the well. However, the amount of drawdown that will occur in PW103-16 if a pumping rate of 1 igpm is utilized from static conditions was estimated by superimposing the drawdown data (late time data) from when the discharge rate was set to 1 igpm (simulating static conditions). See Figure 4.

The required water withdrawal rate for a well, as per Procedure D-5-5 is 3 igpm. This rate encompasses the water withdrawal volumes required during peak hours of the day. However a lower water withdrawal rate can be utilized if it can be proven that the water demands of the residence can be sustained with a storage system. Therefore, to conservatively estimate the water withdrawal volume, it has been assumed that the structure will be a four (4) bedroom residence and the daily water demand is 2,000 L/day (this volume was cited from Part 8 of the Ontario Building Code (hereafter referred to as the OBC) (Ministry of Municipal Affairs and Housing, 2012).

(Note: In Section 6.0 of this report the estimated size of the dwellings are 3 bedroom, therefore the sewage treatment systems were sized to treat 1,600 L/day of sewage (as opposed to the 4 bedroom dwelling outlined above). It has been assumed that some of the water withdrawn for usage may be used outside of the wastewater system and will therefore not be processed by the septic system.)

If the well were to be pumped at a rate of 1 igpm it would take 440 minutes (7 hours, 20 minutes) for the daily water demand of 2,000 L to be satisfied. As per Figure 4, the extrapolated drawdown to 440 minutes from pumping at a rate of 1 igpm would induce a drawdown of approximately 27 m.

The static water elevation recorded at PW103-16 was 244.99 mASL. Therefore a drawdown depth of 27 m would result in the water elevation being 217.99 mASL. Once the daily water demand was achieved the water level in the well would be allowed to recover to static. If recovery commenced at an elevation of 217.99 it would take approximately 544 minutes (9 hours, 4 minutes) for the well to recover to 100% of static (calculated from information plotted on Figure 3).

Therefore a drinking water system equipped with a storage system that withdraws water at a rate of 1 igpm can theoretically work according to the calculations outlined above. The water withdrawal volume of 2,000 L would be satisfied in 440 minutes (7 hours and 20) minutes and recovery back to 100% of static would take approximately 544 minutes (9 hours and 4 minutes). In total the drawdown and recovery response to 100% of static would take 984 minutes (16 hours, 24 minutes), indicating that there is 456 minutes (7 hours, 36 minutes) remaining in the day. The remaining time in the day can act as a buffer if additional pumping/recovery is required.

As mentioned in previous sections of the report, granitic bedrock aquifers are typically heterogeneous in hydraulic conductivity, fracture orientation and fracture depth (as evidenced by the various water supply wells located around the Site). Therefore drilling additional wells in this area and finding an adequate supply of water should be possible. Based on surrounding MOECC water well records and the other 2 wells on site, the poor yield in Well PW103-16 is considered anomalous in this regard. If required, in order to increase well yield, the well can be deepened to contact deep water bearing fractures or hydro-fractured in order to open the aperture of the existing contacted fractures.

The results of the Aquifer Test analysis indicate that the granitic bedrock aquifer into which the wells have been installed is typical of those described in literature since it was reported that the aquifer has a relatively low porosity, K and S values.

The raw water testing indicated that the quality of the groundwater is relatively good. However the HPC indicates that the granitic bedrock aquifer is an environment favourable to the growth of bacteria. It is therefore recommended that each drinking water system on-Site be equipped with an antibacterial treatment system (i.e. chlorine, UV, etc.).

5.0 WASTEWATER ASSESSMENT

As per Procedure D-5-4 Technical Guideline for Individual On-Site Sewage Systems: Water Quality Risk Assessment (Ministry of the Environment, 1996), an assessment was completed to determine the feasibility of utilizing on-site sewage disposal for the development.

The creation of 16 residential lots will increase wastewater effluent loading on the shallow, discontinuous overburden aquifer which is the receiving aquifer system. Additionally, effluent loading to Buffalo Bay will be increased since it is the final receiver. Within the effluent, nitrate is considered the limiting contaminant due to the human health concerns. Procedure D-5-4 requires that the effluent plume at the Site boundary to be within the ODWQS limit of 10 mg/L for nitrate to prevent contamination of adjacent properties. Although natural processes and soil interaction can result in nitrate being attenuated in the receiving aquifer system, Procedure D-5-4 states that only dilution can be used as the principal attenuation mechanism to predict future nitrate concentrations. As such, a mass balance calculation is used to determine the impact of developing residential lots on the Site.

5.1 AVAILABLE DILUTION

The total available dilution for the Site is estimated by the following equation:

$$Qi = A \times S \times I$$

Where: Qi – Volume of Available dilution water

A - Area of the Site

S – Water surplus

I – Infiltration factor

To calculate the water surplus ten year climate normal (data collected between 2081 and 2010) from a weather station located at Trent University. The data was accessed through the Environment Canada website (Environment Canada, 2015). The total yearly precipitation, on average, was 882.1 mm. The total yearly evaporation was, on average 573.5 mm. Therefore the water surplus calculated to be 308.6 mm per year (0.85 mm/day).

One uniform infiltration factor could not be used for the entire Site since the soil conditions and topographic environments vary dramatically between the eastern and western portions of the property. As described above the eastern portion of the property is very hummocky and exhibits shallow soils and exposed bedrock outcrops. The western portion of the Site is characterized by deeper soil and a rolling topography.

Therefore available dilution calculations were completed for the eastern and western portions of the Site separately to determine the available volume of dilution water. In addition to calculating the separate infiltration factors for the eastern and western portions of the Site, the area of each portion of the Site was measured (via available mapping) to determine the total volume of available dilution water generated in each portion of the Site. The calculations of available dilution water for each portion of the Site have been outlined in the table below.

	Western Portion of Site	**Eastern Portion of Site**
Infiltration Factor		
Topography	Rolling = 0.2	Between Hilly and Rolling Land = 0.15
Soil	Silty Sand = 0.3	Exposed Rock, Shallow Soils = 0.2
Cover	Woodland = 0.2	Woodland = 0.2
Infiltration Factor (I)	**0.7**	**0.55**
Volume of Precipitation Water		
Portion Area (A) (m^2)	74,936	52,671
Surplus (S) (m/day)	8.5×10^{-4}	8.5×10^{-4}
Volume of Precipitation Water (AxS)	**63.70 m^3/day (63,700 L/day)**	**44.80 m^3/day (44,800 L/day)**
Volume of Available Dilution Water	**44.59 m^3/day (44,590 L/day)**	**24.62 m^3/day (24,620 L/day)**

5.2 PREDICTIVE ASSESSMENT

Based on Procedure D-5-4, each of the proposed development lots are anticipated to generate an average discharge of 1,000 L/day of sewage effluent. Total nitrogen (all species) ultimately convert to nitrate through the wastewater treatment process. Nitrate is considered to be the critical contaminate in sewage effluent. A nitrate loading of 40 grams/lot/day is required to be normally used to determine the effluent loading from conventional septic systems on the receiving groundwater system.

To evaluate the impact of a septic system on a groundwater resource, a reference point or value is established to assist in determining the extent of the impact, if any. In this respect, the quality of the groundwater that is not impacted by septic system on the Site (i.e. background water quality) should be used for comparison purposes. It has been determined that the shallow discontinuous overburden aquifer will be the receiver of effluent generated on-Site. Since no background water quality exists for this aquifer on-Site, it has been assumed that the ambient concentration of nitrate in the shallow overburden aquifer is 0.01 mg/L.

To determine the adequate lot density for the Site, a mass balance calculation is used to determine the sewage loading for nitrate on the property boundary.

$$Q_tC_t = Q_eC_e + Q_iC_i$$

Where: Q_t = Total volume (Q_e + Q_i)

C_t = Total concentration of nitrate at the property boundary

Q_e = Volume of septic effluent

C_e = Concentration of nitrate in effluent (40 mg/L)

Q_i = Volume of available dilution water

C_i = Concentration of nitrate in dilution water (0.1 mg/L)

In order to determine the concentration of nitrate at the property boundary (C_t), the above mass balance equation is arranged as follows:

$$C_t = \frac{QeCe + QiCi}{Qt}$$

This equation was used for both portions of the Site, the details of which have been outlined in the table below:

	Western Portion of Site	Eastern Portion of Site
Number of Lots in Portion	9	7
Volume of Sewage Effluent (Q_e)	9 Lots x 1,000 L/day = 9,000 L/day	7 Lots x 1,000 L/day = 7,000 L/day
C_e	40 mg/L	40 mg/L
Q_i	44,590 L/day	24,620 L/day
C_i	0.1 mg/L	0.1 mg/L
Q_t	53,350 L/day	31,620 L/day
C_t	**6.83**	**8.97**

5.3 CONCLUSIONS

As per the previous sections of this report, it was determined that a shallow discontinuous overburden aquifer is present on-Site in certain areas. Where present, this aquifer acts as the primary receiver for wastewater effluent. Where the overburden aquifer is not present it has been assumed that the effluent will migrate though the overburden soils, contact the underlying granitic bedrock (which has been assumed to be relatively impervious) and discharge into Buffalo Bay. The granitic bedrock surface is considered to be relatively impervious; therefore the likelyhood of the on-Site waste water treatment systems contaminating the granitic bedrock aquifer on-Site is low. Procedure D-5-4 applies to sites where wastewater treatment systems will discharge effluent into groundwater sources that will be utilized by others down-gradient of the Site. Since it has been determined that any effluent generated on-Site by the proposed developments will discharge into Buffalo Bay and that the bedrock aquifer and the sporadic overburden aquifer are not likely hydraulically connected Procedure D-5-4 does not technically apply. However a predictive assessment was completed for the Site (as per Procedure D-5-4). It was determined that any wastewater travelling off-Site will contain a concentration of nitrate between 8.97 mg/L and 6.83 mg/L. Any groundwater migrating off-Site in the shallow overburden aquifer, or in the unlikely event that the effluent migrates into the bedrock aquifer, it will be safe for human consumption.

6.0 CONCEPTUAL SEPTIC SYSTEM DESIGN

A conceptual design of the proposed development has been outlined on Figure 10 which shows the locations of each septic system, dwelling and well per lot.

The septic systems were sized to treat a daily sewage flow of 1,600 L/day (the daily sewage flow generated from a three (3) bedroom dwelling with no additional flow (as per the OBC)).

The septic systems were design to be fully in-ground for lots 1 through 9 due to the deeper soils present in this area of the Site. The percolation time used for the soils was 8 min/cm. As per the OBC, the length of distribution pipe required for each system was calculated to be 64 m. If the full length of the distribution piping was split into four (4) runs each length of pipe would be 16 m. If each one of the runs were then separated on centres 1.6 m apart the width of the bed would be 6.4 m. Therefore the footprint of the absorption trenches for those wastewater treatment systems servicing lots 1 through 9 will are 16 m x 6.4 m. These dimensions do not include any tankage or any other associated components of each wastewater treatment system.

Due to the shallow soils present in the eastern portion of the Site, the wastewater treatment systems servicing lots 10 through 16 were designed to be fully raised. The length of distribution piping was the same as the lengths calculated for lots 1 through 9 and the footprint of the distribution lines was also the same. However when the length of the mantle and the slopes of the fully raised system were incorporated into the design, the dimensions of each bed increased to 25.9 m x 26.35 m. These dimensions do not include any tankage or any other associated components of each wastewater treatment system.

Other assumptions made for the conceptual layout include the following:

- The structures were assumed to have a footprint of 15 m x 20 m
- The wells were assumed to have a watertight casing to a depth of at least 6 m, therefore according to Table 8.2.1.6.B each well must be installed at least 15 m from distribution piping

The conceptual design outlined in Figure 10 is based on the test pit information and is intended to assist the designers/planners. The conceptual design should not be construed as providing instructions to contractors, who should form their own opinions about Site conditions. It is possible that subsurface conditions beyond the test pit locations may vary from those observed. If significant variations are found before or during construction, Cambium should be contacted so that we can reassess our findings, if necessary.

7.0 CLOSING

Cambium Inc. was retained by Orion Development Properties Inc. (the Client) to complete a hydrogeological assessment of the property located on Lot 17, Concession 14, in the Municipality of Trent Lakes, County of Peterborough (referred to hereafter as the Site). The Client plans to develop the Site and sub-divide the property into 16 residential lots, therefore a hydrogeological assessment, including a D-5-5 assessment and a D-5-4 assessment, were completed.

It was determined that there are water bearing fracture systems located in the bedrock on-Site in the area of wells PW101-16 and PW102-16 that can sustain water withdrawal at the rate outlined in Procedure D-5-5. Well PW103-16 cannot sustain the water withdrawal rate of 3 ipgm outlined in Procedure D-5-5, but it can sustain a water withdrawal rate of 1 igpm and achieve the required water volume demand if it is continuously pumped for 7 hours and 20 minutes and equipped with a water storage system.

Additionally it was determined that water withdrawal from any of the three (3) wells should not induce a significant impact on the surrounding wells or residential water supplies.

Aquifer properties were calculated using Aquifer Test software. It was determined that the aquifer into which the wells have been installed is typical of granitic aquifers and exhibits a low porosity and hydraulic conductivity.

The water quality analysis of the three wells indicated that the water quality was relatively good, however the Heterotrophic Plate Count was considered to be high in each sample. This indicates that the granitic bedrock aquifer is an environmental favourable for the growth of heterotrophic bacteria. An anti-bacterial treatment system (at a minimum) is recommended to be installed on the water supply of each dwelling.

As per procedure D-5-4 a predictive analysis of the nitrate concentrations migrating off-Site was completed. It was calculated that the concentration of nitrate was less than 10 mg/L. Therefore the proposed number of lots to be built on-Site should be acceptable. Additionally, according to the conceptual Site plan outlined on Figure 10 there should be ample room on-Site for the septic systems, dwellings and the wells.

REFERENCES

Agarwal, R. (1980). *A new method to account for producing time effects when drawdown type curves are used to analyze pressure buildup and other test data.*

Barnett, P.J., Cowan. W.R. and Henry, A.P. (1991). Quaternary Geology of Ontario, southern sheet: Ontario Geological Survey. Map 2556, scale 1:1 000 000.

Bear, J. (1979). *Hydraulics of Groundwater.* McGraw-Hill, New York.

Domenico, P. a. (1990). *Physical and Chemical Hydrogeology.* New York: John Wiley & Sons.

Environment Canada. (2015, 09 22). *Canadian Climate Normals 1981-2010 Station Data*. Retrieved 02 04, 2016, from http://climate.weather.gc.ca/index_e.html

Fetter, C. (2001). *Applied Hydrogeology (4th Edition).*

Freeze, R. a. (1979). *Groundwater.* Englewood Cliffs, NJ, Prentice-Hall, 604 p.

Ministry of Municipal Affairs and Housing. (2012). *Code And Guide For Sewage Systems .*

Ministry of the Environment. (1996). Procedure D-5-4 Technical Guideline for Individual On-Site Sewage Systems: Water Quality Risk Assessment.

Ministry of the Environment. (1996). Procedure D-5-5, Technical Guideline for Private Wells: Water Supply Assessment.

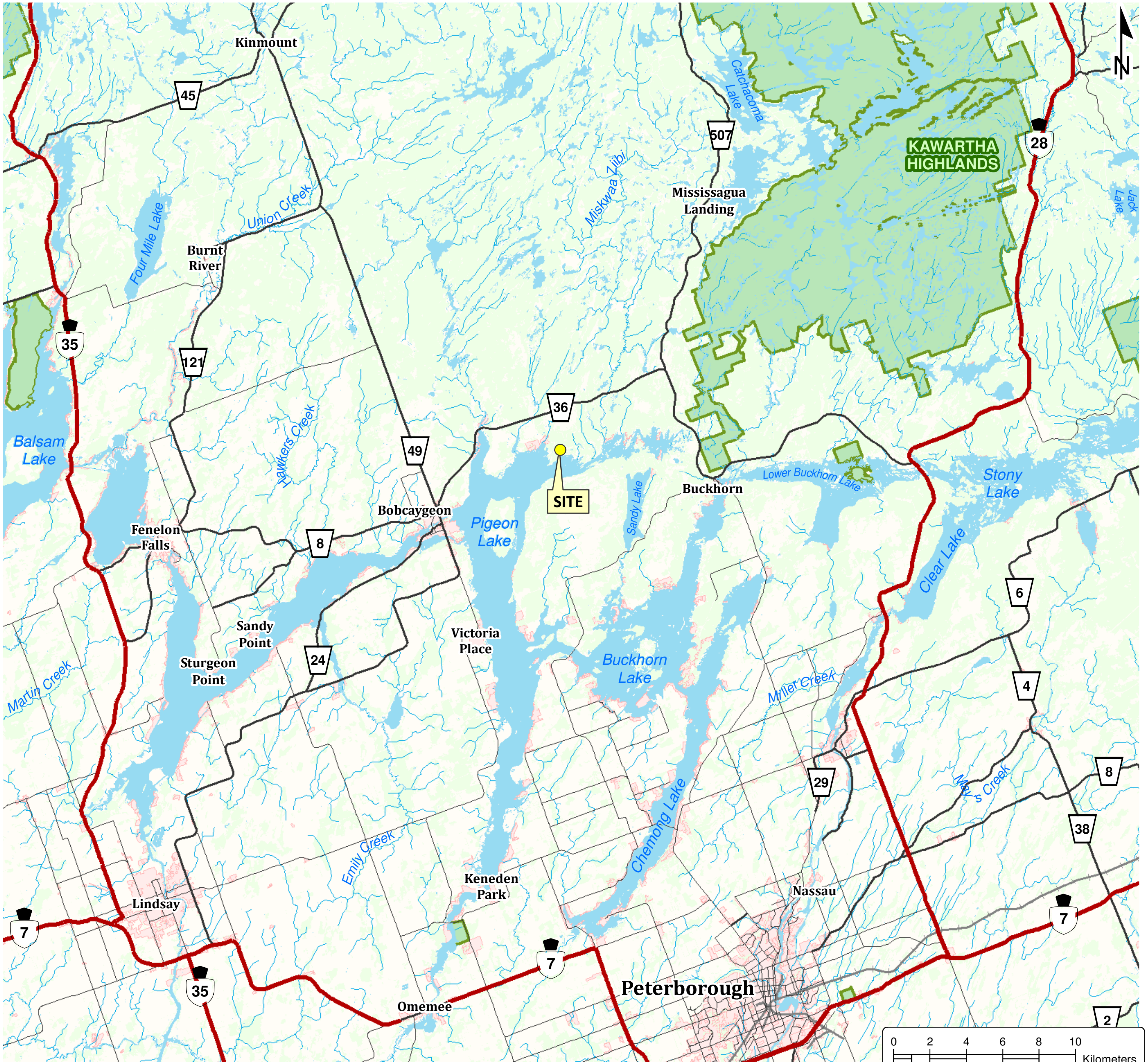
MOECC. (2016). *Map:Well Records*. Retrieved January 22, 2016, from http://www.ontario.ca/environment-and-energy/well-record-information?id=1004645782

Moench, A. (1984). Double-Porosity Models for a Fissured Groundwater Reservoir With Fracture Skin. *Water Resources Research, vol.20. No.7*, pp.831-845.

Ontario Geological Survey. (1991). Bedrock Geology of Ontario, southern sheet; Ontario Geological Survey, Map 2544, scale 1:100 000.

R.C., H. (1983). Basic ground-water hydrology. *U.S. Geological Survey Water-Supply Paper 2220*, 86p.

Appended Figures



HYDROGEOLOGICAL ASSESSMENT

ORION DEVELOPMENT PROPERTIES INC.
Lot 7, Concession 14
Municipality of Trent Lakes, Ontario

LEGEND

- Highway
- Major Road
- Railroad
- Watercourse
- Water Area
- Provincial Park
- Wooded Area
- Built-Up Area

Notes:
- Base mapping features are © Queen's Printer of Ontario, 2015 (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.: 3874-001	Date: March 2016	
	Rev.:	
Scale: 1:300,000	Projection: NAD 1983 UTM Zone 17N	
Created by: GJM	Checked by: KDW	Figure: 1

HYDROGEOLOGICAL ASSESSMENT

ORION DEVELOPMENT PROPERTIES INC.

Lot 7, Concession 14
Municipality of Trent Lakes, Ontario

LEGEND

- Pole
- Pumping Well
- Test Pit
- Overhead Wire
- Proposed Parcel
- Property Line
- Contour (1m)
- Watercourse
- Fence
- Waterbody

Notes:

1. Pumping wells surveyed by Cambium Inc. on January 27, 2016.
2. Base mapping features obtained from a plan by EcoVue Consulting Services Inc. dated November 2014.
11. Proposed parcel fabric obtained from a plan by EcoVue Consulting Services Inc. dated January 2016.
12. Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.

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

PUMPING WELL AND TEST PIT LOCATIONS

Project No.: 3874-001	Date: March 2016
	Rev.:
Horizontal Scale: 1:2000	Vertical Scale: N/A
Drawn By: GJM	Checked By: KDW
Figure: 2	

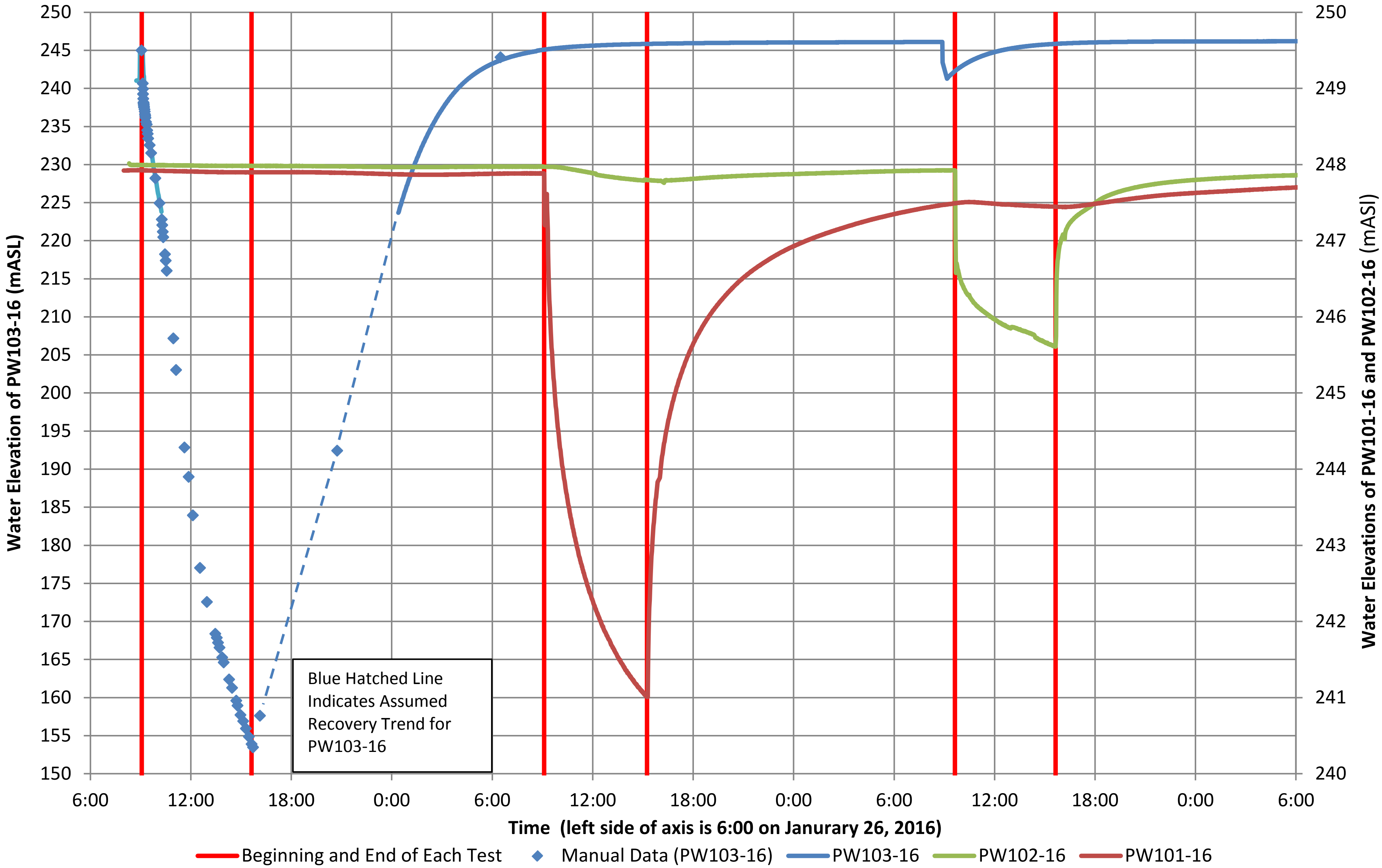


Figure 3. Water Elevations of Pumping Wells

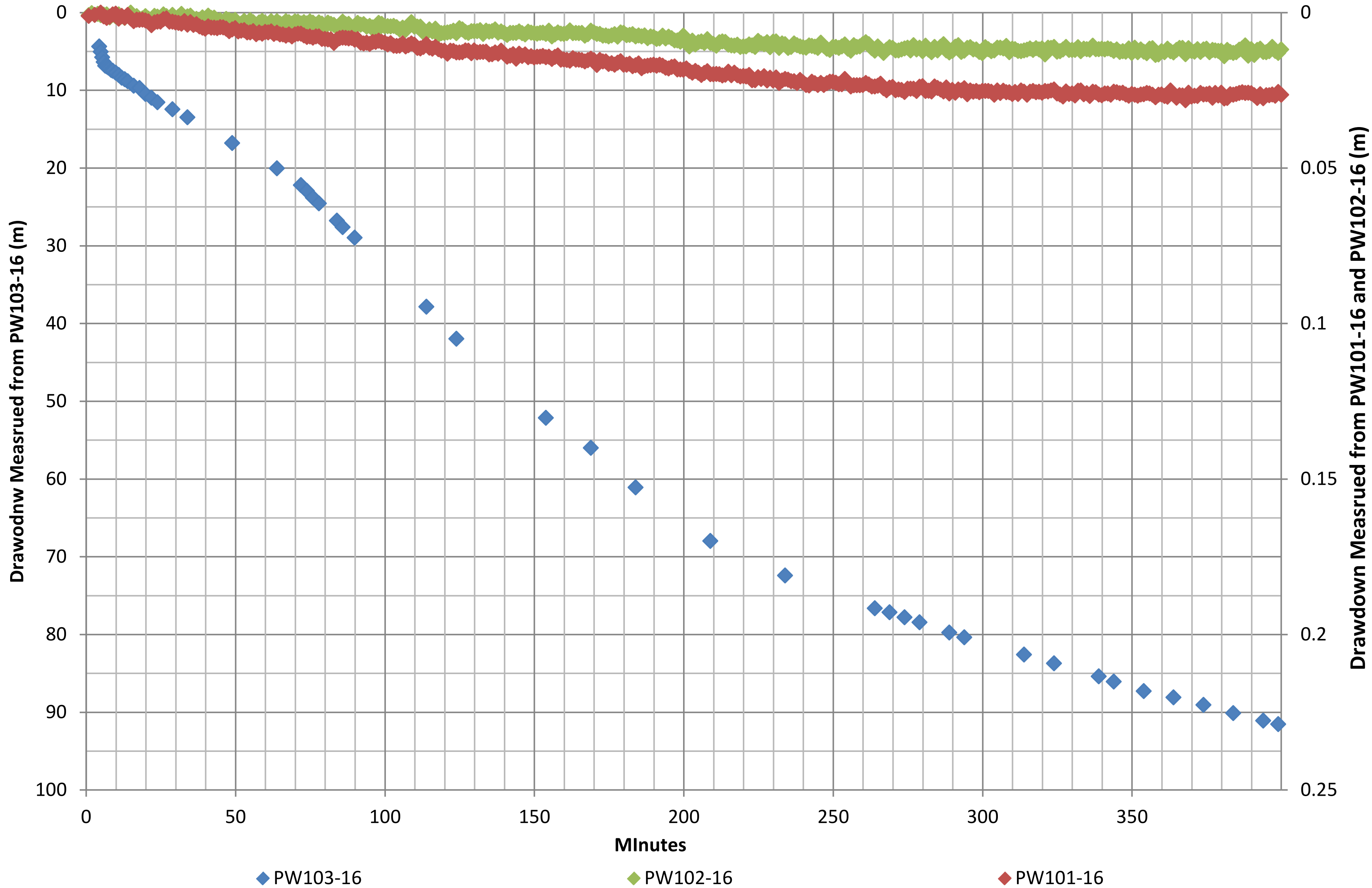


Figure 4. Drawdown From PW103-16 (January 26)

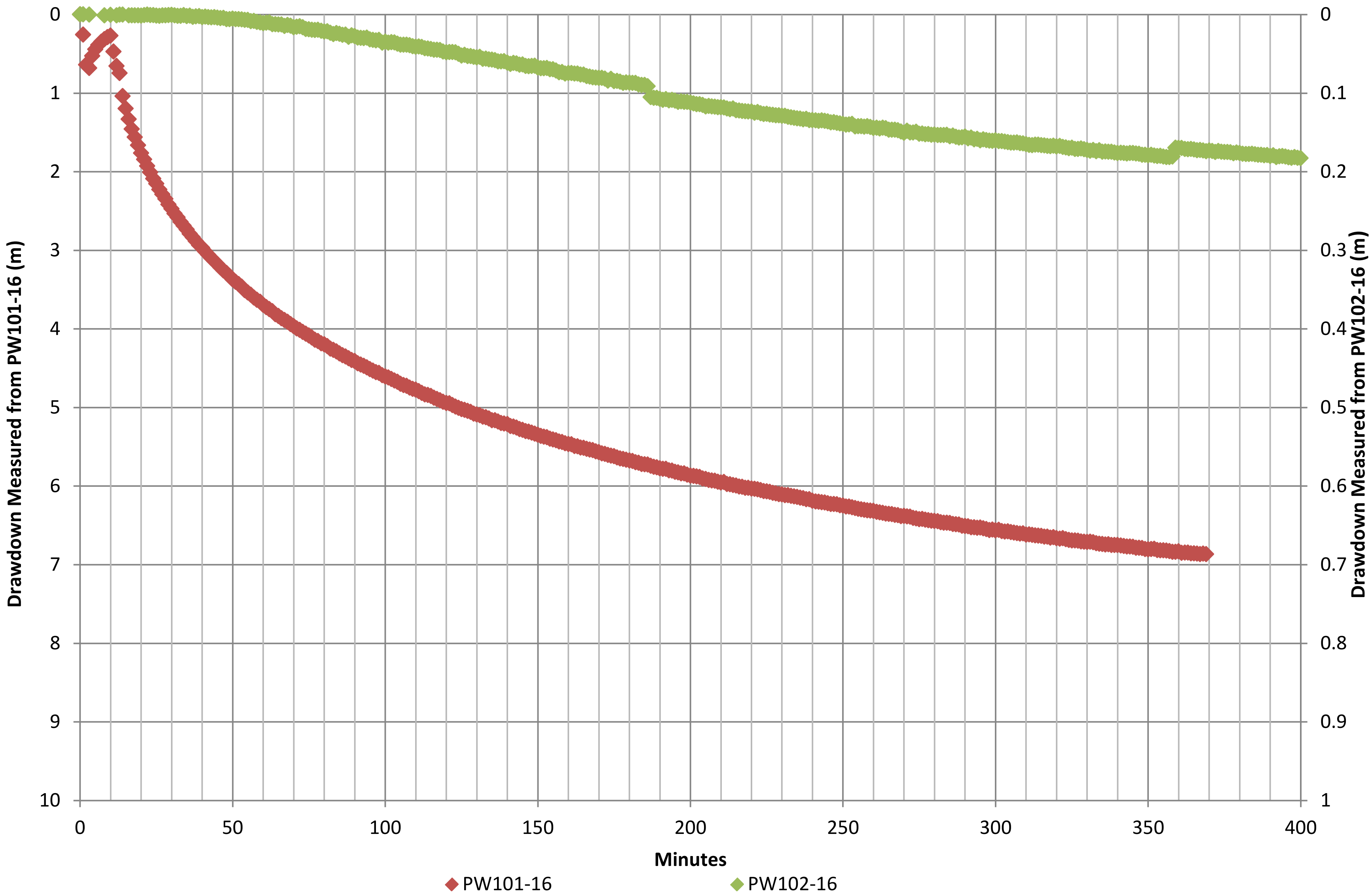


Figure 5. Drawdown From PW101-16 (January 27)

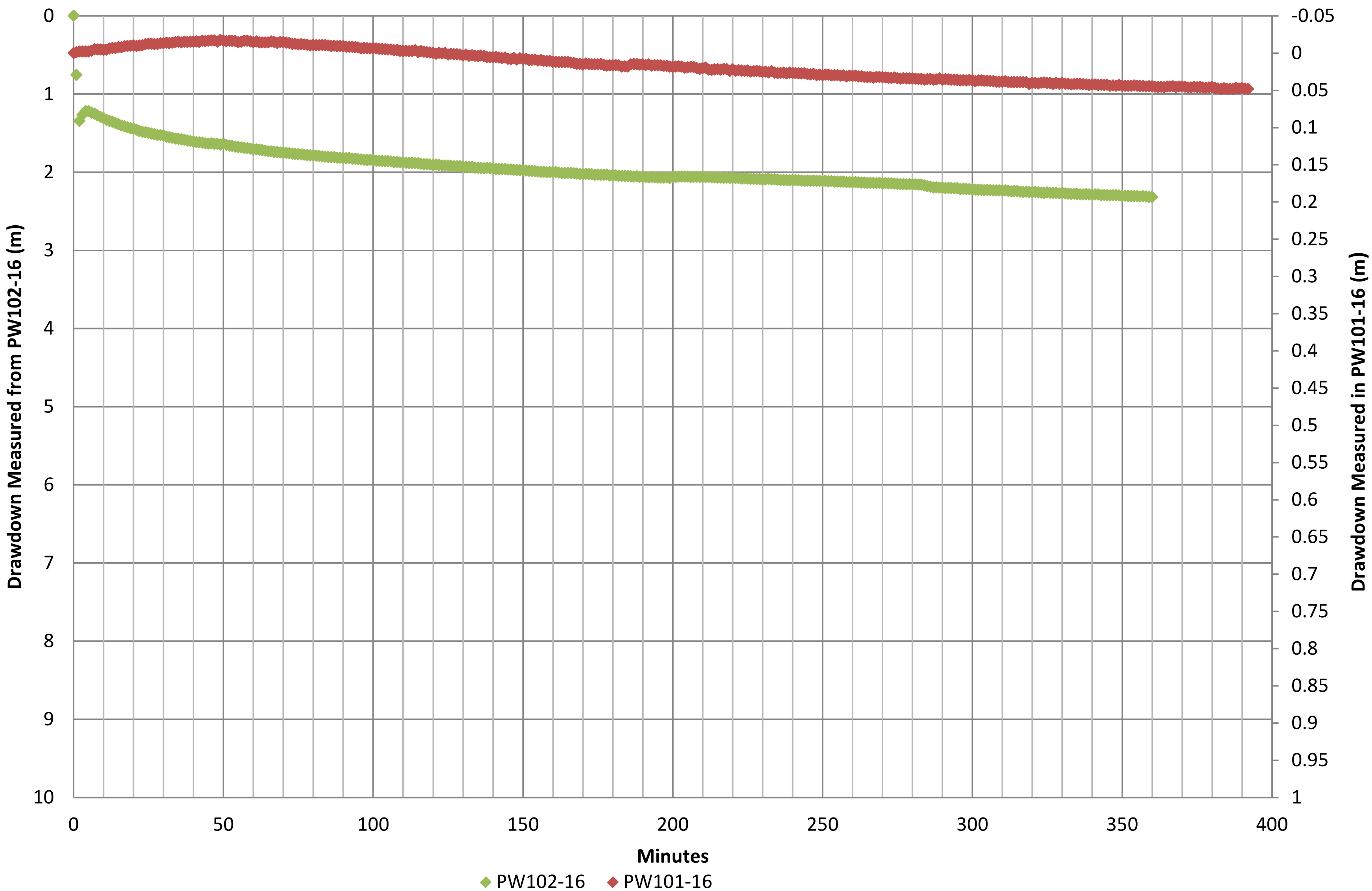


Figure 6. Drawdown from PW102-16 (January 28)

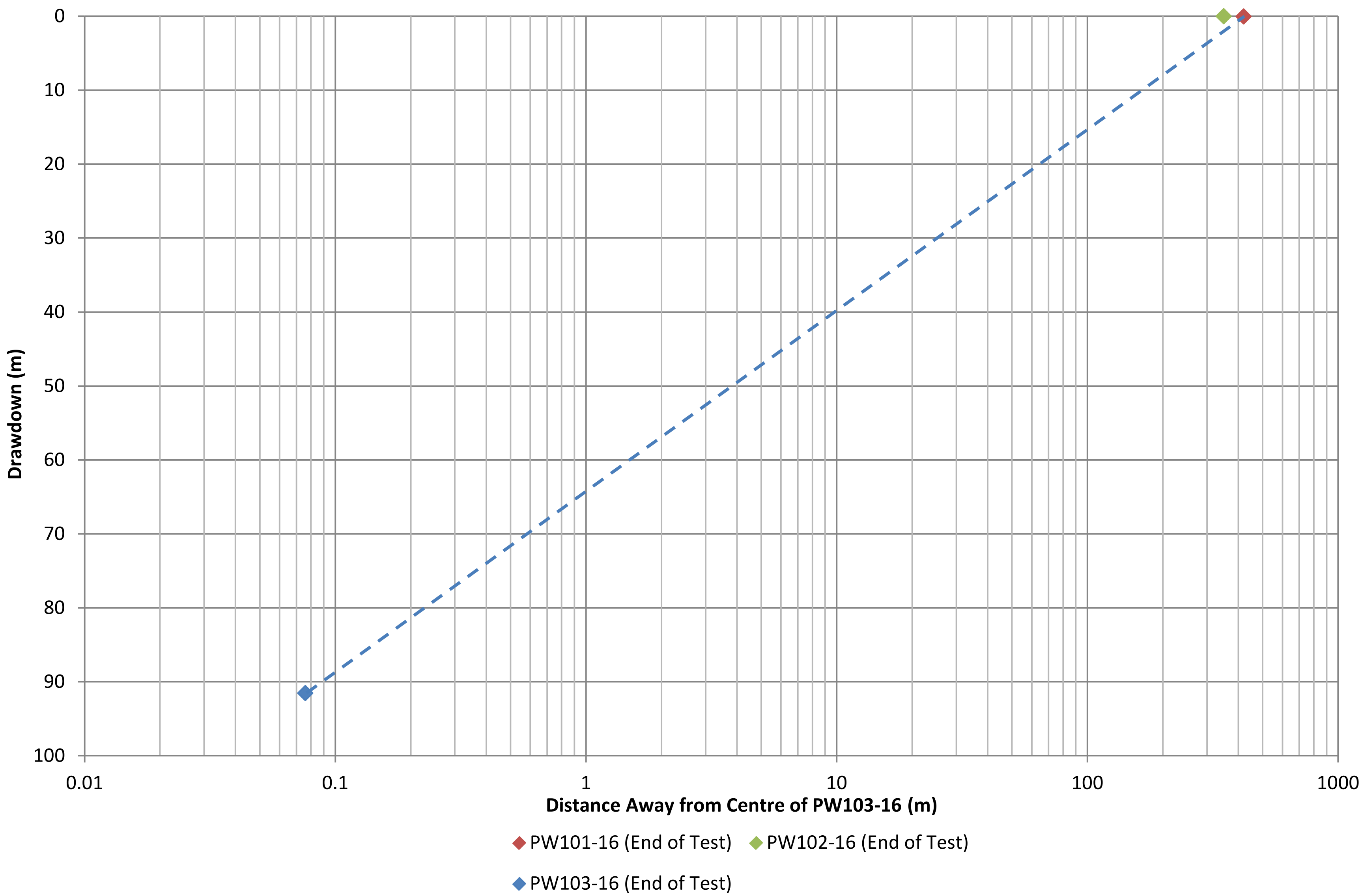


Figure 7. Zone of Influence Induced from PW103-16

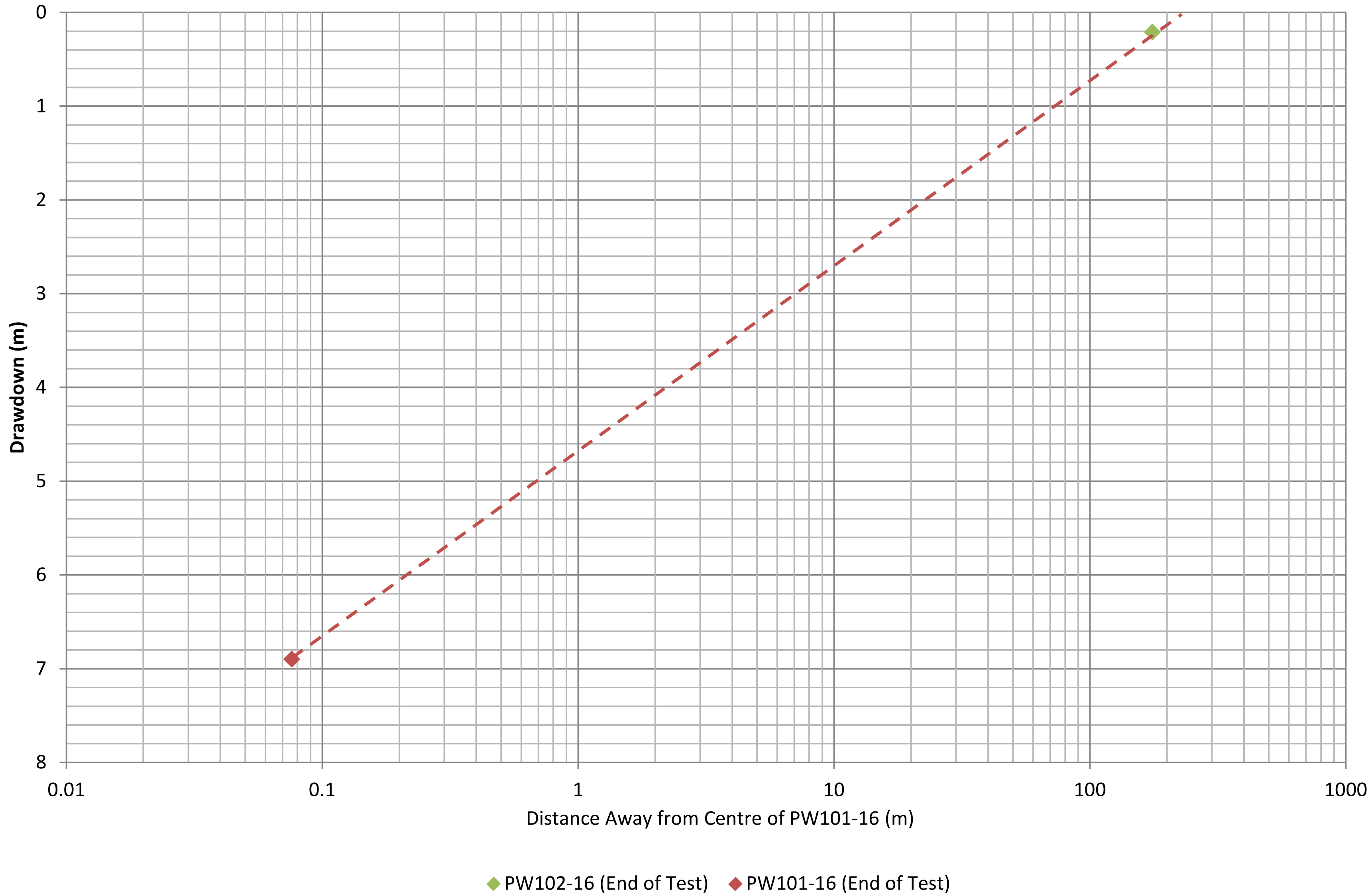


Figure 8. Zone of Influence Induced from PW101-16

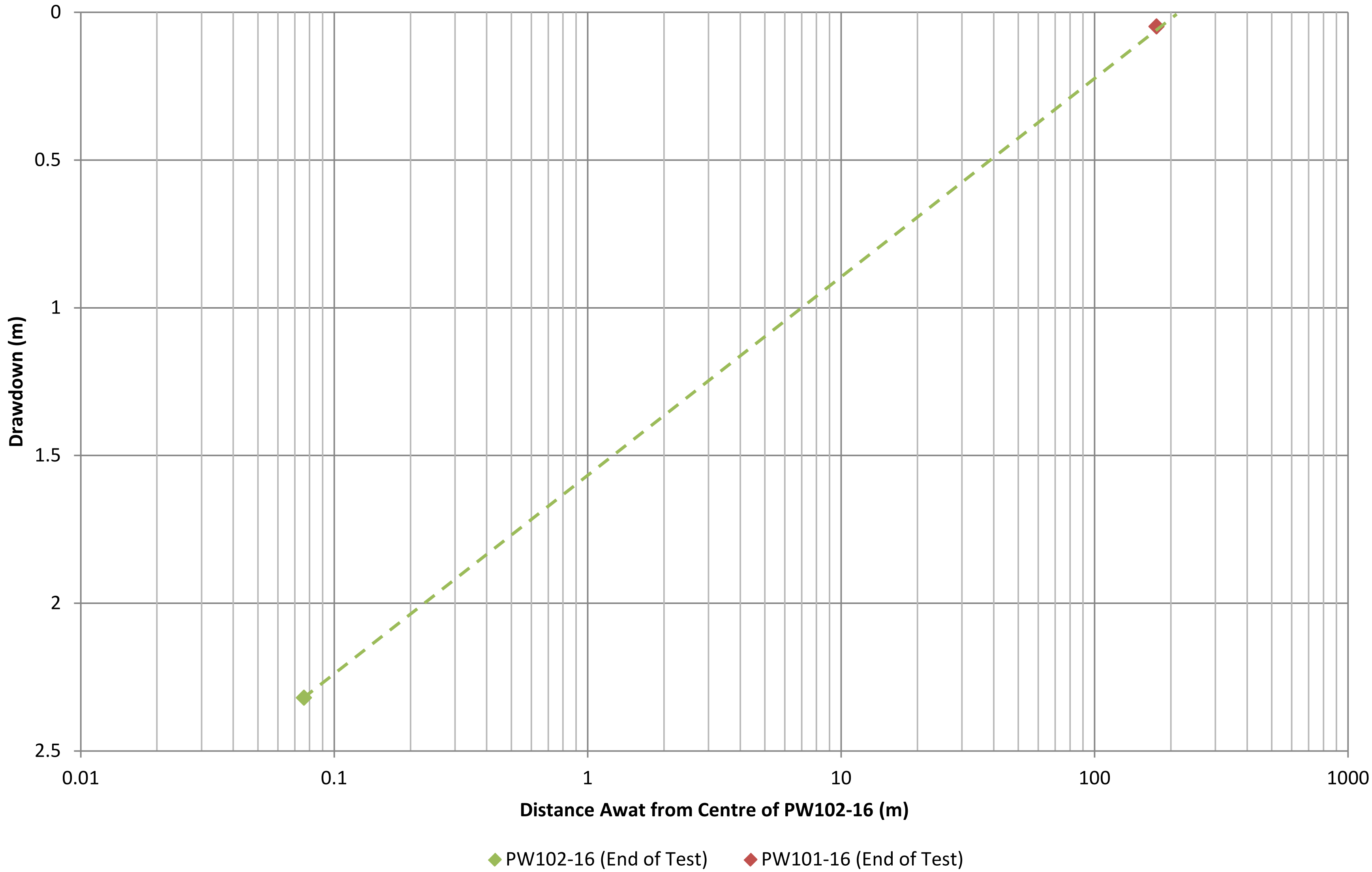
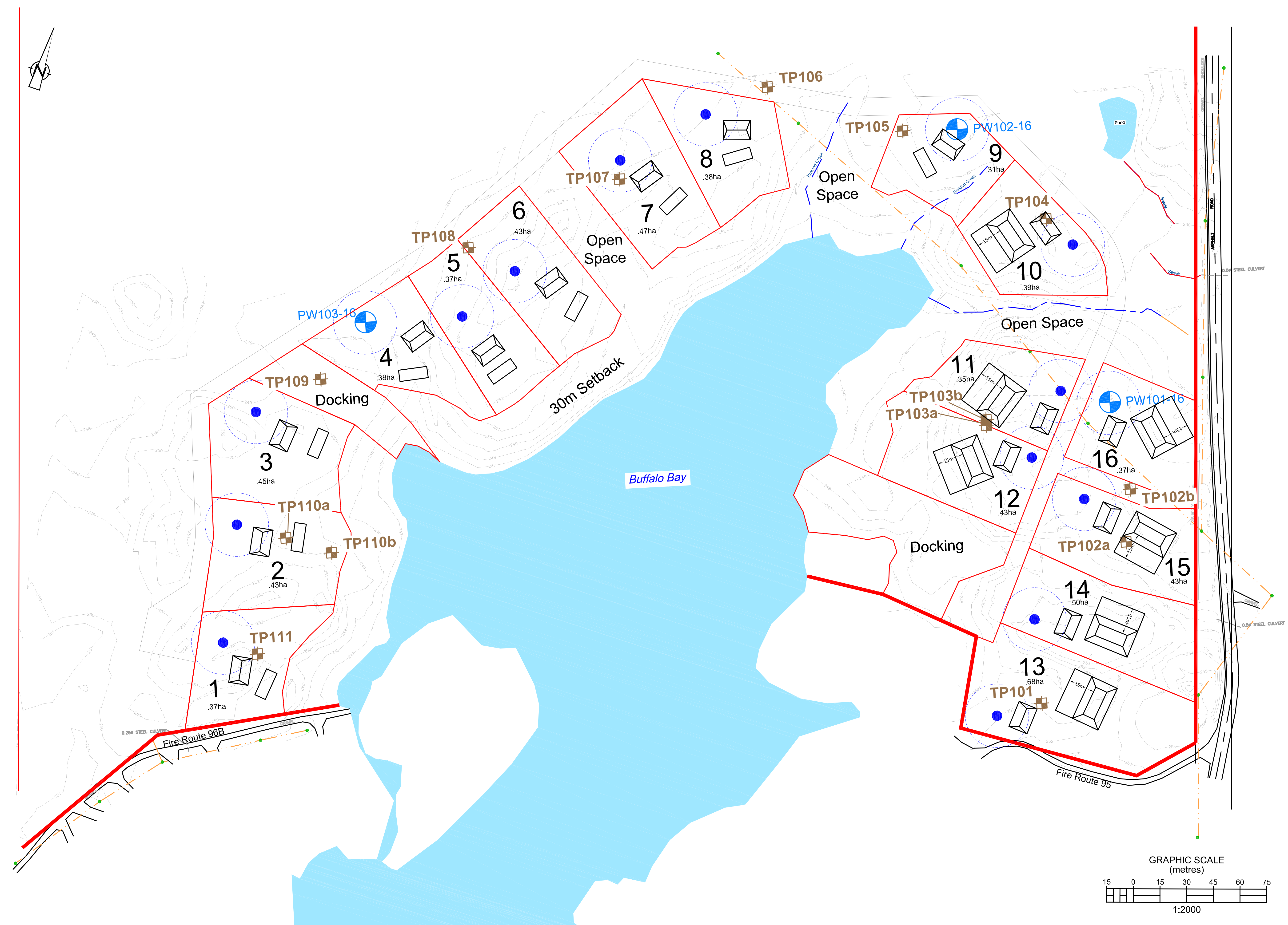


Figure 9. Zone of Influence Induced from PW102-16



HYDROGEOLOGICAL ASSESSMENT
ORION DEVELOPMENT PROPERTIES INC.
Lot 7, Concession 14
Municipality of Trent Lakes, Ontario

LEGEND

- Pole
- Pumping Well
- Drinking Water Well
- 15m Drinking Water Well Setback
- Overhead Wire
- Proposed Parcel
- Property Line
- Contour (1m)
- Watercourse
- Waterbody
- Conceptual Structure
- Conceptual Septic Bed
- Conceptual Raised Septic Bed (15m Mantle)

Notes:

1. 15m well setback only applies when the well is cased to 6 metres with a water-tight casing (otherwise the setback is 30 metres).
2. All other setbacks for distribution piping outlined in the OBC must apply.
3. PW101-16 assumed to service lot 17 as a drinking water well.
4. According to the Constraints / Concept Plan dated November 14, 2014
5. Septic beds for lots 1 - 8 measure 6.4 metres x 16 metres. Fully raised septic beds for lots 9 - 16 measure 25.9 metres x 26.35 metres.
6. Structures have dimensions of 11 metres x 15.2 metres.
7. Placement of the structures, septic beds and wells are conceptual in nature.
8. Pumping wells surveyed by Cambium Inc. on January 27, 2016.
9. Base mapping features obtained from a plan by EcoVue Consulting Services Inc. dated November 2014.
10. Proposed parcel fabric obtained from a plan by EcoVue Consulting Services Inc. dated September 2016.
11. Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.

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

CONCEPTUAL SEPTIC SYSTEM PLAN

Project No.: 3874-001	Date: March 2016 Rev.: November 2016
Horizontal Scale: 1:2000	Vertical Scale: N/A
Drawn By: GJM / Checked By: KDW	Figure: 10

Appended Tables

Table 1

Buffalo Bay

Water Characterization Parameter List

Location	Parameters
PW101-15 PW102-15 PW103-15	Total Dissolved Solids (calculated), Total Suspended Solids, Alkalinity, pH, Colour, Conductivity, Turbidity Hydrogen Sulphide, Sulphide, Organic Nitrogen, Total Kjeldahl Nitrogen, Ammonia+Ammonium (N), Dissolved Organic Carbon, Total Organic Carbon, 4AAP-Phenolics, Chloride, Fluoride, Nitrite (as N) Nitrate (as N), Sulphate, Tannin+Lignin, Methane, Hardness (dissolved), Boron (total), Calcium (total), Iron (total), Potassium (total), Magnesium (total), Sodium (total), Aluminum (total), Antimony (total), Arsenic (total), Barium (total), Beryllium (total), Bismuth (total), Cadmium (total), Cobalt (total), Chromium (total), Copper (total), Manganese (total), Molybdenum (total), Nickel (total), Phosphorus (total), Lead (total), Selenium (total), Silicon (total), Silver (total), Strontium (total), Thallium (total), Tin (total), Titanium (total), Uranium (total), Vanadium (total), Zinc (total) Total Coliform, E. Coli, Heterotrophic Plate Count (HPC). UV Transmittance, Saturation pH, Conductivity (calculated), Cation sum, Anion Sum, Anion-Cation Balance, Langelier's Index, Ion Ratio

Table 2 - Summary of Water Quality

Sample Identification	Units	ODWQS[11]	**PW103-16**	**PW101-16**	**PW102-16**
Sample Date			26-Jan-16	27-Jan-16	28-Jan-16
Total Suspended Solids	mg/L	NV	34	<2	<2
Alkalinity	mg/L as CaCO3	500	163	135	240
pH	N/A	6.5 - 8.5 OG	8.29	8.05	7.93
Colour	TCU	5	5	**11**	4
Conductivity	µs/cm	NV	399	373	541
Tannins & Lignins	mg phen/L	NV	0.34	0.16	<0.05
Turbidity	NTU	5	**28.2**	0.66	0.93
Hydrogen Sulphide	mg/L	NV	< 0.006	<0.006	<0.006
Sulphide	mg/L	0.05	< 0.006	< 0.006	<0.006
Organic Nitrogen	mg/L	0.15	< 0.05	0.05	< 0.05
Nitrogen - Total Kjeldahl (TKN)	mg/L	NV	0.08	0.14	<0.05
Nitrogen - Ammonia & Ammonium	mg/L	NV	0.06	0.09	<0.04
Dissolved Organic Carbon	mg/L	5	1.8	1.8	< 1
Total Organic Carbon	mg/L	NV	2.1	2	< 1.0
Phenolics - Total	mg/L	NV	< 0.002	<0.002	< 0.002
Chloride	mg/L	250	2	5	20
Fluoride	mg/L	1.5	1.23	0.63	0.64
Nitrogen - Nitrite (NO2)	mg/L	1	< 0.03	< 0.03	< 0.03
Nitrogen - Nitrate (NO3)	mg/L	10	< 0.06	<0.06	0.19
Sulphate	mg/L	500	41	48	17
Hardness	mg/L as CaCO3	100	**166**	**147**	**262**
Boron	mg/L	5	0.17	0.137	0.057
Calcium	mg/L	NV	46.7	44.4	85
Iron	mg/L	0.3	0.014	0.060	0.025
Potassium	mg/L	NV	2.49	3.92	2.77
Magnesium	mg/L	NV	12	8.85	12.0
Sodium	mg/L	20	14.8	18.0	11.1
Aluminum	mg/L	0.1	0.01	0.005	0.011
Antimony	mg/L	0.006	0.0011	0.0011	0.0007
Arsenic	mg/L	0.025	0.0006	0.0011	< 0.0002
Barium	mg/L	1	0.125	0.159	0.255
Beryllium	mg/L	NV	< 0.000007	0.000017	< 0.000007
Bismuth	mg/L	NV	0.000014	< 0.000007	< 0.000007
Cadmium	mg/L	0.005	0.000004	0.000006	<0.000003
Cobalt	mg/L	NV	0.000158	0.000022	0.000018
Chromium	mg/L	0.05	0.00095	0.00006	0.00012
Copper	mg/L	1	0.00094	0.00167	0.00075
Manganese	mg/L	0.05	0.0428	0.121	0.00604
Molybdenum	mg/L	NV	0.00458	0.00524	0.00172
Nickel	mg/L	NV	0.0054	<0.0001	0.0002
Phosphorous - Total	mg/L	NV	< 0.003	< 0.003	< 0.003
Lead	mg/L	0.01	< 0.00001	< 0.00001	< 0.00001
Selenium	mg/L	0.01	< 0.00004	0.00007	0.00014
Silicon	mg/L	NV	6.37	4.84	5.18
Silver	mg/L	NV	0.000013	< 0.000002	0.000005
Strontium	mg/L	NV	3.34	2.01	1.75
Thallium	mg/L	NV	0.000009	< 0.000005	0.000022
Tin	mg/L	NV	0.0001	0.00002	0.00003
Titanium	mg/L	NV	0.00031	0.00013	0.00046
Uranium	mg/L	0.02	0.00567	0.00394	0.00159
Vanadium	mg/L	NV	0.00017	0.00074	0.00054
Zinc	mg/L	5	< 0.002	<0.002	0.003
Coliforms- Total	CFU/100 ml	0	0	0	0
Escherichia coli	CFU/100 ml	0	0	0	0
Heterotropic Plate Count - HPC	CFU/1 ml	NV	380	660	33
Methane	L/m3	3 AO	< 0.006	< 0.006	<0.006
Total Dissolved Solids	mg/L	500	218	209	292
Saturation pH	NV	NV	8.06	8.16	7.64
Saturation pH	NV	NV	7.74	7.84	7.32
Conductivity	µs/cm	NV	413	383	574
Cation Sum	meq/L	NV	4.02	3.83	5.78
Anion Sum	meq/L	NV	4.23	3.84	5.71
Anion Cation Balance	%	NV	-2.48	-0.12	0.60
Langelier's Index	NV	NV	0.23	-0.11	0.29
Langelier's Index	NV	NV	0.55	0.21	0.61
Ion Ratio	NV	NV	0.95	1	1.01
pH[6]	-	6.5 - 8.5	7.53	7.74	7.59
Conductivity[6]	µS	NV	400	400	530
Temperature[6]	°C	NV	8.1	7.2	8.9

Notes:

1. Ontario Drinking Water Quality Standard (ODWQS).
2. Parameter name in *(parenthesis)* indicate alternate chemical names.
3. Bold and Shaded values exceed ODWQS criteria.
4. "-" indicates value not analyzed.
5. NV indicates no value.
6. Field Analysis

Appendix A
Test Pit Logs

TEST PIT LOGS
Buffalo Bay
Cambium Reference No. 3874-001

Date: 05-Nov-15 Staff: Cam MacDougall Project #: 3874-001

Test Pit ID	Depth (mbgs[1])	Sample Number	Material Description	Easting	Northing
TP101	0-0.35 0.35-1.70	 1	Organics Brown medium to coarse sand and boulders, trace silt (20% to 30% boulders, unable to sample) Hole open and dry upon completion Refusal on bedrock at 1.70 mBGS	702369	4938718
TP102a TP102b	0-0.01 0-0.35		0.01m of organics, then refusal on bedrock 0.36m of organics, then refusal on bedrock	702386 702379	4938819 4938848
TP103a TP103b	0-0.025 0-0.1		0.025m of organics, then refusal on bedrock 0.1m of organics, then refusal on bedrock	702291 702290	4938857 4938860
TP104	0-0.15 0.15-0.76	1	Organics Brown medium to coarse brown sand and gravel, moist, (10%/20% boulders, unable to sample) Hole open and dry upon completion Refusal on bedrock at 0.76 mBGS	702287	4938978
TP105	0-0.30 0.30-2.00	 1	Organics Brown fine to coarse sand and silt, moist (20%-30% boulders, unable to sample) No Bedrock No Bedrock	702195	4939000
TP106	0-0.30 0.30-2.00 2.10 2.2	 1	Organics Brown fine to coarse sand and gravel, some silt, moist (10%-15% boulders, unable to sample) Water at 2.10m Bedrock and 2.20	702115	4939000
TP107	0-.030 0.30-2.0	 1	Organics Brown fine to medium sand, dry (10%-15% boulders, unable to sample) Hole open and dry upon completion	702052	4938925
TP108	0-0.35 0.35-1.12	 1	Organics Brown medium to coarse sand and gravel, moist (10-15% boulders, unable to sample) Bedrock at 1.12m	701983	4938862

Notes: 1. mbgs = metres below ground surface

TEST PIT LOGS
Buffalo Bay
Cambium Reference No. 3874-001

Date: 05-Nov-15 Staff: Cam MacDougall Project #: 3768-001

Test Pit ID	Depth (mbgs[1])	Sample Number	Material Description	Easting	Northing
TP109	0-0.30		Organics	701927	4938766
	0.30-2.00	1	Brown medium to coarse sand and gravel, moist, (10% boulders, unable to sample)		
			Hole open and dry upon completion		
TP110a	0.05		Bedrock at 2" below surface	701936	4938675
TP110b	0-.23		Organics	701963	4938675
	0.23-2.30	1	Brown fine to coarse sand, some silt, moist		
	2.30		Water at 2.30m		
TP111	0-0.40		Organics	701941	4938608
	0.40-0.90	1	Brown medium to coarse sand, moist (15% boulders, unable to sample)		
	0.90-1.83	2	Grey fine sand, some silt, dry		
			Refusal at 1.83 mBGS		
			Dry upon completion		

Notes: 1. mbgs = metres below ground surface

Appendix B
Test Well Records

WELL #1

742-7907 - FAX

Ontario Ministry of the Environment and Climate Change

Well Tag No. (Place Sticker and/or Print Below) #1 - A123588 CLUSTER

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Measurements recorded in: ☐ Metric ☐ Imperial

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
2394735 ONT. INC.	ORION GROUP Properties LTD.		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
200-989 CREDITSTONE RD.	CONCORD.	ONT.	L4K 4N7	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
NICHOLS. COVE RD.	TRENT LAKES.		

County/District/Municipality	City/Town/Village	Province	Postal Code
PETERBOROUGH.		Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	702327	4903971		

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	To
BLACK - GREY	GRANITE ROCK			0	140

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	20	BENTONITE SLURRY. 3/8 hole plug.	

Results of Well Yield Testing

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

If pumping discontinued, give reason: PUMP BY HYDROGEO.

Pump intake set at (m/ft): 130

Pumping rate (l/min / GPM): 10 G.P.M.

Duration of pumping: 1 hrs + 0 min

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

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

Recommended pump depth (m/ft): 130

Recommended pump rate (l/min / GPM): 10 G.P.M.

Well production (l/min / GPM): 10 + G.P.M.

Disinfected? ☑ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

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	To
6 1/4	STEEL	188W	0	20

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

Construction Record - Screen

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

Map of Well Location

Please provide a map below following instructions on the back.

Water Details

Water found at Depth 27-36 (m/ft) ☐ Gas Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Water found at Depth 20-140 (m/ft) ☐ Gas Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

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

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	140'	6 1/4"

Well Contractor and Well Technician Information

Business Name of Well Contractor: Burgess Well Drilling.

Well Contractor's Licence No.: 1455

Business Address (Street Number/Name): 467 EMILY PARK RD.

Municipality: Omemee.

Province: ONT. Postal Code: K0L2W0 Business E-mail Address:

Bus.Telephone No. (inc. area code): 705 799 5871

Name of Well Technician (Last Name, First Name): WM. S. BURGESS

Well Technician's Licence No.: -836

Signature of Technician and/or Contractor: [signature]

Date Submitted: 2016 01 04

Comments:

Well owner's information package delivered ☐ Yes ☐ No

Date Package Delivered: 2016 01 30

Date Work Completed: 2016 01 20

Ministry Use Only — Audit No. Z 222879

0506E (2014/11) Ministry's Copy

WELL #3.

Ontario — Ministry of the Environment and Climate Change

Well Tag No. (Place Sticker and/or Print Below): CLUSTER A123588

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Measurements recorded in: ☐ Metric ☐ Imperial

Well Owner's Information

First Name: 2394735 ONT. INC.
Last Name / Organization: ORION PROPERTIES INC.
E-mail Address:
☐ Well Constructed by Well Owner
Mailing Address (Street Number/Name): 200-989 Creditstone RD
Municipality: CONCORD
Province: ONT.
Postal Code: L4K 4N7
Telephone No. (inc. area code):

Well Location

Address of Well Location (Street Number/Name): Nichols Cove RD.
Township: TRENT LAKES
Lot:
Concession:
County/District/Municipality:
City/Town/Village:
Province: Ontario
Postal Code:
Other:
UTM Coordinates: NAD 83, Zone 17, Easting 702227, Northing 4909035
Municipal Plan and Sublot Number:

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	To
BROWN	SAND, GRAVEL, BOULDERS.			0	29
BLACK, GREY, GREEN	GRANITE			29	290
RED	GRANITE ROCK			290	-320

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	20	BENTONITE SLURRY, 3/8 hole plug.	

Results of Well Yield Testing

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

If pumping discontinued, give reason: PUMPED BY HYDRO-GEO

Pump intake set at (m/ft): 310

Pumping rate (l/min / GPM): 2 G.P.M

Duration of pumping: 1 hrs + 0 min

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

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

Recommended pump depth (m/ft): 310 ft

Recommended pump rate (l/min / GPM): 2 G.P.M

Well production (l/min / GPM):

Disinfected? ☑ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Method of Construction

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

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
6 1/4	STEEL	188W	0	30
			+2	

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

Construction Record - Screen

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

Map of Well Location

Please provide a map below following instructions on the back.

Water Details

Water found at Depth 30-320 (m/ft) Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify
Water found at Depth ____ (m/ft) Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify
Water found at Depth ____ (m/ft) Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)

Well Contractor and Well Technician Information

Business Name of Well Contractor: WM. BURGESS WELL DRILLING
Well Contractor's Licence No.: 1455
Business Address (Street Number/Name): 467 EMILY PARK RD.
Municipality: Omemee
Province: ONT.
Postal Code: K0L2W0
Business E-mail Address:
Bus. Telephone No. (inc. area code): 705 799 5871
Name of Well Technician (Last Name, First Name): WM. S. BURGESS
Well Technician's Licence No.: 836
Signature of Technician and/or Contractor:
Date Submitted: 2016 02 15

Comments:

Well owner's information package delivered: ☐ Yes ☐ No
Date Package Delivered: 2016 01 30
Date Work Completed: 2016 01 30

Ministry Use Only
Audit No. Z222881
Received

0506E (2014/11) Ministry's Copy © Queen's Printer for Ontario, 2014

WELL #2

Ontario Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. (Place Sticker and/or Print Below)
CLUSTER
A123588

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
2394735 ONT. INC	ORION GROUP PROPERTIES. LTD.		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
200-989, CREDITSTONE RD.	CONCORD.	ONT.	L4K 4N7	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Nichols. Cove. RD.	TRENT LAKES.		

County/District/Municipality	City/Town/Village	Province	Postal Code
		Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	702227	4909025.		

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	To
BROWN	SANDY, CLAY, GRAVEL			0	16.
BLACK - GREY	GRANITE			16	100

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	20	BENTONITE SLURRY.	

Results of Well Yield Testing

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

If pumping discontinued, give reason: PUMPED BY HYDRO GEO. ATT.

Pump intake set at (m/ft) 90'

Pumping rate (l/min / GPM) 10 G.P.M.

Duration of pumping 1 hrs + 0 min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft) 90'

Recommended pump rate (l/min / GPM) 10 G.P.M.

Well production (l/min / GPM) 10 + GPM

Disinfected? ☑ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Method of Construction

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

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
6¼	STEEL	188W	0	20'

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

Construction Record - Screen

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

Map of Well Location

Please provide a map below following instructions on the back.

Water Details

Water found at Depth 30-40 (m/ft) ☐ Gas Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Water found at Depth 90-100 (m/ft) ☐ Gas Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

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

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	100	6¼

Well Contractor and Well Technician Information

Business Name of Well Contractor: WM. BURGESS WELL Drilling. Well Contractor's Licence No. 1455

Business Address (Street Number/Name): 467 EMILY PARK RD. Municipality: Omemee

Province: ONT. Postal Code: K0L 2W0 Business E-mail Address:

Bus. Telephone No. (inc. area code): 705 799 5871 Name of Well Technician (Last Name, First Name): WM. S. BURGESS

Well Technician's Licence No. 1836 Signature of Technician and/or Contractor Date Submitted 2016 01 10

Comments:

Well owner's information package delivered ☐ Yes ☐ No

Date Package Delivered 2016 01 30

Date Work Completed 2016 01 20

Ministry Use Only

Audit No. Z222880

Received

0506E (2014/11)

Ministry's Copy

Appendix C
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

04-February-2016

Cambium Inc.
Attn : Kevin Warner

52 Hunter Street East, Peterborough
Canada, K9H 1G5
Phone: 705-742-7900, Fax:

Date Rec. : 26 January 2016
LR Report: **CA14458-JAN16**
Reference: 3874-001Buffalo Bay

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: MAC	6: AO/OG	7: PW3
Sample Date & Time							26-Jan-16 14:45
Temperature Upon Receipt [°C]	---	---	--	--	--	---	8.0
UV Transmittance [%]	01-Feb-16	14:08	01-Feb-16	15:03	---	---	85.4
Total Suspended Solids [mg/L]	27-Jan-16	15:18	28-Jan-16	15:41	---	---	34
Alkalinity [mg/L as CaCO3]	28-Jan-16	15:15	29-Jan-16	13:04	--	30-500	163
Temperature @ pH [°C]	28-Jan-16	15:15	29-Jan-16	13:04			22.9
pH [no unit]	28-Jan-16	15:15	29-Jan-16	13:04	---	6.5-8.5	8.29
Colour [TCU]	29-Jan-16	15:37	01-Feb-16	10:17	--	5	5
Conductivity [uS/cm]	28-Jan-16	15:15	29-Jan-16	13:05	---	---	399
Turbidity [NTU]	27-Jan-16	16:32	28-Jan-16	08:47	1	5	28.2
Hydrogen Sulphide [mg/L]	27-Jan-16	11:00	27-Jan-16	14:05			< 0.006
Sulphide [mg/L]	27-Jan-16	11:00	27-Jan-16	14:05	--	0.05	< 0.006
Organic Nitrogen [mg/L]	27-Jan-15	20:00	29-Jan-16	14:38	---	0.15	< 0.05
Total Kjeldahl Nitrogen [mg/L]	27-Jan-15	20:00	29-Jan-16	14:38	---	---	0.08
Ammonia+Ammonium (N) [mg/L]	27-Jan-15	20:00	28-Jan-16	15:10	---	---	0.06
Dissolved Organic Carbon [mg/L]	28-Jan-15	12:41	29-Jan-16	13:06	--	5	1.8
Total Organic Carbon [mg/L]	28-Jan-15	12:41	29-Jan-16	13:06			2.1
4AAP-Phenolics [mg/L]	28-Jan-16	12:35	29-Jan-16	15:06	---	---	< 0.002
Chloride [mg/L]	29-Jan-16	11:34	29-Jan-16	16:11	--	250	2
Fluoride [mg/L]	27-Jan-16	14:44	28-Jan-16	09:20	1.5	---	1.23
Nitrite (as N) [mg/L]	28-Jan-16	19:01	29-Jan-16	13:40	1	---	< 0.03
Nitrate (as N) [mg/L]	28-Jan-16	19:01	29-Jan-16	13:40	10	---	< 0.06
Sulphate [mg/L]	29-Jan-16	11:34	29-Jan-16	16:11	--	500	41
Tannin+Lignin [mg phen/L]	28-Jan-16	10:10	28-Jan-16	11:26			0.34
Methane [L/m3]	01-Feb-16	13:48	01-Feb-16	16:46			< 0.006
Hardness (dissolved) [mg/L as CaCO3]	28-Jan-16	14:33	29-Jan-16	14:11	--	80-100	166
Boron (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	5000	---	0.170
Calcium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	46.7
Iron (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	300	0.014
Potassium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	2.49
Magnesium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	12.0
Sodium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	20*	200	14.8
Aluminum (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	--	100	0.010
Antimony (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	6	---	0.0011
Arsenic (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	25	---	0.0006
Barium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	1000	---	0.125

OnLine LIMS

0000606244

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

LR Report : CA14458-JAN16

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: MAC	6: AO/OG	7: PW3
Beryllium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	< 0.000007
Bismuth (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	0.000014
Cadmium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	5	---	0.000004
Cobalt (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	0.000158
Chromium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	50	---	0.00095
Copper (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	1000	0.00094
Manganese (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	--	50	0.0428
Molybdenum (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	0.00458
Nickel (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	0.0054
Phosphorus (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	< 0.003
Lead (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	10	---	< 0.00001
Selenium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	10	---	< 0.00004
Silicon (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	6.37
Silver (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	0.000013
Strontium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	3.34
Thallium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	0.000009
Tin (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	0.00010
Titanium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	0.00031
Uranium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	20	---	0.00567
Vanadium (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	---	---	0.00017
Zinc (dissolved) [mg/L]	28-Jan-16	14:33	29-Jan-16	14:11	--	5000	< 0.002
Total Coliform [cfu/100mL]	26-Jan-16	18:40	28-Jan-16	11:57	0	---	0
E. Coli [cfu/100mL]	26-Jan-16	18:40	28-Jan-16	11:57	0	---	0
Heterotrophic Plate Count (HPC) [cfu/1mL]	26-Jan-16	18:10	28-Jan-16	17:12	---	---	380
Total Dissolved Solids (calculated) [mg/L]	---	---	---	---	---	500	218
Saturation pH [pHs @ 4°C]	---	---	---	---	---	---	8.06
Saturation pH [pHs @20°C]	---	---	---	---	---	---	7.74
Conductivity (calculated) [uS/cm]	---	---	---	---	---	---	413
Cation sum [meq/L]	---	---	---	---	---	---	4.02
Anion Sum [meq/L]	---	---	---	---	---	---	4.23
Anion-Cation Balance [% difference]	---	---	---	---	---	---	-2.48
Ion Ratio	---	---	---	---	---	---	0.95
Langelier's Index [no unit]	---	---	---	---	---	---	0.23
Langelier's Index [no unit]	---	---	---	---	---	---	0.55

MAC - Maximum Acceptable Concentration
AO/OG - Aesthetic Objective / Operational Guideline

Brian Graham B.Sc.
Project Specialist
Environmental Services, Analytical

OnLine LIMS

0000606244

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

05-February-2016

Cambium Inc.
Attn : Kevin Warner

52 Hunter Street East, Peterborough
Canada, K9H 1G5
Phone: 705-742-7900, Fax:

Date Rec. : 29 January 2016
LR Report: **CA14491-JAN16**
Reference: 3874-001Buffalo Bay

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: MAC	6: AO/OG	7: PW1	8: PW2
Sample Date & Time							27-Jan-16 14:30	28-Jan-16 14:30
Temperature Upon Receipt [°C]	---	---	---	---	---	---	5.0	5.0
UV Transmittance [%]	01-Feb-16	14:08	01-Feb-16	15:03	---	---	86.4	96.8
Total Suspended Solids [mg/L]	29-Jan-16	11:50	02-Feb-16	15:32	---	---	< 2	< 2
Alkalinity [mg/L as CaCO3]	01-Feb-16	13:19	02-Feb-16	11:33	--	30-500	135	240
Temperature @ pH [°C]	01-Feb-16	13:19	02-Feb-16	11:33			17.8	17.9
pH [no unit]	01-Feb-16	13:19	02-Feb-16	11:33	---	6.5-8.5	8.05	7.93
Colour [TCU]	01-Feb-16	13:36	01-Feb-16	15:06	--	5	11	4
Conductivity [uS/cm]	01-Feb-16	13:19	02-Feb-16	11:33	---	---	373	541
Turbidity [NTU]	29-Jan-16	14:13	29-Jan-16	14:40	1	5	0.66	0.93
Hydrogen Sulphide [mg/L]	29-Jan-16	14:30	01-Feb-16	12:37			< 0.006	< 0.006
Sulphide [mg/L]	29-Jan-16	14:30	01-Feb-16	12:37	--	0.05	< 0.006	< 0.006
Organic Nitrogen [mg/L]	29-Jan-16	21:45	02-Feb-16	12:22	---	0.15	0.05	< 0.05
Total Kjeldahl Nitrogen [mg/L]	01-Feb-16	10:20	02-Feb-16	12:22	---	---	0.14	< 0.05
Ammonia+Ammonium (N) [mg/L]	29-Jan-16	21:45	01-Feb-16	12:53	---	---	0.09	< 0.04
Dissolved Organic Carbon [mg/L]	01-Feb-16	17:00	02-Feb-16	12:28	--	5	1.8	< 1
Total Organic Carbon [mg/L]	01-Feb-16	17:00	02-Feb-16	12:28			2.0	< 1.0
4AAP-Phenolics [mg/L]	02-Feb-16	08:13	02-Feb-16	15:11	---	---	< 0.002	< 0.002

OnLine LIMS

0000608183

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

LR Report : CA14491-JAN16

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: MAC	6: AO/OG	7: PW1	8: PW2
Chloride [mg/L]	03-Feb-16	12:00	04-Feb-16	08:47	--	250	5	20
Fluoride [mg/L]	29-Jan-16	19:50	01-Feb-16	10:46	1.5	---	0.63	0.64
Nitrite (as N) [mg/L]	29-Jan-16	18:37	01-Feb-16	11:44	1	---	< 0.03	< 0.03
Nitrate (as N) [mg/L]	29-Jan-16	18:37	01-Feb-16	11:44	10	---	< 0.06	0.19
Sulphate [mg/L]	03-Feb-16	12:00	04-Feb-16	08:47	--	500	48	17
Tannin+Lignin [mg phen/L]	01-Feb-16	17:40	03-Feb-16	10:54	---	---	0.16	< 0.05
Methane [L/m3]	01-Feb-16	13:48	01-Feb-16	16:46			< 0.006	< 0.006
Hardness (dissolved) [mg/L as CaCO3]	02-Feb-16	14:19	03-Feb-16	11:21	--	80-100	147	262
Boron (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	5000	---	0.137	0.057
Calcium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	44.4	85.0
Iron (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	300	0.060	0.025
Potassium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	3.92	2.77
Magnesium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	8.85	12.0
Sodium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	20*	200	18.0	11.1
Aluminum (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	--	100	0.005	0.011
Antimony (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	6	---	0.0011	0.0007
Arsenic (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	25	---	0.0011	< 0.0002
Barium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	1000	---	0.159	0.255
Beryllium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	0.000017	< 0.000007
Bismuth (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	< 0.000007	< 0.000007
Cadmium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	5	---	0.000006	< 0.000003
Cobalt (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	0.000022	0.000018
Chromium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	50	---	0.00006	0.00012
Copper (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	1000	0.00167	0.00075
Manganese (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	--	50	0.121	0.00604
Molybdenum (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	0.00524	0.00172
Nickel (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	< 0.0001	0.0002
Phosphorus (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	< 0.003	< 0.003
Lead (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	10	---	< 0.00001	< 0.00001
Selenium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	10	---	0.00007	0.00014
Silicon (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	4.84	5.18
Silver (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	< 0.000002	0.000005

OnLine LIMS

0000608183

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

LR Report : **CA14491-JAN16**

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: MAC	6: AO/OG	7: PW1	8: PW2
Strontium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	2.01	1.75
Thallium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	< 0.000005	0.000022
Tin (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	0.00002	0.00003
Titanium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	0.00013	0.00046
Uranium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	20	---	0.00394	0.00159
Vanadium (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	---	---	0.00074	0.00054
Zinc (dissolved) [mg/L]	02-Feb-16	14:19	03-Feb-16	11:21	--	5000	< 0.002	0.003
Total Coliform [cfu/100mL]	29-Jan-16	10:25	30-Jan-16	14:47	0	---	0	0
E. Coli [cfu/100mL]	29-Jan-16	10:25	30-Jan-16	14:47	0	---	0	0
Heterotrophic Plate Count (HPC) [cfu/1mL]	29-Jan-16	10:25	01-Feb-16	08:56	---	---	660	33
Saturation pH [pHs @ 4°C]	---	---	---	---	---	---	8.16	7.64
Saturation pH [pHs @20°C]	---	---	---	---	---	---	7.84	7.32
Total Dissolved Solids (calculated) [mg/L]	---	---	---	---	---	---	209	292
Conductivity (calculated) [uS/cm]	---	---	---	---	---	---	383	574
Cation sum [meq/L]	---	---	---	---	---	---	3.83	5.78
Anion Sum [meq/L]	---	---	---	---	---	---	3.84	5.71
Anion-Cation Balance [% difference]	---	---	---	---	---	---	-0.12	0.60
Ion Ratio	---	---	---	---	---	---	1.00	1.01
Langelier's Index [no unit]	---	---	---	---	---	---	-0.11	0.29
Langelier's Index [no unit]	---	---	---	---	---	---	0.21	0.61

Brian Graham B.Sc.
Project Specialist
Environmental Services, Analytical

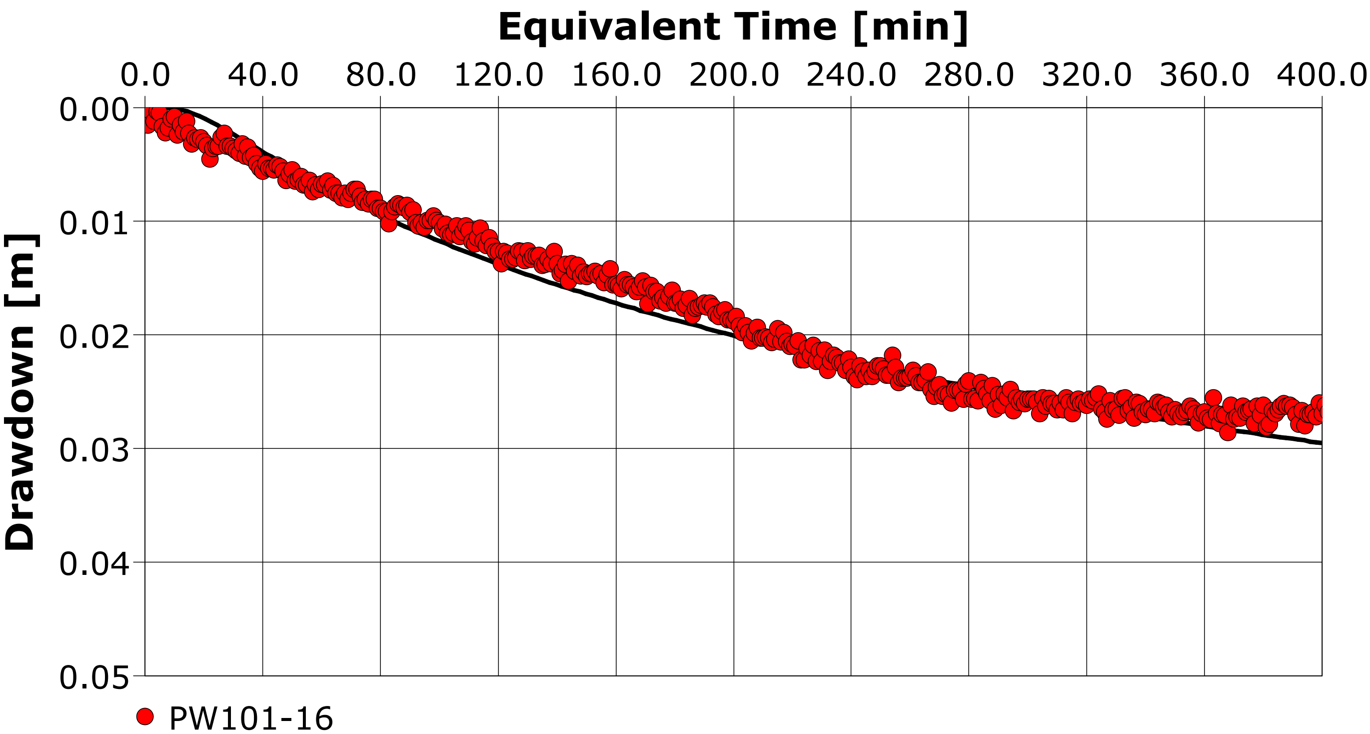
OnLine LIMS

0000608183

Appendix D
Aquifer Test Analysis

Cambium Inc. 52 Hunter St. East Peterborough Ontario	**Pumping Test Analysis Report** Project: Buffalo By Hydrogeological Number: 3874-001 Client: EcoVue Consulting Services Inc.

Location: Buffalo Bay	Pumping Test: Pumping Test 1	Pumping Well: PW103-16
Test Conducted by: C.MacDougall		Test Date: 26/01/2016
Analysis Performed by:	New analysis 1	Analysis Date: 09/02/2016
Aquifer Thickness: 94.64 m	Discharge: variable, average rate 0.0081481 [m³/min]	

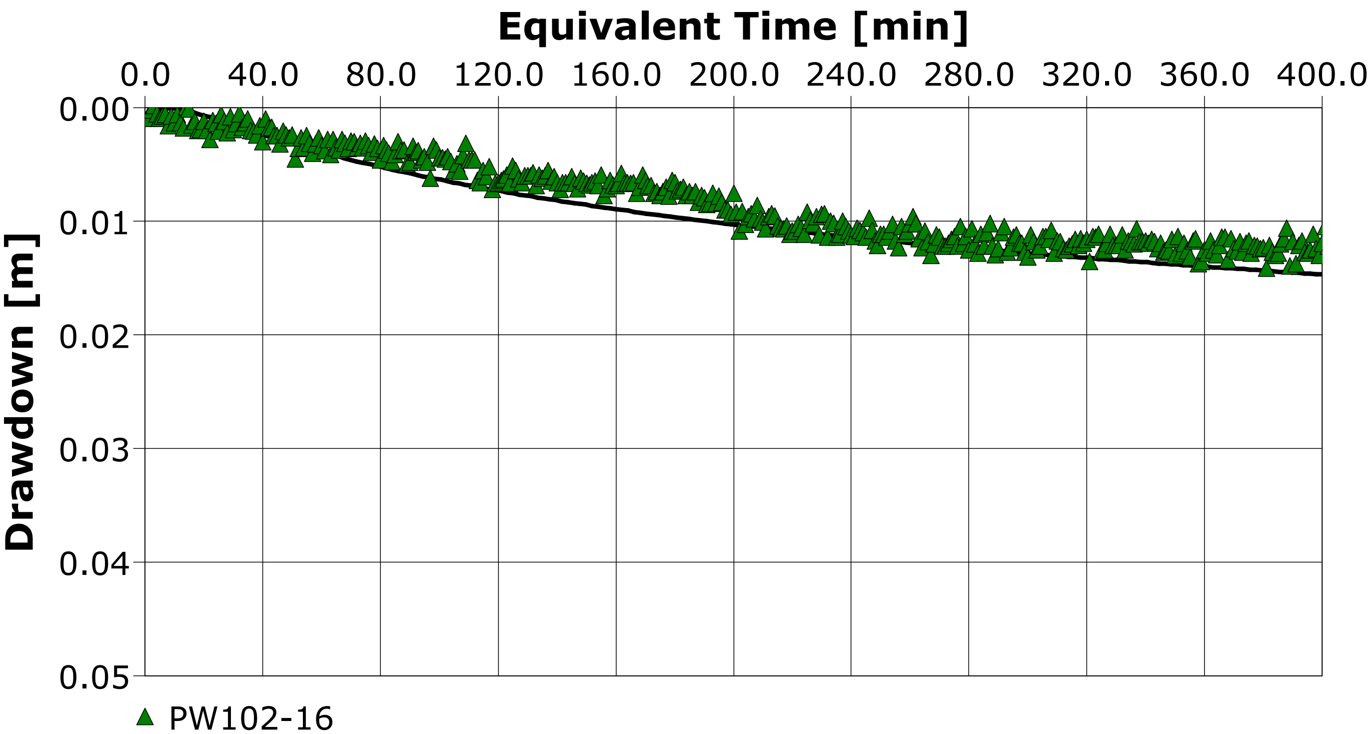


Calculation using Double Porosity

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Specific storage	Sigma	Lambda	Radial Distance to PW [m]
PW101-16	5.98×10^{1}	6.32×10^{-1}	3.48×10^{-5}	1.00×10^{5}	1.00×10^{-15}	420.99

Cambium Inc. **52 Hunter St. East** **Peterborough** **Ontario**	**Pumping Test Analysis Report**
	Project: Buffalo By Hydrogeological
	Number: 3874-001
	Client: EcoVue Consulting Services Inc.

Location: Buffalo Bay	Pumping Test: Pumping Test 1	Pumping Well: PW103-16
Test Conducted by: C.MacDougall		Test Date: 26/01/2016
Analysis Performed by:	New analysis 1	Analysis Date: 09/02/2016
Aquifer Thickness: 94.64 m	Discharge: variable, average rate 0.0081481 [m³/min]	



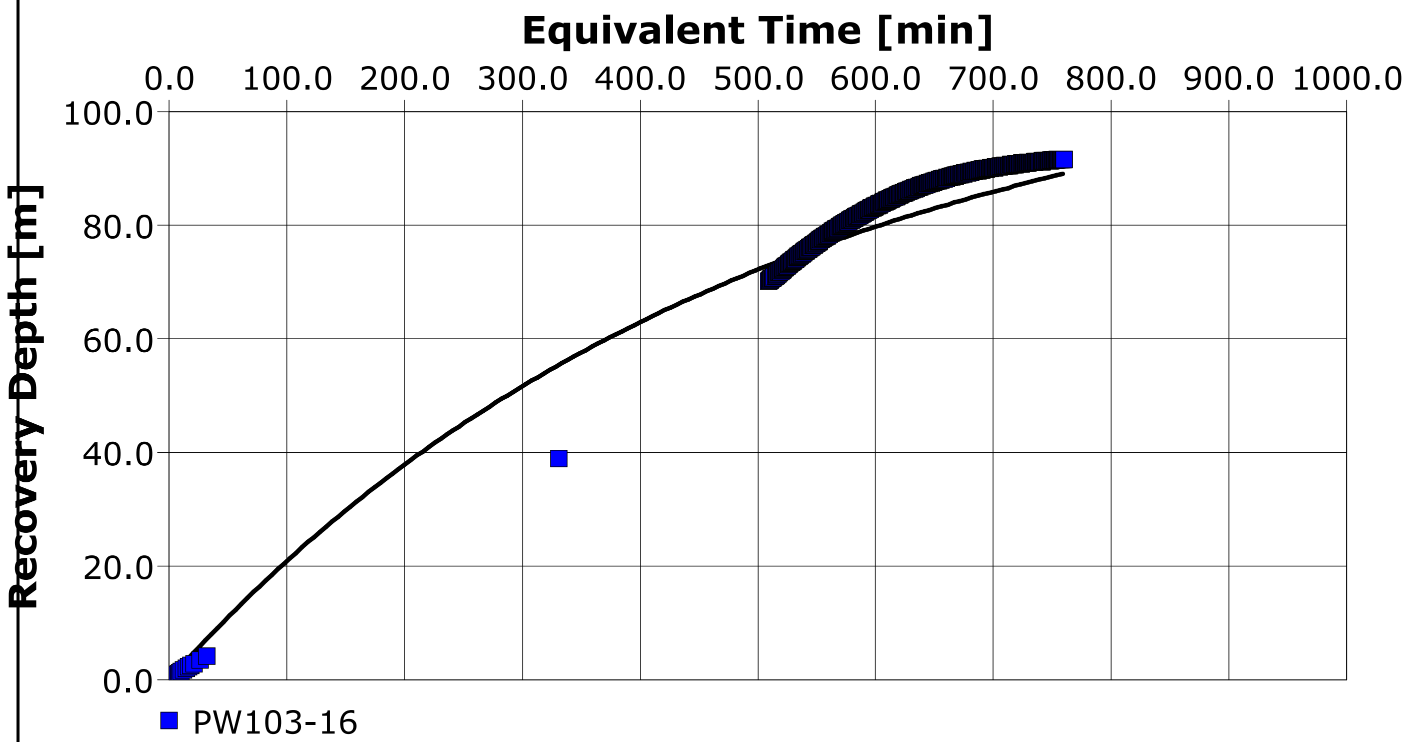
Calculation using Double Porosity

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Specific storage	Sigma	Lambda	Radial Distance to PW [m]
PW102-16	1.32×10^{2}	1.39×10^{0}	9.10×10^{-5}	1.00×10^{5}	1.00×10^{-15}	349.87

Cambium Inc.
52 Hunter St. East
Peterborough
Ontario

Pumping Test Analysis Report	
Project: Buffalo By Hydrogeological	
Number: 3874-001	
Client: EcoVue Consulting Services Inc.	

Location: Buffalo Bay	Pumping Test: Pumping Test 1	Pumping Well: PW103-16
Test Conducted by: C.MacDougall		Test Date: 26/01/2016
Analysis Performed by:	New analysis 1	Analysis Date: 09/02/2016
Aquifer Thickness: 94.64 m	Discharge: variable, average rate 0.0081481 [m³/min]	



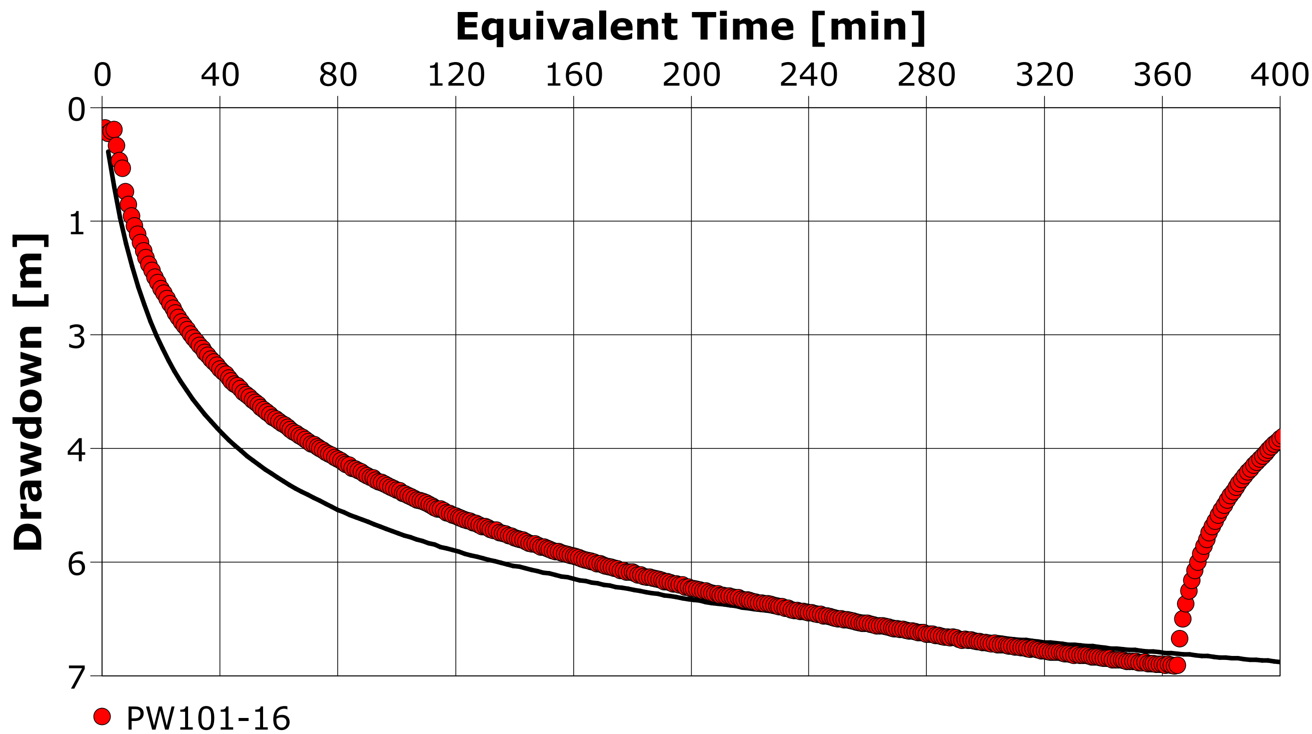
Calculation using AGARWAL + Agarwal skin

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	Skin factor	Radial Distance to PW [m]
PW103-16	2.03×10^{-1}	2.14×10^{-3}	5.00×10^{-1}	2.00×10^{1}	0.08

Cambium Inc.
52 Hunter St. East
Peterborough
Ontario

Pumping Test Analysis Report
Project: Buffalo By Hydrogeological
Number: 3874-001
Client: EcoVue Consulting Services Inc.

Location: Buffalo Bay	Pumping Test: Pumping Test 2	Pumping Well: PW101-16
Test Conducted by: C. MacDougall		Test Date: 27/01/2016
Analysis Performed by:	New analysis 1	Analysis Date: 09/02/2016
Aquifer Thickness: 38.66 m	Discharge: variable, average rate 0.0234 [m³/min]	

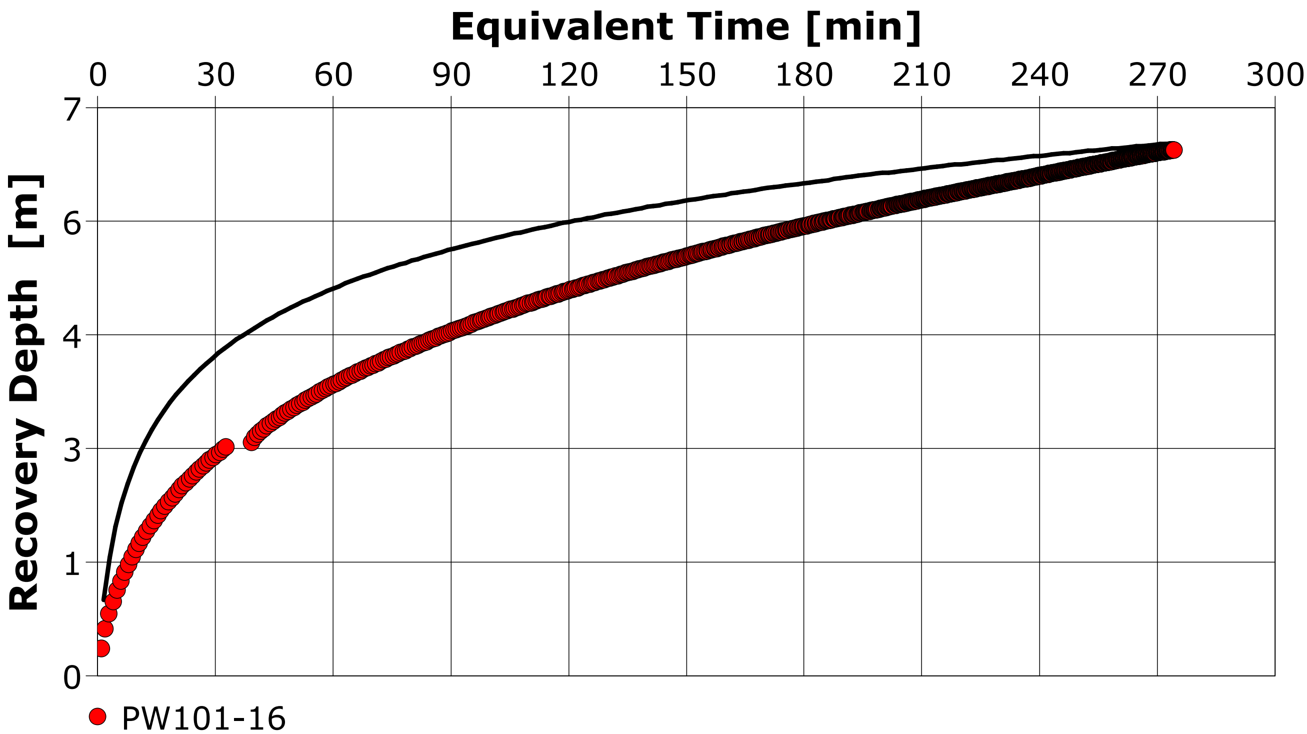


Calculation using Agarwal skin

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	Skin factor	Radial Distance to PW [m]
PW101-16	6.50×10^{-1}	1.68×10^{-2}	5.00×10^{-1}	1.00×10^{0}	0.08

Cambium Inc. **52 Hunter St. East** **Peterborough** **Ontario**	**Pumping Test Analysis Report** Project: Buffalo By Hydrogeological Number: 3874-001 Client: EcoVue Consulting Services Inc.

Location: Buffalo Bay	Pumping Test: Pumping Test 2	Pumping Well: PW101-16
Test Conducted by: C. MacDougall		Test Date: 27/01/2016
Analysis Performed by:	New analysis 1	Analysis Date: 09/02/2016
Aquifer Thickness: 38.66 m	Discharge: variable, average rate 0.0234 [m³/min]	

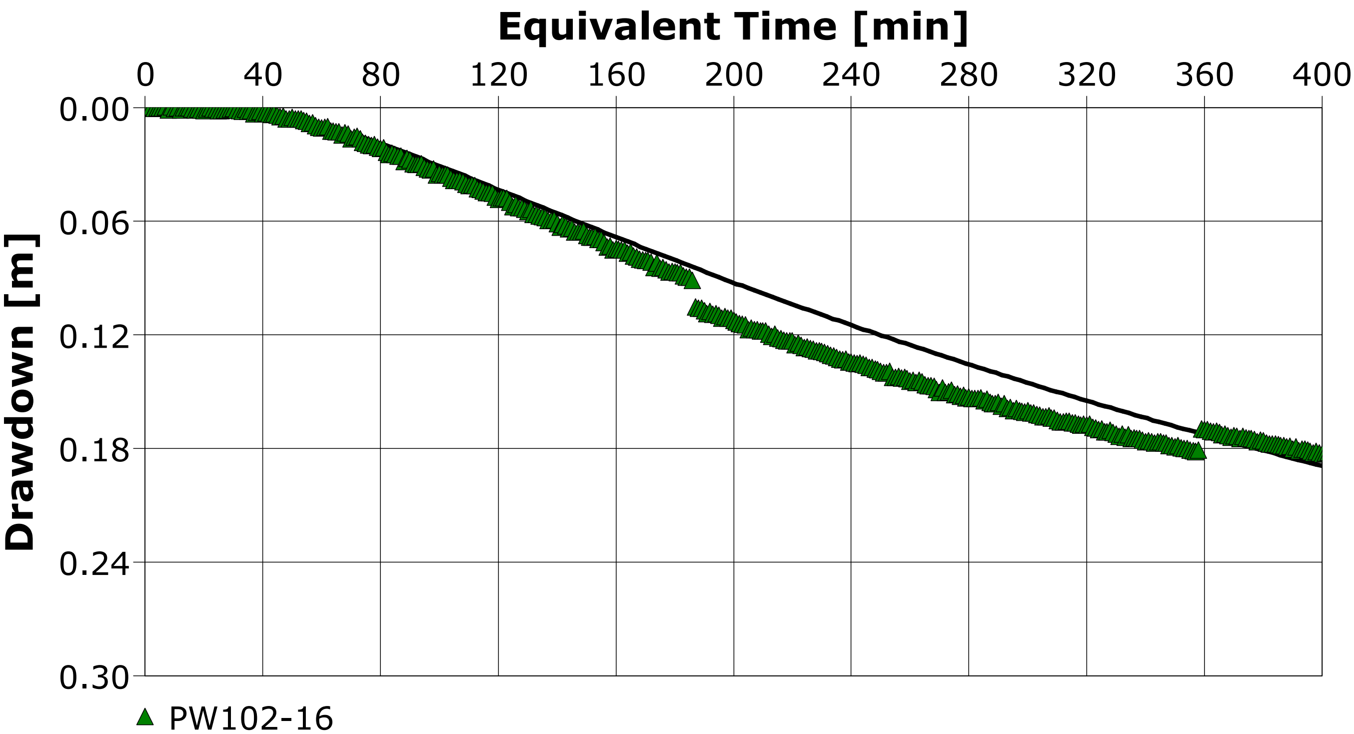


Calculation using AGARWAL + Agarwal skin

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	Skin factor	Radial Distance to PW [m]
PW101-16	2.32×10^{0}	6.00×10^{-2}	4.75×10^{-1}	3.69×10^{-3}	0.08

Cambium Inc. 52 Hunter St. East Peterborough Ontario	**Pumping Test Analysis Report** Project: Buffalo By Hydrogeological Number: 3874-001 Client: EcoVue Consulting Services Inc.

Location: Buffalo Bay	Pumping Test: Pumping Test 2	Pumping Well: PW101-16
Test Conducted by: C. MacDougall		Test Date: 27/01/2016
Analysis Performed by:	New analysis 1	Analysis Date: 09/02/2016
Aquifer Thickness: 38.66 m	Discharge: variable, average rate 0.0234 [m³/min]	

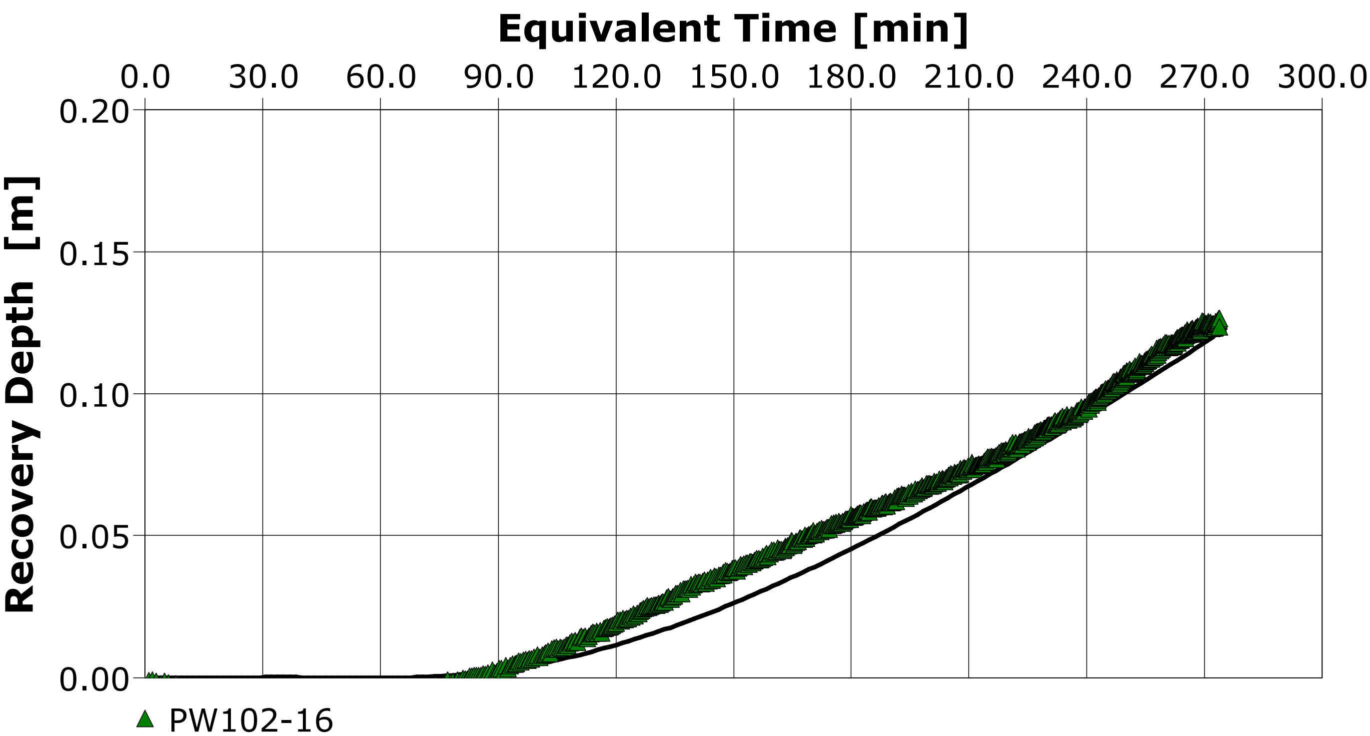


Calculation using Double Porosity

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Specific storage	Sigma	Lambda	Radial Distance to PW [m]
PW102-16	3.00×10^{0}	7.76×10^{-2}	3.48×10^{-5}	1.00×10^{5}	1.00×10^{-15}	175.58

Cambium Inc. 52 Hunter St. East Peterborough Ontario	**Pumping Test Analysis Report** Project: Buffalo By Hydrogeological Number: 3874-001 Client: EcoVue Consulting Services Inc.

Location: Buffalo Bay	Pumping Test: Pumping Test 2	Pumping Well: PW101-16
Test Conducted by: C. MacDougall		Test Date: 27/01/2016
Analysis Performed by:	New analysis 1	Analysis Date: 09/02/2016
Aquifer Thickness: 38.66 m	Discharge: variable, average rate 0.0234 [m³/min]	

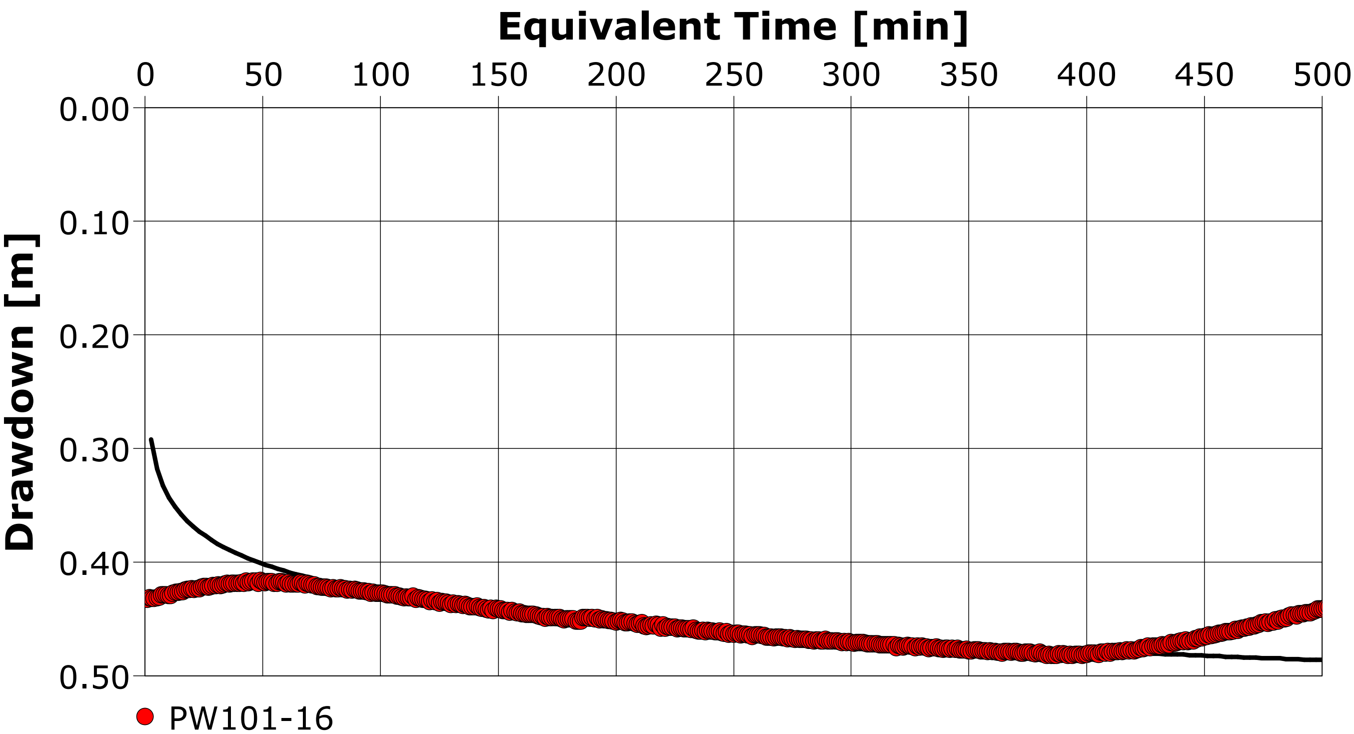


Calculation using AGARWAL + Double Porosity

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Specific storage	Sigma	Lambda	Radial Distance to PW [m]
PW102-16	9.05×10^{-1}	2.34×10^{-2}	3.48×10^{-5}	1.00×10^{0}	1.00×10^{1}	175.58

Cambium Inc. 52 Hunter St. East Peterborough Ontario	**Pumping Test Analysis Report**
	Project: Buffalo By Hydrogeological
	Number: 3874-001
	Client: EcoVue Consulting Services Inc.

Location: Buffalo Bay	Pumping Test: Pumping Test 2	Pumping Well: PW102-16
Test Conducted by: C.MacDougall		Test Date: 28/01/2016
Analysis Performed by:	New analysis 1	Analysis Date: 09/02/2016
Aquifer Thickness: 27.62 m	Discharge: variable, average rate 0.0239 [m³/min]	

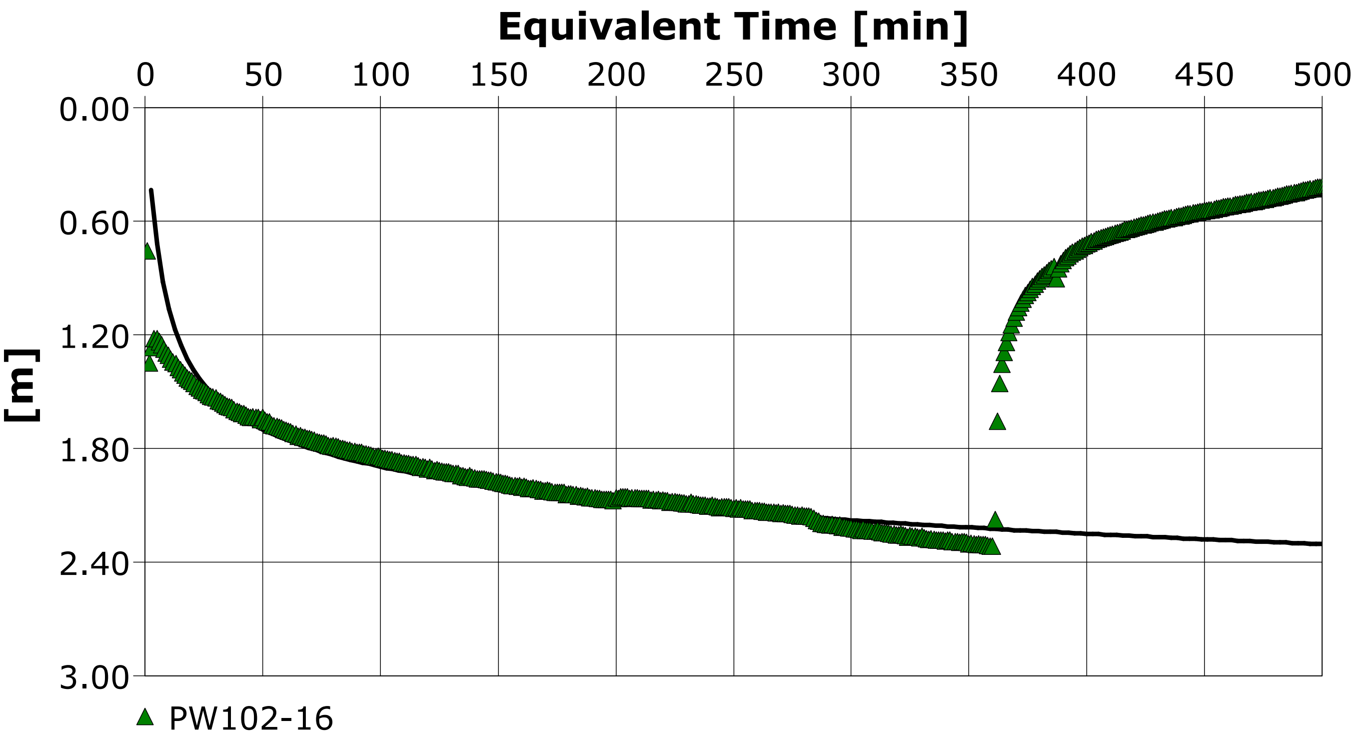


Calculation using Double Porosity

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Specific storage	Sigma	Lambda	Radial Distance to PW [m]
PW101-16	1.34×10^{1}	4.85×10^{-1}	6.16×10^{-10}	1.00×10^{5}	1.00×10^{-15}	175.58

Cambium Inc. 52 Hunter St. East Peterborough Ontario	**Pumping Test Analysis Report**
	Project: Buffalo By Hydrogeological
	Number: 3874-001
	Client: EcoVue Consulting Services Inc.

Location: Buffalo Bay	Pumping Test: Pumping Test 2	Pumping Well: PW102-16
Test Conducted by: C.MacDougall		Test Date: 28/01/2016
Analysis Performed by:	New analysis 1	Analysis Date: 09/02/2016
Aquifer Thickness: 27.62 m	Discharge: variable, average rate 0.0239 [m³/min]	

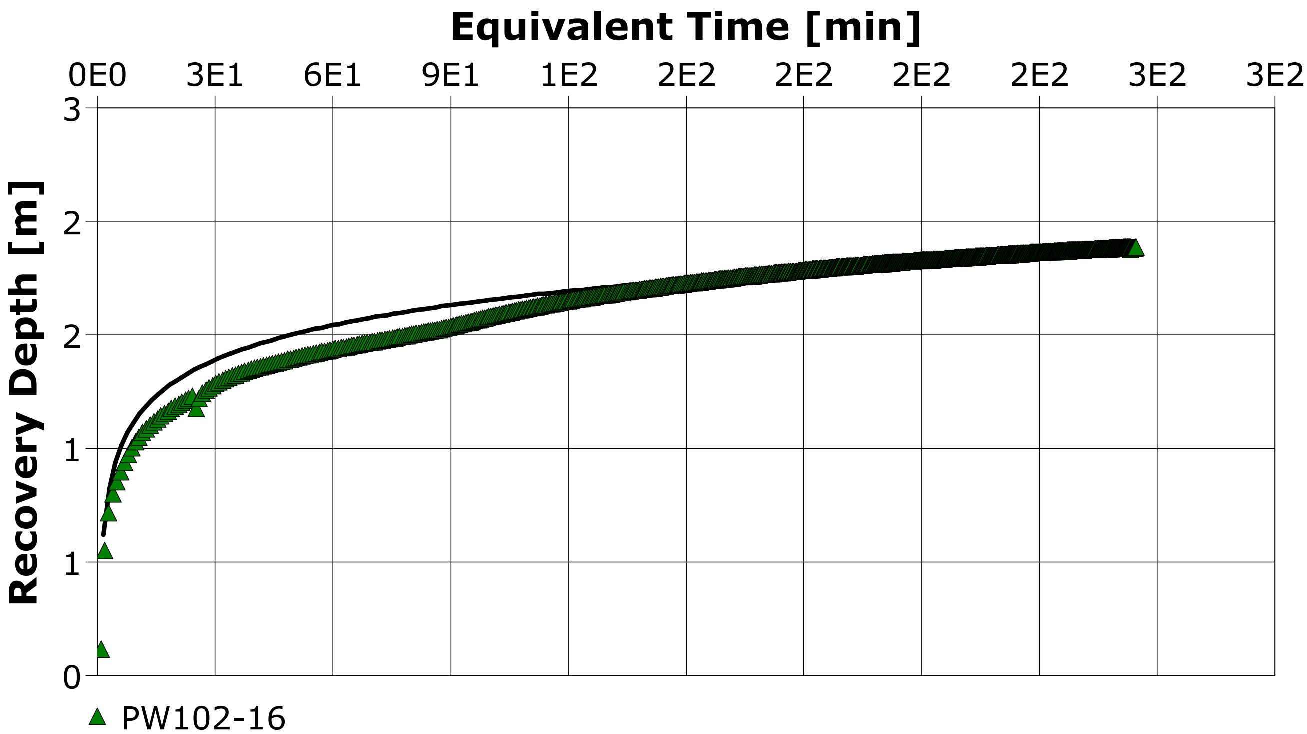


Calculation using Agarwal skin

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	Skin factor	Radial Distance to PW [m]
PW102-16	2.05×10^{0}	7.42×10^{-2}	5.00×10^{-1}	1.75×10^{0}	0.08

Cambium Inc. 52 Hunter St. East Peterborough Ontario	**Pumping Test Analysis Report** Project: Buffalo By Hydrogeological Number: 3874-001 Client: EcoVue Consulting Services Inc.

Location: Buffalo Bay	Pumping Test: Pumping Test 2	Pumping Well: PW102-16
Test Conducted by: C.MacDougall		Test Date: 28/01/2016
Analysis Performed by:	New analysis 1	Analysis Date: 09/02/2016
Aquifer Thickness: 27.62 m	Discharge: variable, average rate 0.0239 [m^3/min]	



Calculation using AGARWAL + Agarwal skin

Observation Well	Transmissivity [m^2/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	Skin factor	Radial Distance to PW [m]
PW102-16	1.08×10^{1}	3.91×10^{-1}	2.52×10^{-1}	5.00×10^{-1}	0.08