Appendix A
Field Investigations
CAMBRIDGE EAST IUS WATER SUPPLY CLASS ENVIRONMENTAL ASSESSMENT

Appendix A
Field Investigations

Submitted to:
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Report Number: 05-1112-010
Distribution:
1 e-copy Regional Municipality of Waterloo
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1.0 INTRODUCTION

The Regional Municipality of Waterloo (the Region) is undertaking a municipal Class Environmental Assessment (EA) to identify the preferred alternative for optimizing municipal groundwater supply taking in Cambridge East. This EA is a component of a larger project; the Integrated Urban System Groundwater Supply Optimization and Expansion Project (IUS Project) that was initiated in 2005 and directed to develop additional supplies in select areas across the Region. The Cambridge East EA Study Area, as shown on Figure 1, includes the Pinebush, Clemens Mill and Shade’s Mills well fields. It is approximately bounded on the west by Franklin Boulevard and extends east of Townline Road to include portions of the Townships of Puslinch and North Dumfries. It is approximately bounded on the north by Highway 401 and extends to Clyde Road in the south.

The EA is focused on assessing options for optimizing the Region’s municipal well supplies to meet existing treatment capacity at the Pinebush, Turnbull (Clemens Mill) and Shade’s Mills Water Treatment Plants (WTPs). Golder Associates Ltd. (Golder) in association with Triton Engineering Ltd. (Triton) were retained by the Region to carry out the EA. S.S. Papadopulos & Associates Inc. (SSPA) and Matrix Solutions Inc. (Matrix) were retained by the Region to complete groundwater modelling to support the hydrogeological assessment for the EA.

As part of the studies supporting the Class EA, Golder Associates (Golder) undertook a comprehensive field program to characterize the hydrogeological conditions in the vicinity of the Cambridge East Study Area. This technical appendix (Appendix A) of the Hydrogeological and Natural Environment Report for the project provides the factual results of this field program. These results were previously reported in a series of draft reports, technical memoranda and presentations and have been compiled here to provide a single comprehensive summary of the methodology and results of the Cambridge East IUS Project field program.

In addition to the field program carried out under the IUS Project, during the course of the EA a number of additional well field optimization investigations were carried out as part of other Region projects in the Pinebush, Clemens Mill and Shade’s Mills well fields. These investigations were completed at existing wells sites that supply the Cambridge East EA Water Treatment Plants and are also summarized in this report.

1.1 Overview of the IUS Project Field Investigations

The field program for IUS Project Task B at the Cambridge East Study Area included:

- An extensive test drilling program to assess hydrogeological conditions to the base of the bedrock aquifer including:
  - Drilling, installing and step testing twelve (12) 152 mm (6-inch) diameter test wells;
  - Drilling, installing and step testing five 305 mm (12-inch) diameter test production wells at the five most favourable test well sites; and
  - Monitoring well drilling and installation at 20 sites (72 piezometers) completed in the bedrock and overburden at locations up to about 1 km from the test wells.
- Geophysical logging and flow profiling of boreholes that were completed as test wells and monitoring wells;
- The development of comprehensive monitoring programs in support of a long-term pumping test including: shallow water table piezometers located in environmentally sensitive areas and cold water streams, private
wells, multi-level monitoring well nests, staff gauges in lakes and ponds, stream flow measuring stations and ecological monitoring transects;

- A 28-day long-term pumping test with a staggered start of pumping from three test production wells;
- Three additional constant rate pumping tests, ranging from 3 to 6 days in duration, at other test wells and test production wells;
- Sampling for water quality;
- Communication with the public and public meetings focused on the field testing program; and
- Comprehensive analysis of all test data to assess long-term aquifer yields and potential effects on nearby sensitive environmental features and groundwater users. The analysis is supported by numerical groundwater modelling completed by SSPA and Matrix (2016) (Appendix D).

1.2 Phases of the Field Investigations

The IUS Project field investigations for the Cambridge East EA were carried out between 2005 and 2009 and are summarized in Tables A1-A through A1-C.

Additional well field optimization investigations were carried out at some of the existing well sites as part of other Region projects between 2009 and 2016 and these are summarized in Table A1-D.

For reporting purposes these investigations are described below.


The initial program for the Cambridge East investigations was focused in the Pinebush, Clemens Mill and Shade’s Mills Well Fields. The program included installation and step testing of six test wells (two for Pinebush, three for Clemens Mill and one for Shade’s Mills), drilling and step testing of three test production wells (CMPW2-06, PBPW1-06 and CMPW1-06), installation of 10 monitoring well nests, conversion of two test wells into bedrock monitoring nests and a 28-day pumping test of the three test production wells. The 28-day pumping test was completed with a staged start of pumping from the three test production wells (CMPW2-06, PBPW1-06 and CMPW1-06) at rates of 37.5 L/s, 39.1 L/s and 37.5 L/s, respectively.

Due to the modest result obtained at the Shade’s Mills test well (SMTW1-05), additional testing in Shade’s Mills was proposed for Phase II to further investigate groundwater supply potential in that area. Also, investigations further west of Puslinch Lake were explored to expand options for the Pinebush well field.

**Phase II (2007/2008) – Additional Pinebush and Shade’s Mills IUS Project Testing**

Based on the results of the Phase I testing, the second phase of the Cambridge East investigations was initiated in 2007. During this phase, additional testing was undertaken in the Clemens Mill and Shade’s Mills Well Fields. In total, three test wells were drilled and step-tested in Shade’s Mills. Two of these test wells were converted into bedrock monitoring well nests (SMTW2-07 and SMTW3-07). The Shade’s Mills bedrock monitoring nests were sampled for water quality and an analysis was done to investigate groundwater sulphate concentrations. An overburden monitoring nest was installed and a 3-day pumping test was conducted at the third Phase II Shade’s Mills test well (SMTW4-08). Subsequently the third test well was converted to a bedrock monitoring
well nest. In Pinebush, a third test well (PBTW3-07) was installed and step-tested. Following this test, a test production well (PBPW2-08) was drilled, step tested and then a 3-day constant rate test was conducted.

Phase II did not identify any suitable sources in the Shade’s Mill well field, so additional testing further east in the Town of Clyde was proposed for Phase III investigations.

**Phase III (2008/2009) – North Dumfries IUS Project Testing**

In 2008, a third phase of investigations was initiated in the vicinity of Clyde in the Township of North Dumfries. Initially two test wells (NDTW1-08 and NDTW2-08) were drilled and step-tested. Following these tests, a test production well (NDPW1-08) was drilled at the most favourable location and the remaining test well was converted into a monitoring well nest. At two additional sites, monitoring well nests (including piezometers in the bedrock and overburden) were installed and three additional shallow overburden monitoring well nests were installed. In 2009, two constant rate pumping tests were conducted at the test production well. The first was a 2-day test on the open bedrock borehole and the second was a 7-day test on the borehole with a packer installed to isolate the Gasport Formation.

**Additional Well Field Optimization Investigations (2009 – 2016)**

Additional testing was completed in the Pinebush, Clemens Mill and Shade’s Mills Well Fields as part of other Region projects. In the Pinebush Well Field, following testing at four pilot test wells, three additional test wells were installed. The Pinebush test wells included two wells in the deep bedrock (P10A close to P10 and PBTW1-10 near the Pinebush Water Treatment Plant) and one in the deep overburden/shallow bedrock (P10B near P10). Several monitoring well nests were installed close to P10 (Burnside, 2010, 2011; Stantec, 2013a). A steel liner was also installed in well P17 in 2011. In 2012, Well P11 was overdrilled to remove the casing and a new casing was installed to a deeper depth (44 m) below ground. A 15-day constant rate test of the three test wells and P17 was conducted (Stantec, 2013a). In 2014, a steel liner was installed in P9, a new well (P15A) was installed as an eventual replacement for well P15 and a constant rate pumping test was conducted at P9 and P15A (Stantec, 2015).

In the Clemens Mill Well Field, G16 was deepened and a steel liner installed (Lotowater, 2011). Well rehabilitation was performed on G17 and a steel liner was also installed in G6. In the Shade’s Mills Well Field, a test production well (G40) and new monitoring well nest were installed in the vicinity of G38 and G39. A 6-day constant rate pumping test was conducted at G40, G38 and G39 (Stantec, 2013b). These investigations are summarized in this report and the reader is to refer to the above mentioned references for additional details.

**2.0 PHASE I INVESTIGATIONS (2005/2006) PINEBUSH, CLEMENS MILL AND SHADE’S MILLS WELL FIELDS**

**2.1 Well Drilling and Construction**

The details regarding the field methodology used in the well drilling and testing, and the test well, test production well and monitoring well schematics are provided in Attachment A1. The locations of wells drilled as part of the IUS investigations are shown on Figure A1.
2.1.1 Test Wells and Test Production Wells

In Phase I, under the Region contracts Q2005-1008 and Q2005-1012, five 152 mm (6-inch) diameter test wells were constructed by Davidson Well Drilling Ltd., under the supervision of Golder personnel. These test wells included: SMTW1-05, PBTW1-05, CMTW1-05, CMTW2-05 and CMTW3-05. Drilling of the first five test wells took place between August 9, 2005 and November 15, 2005. These test wells were drilled using a Gardner Denver mud rotary drilling rig. A sixth 152 mm (6-inch) diameter test well (PBTW2-06) was drilled under the Region of Waterloo contract Q2006-014 by Gerrits Well Drilling Inc. using a Foremost DR-12 air rotary drill rig. Test well construction details are provided in Table A2.

Three of the test well sites were chosen for installation of adjacent 305 mm (12-inch) diameter test production wells based on the results of the test well drilling and step testing. Details regarding the step testing are provided in Section 2.3. Details regarding the site selection process are provided in the main report text for the Hydrogeology and Natural Environment Report.

Under the Region contract Q2006-015, the three test production wells (CMPW1-06, CMPW2-06 and PBPW1-06) were drilled by Gerrits Well Drilling Inc., under the supervision of Golder personnel, using a Foremost DR-12 air rotary drill rig. Drilling commenced on May 8, 2006 at the CMPW1-06 well site and finished on July 14, 2006 with the completion of test production well PBPW1-06. Test production well construction details are provided in Table A2.

2.1.2 Monitoring Wells

Five monitoring well nests were constructed by Gerrits Well Drilling Inc. under the supervision of Golder personnel during the period of May 15, 2006 to July 24, 2006. The monitoring wells were drilled with an air rotary drilling rig. Four of the monitoring well nests (CMOW1-06, CMOW2-06, PBOW1-06 and PBOW2-06) consisted of three bedrock piezometers and three overburden piezometers to monitor the overburden and bedrock aquifer units. Three of these wells were located east of Townline Road in Puslinch (CMOW2-06, PBOW1-06 and PBOW2-06) and one was located in Cambridge East (CMOW1-06). The fifth monitoring well nest (CMOW3-06) was drilled as a bedrock monitoring well nest adjacent to an existing overburden monitoring well nest (OW4-92). Well construction details for the monitoring nests are provided in Table A3.

Two of the test wells (CMTW3-05 and SMTW1-05) were converted into bedrock monitoring well nests. Nests of two or three shallow overburden monitoring wells (less than 15 m depth) were installed to improve understanding of the shallow groundwater flow system adjacent to Puslinch Lake (well nests PLOW1-06 and PLOW2-06) and adjacent to Hilborn Pond (well nest HPOW1-06). The shallow overburden monitoring wells were installed by Strata Soil Sampling Inc. using a direct push continuous core drilling rig.

2.1.3 Borehole Testing

At each drilling location, overburden samples were taken for grain-size analyses and bedrock drill cuttings were collected. Details of the field methodologies used are provided in Attachment A1. The air rotary cuttings obtained during drilling provided limited information on geologic materials, although the condition of the rock mass where weathered was apparent from inspection of drill cuttings. Mud rotary cuttings obtained during drilling through the overburden provided limited information on overburden geologic materials. The results from the grain-size analyses and photos of the rock chips are included in Attachment A2.
Geophysical logging was carried out by Golder geophysicists in the test wells, test production wells and bedrock monitoring wells. The geophysical logs completed included gamma, conductivity and optical televiwer. Caliper logging was performed at wells CMTW2-05 and PBTW1-05. The geophysical logs (natural gamma, conductivity and optical televiwer) were used to aid in interpretation of borehole stratigraphy. The natural gamma log response was useful for distinguishing the stratigraphic contacts in cases where there was a contrast in clay content in the overburden or shale content in the bedrock. The methodology used for the borehole logging is provided in Attachment A1.

The results of the test well, test production well and monitoring well drilling and testing are provided in the borehole records in Attachment A2. The natural gamma and inductive conductivity geophysical log data is presented beside the stratigraphy in the borehole log records. The borehole records were completed prior to Ontario Geological Survey (OGS) publication of the preliminary revised Silurian Bedrock Stratigraphy (Brunton, 2008) and therefore follow the earlier bedrock stratigraphic nomenclature. Photographs of the test well bedrock drill cuttings, and the grain size analysis results used to confirm overburden lithologies, are also included in Attachment A2. Driller’s water well records are also included in Attachment A2.

The interpretation of the bedrock geology at the drilling locations, following the revised nomenclature (Brunton, 2008, 2009; Brunton and Britnell, 2011), is presented in Table A4. The bedrock geology interpretation is based on the drill cuttings, the natural gamma log response, the optical televiwer log data and an examination of borehole records for existing wells in the Cambridge East area. The bedrock geology interpretations were developed in consultation with Frank Brunton of the OGS.

2.2 Permits to Take Water

Step testing of the six test wells (CMPW1-05, CMPW2-05, CMPW2-05, PBPW1-05, PBPW2-06 and SMTW1-05) during Phase I of the field work was conducted under the Category II Permit to Take Water (PTTW) number 6223-6ERJQG. This permit was issued on September 8, 2005 and expired on July 30, 2006. A Category III PTTW number 5514-683QNG, was issued on July 27, 2006 to allow step testing and the 28-day aquifer testing of the three test production wells, CMPW1-06, CMPW2-06 and PBPW1-06. An addendum to this application was submitted on July 20, 2006 to provide additional information regarding the testing program. The amended PTTW number 0458-6TDH4X was issued on September 7, 2006 in order to correct a clerical error by the Ontario Ministry of the Environment and Climate Change (MOECC). These permits are included in Attachment A3.

2.3 Step Testing

Step-drawdown tests of 8-hour duration were conducted at each of the six test wells and each of three test production wells that were drilled during Phase I Investigations. A summary of the dates and pumping rates of the step tests completed is presented in Table A5. Step testing of the first five of the test wells (PBTW1-05, CMTW1-05, CMTW2-05, CMTW3-05 and SMTW1-05) was completed during the period of September 8, 2005 and November 5, 2005 by Davidson Well Drilling Ltd. Step testing of the sixth test well (PBTW2-06) and the first three test production wells (PBPW1-06, CMPW1-06 and CMPW2-06) was completed between June 7 and August 16, 2006 by Gerrits Well Drilling Inc. The fourth step was not completed for test production well CMPW1-06 since the pump broke suction at the fourth step pumping rate.
2.3.1 Monitoring Program

Water levels in nearby private wells were monitored with dataloggers to assess water level changes during step testing. Two private wells, as listed by the Region’s Water Resources Analysis System (WRAS+) database unique well identifiers (9203306 and 9202055) were monitored near PBTW1-05, two wells (9200728 and 1000545) near CMTW1-05, and one well (ID# DW08) near CMTW2-05. Following the above step testing, letters were sent to these well owners providing the results of the monitoring of their wells.

Flow profile logging was performed by personnel from Lotowater Ltd. during step testing of the three test production wells (PBPW1-06, CMPW1-06 and CMPW2-06). Flow profiling methods are outlined in Attachment A1. The flow profiles are included in Attachment A2.

2.3.2 Discharge Conveyance

Water from the test was conveyed away from the wellhead area by temporary piping, and discharged to nearby storm sewers or suitable surface water features. Discharge of water from the step testing was coordinated with City of Cambridge operations staff. Flow dissipation measures were used, as necessary, to avoid erosion. Given the short duration of the step tests and the depth of the aquifers tested, recirculation of pumped water back to the aquifer was not an issue for the step testing. Discharge locations for the long term 28-day test are described in Section 2.5.2 and shown on Figure A3.

2.3.3 Water Quality Sampling

Water samples were collected from the six test wells at the end of the step pumping tests. Key parameters that were analyzed included chloride, sodium, sulphate, hardness, iron and manganese. Water quality results are included in Attachment A8.

2.3.4 Observed Response

The drawdown at the end of each step, and the specific capacity calculated at the end of each step test, are presented in Table A6. Hydrographs, which allow a comparison of the drawdowns during the step testing for the test wells and test production wells, are shown on Figures A4 and A5, respectively. Graphs for each of the step tests showing drawdown vs. log time at each step are included in Attachment A4. The key results of the step testing at the test wells are as follows:

- At the end of the last step, water levels in some of the test wells (PBTW1-05, PBTW2-06, CMTW1-05, CMTW2-05, CMTW3-05 and SMTW1-05) were still slightly declining. Steady-state had not been reached;
- PBTW1-05 and PBTW2-06 showed the least drawdown (less than 2 m) and highest specific capacity at the maximum step pumping rate of 1,309 m³/day (15.1 L/s);
- CMTW2-05 also showed relatively minor drawdown and high specific capacity at the maximum step pumping rate; and
- SMTW1-05 showed the greatest drawdown (9.6 to 11.1 m) and lowest specific capacity at the maximum step pumping rate of 1,309 m³/day (15.1 L/s).

Test production well sites were selected at PBTW2-06, CMTW1-05 and CMTW2-05 based on the results of the test well program as further described in the main text of the Hydrogeology and Natural Environment Report.

The following key results are noted for the step testing of the test production wells:
At the end of the last step, water levels in the test production wells were still slightly declining. Steady-state had not been reached;

The test production wells CMPW2-06 and PBPW1-06 showed the least amount of drawdown (less than 6.5 m) and the highest specific capacity (12 L/s/m) at the maximum step pumping rate of 6,540 m³/day (75.7 L/s); and

CMPW1-06 (Portuguese Club) pump broke suction when pumping was increased to the last step rate (75.7 L/s) and had a lower specific capacity of 3 L/s/m.

### 2.4 Private Well Inventory

Prior to the long-term 28-day pumping test, a private well inventory was conducted during July and August of 2006. The inventory was completed within a 1 km radius of each of the three test production wells (CMPW1-06, CMPW2-06 and PBPW1-06). The private wells are plotted on Figures A5.1 and A5.2 in Attachment A5. The results of the well inventory are presented in Tables A5.1 and A5.2 in Attachment A5.

### 2.5 28-Day Pumping Test (PBPW1-06, CMPW1-06 and CMPW2-06)

A long-term (28-day) pumping test was completed with a staged start of pumping from the first three test production wells (PBPW1-06, CMPW1-06 and CMPW1-06). The schedule of the pumping test is outlined below and in Table A7.

<table>
<thead>
<tr>
<th>Date</th>
<th>Pumping Test Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept 5, 2006</td>
<td>Start up of CMPW2-06 at 12 noon at a constant rate of 3,240 m³/day (37.5 L/s).</td>
</tr>
<tr>
<td>Sept 13, 2006</td>
<td>Start up of PBPW1-06 at 1:30 pm at a constant rate of 3,378 m³/day (39.1 L/s).</td>
</tr>
<tr>
<td>Sept 19, 2006</td>
<td>Start up of CMPW1-06 at 12:45 pm at a constant rate of 3,240 m³/day (37.5 L/s).</td>
</tr>
<tr>
<td>Oct 2, 2006</td>
<td>Shutdown of CMPW1-06, CMPW2-06 and PBPW1-06 at 12 noon.</td>
</tr>
</tbody>
</table>

#### 2.5.1 Monitoring Program

The monitoring program included wells, shallow piezometers, surface water stations and ecological monitoring stations. The locations of the monitoring stations are shown in Figure A2. Table A8 lists the locations monitored and the methods used to monitor these sites.

Water levels were monitored in six test and test production wells, 65 piezometers in 19 monitoring well nests, 16 private wells, six stream piezometers, and three surface water gauges. In total 60 electronic dataloggers were deployed measuring water levels at five minute intervals. Manual water level measurements were taken on a daily or weekly basis. Surface water levels were monitored using staff gauges in Puslinch Lake, Little Lake and Hilborn Pond, as well as in three private ponds. The monitoring included shallow groundwater levels in stream piezometers and stream levels at four locations in Cedarbrook Creek. Portuguese Swamp water levels were monitored in shallow piezometers CMOW1D-92 and CMOW2D-92.

Eight ecological monitoring stations were set up to monitor vegetation in environmentally sensitive areas throughout the pumping test. The sites were selected to include nearby representative environmentally sensitive features including Portuguese Swamp, Cedarbrook Creek and McCormick Bog. The monitoring also included
areas of bog, marsh and wetland type communities at distances of 2 to 5 km from the pumping wells, considered as representative background monitoring sites. Monitoring began in advance of the testing (July 24, 2006) with an inventory of the plant species at each of these locations. Shallow piezometers were installed at these sites to monitor changes in water levels. During the pumping test, each site was visited weekly, photos were taken, changes to the vegetation were observed and water levels in the shallow piezometers were measured. This work was conducted by Golder biologists.

2.5.2 Discharge Conveyance

In order to avoid the possibility for recirculation of discharge water back to the aquifer, measures were taken to convey the discharge water from the long-term pumping test out of the recharge area for the wells. Figure A3 shows the discharge conveyance from the three wells. Discharge during testing was arranged in coordination with operations staff from the City of Cambridge.

Water pumped from CMPW2-06 was discharged into the storm sewer inlet on Cedarbrook Crt. This water was channelled through the storm sewer, which passes under Cedarbrook Crt. and discharges into the Hilborn storm water management pond. Hilborn Pond outlets into Cedarbrook Creek, which flows into Mill Creek. Water pumped from CMPW1-06 was conveyed through temporary piping to the storm sewer inlet at Townline Road and Saginaw Parkway. This storm sewer discharges into Cedarbrook Creek upstream from Hilborn Pond. Approval for the discharge to the storm water pond was given by the City of Cambridge.

Discussions were held with the Grand River Conservation Authority (GRCA) and the Ministry of Natural Resources (MNR) regarding the combined discharge from two test production wells (CMPW1-06 and CMPW2-06) to Hilborn Pond that overflows into Cedarbrook Creek. The planned monitoring of groundwater levels at in-stream piezometers was augmented as follows:

- The start of the test was delayed for five days because of a then pending significant storm event. This storm event was not as intense in the Cambridge East area as expected and pumping commenced on September 5, 2006;
- At the request of GRCA, an electro fishing survey was conducted on September 1, 2006, immediately prior to the beginning of the test. The presence of cold water fish species was confirmed during this survey. (documentation of the fish survey is contained in Attachment A6);
- Inspections of the creek and pond were conducted during start up and daily for the first three days with less frequent inspections thereafter; inspections were conducted by an experienced team including aquatic scientists, surface water engineers and hydrogeologists;
- Creek water samples were collected daily at two locations and inspected visually for clarity with laboratory analysis of total suspended solids (TSS). These two locations were at the discharge from Hilborn Pond and at the culvert passing under Avenue Road;
- Daily water temperature measurements were made at four locations along this creek and a continuous record of creek water temperatures was obtained immediately below the pond outlet and downstream near the confluence with Mill Creek;
- Measurements of creek flow were collected daily at a location downstream of Avenue Road near the confluence with Mill Creek. (See Figure A6.52 in Attachment A6) Groundwater levels were also measured...
daily at in-stream piezometers to confirm that discharge (upward) gradients were maintained. Groundwater levels were also measured daily at the shallow nested piezometer located immediately adjacent to the outlet of Hilborn Pond;

- The outlet from Hilborn Pond was temporarily modified to prevent clogging from floating weed and consequent rise in pond water levels; and

- For the first 14 days, only the CMPW2-06 was discharged into Hilborn Pond. Given the stable condition of the creek as observed during this period, pumping from CMPW1-06 was initiated with the combined discharge reporting through Hilborn Pond. Again daily inspections of the condition of the creek were conducted for the next three days as well as the continuation of daily TSS, temperature and flow monitoring. (See Figure A6.52 in Attachment A6). Particular attention was paid to reaches of the creek with a greater potential for bank undercutting or erosion of the stream bed. Creek conditions remained stable with respect to the potential for erosion or scouring and so the combined discharge was maintained for a further 13 days, with pumping terminated on October 2, 2007. In the event that unstable conditions were observed or suspected, pumping from the CMPW2-06 would have been terminated.

Discussions were held with the City of Cambridge to evaluate the feasibility of discharging pumped water from PBPW1-06 to the sanitary sewer. The capacity of the sanitary sewer system was reviewed by MTE consultants who determined that an additional pump was needed at the Burnett Avenue pumping station. This report is included in Attachment A6. A temporary pump was installed in the pumping station to handle the addition of groundwater to the sanitary sewer system.

Water pumped from PBPW1-06 was initially discharged, beginning on September 13, 2006 into a local storm water pond, while the connections and pump modifications for discharge to the sanitary sewer were completed. After three days, discharge water was directed through temporary piping into the sanitary sewer system approximately 300 m south of the test production well. The flow of water to the sanitary pumping station was inspected by both City staff and Golder when well water was first discharged to the sanitary sewer on September 15, 2006. The performance of the sewer system and the additional pump were as expected in that sump water levels were maintained within desirable levels. Discharge to the sanitary sewer was continued for 19 days to the end of the test on October 2, 2006.

### 2.5.3 Water Quality Sampling

As shown in Table A10, water samples were collected from each of the three test production wells (CMPW1-06, CMPW2-06 and PBPW1-06) during the pumping test. For the duration of the testing period, water samples were collected from each of the three wells three times per week. Field measurements were taken of temperature, pH, and electrical conductivity. Samples were submitted to the Region’s Water Services Laboratory for water quality analysis for ODWS (Ontario Drinking Water Standard) parameters to determine local water quality at each site. At the end of the test, additional samples were collected and submitted to the University of Waterloo Isotope Lab for analysis of stable isotopes (deuterium and oxygen-18), tritium and sulphur-34. For organic chemistry and radionuclides analysis, samples were collected on Sept 29, 2006 and submitted to the Region’s Water Services Laboratory. Water quality results are discussed in Section 2.7.
2.5.4 Observed Responses

Figure A6 shows a hydrograph of the three production wells: CMPW1-06, CMPW2-06 and PBPW2-06, along with the pumping rates and daily precipitation as recorded at the GRCA’s Shade’s Mills station. Figures A7 and A8 present the drawdown observed in the Gasport Formation and lower overburden, respectively, in plan view. Table A8 presents the drawdown for all monitoring wells at the end of the 28-day pumping test. Key hydrographs from this test are shown on Figures A9 through A18. Composite plots showing observed drawdown from pumping at CMPW1-06, CMPW2-06 and PBPW1-06 versus (time/radius)$^2$ are presented on Figures A6.45 through A6.47 in Attachment A6. Hydrographs of all monitoring wells are also included in Attachment A6 (Figures A6.1 through A6.15).

Test Production Well Drawdowns

The drawdowns in the test production wells during the 28-day pumping test are shown on Figure A6. The following key observations are noted regarding the drawdowns observed in the test production wells:

- In each of these wells, most of the drawdown occurred within the first 24 hours after pumping began; after which time these water levels approached a steady-state condition;
- Following shut down of the pumping test, water levels in the pumping wells recovered above the initial static levels within 48 hours;
- The least drawdown at the end of the test was observed in PBPW1-06 (2.5 m), with more drawdown observed at CMPW2-06 (5.4 m) and the greatest drawdown observed in CMPW1-06 (10.4 m);
- There was little interference (<0.5 m) observed in PBPW1-06 from pumping at the other two test production wells; conversely, there was also little interference (<1 m) observed at the CMPW1-06 and CMPW2-06 from pumping at PBPW1-06;
- Interference between CMPW1-06 and CMPW2-06 was about 2 m for each of these wells; and
- The water levels in wells CMPW2-06 and CMPW1-06 showed minor influences from nearby municipal pumping at wells G16, G17 and G18. These municipal wells were cycling in unison. Fluctuations of up to approximately 0.5 m occurred in these two test production wells as the existing municipal wells cycled off and on. The cycling of these well did not influence well PBPW1-06, located further to the north. Comparison plots showing the municipal pumping from existing wells in relation to water levels in the test production wells are presented on Figure A6.44 in Attachment A6. The municipal supply wells of the Pinebush well field typically do not cycle in the same manner as for the Clemens Mill wells and interference from these wells was not observed in water levels at the test production wells.

Overview of Water Level Responses

The drawdowns at the end of the test are plotted for all bedrock wells monitored (Figure A7) and for all overburden monitoring wells monitored (Figure A8). The drawdown values for wells with monitored intervals in the deep bedrock (Gasport Formation) are highlighted and contoured on Figure A7. On Figure A8, the drawdown values for wells with monitored intervals in the lower overburden are highlighted and contoured.

- Drawdowns observed in the bedrock at the end of the test are summarized as follows:
Observed drawdowns at the end of the test were greatest in the Gasport Formation, with values ranging from 1.2 m (at CMTW3A-05) to 4.4 m (at CMOW1A-06);

Observed drawdowns in the Gasport Formation were greatest in the vicinity of the CMPW1-06 and CMPW2-06. Drawdowns were relatively lower in the Gasport Formation in monitoring wells east of PBPW1-06 near Puslinch Lake (CMOW5A-94 and PBOW2A-06);

The observed drawdowns were largely confined to the lower bedrock Gasport Formation in the southern part of the Study Area near Mill Creek with little (<0.4 m) to no drawdowns observed in wells in the Guelph Formation (CMOW2B/C-06 and SMTW1B/C-05). The observed drawdowns were also largely confined to the lower bedrock Gasport Formation in the central part of the Study Area, with observed drawdown ranging from 0.6 m to 1.6 m in the Guelph Formation;

In the area to the east of PBPW1-06, approaching Puslinch Lake, drawdowns were more evenly distributed between the Gasport and Guelph Formations, with drawdown values of 1.4 m to 2.0 m observed in the Guelph Formation in wells PBOW2B/C-06 and CMOW5C/D-94, respectively;

Drawdowns were observed in the bedrock at wells located up to about 1 km from the test production wells; and

Wells located at distances greater than 1 km from the test production wells and completed in the bedrock included TW9-78, at distance of approximately 1.5 km, and TW10-78 at a distance of approximately 5 km. Water levels in these two wells did not show any responses to pumping from the three test production wells in Cambridge East.

Drawdowns observed in the overburden at the end of the test are summarized as follows:

Drawdowns of more than 0.1 m were observed in overburden wells at distances of up to about 1.3 km from the test production wells;

The observed lower overburden responses were greatest in wells located northeast of PBPW1-06, with end-of-test drawdown values of 1.2 m to 1.3 m observed in wells PBOW2D-06 and CMOW5E-94, located at distances of about 500 m and 550 m, respectively, from the test production wells;

In the vicinity of the Portuguese Swamp and CMPW2-06, drawdowns in the lower overburden ranged from 0.2 m to 0.9 m;

On the southwest shore of Puslinch Lake and at McCormick’s Point on Puslinch Lake, drawdowns in the lower overburden were approximately 0.4 m in wells PLOW1A-06, PLOW2A-06 and C2; and

Water level responses to pumping were not observed in the lower overburden at the following locations: Puslinch Township Concession 1 area located 4 to 5 km to the east of Townline Road (wells 9203311 and MW1D); on the northeast shore of Puslinch Lake (well 6710783); in the Shade’s Mills reservoir area (well SM3B-93) and in the western area of Portuguese Swamp (well CMOW1B-92).

The responses at private wells, shallow overburden wells and the water table are described below.

Responses in Private Wells

During the pumping test there were no interruptions to private well water supplies.
The following are the key observations regarding private well water level responses:

- Water level declines observed in nearby deeper private wells completed in the bedrock or lower overburden were generally less than about 1.5 m during the testing. An example of the responses of a private well (ID#9203306) completed in the upper bedrock is shown on Figure A12. This well is located on Townline Road at a distance of about 500 m from PBPW2-06. This hydrograph shows regular fluctuations of up to 4 m that occurred as a result of regular cycling of this well for domestic water supplies. The effect of test well pumping is observed to be about 0.8 m when pumping began at PBPW2-06, with a total drawdown of about 1.4 m recorded at the end of testing. Drawdown from the pumping test did not impact operation of any private wells. Water levels in this well, and in all private wells monitored, recovered to above pre-pumping test levels within less than 48 hours; and

- Water levels in shallow private wells increased during testing in response to seasonal rains. An example of the responses of a private well that was largely influenced by seasonal rains is shown on Figure A13 (well 6710783), located on Lake Road on the north side of Puslinch Lake.

Responses of Shallow Water Table

The following are the key observations regarding the shallow water table responses during the testing:

- The shallow water table, ponds and lake levels all rose during the testing period in response to seasonal rains;

- For example, in the Mill Creek area adjacent to Avenue Road, the water level response hydrographs during testing are shown for the bedrock, overburden and shallow water table on Figures A14 and A15. In this area, drawdown was limited to the lower Gasport Formation while water levels in the overlying Guelph Formation (SMTW1BC-05) did not respond to pumping. Therefore, the shallow water table hydrograph (well 9203305) was representative of the background influence of the seasonal rains on the water table during the testing period and was not influenced by the pumping test;

- In the Portuguese Swamp area, shallow water table water levels were found to increase during the testing in response to rainfall events as illustrated on Figure A16 (CMOW1CD-92);

- During the pumping test, upward vertical hydraulic gradients, as measured in shallow piezometers and stream level stations, were maintained in Cedarbrook Creek; this in spite of the higher creek water levels resulting from the discharge of pumped water from two test wells into Hilborn Pond and Cedarbrook Creek; and

- Wetland shallow water levels increased at all ecological monitoring stations and vegetation changes reflected only seasonal variability, as observed at background monitoring sites.

Responses in Puslinch Lake Area

The responses during pumping in the Puslinch Lake area are illustrated on the hydrographs shown on Figures A17 and A18. Figure A17 shows the responses in the shallow piezometer nest PLOW1-06 in relation to the Puslinch Lake level, nearby overburden well C2 and monitoring well PBOW2F-06. Piezometer PLOW1B-06 (<5 m deep) showed responses similar to the Puslinch Lake level and typical of shallow wells in sandy materials influenced by seasonal rains. The responses in PLOW1B-06 were similar to the shallow water table well responses of well 9203305, shown on Figure A18 that was not influenced by pumping.
Figure A18 also includes the responses in a shallow water table at well PTOW1 (<5m deep) and a private water well (6710783), both located to the northeast of Puslinch Lake. Water levels in these wells also rose during the testing period in response to rainfall events.

The data from the wells monitored adjacent to Puslinch Lake showed that downward vertical hydraulic gradients were present between the lake level and the underlying lower overburden sand and gravel aquifer materials in these locations. These downward gradients were present before the test pumping program began and continued through the testing period. For the shallow wells that showed a response to pumping, the magnitude of the downward vertical gradient increased during the testing period.

### 2.5.5 Aquifer Parameter Estimates

The bedrock transmissivity and storativity estimates were interpreted from the pumping test data using a Cooper Jacob solution. Figures A6.45 through A6.47 in Attachment A6 show composite drawdown versus \((\text{time/radius}^2)\) plots for each of the test production wells (CMPW1-06, CMPW2-06 and PBPW1-06). These figures present the observed drawdown normalized with respect to the distance from the pumping well.

The Effective Transmissivity \((T)\) can be estimated by applying an effective Cooper Jacob method to the observed drawdown as follows:

\[
T = \left(\frac{2.303}{4\pi}\right) \times \left(\frac{Q}{\Delta S}\right)
\]

Where:
- \(Q\) = pumping rate (m\(^3\)/day)
- \(\Delta S\) = slope of the observed drawdown hydrograph per log cycle

The bedrock transmissivity and storativity estimates based on analysis of data from the long-term pumping test are presented in Table A9. The following summarizes the interpreted aquifer hydraulic parameters for the 28-day (CMPW1-06, CMPW2-06 and PBPW1-06) pumping test:

- Estimated transmissivity values in the vicinity of the test production wells varied in a relatively narrow range, averaging 688 m\(^2\)/day at PBPW1-06, 534 m\(^2\)/day at CMPW1-06 and 653 m\(^2\)/day at CMPW2-06; and
- Storativity values estimated from observation well data in the Gasport Formation, range from \(2 \times 10^{-5}\) to \(8 \times 10^{-6}\) m/m.

Step tests were also analysed using Aqtesolv to estimate transmissivity and hydraulic conductivity values based on aquifer thicknesses. The Aqtesolv results are included in Attachment A4. Hydraulic parameter estimates based on interpretation of the step tests are included in Table A9.

### 2.6 Public Communication

During the drilling of monitoring wells at sites in Puslinch Township, a number of local residents became concerned as to the extent and purpose of the program. Local residents organized a meeting to which the Region was invited to explain the program and hear local concerns first hand. This meeting was held at the Clifford Evans Training Centre in Puslinch on July 6, 2006 and attended by about 100 residents (Attachment A7 includes the list of attendees). Representatives from the Region presented on overview of the IUS water supply program and the background to municipal groundwater pumping in the Cambridge East area. They noted that the objective of the program was to restore groundwater pumping rates to levels required to meet the available...
capacity at the existing treatment plants. Representatives from Golder presented details of the program including the rationale for the monitoring well nests that were then being installed in Puslinch, the monitoring program that included extensive monitoring of water levels in private wells and environmentally sensitive areas (ESAs) and the planned 28-day pumping test of the three test production wells located in Cambridge East.

The key technical and procedural concerns expressed were as follows (in no order of priority):

- The Township should have input on the selection of private water wells for inclusion in the monitoring plan that should be expanded to include locations at distances of more than 1 km from the test pumping wells;
- Contingency plans for possible disruption to well water supplies should be augmented and communicated; including a clear protocol for an emergency response contact and for the timely provision of water;
- Since the discharge of pumped water within the watershed could compromise monitoring of the elevation of the water table at environmentally sensitive areas and shallow water wells, the pumped water should be discharged to flow outside the watershed. In addition, discharge from the Portuguese Club test well (CMPW1-06) to the storm sewer on Townline Road had the potential to cause flooding locally on the east side of the road;
- The testing program might impact water levels in Puslinch Lake, environmentally sensitive areas, wetlands, Mill Creek and constructed ponds;
- Regular updates of water level monitoring data obtained during the pumping test should be provided to private well owners during the testing;
- Water level monitoring data from private wells obtained during the pumping test should be provided to the private well owners after completion of the testing;
- The overview of the testing program should be documented and made available to local residents who could not attend the residents meeting; and
- A follow-up meeting should be held to present the results of the testing program.

The following activities were completed to address these concerns:

- Two site visits were conducted with the Township’s hydrogeologist, Mr. Stan Denhoed, (July 28 and August 17, 2006) to select additional locations for inclusion in the monitoring program; including private wells, existing monitoring wells, a location adjacent to Hilborn Pond and two locations immediately adjacent to Puslinch Lake were identified for the installation of shallow monitoring well nests. Discussions addressed the following: private wells preferred for the installation of data loggers; installation of staff gauges at private ponds, and Puslinch and Little Lakes; private wells that potentially would be most at risk during the pumping test; provision of emergency water supplies; locations for the discharge of pumped water and provision of regular updates of the water level monitoring data during testing; and
- A detailed contingency plan was developed. The Region’s emergency call centre number was provided to all residences served with a private water well located within 1 km of the test pumping wells. A water supply contractor was retained to provide water on an emergency basis to any residents whose well water supply was disrupted during the test. Also, five nearby residences with shallow (<10m deep) water wells were visited and offered the installation of a temporary water storage tank to facilitate the timely provision of
an emergency water supply if requested. Only two residents felt this measure was warranted. No calls were received at the emergency call centre in relation to the pumping test program.

The plan for the discharge of pumped water was modified as follows:

- For CMPW2-06, discharge water was piped to the storm sewer at Saginaw Parkway that in turn reported to Hilborn Pond, with overflow to Cedarbrook Creek, a tributary of Mill Creek;
- For PBPW1-06, discharge water was directed to the sanitary sewer system;
- For CMPW1-06, discharge water was directed to Hilborn Pond as per the original plan;
- The monitoring program for Cedarbrook Creek was enhanced to ensure that the combined discharge from two test wells did not compromise fish habitat;
- The program included considerable monitoring in the vicinity of environmentally sensitive areas including at eight wetland transects for monitoring of water levels and vegetation stress. The program was expanded to include additional private wells, additional monitoring wells nests installed at three key locations, staff gauges installed in private ponds and extensive use of data loggers to collect water level measurements; and
- A Question and Answer handout was prepared and provided to the Township Office for local distribution. This handout contained responses to a number of concerns expressed at the residents meeting including an overview of the revised monitoring program, the process for addressing water supply disruptions and advising of the provision of water level monitoring data from representative locations during the testing program. A copy of this Question and Answer document is provided in Attachment A7.

The testing program was conducted beginning September 5, 2006 and pumping was stopped on October 2, 2006.

No calls were received at the Region’s emergency call centre in relation to this pumping test program.

- During the 28-day pumping test, information updates, including the status of the pumping wells and water level measurements from representative monitoring locations presented graphically were compiled and forwarded to the Township office via email at the end of each week. These measurements were collected manually on a daily basis, rather than recovering and re-setting data loggers for each weekly update. At the completion of the testing program, including a period of time for the recovery of water levels following the cessation of pumping, a letter containing the results of the water level monitoring were sent to the owner of each of the private wells monitored;
- Complaints were received from residents on Cedarbrook Court (at CMPW1-06) regarding the noise levels from the generator required to operate the test pump. A 12 foot high wall of plywood sheeting was erected around the exterior of the generator housing. This had the effect of reducing noise levels and no further complaints were received. In advance of pumping at the PBPW1-06, a similar 12 foot high wall was erected around the generator housing. No complaints were received regarding noise levels at this location; and
- One complaint was received from a resident on Townline Road whose well was reported to contain fuel or sewage like odours. Golder was advised that this condition was first noted long before the testing program.
A site visit indicated a very poor condition of the well head. The well owner was advised to have a well driller inspect the well with the view to reconstructing this well. The reported condition was not related to the well testing program.

Following completion of the testing program, including monitoring as water levels recovered, along with subsequent analyses of test data, a follow up meeting was held with residents of Puslinch to present the results. This meeting was held on January 29, 2007 at the Clifford Evans Training Centre and attended by about 50 residents (see Attachment A7 for list of attendees). The monitoring results were presented on a number of graphs from representative monitoring locations across the Study Area.

### 2.7 Water Quality Results

Table A11 provides the inorganic and physical water quality results from samples taken from each of the test production wells toward the end of the 28-day pumping test on September 29, 2006. Table A12 provides the results of the isotopic analyses. Detailed tables of all water quality data from the 28-day pumping test are provided in Tables A8.2 (Inorganic Water Quality), A8.5 (Organic Water Quality) and A8.6 (isotopes and radionuclides) of Attachment A8.

#### 2.7.1 Inorganic Groundwater Chemistry

A summary of water quality results from the general (inorganic) water quality analyses for each of the test wells are presented in Table A11. This included one sample collected from each of the first five step tests, 23 samples collected from the three test production wells during the 28-day pumping test and two samples collected from bedrock wells in Puslinch; one flowing domestic well (6699 Concession 1) and a flowing monitoring well, TW10-78.

The chemistry of groundwater obtained during pumping of the test wells was dominated by the presence of calcium and bicarbonate ions consistent with this carbonate (dolomite) bedrock aquifer. Calcium concentrations ranged from 80 mg/L to a high of 235 mg/L with values typically less than 120 mg/L, alkalinity concentrations (expressed as CaCO₃) ranged from 219 to 265 mg/L and hardness from 310 to 791 mg/L. Sulphate was present in concentrations ranging from a low of 23 mg/L to as much as 492 mg/L. This range likely reflects the irregular distribution of gypsum and or anhydrite (sulphate minerals) within the bedrock aquifer. It is to be noted that the sulphate concentrations reported for CMPW2-06 on September 8, 2006 (10.8 mg/L) appear anomalously low and are not considered as representative.

Distinct differences were observed in major ion chemistry between the wells tested. In the Pinebush area (PBTW1-05 -1 sample; and PBPW1-06 – 7 samples) calcium concentrations ranged from 84 mg/L at PBTW1-05 to values that declined from 105 to 94 mg/L over the 7 samples obtained during pumping at PBPW1-06. Similarly, hardness concentrations declined over the 28-day pumping test from 404 to 364 mg/L while alkalinity values typically ranged between 240 and 250 mg/L.

For the wells tested in the Clemens Mill well field area (CMTW1-05, CMTW2-05 and CMTW3-05, (one sample from each), CMPW1-06 – 5 samples, and CMPW2-06 – 11 samples) calcium concentrations ranged from 83 to 155 mg/L. During the 28-day pumping test, calcium concentrations at CMPW1-06 were consistently in the 83 to 90 mg/L range while higher concentrations were observed at CMPW2-06; in the 110 to 124 mg/L range.

At the Shade’s Mills site (SMTW1-05 – 1 sample) higher concentrations of calcium (235 mg/L) and hardness (791 mg/L) were observed.
Sulphate concentrations also varied across the Study Area with much higher concentrations of 492 mg/L reported at SMTW1-05. This is consistent with sulphate data reported from earlier studies conducted in the Shade’s Mills area (Lotowater 1993b). For the other two well field areas, lower sulphate concentrations were reported with values typically in the range of 85 to 90 mg/L at CMPW1-06 and 188 to 229 mg/L at CMPW2-06. The lowest sulphate concentrations were reported for the one sample obtained from CMTW3-05.

Chloride concentrations were low with values generally less than 10 mg/L with slightly higher values at PBTW1-06, varying between 12 and 17 mg/L and no obvious trends over time evident. As noted by Lotowater (1994), where elevated chloride concentrations are observed, these are typically highest in the shallow overburden and decrease markedly with depth. Elevated chloride concentrations likely originate from local road salting practices. The lowest chloride concentrations of 4.5 mg/L were reported at CMTW3-05, which also reported the lowest sulphate concentrations of 28.1 mg/L. Concentrations of nitrate were also low with all values reported at <0.10 mg/L for samples collected in Cambridge East. Higher nitrate values, although not above the ODWS value of 10 mg/L, were reported for the two wells in Puslinch (6699 Concession #1 and TW10-78), with 0.53 and 3.33 mg/L, respectively. It should also be noted that the two wells in Puslinch contain much lower sulphate concentrations than those sampled in Cambridge East, with values of 29.1 and 24.2 mg/L reported at Concession #1 and TW10-78, respectively.

Iron and manganese were present at elevated concentrations. Iron concentrations in excess of the ODWS were recorded at PBTW1-05 (0.552 mg/L) and varied from 0.21 to 0.27 mg/L at PBPW1-06 during the 28-day pumping test. In the Clemens Mill area, reported concentrations of iron ranged from less than 0.1 mg/L at CMTW3-05 (which also had the lowest chloride and sulphate values) to typically about 0.10 to 0.13 mg/L at CMPW1-06, to higher values ranging between 0.18 to 0.27 mg/L at CMPW2-06. Manganese concentrations were typically below 0.01 mg/L although higher values were reported from the samples collected during step testing at CMTW3-05, PBTW1-05 and SMTW1-05, with values ranging from 0.015 to a maximum of 0.048 mg/L.

These water quality results were compared to the ODWS. With respect to hardness concentrations, all reported values exceeded the operational guidelines (OG) value of 80-100 mg/L; a common occurrence in the dolomite bedrock aquifers in this area of Southern Ontario. One sample for iron, collected at PBTW1-05 (0.55 mg/L), also exceeded the ODWS Aesthetic Objective (AO) of 0.3 mg/L. Canadian Drinking Water Guidelines (CDWG) for manganese are currently being updated, including a new health based MAC of 0.1 mg/L and a new AO of 0.02 mg/L, which is higher than the current ODWS AO of 0.05 mg/L. While there were not any exceedances in manganese in the test production wells, there were a number of AO manganese exceedances in other wells sampled compared to the updated standards. These wells included: CMTW3-05, PBTW1-05 and TW10-78. A number of monitoring wells in Shade’s Mills, with concentrations of manganese ranging from 0.10 to 0.25 mg/L, also exceeded the health-based MAC. All other inorganic parameters met the ODWS, although some reported results approached their ODWS values as follows: a sulphate concentration of 492 mg/L and aluminium concentration of 0.092 mg/L, both reported from the step test at SMTW1-05. Data developed from the long-term pumping test are expected to be more representative of water quality conditions in the bedrock aquifer in Cambridge East, as compared to the sample results obtained during step testing.

### 2.7.2 Isotope Results

Analysis of the isotopic composition was conducted to assess the possible age and origin of groundwater in the bedrock aquifer in Cambridge East. Samples of pumped groundwater were collected at the three test production wells and two flowing artesian wells in Puslinch (a domestic well on Concession 1 and monitoring well TW10-
78). These samples were analysed for oxygen-18 ($^{18}$O), deuterium ($^2$H), tritium ($^3$H) and sulphur-34 ($^{34}$S) isotopes at the University of Waterloo. Results from these analyses are presented in Table A12.

The presence of tritium in the test production wells, with concentrations ranging between <0.8 to 5.7 TU, indicate at least a component of 'modern' groundwater recharged after 1952. It is likely that this water reflects a mix of older water and younger water (Fritz and Clark, 1997). The sampled wells in Puslinch contained higher tritium concentrations of 13.1 and 14.5 TU respectively at 6699 Concession 1 and TW10-78. Groundwater recharge to these wells is likely modern with ages between <5 and 10 years old (Fritz and Clark, 1997), but could have been recharged as far back as the early 1970s.

The stable isotope values from the test production wells in Cambridge East and the two wells in Puslinch have been plotted (Figure A19) on the Local Meteoric Water Line (LMWL) as determined by Fritz, et al (1987), based on work completed in Simcoe, Ontario. The Cambridge East values for delta deuterium (v) and delta oxygen-18 ($\delta^{18}$O) lie close to the LMWL indicating that the isotopic signature reflects that of precipitation. The isotopic signatures for CMPW2-06 and TW10-78 are slightly enriched (less negative) (i.e., they lie slightly to the right of the LMWL); this could indicate that the recharge water for these wells has undergone some evaporation in the unsaturated zone prior to reaching the water table. The stable isotopic signatures for the test production wells are within the range of isotopic values found in local groundwater as reported by Stotler (2003).

With respect to the sulphur-34 isotopic values for the three test production wells, sampled groundwater has a similar range of $\delta^{34}$S signatures (24.6 to 29.1‰). These isotopic signatures are typical for sulphates with a marine origin, consistent with the formation of the bedrock aquifer in a marine environment. The sulphur would mostly likely originate from the dissolution of sulphate from gypsum and anhydrite (sulphate minerals in the carbonate), but could also be from minor sulphate nodules and laminations on bedding planes (Clark and Fritz, 1997).

For the results from the wells in Puslinch, TW10-78 and 6699 Concession #1, the $\delta^{34}$S values were more depleted, ranging from 2.7 to 3.3‰. These $\delta^{34}$S values match typical sulphate signatures of atmospheric deposition. The source of sulphate in the groundwater in these wells likely originates from precipitation.

The isotopic data suggest the bedrock water in Cambridge East is mixed and includes a component of relatively young water likely recharged from precipitation since 1952. The sulphur is sourced from the dissolution of gypsum, reflecting a marine origin for these rocks. Elevated sulphate concentrations are expected to persist with long-term pumping in the area. The sampled water in Puslinch indicated a slightly different origin that in part reflects that these wells do not extend completely through the Guelph-Gasport Formation (as do the test wells in Cambridge) and that they are free flowing (albeit at very low rates) rather than being actively pumped. Groundwater sampled from these wells reflects recent recharge from precipitation with perhaps a longer residence time in the unsaturated zone to account for the isotopically lighter signature evident from the $\delta^2$H and $\delta^{18}$O results.

### 2.7.3 Organic Groundwater Chemistry

The results from the Organic Water Chemistry Analyses are shown in Table A8.5 of Attachment A8. These results were all below the method detection limits (MDL) reported by the Region’s Water Services Laboratory, with the exception of total xylenes, as discussed further below. All reported parameters were below the Maximum Acceptable Concentrations (MAC) and the Interim Maximum Acceptable Concentrations (IMAC) as outlined in the ODWS.
Low levels of xylene (total) were detected in all three test production wells, ranging from 0.005 to 0.022 mg/L. These concentrations were below the current aesthetic objective (AO) of 0.3 mg/L for total xylenes. However, in 2014, Health Canada set a health-based CDWG for xylenes at 0.09 mg/L and an AO of 0.02 mg/L, which will be adopted into the ODWS in 2017. The concentration of 0.022 mg/L of total xylenes at CMPW1-06 will exceed the new ODWS AO. While the origin of this xylene is not known, it could be an artifact of well construction and this occurrence is not thought to reflect a local land use or water quality concern. However, these wells should be resampled to establish that xylenes do not represent a concern for a future municipal groundwater supply.

The MDLs for two compounds, 2,4-Dichlorophenol and 2,3,4,6-Tetrachlorophenol in the PBPW1-06, CMPW1-06, CMPW2-06 and PBPW2-08 samples, as reported by the Region’s Water Services Laboratory, were higher than the objectives set out in the ODWS. The Region reported an MDL for 2,4-Dichlorophenol of 0.005 mg/L, a value that exceeded the AO of 0.0003 mg/L for this parameter and for 2,3,4,6-Tetrachlorophenol, the reported MDL of 0.001 mg/L was equal to the AO value for this parameter. This does not indicate that these compounds are necessarily present in this water; however, these parameters should be re-analyzed in the future using appropriate detection limits.

Some parameters included in the ODWS Table 2 were not reported by the Region’s Water Services Laboratory; these included NDMA, NTA, antimony, bromate and arsenic. Prior to bringing new wells online, these wells should be re-sampled and analyzed for the full ODWS suite, confirming the MDLs meet the ODWS. Based on discussions with the Region, it is also recommended that these wells be analyzed for 1,4 Dioxane, a compound that has been detected in municipal wells elsewhere in the Region.

2.7.4 Radionuclides

The analyses for the radionuclides are reported on Table A12 and indicate all values at less than reported detection limits.

3.0 PHASE II INVESTIGATIONS (2007/2008) PINEBUSH AND SHADE’S MILLS WELL FIELDS

After completion of the Phase I Investigations, further exploration in the Pinebush Well Field, at sites located further away from Puslinch Lake, lead to the site selection of PBTW3-07 for installation of a test well. Following drilling and step testing results, a test production well (PBPW2-08) was drilled and installed adjacent to PBTW3-07. A step test followed by a 3-day constant rate pumping test was conducted at PBPW2-08.

In an attempt to find more productive sites in the Shade’s Mills Well Field, two locations (SMTW2-07 and SMTW3-07) were chosen for additional test wells. Following unfavourable step test results at these two sites and high concentrations of sulphate, these test wells were converted into bedrock monitoring nests. A site further to the east was selected to install a new test well, SMTW4-08. A 3-day constant rate pumping test was run on this well.

3.1 Well Drilling and Construction

3.1.1 Test Wells and Test Production Well

In Phase II, additional test wells (SMTW2-07, SMTW3-07, SMTW4-08 and PBTW3-07) were drilled by Gerrits Well Drilling Incorporated under the Region contract Q2007-029. Wells SMTW2-07 and SMTW3-07 were drilled
between August 14 and 23, 2007. Well PBTW3-07 was drilled between December 18 and 20, 2007. Well SMTW4-08 was drilled between February 13 and 18, 2008. Test production well PBPW2-08 was drilled and installed adjacent to PBTW3-07 in April, 2008. Each of these wells were drilled using a Foremost DR-12 air rotary drill rig. Borehole logs for these wells are provided in Attachment A2. Well construction details are provided in Table A2.

3.1.2 Borehole Testing

At each of the drilling locations, overburden samples were taken for grain-size analyses and bedrock drill cuttings were collected. Details of the methodologies used are provided in Attachment A1. The air rotary cuttings obtained during drilling provided limited information on geologic materials although the condition of the rock mass, where weathered, was apparent from inspection of drill cuttings. Mud rotary cuttings obtained during drilling through the overburden provided limited information on overburden geologic materials. Results from the grain-size analyses and photos of the rock chips are included in Attachment A2.

Geophysical logging was carried out by Golder geophysicists in the test wells, test production wells and bedrock monitoring wells. Downhole natural gamma and conductivity logs were completed at all of the wells. Optical televiwer logs were completed at SMTW2-07, SMTW3-07, SMTW4-07 and PBTW3-07. The geophysical logs (natural gamma, conductivity and optical televiwer) were used to aid in interpretation of borehole stratigraphy. The natural gamma log response was useful for distinguishing the stratigraphic contacts in cases where there was a contrast in clay content in the overburden or shale content in the bedrock. The methodology used for the borehole logging is provided in Attachment A1.

The borehole records were completed prior to OGS publication of the preliminary revised Silurian Bedrock Stratigraphy (Brunton, 2008) and therefore, follow the earlier bedrock stratigraphic nomenclature. The results of the test well, test production well and monitoring well drilling are provided in the borehole log records in Attachment A2. The natural gamma and inductive conductivity geophysical log data are presented beside the stratigraphy in the borehole log records. Photographs of the test well bedrock drill cuttings and the grain size analysis results used to confirm overburden lithologies are also included in Attachment A2.

The interpretation of the bedrock geology at the drilling locations, following the revised nomenclature (Brunton, 2008, 2009; Brunton and Britnell, 2011), is presented in Table A4. The bedrock geology interpretation is based on the drill cuttings, the natural gamma log response, the optical televiwer log data and an examination of borehole records for existing wells in the Cambridge East area. The bedrock geology interpretations were developed in consultation with Frank Brunton of the OGS.

3.1.3 Monitoring Wells

Following step testing, on October 10 to 14, 2007 the two test wells SMTW2-07 and SMTW3-07 were converted into bedrock monitoring nests by Gerrits Well Drilling Inc. In addition, the existing well SM3A-93, was converted into a bedrock monitoring nest with three piezometers. Prior to the conversion, this well was an open hole in the bedrock from the bottom of the casing at approximately 24 m to a depth of 137.5 m bgs. Concurrent to drilling of test well SMTW4-08, one overburden monitoring nest, SMOW1ABC-08 was drilled and installed (February 12 to 14, 2008) by All-Terrain Drilling Ltd. to the south of SMTW4-08. Construction details for the monitoring well nests are provided in Table A3. Borehole logs for these wells are included in Attachment A2.
3.2 Permits to Take Water

A Category II permit application was submitted on June 25, 2007 for the step testing of the test wells SMTW2-07, SMTW3-07 and PBTW3-07 and the test production well PBPW2-08. The permit, PTTW No. 8518-76HNTQ, was issued to the Region of Waterloo on September 17, 2007. This permit expired on December 31, 2007 before PBTW3-07 could be tested and prior to drilling PBPW2-08. On January 9, 2008 a second Category II permit application was submitted for the step testing of PBTW3-07, PBPW2-08 and SMTW4-08 and the constant rate (3-day) testing of PBPW2-08 and SMTW4-08. The permit, PTTW No. 3311-7AYQF9, was issued to the Region of Waterloo on January 22, 2008. Copies of these PTTWs are found in Attachment A3.

3.3 Step Testing

Step-drawdown tests of 8-hour duration were conducted at the four test wells and one test production well during this phase of the investigation. A summary of the step tests completed is presented in Table A5. Wells SMTW2-07 and SMTW3-07 were step tested on September 18 and September 20, 2007, respectively. Step testing for the next group of wells (SMTW4-08, PBTW3-07 and PBPW2-08) took place between February 6, 2008 and April 30, 2008.

An additional fifth step was conducted at PBTW3-07 at a rate of 2,160 m³/day (25 L/s). The test production well, PBPW2-08, was tested in four steps each of 2 hours duration with rates of approximately 1,637, 2,455, 3,273 and 5,237 m³/day (18.9, 28.4, 37.9 and 60.6 L/s).

3.3.1 Monitoring Program

Monitoring of private wells was also done for the following step tests: PBTW3-07 (9202055 and 9203308); SMTW4-08 (6504527, 9203305, 6500644 and 6505664).

Flow profiling logging was conducted by Lotowater personnel during step testing at the following test wells: SMTW2-07, SMTW3-07 and PBTW3-07. The flow profiling at SMTW4-08 was conducted during the constant rate pumping test. The methodology used for flow profile logging is outlined in Attachment A1. The flow profiles are included in Attachment A2.

3.3.2 Discharge Conveyance

Water from the tests was conveyed away from the wellhead area by temporary piping, and discharged to nearby suitable surface water features (Figure A3). Flow dissipation measures were used, as necessary, to avoid erosion. Given the short duration of the step tests and the depth of the aquifers tested, recirculation of pumped water back to the aquifer was not an issue for the step testing.

3.3.3 Water Quality Sampling

As outlined in Table A10, water samples were taken from each of the test wells (SMTW2-07, SMTW3-07 and PBTW3-07) during step testing and submitted to the Region’s laboratory for analysis of general chemistry including major cations and anions. The test well SMTW4-08 and test production well PBPW2-08 were not sampled during the step testing but were sampled during the longer term testing. Results from the water quality analyses are presented in Attachment A8.
3.3.4 Observed Responses

The drawdown and the specific capacity calculated at the end of each step, are presented in Table A6. Hydrographs, which also present a comparison of the drawdowns during the step testing for the test wells and test production wells, are shown in Figures A4 and A5. Graphs for each of the step tests showing drawdown vs. log time at each step are also presented on Figures A4.1, A4.2 and A4.4 in Attachment A4. The key results of the step testing at the test wells are summarized as follows:

- At the end of each step in test wells SMTW2-07 and SMTW3-07 water levels continued to decline. At the end of each step in wells SMTW4-08, PBTW3-07 and PBPW2-08 water levels were declining slightly but were approaching steady-state levels;

- Compared to the other test wells, SMTW2-07 and PBTW3-07 showed the greatest drawdown (9.6 to 11.1 m) and lowest specific capacities (1.5 L/s per metre drawdown and 1.4 L/s per meter drawdown, respectively) at the maximum step rate of 1,309 m$^3$/day (15.1 L/s);

- Compared to the other test wells, SMTW4-08 showed the least drawdown (3.0 m) and the highest specific capacity during the fourth step (5.1 L/s per metre drawdown); and

- Compared to the other Pinebush test production well (PBPW1-06), PBPW2-08 showed a greater drawdown (14.3 m) and a lower specific capacity (4.2 L/s per metre drawdown).

3.4 Additional Water Quality Sampling

In October and November, 2007 additional water quality samples were collected from the piezometer nests installed in the following wells: SMTW1ABC-05, SMTW2ABC-07, SMTW3ABC-07, SM3ABC-07 and CMOW2ABC-06. These samples were submitted to the Region's laboratory for key parameters including chloride, sodium, sulphate, hardness, iron and manganese. This sampling was conducted to better understand any trends in the distribution of sulphate in zones of the bedrock aquifer.

The water quality results from this sampling are presented in Table A8.4 and Figure A8.1 in Attachment A8.

3.5 Private Well Inventory

A private well inventory was completed prior to the 28-day pumping test during the Phase I investigations. No additional private well inventory was completed during the Phase II investigations.

3.6 SMTW4-08 (3-Day) Pumping Test

Following recovery from the step test, a 3-day constant rate pumping test was conducted at well SMTW4-08 from March 3 to March 6, 2008. The schedule of the pumping test is outlined in Table A7 and below:

<table>
<thead>
<tr>
<th>Date</th>
<th>Pumping Test Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 3, 2008</td>
<td>Start up of SMTW4-08 at 11:05 am at a constant rate of 1,964 m$^3$/day (22.7 L/s).</td>
</tr>
<tr>
<td>March 6, 2008</td>
<td>Shutdown of SMTW4-08 at 11:05 am.</td>
</tr>
</tbody>
</table>

3.6.1 Monitoring Program

Water levels were monitored manually and/or with dataloggers in the pumping well and observation wells within a 3.6 km radius of SMTW4-08. Monitoring sites included two test wells, two active municipal production wells.
(G38 and G39), 19 monitoring sites with 45 piezometers and six private wells (along Avenue Road and Clyde Road). In total 55 electronic dataloggers were deployed during this test (Table A8). The dataloggers in two of the private wells failed during the testing period.

### 3.6.2 Discharge Conveyance

For the step test and constant rate test at SMTW4-08, water was conveyed away from the wellhead area by temporary piping, and discharged into Mill Creek (Figure A3). Flow dissipation measures were used, as necessary, to avoid erosion. The overburden monitoring wells, SMOW1ABC-08, were monitored to ensure that the recirculation of pumped water back into the aquifer was not an issue at this site.

### 3.6.3 Water Quality Sampling

During the pumping test, three water quality samples were taken from SMTW4-08 and submitted to the Region's laboratory for analysis of general chemistry and major cations and anions. Results from these analyses are included in Table A8.1 in Attachment 8.

### 3.6.4 Observed Response

A hydrograph showing the responses of SMTW4-08 during the 3-day test, and other key hydrographs are included on Figure A20. Figure A21 presents the drawdown observed in the Gasport Formation in plan view. Table A8 shows the amounts of drawdown in each monitoring well. Hydrographs from this test are provided on Figures A6.16 through A6.21. Drawdown versus log time plots of key wells are included on Figure A6.42 in Attachment A6.

#### Test Production Well Drawdown

- The drawdown at the end of 72 hours of pumping at a rate of 1,964 m³/day (22.8 L/s) in SMTW4-08 was 5.7 m;
- The specific capacity estimated at the end of the test was 3.9 L/s/m;
- At the end of the test, the remaining available drawdown (depth of water above the bottom of the casing) was approximately 18.4 m, which is 75% of the total initial available drawdown of 24.4 m;
- The most rapid drawdown occurred during the first 12 hours of pumping; by the end of the test, water levels in SMTW4-08 had stabilized;
- Recovery to higher than initial static conditions in SMTW4-08 occurred within 24 hours of shutting off the pump; and
- There was a slight interference in SMTW4-08 due to the cyclic use of Municipal Production Wells G16, G17 and G18.

#### Overview of Water Level Responses

- During this pumping test, similar to the 28-day pumping test, interference from the cyclic pumping of G16, G17 and G18 was observed in the following wells screened in the Gasport Formation: CMOW1A-06, CMOW2A-06, PBow1A-06 and SMTW1A-06. The lines for these wells on the hydrographs and the drawdown versus log time plots are smoother, as water levels in these wells were measured at a 1 hour frequency as compared to a 5 minute frequency in SMTW4-08;
The zone of influence in the deep Gasport Formation extended to less than 1.5 km in the southwest (no drawdown was observed at SMTW2A-08); to greater than 2.7 km to the north (0.8 m drawdown was observed at PBOW1A-08; no drawdown was observed at PBOW2A-06 – 3.6 km); to slightly greater than 1.1 km to the west (0.3 m drawdown observed at SM3A-07). There were no observation wells monitored to the east or south of SMTW4-08 during this pumping test;

The zone of influence in the Guelph Formation was much smaller than that in the Gasport Formation. No drawdown was observed at CMOW1C-06, at 1 km distance to the north, or at SMTW1C-05 at 0.6 km to the west, however, 0.3 m of drawdown was observed at SMTW3C-07 to the southwest;

At nearby wells in the overburden, a small amount of drawdown was observed. At SMOW1A-08, 0.27 m of drawdown occurred and in the shallower SMOW1B-08, 0.12 m of drawdown occurred;

During the testing period, the shallow water table (SMOW1C-08) increased due to a rainfall event; and

No interference was observed at any of the private wells monitored.

3.6.5 Aquifer Parameter Estimates

The bedrock transmissivity and storativity estimates were interpreted from the pumping test data using a Cooper Jacob solution. Figure A6.49 in Attachment A6 shows a composite drawdown versus (time/radius^2) plot for SMTW4-08. This figure presents the observed drawdown normalized with respect to the distance from the pumping well.

The Effective Transmissivity (T) can be estimated by applying an effective Cooper Jacob method to the observed drawdown as outlined in Section 2.5.5. The following summarizes the interpreted aquifer hydraulic parameters for the SMTW4-08 (3-day) pumping test:

All of the observation wells plotted on this figure that are screened in the Gasport Formation had a similar drawdown slopes. SMOW1A-08, a deep overburden well, had a different slope although there is a connection to the Gasport Formation at this location. A delay in response was observed at SMTW3AB-07 and an even greater delay in response was observed at SM3A-07;

Based on the drawdown slopes, the transmissivity in the vicinity of SMTW4-08 was estimated to be approximately 275 m^2/day; and

The storativity, based on drawdown slopes through SMTW1A-05, CMOW1A-06 and CMOW2A-06 was estimated to be 7 x 10^-5 m/m. Higher storativity values are observed at SMTW2A-07 and SM3A-07.

3.7 PBPW2-08 (3-Day) Pumping Test

A 3-Day constant rate test was conducted at the Can-Amera Parkway test production well (PBPW2-08) as outlined in Table A7 and below:

<table>
<thead>
<tr>
<th>Date</th>
<th>Pumping Test Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 5, 2008</td>
<td>Start up of PBPW2-08 at 11:20 am at a constant rate of 3,273 m^3/day (37.9 L/s).</td>
</tr>
<tr>
<td>May 8, 2008</td>
<td>Shutdown of PBPW2-08 at 11:20 am.</td>
</tr>
</tbody>
</table>
3.7.1 Monitoring Program

Water levels were monitored prior to, during and after the testing period with electronic dataloggers in PBPW2-08 as well as two other test production wells, two test wells, 15 monitoring sites (including 43 piezometers) and two private wells within a 2.7 km radius of PBPW2-08. The Portuguese Swamp water level was monitored and the shallow water table was monitored during testing at the OW1D-92 site. Two private wells located along Townline Road were monitored; these wells had been monitored previously during the 28-day pumping test in Phase I.

3.7.2 Discharge Conveyance

Discharge water during the pumping test was conveyed via flexible tubing to the storm water pond approximately 100 m west of the site (Figure A3).

3.7.3 Water Quality Sampling

Three water quality samples were taken during the testing period and submitted to the Region’s laboratory for analysis of general chemistry, major cations and anions and organic parameters. Results from these analyses are included in Tables A8.3 (inorganics) and A8.5 (organics) in Attachment 8.

3.7.4 Observed Responses

Hydrographs of key monitoring wells from this test are shown on Figure A22. Figure A23 presents the drawdown observed in the Gasport Formation in plan view. Table A8 shows the amounts of drawdown in the observation wells. A complete set of hydrographs from monitoring wells measured during this test are included in Attachment A6 (Figures A6.22 through A6.27) and drawdown versus log time plots of PWPW2-08 and key observation wells during the PBPW2-08 test are presented on Figure A6.42 of Attachment A6.

Test Production Well Drawdown

- The drawdown at the end of 72 hours at a pumping rate of 3,378 m³/day (37.9 L/s) in PBPW2-08 was 8.7 m;
- The specific capacity estimated at the end of the test was 4.4 L/s/m;
- At the end of the test, the remaining available drawdown (depth of water above the bottom of the casing) was approximately 14.2 m, which is 70% of the total initial available drawdown of 19.9 m;
- The majority of the drawdown occurred within the first 12 hours of pumping. By the end of the 3-day test the water level continued to decline slightly. Water levels had not yet stabilized; and
- Recovery to pre-static conditions in PBPW2-08 occurred within 72 hours of shutting off the pump.

Overview of Water Level Responses

- As observed in the Drawdown Versus Log Time plots (Figure A6.42), the slopes of drawdown were similar for PBPW2-08, PBTW3-07 and CMTW3A-05;
- Drawdown in the Gasport Formation was observed as far east as PBOW2A-06 (0.5 m at 1.5 km); no drawdown was observed at PBOW1A-06 (1.8 km). South of PBPW2-08 a drawdown of 1.23 m was seen at CMTW3A-05 (0.7 km) and no drawdown was observed at CMOW1A-06 (1.4 km). 0.5 km north of the test
production well at OW1A-92 (screened through both the Guelph and Gasport Formations), a drawdown of 1.93 m was observed. There were no monitors to the north or to the west of the test production well;

- It is noted that in the deep Gasport monitor at PBOW1A-06 there was no response to testing at PBPW2-08, whereas both the shallow bedrock (Guelph) monitor (PBOW1C-06) and the shallow overburden monitor (PBOW1F-06) responded to the aquifer test with 0.12 m of observed drawdown;

- The zone of influence in the Guelph Formation was less than that in the Gasport Formation. To the south, a drawdown of 0.34 m was observed at CMTW3C-05 and to the east a drawdown of 0.12 was observed in PBOW1C-06;

- An overburden response to pumping was observed as far east as PLOW1A-06 (2.1 km) with a drawdown of 0.09 m. No overburden responses were observed in the monitors to the north and south of PBPW2-08; and

- No drawdown was observed in the Portuguese Swamp water table and shallow groundwater level at OW1D-92 and OW2C-92.

### 3.7.5 Aquifer Parameter Estimates

The bedrock transmissivity and storativity estimates were interpreted from the pumping test data using a Cooper Jacob solution. Figure A6.48 in Attachment A6, shows a composite drawdown versus (time/radius$^2$) plot for PBPW2-08. This figure presents the observed drawdown normalized with respect to the distance from the pumping well.

The Effective Transmissivity ($T$) can be estimated by applying an effective Cooper Jacob method to the observed drawdown, as outlined in Section 2.5.5. The following summarizes the interpreted aquifer hydraulic parameters for the PBPW2-08 (3-day) pumping test:

- The drawdown slopes of the PBTW3-07 and PBTW2-08 were similar; the slopes of all other monitors on this plot were shallower;

- Based on the drawdown slopes through PBTW3-07 and PBPW2-08, the transmissivity in the vicinity of PBPW2-08 was estimated to be 333 m$^2$/day; and

- The storativity, based on the drawdown slope through PBTW3-08, was $1 \times 10^{-4}$ m/m. Lower storativity values were estimated at all other monitoring wells on Figure A6.48 in Attachment A6.

### 3.8 Public Communication

Prior to drilling test wells SMTW2-07, SMTW3-07, SMTW4-08 and PBTW3-07 and test production well PBPW2-08, residents within a 500 m radius of the drilling sites were provided with a notice to advise them about the upcoming drilling. Prior to step testing and constant rate testing, private well owners were also provided with notices to advise them about the upcoming aquifer testing. These notices provided information about the testing program as well as contact information for the Region and Golder.

The private well owners whose wells were monitored during the SMTW4-08 and PBTW2-08 constant rate tests were provided with a letter and a hydrograph of their well’s response during testing.
3.9 Water Quality Results

Results from the general (inorganic) water quality analyses for the test wells (PBTW1-07, SMTW2-07, SMTW3-07, and SMTW4-08) are included in Table A8.1, from test production well PBPW1-08 in Table A8.2 and from the additional Shade’s Mills sampling event in Table A8.4. The key parameters analyzed included chloride, sodium, sulphate, hardness, iron, and manganese.

At PBTW2-07 and PBPW2-08, with the exception of hardness all parameters analyzed were below the ODWS. The concentrations of hardness (329 to 346 mg/L) were slightly lower than those measured at PBPW1-06 during 2006 testing. Concentrations of all other major cations and anions were slightly lower than those observed at PBPW1-06, with concentrations of iron ranging from 0.034 to 0.055 mg/L, chloride ranging from 2.0 to 9.2 mg/L, and sulphate ranging from 58.2 to 72.8 mg/L. All organic parameters analyzed at PBPW2-08 were below the laboratory method detection limits (Table A8.5).

Relative to the other Cambridge East well fields, concentrations of sulfate and hardness were significantly higher in the Shade’s Mills well field at SMTW2-07 and SMTW3-07, SMTW4-08 and the bedrock well nest SMTW1ABC-05, SMTW2ABC-07, SMTW3ABC-07 and SM3ABC-07, largely exceeded the ODWS. Concentrations of hardness ranged from 316 mg/L in SMTW1C-05 to 1,900 mg/L at SMTW2-07. Concentrations of sulphate ranged from 33.8 mg/L at SMTW1C-05 to as high as 1,530 mg/L at SMTW2-07. The distribution of sulphate during testing in Shade’s Mills is shown on Figure A8.1 in Attachment A8. Elevated concentrations of sulphate were observed in many of the bedrock wells that screened either the Guelph or the Gasport formations. It is noted that high concentrations of hardness and sulphate were also observed in the intermediate bedrock monitor at CMOW2B-06, to the north of the Shade’s Mills well field, with concentrations of 1,260 mg/L and 1,060 mg/L, respectively.

The range of concentrations of chloride in the Shade’s Mills wells was 1.0 to 31.1 mg/L, which was similar to other test wells in East Cambridge. Sodium concentrations ranged from 1.6 to 46.3 mg/L. Concentrations of iron and manganese in water from the Shade’s Mills test wells were low, with a range of values of 0.084 to 0.132 mg/L and 0.005 to 0.015 mg/L, respectively. Concentrations of iron in the groundwater exceeded the ODWS for the following wells: SMTW1C-05 and SMTW2C-07 (upper Guelph Formation), SMTW3A-07 (Gasport Formation) and SM3ABC-07 (Guelph and Gasport Formations). Concentrations of manganese in the groundwater exceeded the AO for the following wells: SMTW3A-07, SMTW2C-07, and CMOW2C-06. Concentrations of manganese in the SM3ABC-07 well nest also exceeded the updated MAC. Aluminium concentrations in the water sampled from the SM3ABC-07 well nest exceeded the ODWS, with values ranging from 0.68 to 9.35 mg/L. No analyses for organic parameters were conducted for any of the Shade’s Mills test wells.

4.0 PHASE III INVESTIGATIONS (2008/2009) TOWNSHIP OF NORTH DUMFRIES

Further to the east in North Dumfries, two locations in Clyde Park were selected for the installation of the final test wells. Considering the results of the step test, the location of NDTW2-08 was selected as the most favourable location for the final test production well (Figure A1).
4.1 Well Drilling and Construction

4.1.1 Test Wells and Test Production Well

During Phase III, the two test wells (NDTW1-08 and NDTW2-08) were drilled by Gerrits Well Drilling Inc., under the Region Contract Q2008-021. These wells were drilled simultaneously with two drill rigs (Foremost DR-24) between October 1 and 8, 2008. The final test production well NDPW1-08 was also drilled by Gerrits under the same contract. It was drilled between December 20 and 28, 2008. Table A2 presents a summary of the drilling and well construction for the test wells drilled.

Borehole log records are found in Attachment A2. Geophysical logging was performed at NDTW1-08 and NDTW2-08, as described in Attachment A1.

4.1.2 Monitoring Wells

Under the Region contract Q2008-021, two monitoring well nests were constructed by Gerrits Well Drilling Inc. and three shallow overburden well nests were installed by CMT Engineering in North Dumfries between October 28 and November 19, 2008. The two monitoring well nests (NDOW1-08 and NDOW2-08) were drilled using an air rotary rig and consisted of three bedrock piezometers and two overburden piezometers to monitor the active groundwater flow system. In addition, test well NDTW1-08 was also converted into a bedrock monitoring nest. The three shallow overburden well nests (NDOW3AB-08, NDOW4AB-08 and NDOW5-08) were drilled by CMT Engineering using a Geo Probe direct push rig.

The drilling and well construction for the monitoring wells is summarized in Table A3 and the locations of these monitoring wells are shown on Figure A2. Borehole log records are found in Attachment A2.

4.1.3 Borehole Testing

At all of the drilling locations overburden samples were taken for grain-size analyses and bedrock drill cuttings were collected. Details of the field methodologies used are provided in Attachment A1. The air rotary cuttings obtained during drilling provided limited information on geologic materials although the condition of the rock mass, where weathered, was apparent from inspection of drill cuttings. Mud rotary cuttings obtained during drilling through the overburden provided limited information on overburden geologic materials. Results from the grain-size analyses and photos of the rock chips are included in Attachment A2.

Geophysical logging was carried out by Golder geophysicists in NDTW1-08 and NDTW2-08. Downhole natural gamma, conductivity logs and optical televiewer logs were completed. The geophysical logs (natural gamma, conductivity and optical televiewer) were used to aid in interpretation of borehole stratigraphy. The natural gamma log response was useful for distinguishing the stratigraphic contacts in cases where there was a contrast in clay content in the overburden or shale content in the bedrock. The methodology used for the borehole logging is provided in Attachment A1.

The borehole records were completed prior to OGS publication of the preliminary revised Silurian Bedrock Stratigraphy (Brunton, 2008) and therefore, follow the earlier bedrock stratigraphic nomenclature. The results of the test well, test production well and monitoring well drilling are provided in the borehole log records in Attachment A2. The natural gamma and inductive conductivity geophysical log data are presented beside the stratigraphy in the borehole log records. Photographs of the test well bedrock drill cuttings and the grain size analysis results used to confirm overburden lithologies are also included in Attachment A2.
The interpretation of the bedrock geology at the drilling locations, following the revised nomenclature (Brunton, 2008, 2009; Brunton and Britnell, 2011), is presented in Table A4. The bedrock geology interpretation is based on the drill cuttings, the natural gamma log response, the optical televiewer log data and an examination of borehole records for existing wells in the Cambridge East area. The bedrock geology interpretations were developed in consultation with Frank Brunton of the OGS.

4.2 Permits to Take Water

The following summarizes the PTTWs obtained for the testing:

- A Category II Permit (PTTW No. 3808-7K9PSS) for step testing the Clyde Park test wells (NDTW1-08 and NDTW2-08) was issued on October 9, 2008;
- A Category II permit application was submitted on November 13, 2008 for the step testing and long-term constant rate testing of the Clyde Park test production well NDPW1-08. The permit (PTTW NO 280-7MCMMT) was issued on December 15, 2008 and expired on February 28, 2009. Due to issues with the generator and discharge conveyance, the constant-rate pumping test was cut short from a planned 7 days to 2 days. A new Category II permit application was submitted on July 17, 2009 for step-testing and long-term testing of NDPW1-08. PTTW No 5351-7VBNWA was issued on August 27, 2009; and
- Access agreements were secured from each property owner and copies along with relevant correspondence were included with the PTTW applications.

Copies of PTTWs issued by the MOECC are provided in Attachment A3.

4.3 Step Testing

The North Dumfries Test wells (NDTW1-08 and NDTW2-08) were step tested in October 2008. They were tested in four steps each of 2 hours duration with rates of approximately 327, 655, 982 and 1,309 m$^3$/day (3.8, 7.6, 11.4, and 15.1 L/s). Flow profiling was conducted during step testing at these two test wells.

The test production well NDPW1-08 was step tested twice, once over the entire open borehole, and once with a packer set to sleeve off the Guelph and Eramosa Formations. These tests took place on January 13, 2009 and September 23, 2009. Each step-drawdown test was 8-hours long and is summarized in Table A5. During the January 2009 test at NDPW1-08, the fourth step was at a rate of 6,396 m$^3$/day (74 L/s). The constant rate test was initiated immediately following the fourth step. During the September, 2009 test at NDPW1-08, the fourth step was at a rate of 6,049 m$^3$/day (70 L/s).

4.3.1 Monitoring Program

Flow profile logging was performed by personnel from Gerrits Well Drilling during step testing at NDTW1-08 and NDTW2-08. Flow profiling techniques are outlined in Attachment A1. The flow profiles are included in Attachment A2. During both step tests at NDPW1-08, data loggers were installed in five private wells to monitor water level responses to pumping.

4.3.2 Discharge Conveyance

Water from the test was conveyed away from the wellhead area by temporary piping, and discharged to the nearby drainage ditch. Flow dissipation measures were used, as necessary, to avoid erosion. Given the short
duration of the step tests and the depth of the aquifers tested, recirculation of pumped water back to the aquifer was not an issue for the step testing.

4.3.3 Water Quality Sampling

As outlined in Table A10, water samples were taken at the end of each step test from NDTW1-08 and NDTW2-08 and submitted to the Region’s laboratory for analysis of general chemistry including major cations and anions. Results from the water quality analyses are presented in Table A8.1 of Attachment A8. The test production well NDPW1-08 was not sampled during step testing but was sampled during both of the constant rate tests.

4.3.4 Observed Responses

The drawdown at the end of each step and the specific capacity estimated at the end of each step test are presented in Table A6. Hydrographs, which also present comparison of the drawdowns during the step testing for the test wells and test production wells, are shown on Figures A4 and A5. Graphs for each of the step tests showing drawdown versus log time at each step are also presented on Figure A4.5 in Attachment A4. The key results of the step testing at the test wells are as follows:

- At the end of each step in the test wells NDTW1-08 and NDTW2-08, and in both step tests at NDPW1-08, water levels continued to decline slightly;
- Test well NDTW2-08 showed less drawdown (2.4 m) compared to NDTW1-08, with 3.4 m of drawdown. NDTW2-08 had a higher specific capacity of 6.4 L/s per metre of drawdown compared to a specific capacity of 4.5 L/s/m in NDTW1-08; and
- The Clyde Park test production well (NDPW1-08) had a specific capacity of 9.5 L/s/m at the end of the January test and a lower specific capacity of 6.4 L/s/m at the end of the September test when the well was sleeved to draw only water from the Gasport Formation.

4.4 Private Well Inventory

Prior to conducting aquifer testing at the North Dumfries test wells, a private well inventory was conducted during the month of September, 2008. This inventory was completed within a 1 km radius of the Clyde Park test production well (NDPW1-08). The private wells are plotted on Figure A2. The results of the well inventory are presented in Table A5.3 of Attachment A5. The wells found in the inventory were matched with the well records from the WRAS+ database where possible.

4.5 NDPW1-08 (2-Day) Pumping Test

The first of two constant rate pumping tests at NDPW1-08 took place from January 13 to January 15, 2009. Details are outlined below and in Table A7.

<table>
<thead>
<tr>
<th>Date</th>
<th>Pumping Test Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 13, 2009</td>
<td>Start of step testing of NDPW1-08 at 7:45 am. Each step lasted for 2 hours at the following rates: 3,273, 4,366, 5,453, 6,396 m³/day (37.9, 50.5, 63.1, 74.0 L/s)</td>
</tr>
<tr>
<td>January 13, 2009</td>
<td>Start of constant rate test of NDPW1-08 at 3:45 pm at a rate of 6,394 m³/day (74.0 L/s), immediately following the step-testing.</td>
</tr>
<tr>
<td>January 15, 2009</td>
<td>Shutdown of NDPW1-08 at 12:45 pm. The test was ended early due to generator failure and ice jams restricting flow of water through culverts.</td>
</tr>
</tbody>
</table>
The constant rate test began immediately following the Step Test at a rate of 6,394 m³/day (74 L/s). The static water level was flowing prior to the pumping test and was assumed to be 1.0 m above ground surface.

4.5.1 Monitoring Program

Water levels were monitored with electronic dataloggers in the test production well, two test wells, 13 monitoring locations (including 39 piezometers), and five private wells. In total 46 electronic dataloggers were deployed during this pumping test. In addition, 3 ponds were monitored manually using staff gauges.

4.5.2 Discharge Conveyance

Discharge water during the pumping test was conveyed over 1 km west of NDPW1-08 to a wetland on the Cambridge Golf Club Property (Figure A3). This test was shut down early due to a generator failure and ice jams restricting flow through culverts.

4.5.3 Water Quality Sampling

One water quality sample was taken during the testing period on January 14, 2009. This sample was submitted to Maxxam’s laboratory for analysis of general chemistry including major cations and anions.

4.5.4 Observed Responses

Figure A24 includes hydrographs of NDPW1-08 and other key monitoring wells, along with the pumping rates and daily precipitation as recorded at Waterloo Regional Airport Climate Station. Figure A25 presents the drawdown observed in the Gasport Formation in plan view. Table A8 presents the drawdown for all monitoring wells at the end of the 2-day pumping test. Hydrographs of all monitoring wells are included in Attachment A6 (Figures A6.28 through A6.33).

Figure A6.50 in Attachment A6 is a composite plot showing observed recovery from pumping at NDPW1-08 versus (time/radius)².

Test Production Well Drawdown

- The drawdown at the end of the 2-Day Test in NDPW1-08 was approximately 11.2 m; the specific capacity at the end of this test was 6.6 L/s/m;
- The majority of the drawdown occurred within the first 12 hours of pumping. By the end of the 2-Day test the water level continued to decline slightly. Water levels had not yet stabilized; and
- Recovery to pre-static conditions in PBPW2-08 occurred within 48 hours of shutting off the pump.

Overview of Water Level Responses

- Drawdown in the Gasport of 2.9 m was observed as far northwest as PBOW1A-06 (3.5 km). A drawdown of 3.9 m was observed at SMTW1A-05, 3.7 km southwest of NDPW1-08;
- The zone of influence in the Guelph Formation is much smaller than that in the Gasport Formation. Immediately to the east, a drawdown of 2.38 m was observed at NDTW1C-08 (0.2 km). No drawdown was observed 0.6 km to the northeast at NDOW1C-08. To the southwest, a drawdown of 1.35 m was observed at NDOW2C-08;
Prior to, during and after the testing, a seasonal trend of decline in shallow overburden water levels was observed. A drawdown due to testing of 0.6 m was observed in the deep overburden at NDOW2D-08 (0.6 km southwest); and

Interference was observed at two of the four private wells monitored with drawdowns of between 1.2 and 1.7 m for wells with IDs 6506418 and 9202389; this drawdown did not impact operation of these wells.

4.5.5 Aquifer Parameter Estimates

The bedrock transmissivity and storativity estimates were interpreted from the pumping test data using a Cooper-Jacob solution. Figure A6.50 in Attachment A6 shows the composite recovery versus \( \text{time}/\text{radius}^2 \) plot for the open hole test production well (NDPW1-08). This figure presents the observed drawdown normalized with respect to the distance from the pumping well. Aquifer Hydraulic Parameter estimates are also summarized in Table A9.

The Effective Transmissivity \((T)\) can be estimated by applying an effective Cooper-Jacob method to the observed drawdown as outlined in Section 2.5.5. The following summarizes the interpreted aquifer hydraulic parameters for the NDPW1-08 (2-Day) pumping test, when the test production well was open over both the Guelph and Gasport formations:

- The transmissivity around NDPW1-08 over the entire bedrock formation was estimated to be 434 m\(^2\)/day; and
- The \( S/S' \) value is greater than one, indicating that recovery occurs faster than it would if all the water that came in to replenish the drawdown cone was supplied by storage. There are several processes which could provide water in addition to storage; the effects of pumping propagate to a lateral source of water, or upward to a shallower source of water, or laterally to a region of much higher transmissivity, or vertically to a water table aquifer.

4.6 NDPW1-08 (6-Day) Pumping Test

Details regarding the second pumping test at NDPW1-08 are outlined below and in Table A7.

<table>
<thead>
<tr>
<th>Date</th>
<th>Pumping Test Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 15, 2009</td>
<td>Installation of a packer to a depth of 66 m below ground surface at NDPW1-08 and NDTW2-08.</td>
</tr>
<tr>
<td>September 23, 2009</td>
<td>Start of step testing of NDPW1-08 at 8:55 am. Each step lasted for 2 hours at the following rates: 3,273, 4,366, 5,453, 6,049 m(^3)/day (37.9, 50.5, 63.1, 70.0 L/s).</td>
</tr>
<tr>
<td>September 24, 2009</td>
<td>Start of constant rate test of NDPW1-08 at 11:15 am at a rate of 4,321 m(^3)/day (50.0 L/s).</td>
</tr>
<tr>
<td>September 30, 2009</td>
<td>Shutdown of NDPW1-08 at 1:30 pm.</td>
</tr>
<tr>
<td>October 1, 2009</td>
<td>Deflation and removal of packers at NDPW1-08 and NDTW2-08.</td>
</tr>
</tbody>
</table>

On September 15, 2009, prior to conducting this pumping test, packers were installed in the open boreholes at NDPW1-08 and the neighbouring NDTW2-08 from ground surface to the top of the Gasport Formation, to a depth of approximately 66 m below ground surface. These wells were sleeved off to reduce potential interference with nearby neighbouring private wells. The second constant rate pumping test took place between...
September 24 and 30 2009, this time at a lower rate of 4,321 m³/day (50 L/s). The packers were removed from NDPW1-08 and NDTW2-08 following the test on October 1, 2009.

### 4.6.1 Monitoring Program

In addition to the same monitoring network that was used in January, additional monitoring well nests were included and monitoring locations were set up at the discharge site, along the flow path of the discharge along the culverts and ditches along Clyde Road and in the wetland areas to the south of Clyde Road. During this test, water levels were monitored in the test production well, two test wells, 18 monitoring locations (including 48 piezometers), five private wells and two staff gauges. In total 52 electronic dataloggers were deployed during this pumping test.

### 4.6.2 Discharge Conveyance

Discharge water during the pumping test, was conveyed over 1 km west of NDPW1-08 to a wetland on the Cambridge Golf Club Property (Figure A3). Prior to this test, the Region of Waterloo Public Works Department dug out the ditches long Clyde Road, replaced a culvert and built a berm along the southern edge of the Cambridge Golf Club property to prevent any potential issues with flooding due to discharged water.

### 4.6.3 Observed Responses

Figure A26 provides hydrographs of NDPW1-08 and other key monitoring wells along with the pumping rates, dates of packer installation and daily precipitation as recorded at Waterloo Regional Airport Climate Station. Figure A27 presents the drawdown observed in the Gasport Formation in plan view. Table A8 presents the drawdown for all monitoring wells at the end of the 6-day pumping test. Figure A6.51 in Attachment A6 is a composite plot showing observed recovery from pumping at NDPW1-08 versus (time/radius²). Hydrographs of all monitoring wells are also included in Attachment A6 (Figures A6.34 through A6.39).

#### Test Production Well Drawdown

- During the 6-day pumping test, the maximum drawdown at NDPW1-08 at a rate of 4,321 m³/day (50 L/s) (occurring after 2 days into the pumping test) was 9.02 m. The specific capacity estimated during the maximum drawdown was 5.5 L/s/m; and

- After two days of pumping, slightly rising water levels were observed in the test production well, and many of the observation wells in the monitoring network.

#### Overview of Water Level Responses

- The installation of the packers in NDPW1-08 and NDTW2-08 resulted in decreases in water levels from about 0.6 to 1.0 m in NDTW1B-08, NDTW1C-08 and in two private wells (IDs 6506418 and 9202389);

- The zone of influence in the Gasport Formation was slightly smaller as compared to the 2-day pumping test. A maximum drawdown of 2.7 m was observed to the north at PBOW1A-06 (3.5 km). A drawdown of 2.5 m was observed to the southwest at SMTW1A-05 (3.7 km);

- Compared to the 2-day pumping test conducted without a packer, the zone of influence in the Guelph Formation was much smaller. Immediately to the east, a drawdown of 0.07 m was observed at NDTW1C-08 (0.2 km). No drawdown was observed at CMOW2C-06 (2.6 km to the north). To the southwest, a drawdown of 0.95 m was observed at NDOW2C-08;
In the deep overburden a drawdown of 0.37 m was observed at NDOW2D-06; and

Water level declines were observed at two of the four private wells monitored, with drawdowns of approximately 0.09 m for wells with IDs 6506418 and 9202389. The impact from the pumping test on these wells was minimal as the cyclic operation of these wells for domestic water supply resulted in drawdowns of 1 to 2 m.

4.6.4 Aquifer Parameter Estimates

The bedrock transmissivity and storativity estimates were interpreted from the pumping test data using a Cooper Jacob solution. Figure A6.51 in Attachment A6 shows the composite drawdown versus (time/radius^2) plot for the sleeved test production well (NDPW1-08). This figure presents the observed drawdown normalized with respect to the distance from the pumping well.

The Effective Transmissivity (T) can be estimated by applying an effective Cooper Jacob method to the observed drawdown, as outlined in Section 2.5.5. The following summarizes the interpreted aquifer hydraulic parameters for the NDPW1-08 (6-day) pumping test when the well was sleeved to isolate the Gasport Formation from the Guelph Formation.

- The transmissivity of the Gasport Formation at NDPW1-08 was estimated to be 305 m^2/day; and
- The storativity, based on the drawdown slope between NDOW1A-08 and NDOW2A-08 was estimated to be 5 x 10^-5 m/m.

4.7 Public Communication

Prior to drilling and testing of wells in North Dumfries, a public meeting was held on September 11, 2008. The meeting was held at Clyde Park to inform residents of the testing program and answer questions. A copy of the community sign in sheet and log of community concerns is included in Attachment A7.

4.8 Water Quality Results

Similar to the other Cambridge East well fields, concentrations of hardness at the North Dumfries test wells exceeded the ODWS, with concentrations ranging from 523 to 755 mg/L, concentrations of all other major ions met ODWS standards. The water chemistry in North Dumfries was dominated by the presence of bicarbonate ions, with alkalinity ranging from 222 mg/L to 276 mg/L. Calcium concentrations ranged from 126 to 203 mg/L, whereas sulphate concentrations ranged from 250 to 465 mg/L. This range likely reflects the irregular distribution of gypsum and or anhydrite (sulphate minerals) within the bedrock aquifer. In general, water quality in North Dumfries tended toward a sulphate-bicarbonate type, but not as strongly as the wells located in the Shade’s Mills well field.

Chloride concentrations in the North Dumfries test wells ranged from 23 to 29 mg/L, within the higher end of the ranges of concentrations observed in other Cambridge East wells. All concentrations of nitrite and nitrate were lower than the method detection limits of the laboratory. Concentrations of iron (0.06 to 0.54 mg/L) and manganese (0.004 to 0.009 mg/L) were generally within the ranges observed at other Cambridge East municipal bedrock wells.
5.0 ADDITIONAL WELL FIELD OPTIMIZATION INVESTIGATIONS

5.1 Pinebush Well Field – Construction and Testing of Test Wells P10A, P10B, PBTW1-10 and Production Well P17

In 2010, the Region completed the construction of test production wells P10A (Burnside, 2011) and PBTW1-10 (Burnside, 2010) in the deep bedrock aquifer at the sites of existing Production Well P10 and the Pinebush Water Treatment Plant, respectively. Well P10A is a 300 mm diameter well with an open hole through the Gasport Formation from 58 to 122 m below grade, whereas PBTW1-10 is a 203 mm diameter well with an open hole through the Guelph to Gasport Formations from 50 to 107 m below grade. Based on the results of the 2010 borehole testing program, an additional drilling and testing program was completed in the vicinity of wells P10 and P11/P17 which led to the installation of test production well P10B, a 324 mm diameter well with a gravel pack straddling the overburden/bedrock (Guelph Formation) interface close to P10. Pilot hole testing in the vicinity of wells P11/P17 indicated insufficient capacity within the overburden/upper bedrock aquifer. Alternatively, well P11 was overdrilled and a new 254 mm well casing installed deeper into the bedrock to a depth of 44.0 mbgs to prevent sand production. A steel well liner was installed in Production Well P17 from 3.1 m below grade to 48.2 m below grade to increase the available drawdown in this well (Stantec, 2013a).

In 2011, a 15-day constant rate pumping test at wells P10A, P10B, PBTW1-10 and P17 was conducted to evaluate sustainable aquifer yield, potential well interference and well field optimization (Stantec, 2013a). The 15-day test included a staggered start to allow for impacts to be assessed at each pumping location. The total combined pumping rate was as high as about 156 L/s. Pumping rates at nearby production wells in the Pinebush, Clemens Mill and Hespeler well fields were maintained at constant rates during testing. Based on analysis of the stages of the constant rate pumping test results, the transmissivity and storativity values at each of the test locations were estimated as follows:

<table>
<thead>
<tr>
<th>Test Well</th>
<th>Transmissivity (m³/day)</th>
<th>Storativity (m/m)</th>
<th>Formation Screened</th>
<th>Solution Used in Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>P17</td>
<td>130</td>
<td>3 E-05</td>
<td>Gasport</td>
<td>Theis confined</td>
</tr>
<tr>
<td>PBTW1-10</td>
<td>320</td>
<td>3 E-06</td>
<td>Guelph to Gasport</td>
<td>Theis confined</td>
</tr>
<tr>
<td>P10A and PBTW1-10</td>
<td>370</td>
<td>1 E-06</td>
<td>Guelph to Gasport</td>
<td>Theis confined</td>
</tr>
<tr>
<td>P10A</td>
<td>140 to 220</td>
<td>1 E-04 to 2 E-04</td>
<td>Gasport</td>
<td>Cooper-Jacob</td>
</tr>
<tr>
<td>P10B</td>
<td>440 to 520</td>
<td>2 E-03 to 1 E-04</td>
<td>Overburden and Guelph</td>
<td>Theis confined</td>
</tr>
</tbody>
</table>

Water quality from P10B and PBTW1-10 met all health-related ODWS criteria. Water quality in the deeper bedrock wells (P17, P10A and PBTW1-10) had low chloride and sodium concentrations whereas P10B had higher concentrations, likely due to the effects of nearby road salting (Stantec, 2013a). Elevated concentrations of iron (0.6 to 1.2 mg/L) and turbidity (6 to 13 NTU) at P10A and P10B, exceeded the Aesthetic Objectives of the ODWS. Concentrations of hardness exceeded the Operational Guidelines of the ODWS in all of the wells, as did concentrations of organic nitrogen at P10B and PBTW1-10 and total dissolved solids (TDS) at P10B. Stantec (2012) classified PBTW1-10 and P10B as GUDI with Effective Filtration (GUDI-EF) while testing by Burnside (2011) classified P10A as groundwater. A final GUDI evaluation for P17 was not completed as part of the investigation due to potential interference from the temporary packer installed at P11 during the test. The long-term sustainable yield (Stantec, 2013a) of P17 is 26 L/s (2,246 m³/day), the Gasport Formation in the
vicinity of P10A and PBTW1-10 is approximately 70 L/s (6,048 m³/day) and the overburden/Guelph Formation at P10B is estimated at 30 L/s (2,592 m³/day).

5.2 Clemens Mill Well Field – G16 Investigations

In March and April, 2011, Production Well G16 was deepened to a depth of about 126.5 m below grade and a liner was installed in this well to a depth of about 58 m below grade. These changes resulted in an increased well performance at G16 with an increase in specific capacity to 4.4 L/s/m (380 m³/day/m) (Lotowater, 2011).

5.3 Shade’s Mills Well Field – Construction and Testing of SM-PW1-11

In 2011 and 2012, test drilling was conducted within the deep overburden and shallow bedrock in the vicinity of Production Wells G38 and G39 and a test production well, SM-PW1-11 (later renamed G40), was constructed and tested. Wells G38 and G39 were rehabilitated and a 6-day constant rate pumping test was conducted at SM-PW1-11, G38 and G39 to evaluate the capacity of the new well and recommend an optimized pumping scenario for the three wells. A GUDI assessment of the new well was also completed (Stantec, 2013b).

Similar to wells G38 and G39, SM-PW1-11 was installed in the overburden with a 60 slot screen stainless steel well screen from 33.6 m to 40.5 m below grade in sand and gravel outwash deposits, the main producing Shade’s Mills aquifer. The well was naturally developed. Following performance testing of SM-PW1-11 and rehabilitation and performance testing of G38 and G39, a 6-day constant rate pumping test was conducted, with a staggered start of G38, G39 and SM-PW1-11 at a combined rate of approximately 85 L/s (7,344 m³/day).

Based on analysis of the results of the constant rate pumping test, using the Hantush (1964) Solution for a leaky confined aquifer, the transmissivity of the aquifer was estimated to be about 780 m²/day with a storativity of 0.003 m/m and a leakage parameter of 0.0006 day⁻¹. This transmissivity and leakage parameter were lower than that estimated during historical testing of G38 and G39 at 1,300 m²/day and 0.006 day⁻¹, respectively (Golder, 1995). Stantec concluded that the decrease in transmissivity in the aquifer was due to the accumulation of sediment in the Shade’s Mills Reservoir and subsequent decrease in leakage (i.e., recharge to the aquifer system) (Stantec, 2013b). No effects were observed in any adjacent surface water features including the Shade’s Mills Reservoir or Mill Creek during the 6-day pumping test.

Water quality from the test production well SM-PW1-11 met all health-related ODWS criteria, with exceedances for the following non-health related parameters: hardness, manganese, organic nitrogen and colour. Similar to G38 and G39, SM-PW1-11 was classified as a GUDI well with Effective Filtration (GUDI-EF) (Stantec, 2013b).
6.0 REFERENCES


APPENDIX A
FIELD INVESTIGATIONS - CAMBRIDGE EAST IUS WATER SUPPLY CLASS EA


Stantec Consulting Ltd. (Stantec), 2013a. Pinebush Road Well Field Construction and Testing of Test Wells P10A, P10B, TW1 10 and Production Well P17. Prepared for the Regional Municipality of Waterloo.


### Table A1-A
Summary of Field Investigations - Phase I (2005/2006)

<table>
<thead>
<tr>
<th>Date</th>
<th>Well Field</th>
<th>Drilling and Aquifer Testing Details</th>
<th>Region of Waterloo Contract Number</th>
<th>Sub-Contractor</th>
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<tr>
<td>Aug 9-30, 2005</td>
<td>Pinebush, Clemens Mills &amp; Shades Mills</td>
<td>Drilling and installation of 152 mm diameter test wells SMTW1-05, PBTW1-05 and CMTW1-05</td>
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<td>Davidson Well Drilling Ltd.</td>
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<td>Sep 13-19, 2005</td>
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<td>Davidson Well Drilling Ltd.</td>
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<td>Nov 1-15, 2005</td>
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<td>Nov 17-21, 2005</td>
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<td>Clemens Mills and Shades Mills</td>
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<td>Gerrits Well Drilling Inc.</td>
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<td>May 15 to July 5, 2006</td>
<td>Pinebush and Clemens Mills</td>
<td>Drilling and installation of 4 monitoring well nests with 3 bedrock and 3 overburden monitors in each nest (CMOW1-06, CMOW2-06, PBO1-06 and PBO2-06) and drilling and installation of bedrock monitoring nest at CMOW3-06</td>
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<td>May 8 to July 14, 2006</td>
<td>Pinebush and Clemens Mills</td>
<td>Drilling and Installation of three 305 mm test production wells, PBPW1-06, CMPW1-06 and CMPW2-06</td>
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<td>Sep 5 to Oct 2, 2006</td>
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<td>28-day pumping test of CMPW1-06, CMPW2-06 and PBPW1-06</td>
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<td>Gerrits Well Drilling Inc.</td>
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<td>Aug 14-23, 2007</td>
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<td>Drilling and installation of 152 mm diameter test wells SMTW2-07 and SMTW3-07</td>
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<td>Sep 6-11, 2007</td>
<td>Shades Mills</td>
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<td>Oct 10-14, 2007</td>
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<td>Dec 18-20, 2007</td>
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<td>Drilling and installation of 152 mm diameter test well PBTW3-07</td>
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<td>Feb 13-19, 2008</td>
<td>Shades Mills</td>
<td>Drilling and installation of 152 mm diameter test well SMTW4-08</td>
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<td>Feb 12-14, 2008</td>
<td>Shades Mills</td>
<td>Installation of overburden Monitoring nest SMOW1ABC-08</td>
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<td>Mar 2, 2008</td>
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<td>Step testing of SMTW4-08</td>
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<td>Mar 3-6, 2008</td>
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<td>3-day pumping test at SMTW4-08</td>
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<td>Mar 12 to Apr 18, 2008</td>
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<td>Drilling and installation of test production well PBPW2-08</td>
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<td>Shades Mills</td>
<td>Conversion of SMTW4-08 into bedrock monitoring nest</td>
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<td>Date</td>
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<td>Region of Waterloo Contract Number</td>
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<td>Oct 1-8, 2008</td>
<td>Town of Clyde</td>
<td>Drilling and installation of 152 mm diameter test wells NDTW1-08 and NDTW2-08</td>
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<td>Oct 16-20, 2008</td>
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<td>Step Testing of NDTW1-08 and NDTW2-08</td>
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<td>Dec 2-17, 2008</td>
<td>Town of Clyde</td>
<td>Conversion of NDTW1-08 into monitoring well nest</td>
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<td>Dec 20-28, 2008</td>
<td>Town of Clyde</td>
<td>Drilling of 503 mm test production well NDPW1-08</td>
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<td>Gerrits Well Drilling Inc.</td>
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<tr>
<td>Oct 28 to Dec 22, 2008</td>
<td>Town of Clyde</td>
<td>Drilling and installation of NDO1-08 and NDO2-08 (3 bedrock and 2 overburden monitors)</td>
<td></td>
<td>CMT Engineering</td>
</tr>
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<td>Oct 28 to Nov 19, 2008</td>
<td>Town of Clyde</td>
<td>Drilling and installation of overburden monitoring nests NDO3-08, NDO4-08 and NDO5-08</td>
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<td>Gerrits Well Drilling Inc.</td>
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<tr>
<td>Jan 13-15, 2009</td>
<td>Town of Clyde</td>
<td>Step testing and 2-Day pumping test of NDPW1-08</td>
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<tr>
<td>Sep 23-30, 2009</td>
<td>Town of Clyde</td>
<td>Step testing and 7-Day test of packered NDPW1-08</td>
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Golder Associates
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<th>Well Field</th>
<th>Drilling and Aquifer Testing Details</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>April, 2009</td>
<td>Pinebush</td>
<td>New production well G5A drilled beside G5, cased through the upper bedrock (Reformatory Quarry Fm) and open in deeper water producing zones (Goat Island and Gasport Fms).</td>
<td>Davidson Drilling</td>
</tr>
<tr>
<td>June, 2009</td>
<td>Pinebush</td>
<td>A 225 mm diameter steel liner installed and cemented into place in G5 to a depth of 22.3 m below ground surface.</td>
<td>Lotowater</td>
</tr>
<tr>
<td>June 2009 and Dec 2009</td>
<td>Pinebush</td>
<td>Step testing and pre and post acid injection at G5A.</td>
<td></td>
</tr>
<tr>
<td>Feb 25 - Mar 3, 2010</td>
<td>Pinebush</td>
<td>6-Day pumping test conducted at G5A</td>
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</tr>
<tr>
<td>Oct. 2009</td>
<td>Pinebush</td>
<td>Drilling and Installation of test well P10-TW1-09</td>
<td>Well Initiatives</td>
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<tr>
<td>Dec. 2009</td>
<td>Pinebush</td>
<td>Drilling and Installation of test well P10-TW2-09</td>
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</tr>
<tr>
<td>Jan - April 2010</td>
<td>Pinebush</td>
<td>Conversion of P10-TW2-09 into P10A, a 300 mm test production well and conversion of P10-TW1-09 into a multi-level well.</td>
<td>Davidson Drilling</td>
</tr>
<tr>
<td>Apr. 2010</td>
<td>Pinebush</td>
<td>P10 reconstructed, sealing of low water production zone at the bottom of the well with bentonite and capped with cement</td>
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<tr>
<td>Apr. 2010</td>
<td>Pinebush</td>
<td>Drilling and construction of overburden monitoring wells P10-TW1D-10 and P10-TW1E-10.</td>
<td>Pro Core Drilling</td>
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<tr>
<td>May 6-13, 2010</td>
<td>Pinebush</td>
<td>Step testing and 6-Day pumping test at P10A</td>
<td>Lotowater</td>
</tr>
<tr>
<td>July - Aug 2010</td>
<td>Pinebush</td>
<td>Drilling of 203 mm test production well PBTW1-10</td>
<td>Davidson Drilling</td>
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<tr>
<td>Feb - Mar 2011</td>
<td>Pinebush</td>
<td>Drilling of pilot test holes PB-TW1-11 and PB-TW3-11 near P10 and PB-TW2-11 and PB-TW4-11 near P11/P17.</td>
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<tr>
<td>Apr 29 - May 25, 2011</td>
<td>Pinebush</td>
<td>Drilling and installation of Test Well P10B at P10 site</td>
<td>Gerrits Well Drilling Inc.</td>
</tr>
<tr>
<td>July, 2011</td>
<td>Pinebush</td>
<td>Conversion of PB-TW4-11 into a deep overburden monitoring well (PBOW1A-11) and drilling and installation of a shallow overburden monitoring well (PBOW1B-11).</td>
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<tr>
<td>Mar - Apr, 2012</td>
<td>Pinebush</td>
<td>Overdrilling and removal of P11 well casing, installation of new 250 mm casing to 44 m</td>
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<tr>
<td>June 2-10, 2011</td>
<td>Pinebush</td>
<td>Installation of a 254 mm ID steel well liner to a depth of 48.2 m BGS in P17.</td>
<td>Well Initiatives</td>
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<tr>
<td>Oct 4-19, 2011</td>
<td>Pinebush</td>
<td>15-day pumping test conducted at P17, PBTW1-10, P10A and P10B.</td>
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<tr>
<td>Jan. 2013</td>
<td>Pinebush</td>
<td>Drilling of two test wells PB-TW1-13 and PB-TW2-13</td>
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<tr>
<td>Apr - May 2013</td>
<td>Pinebush</td>
<td>Drilling and construction of well P15A by overdrilling PB-TW2-13</td>
<td>Gerrits Well Drilling Inc.</td>
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<tr>
<td>May. 2013</td>
<td>Pinebush</td>
<td>Conversion of PB-TW1-13 into a multi-level monitoring well nest</td>
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<tr>
<td>May, 2014</td>
<td>Pinebush</td>
<td>In P9, a 200 mm diameter stainless steel liner was installed to a depth of 54.3 m below ground surface. The liner was installed to address concerns of cascading water from shallow bedrock water producing features.</td>
<td>Lotowater</td>
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<tr>
<td>Date</td>
<td>Well Field</td>
<td>Drilling and Aquifer Testing Details</td>
<td>Contractor</td>
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<tr>
<td>May - June 2014</td>
<td>Pinebush</td>
<td>Performance and constant rate testing at P9 and P15A to confirm capacity and optimum pumping configuration of these two wells. P15A is expected to replace P15 when brought online.</td>
<td>Gerrits Well Drilling Inc.</td>
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<tr>
<td>Jun - August, 2011</td>
<td>Shades Mills</td>
<td>Overdrilling and conversion of SM-TW1-11 into a 305 mm, naturally developed Test Production Well, later to become G40. Well step tested.</td>
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<tr>
<td>Jan 31 - Feb 7, 2012</td>
<td>Shades Mills</td>
<td>6-day pumping test conducted at G40, G38 and G39.</td>
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<tr>
<td>Jan. 2012</td>
<td>Shades Mills</td>
<td>Rehabilitation of wells G38 and G39</td>
<td>Well Initiatives</td>
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<tr>
<td>Aug, 2010</td>
<td>Clemens Mills</td>
<td>Well inspection and testing at G18. Variable rate pumping test indicated well performing at close to as constructed capacity.</td>
<td>Lotowater</td>
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<tr>
<td>Mar - Apr 2011</td>
<td>Clemens Mills</td>
<td>G16 deepened to a depth of 126.5 m bgs and a liner was installed to a depth of 58 m bgs. Lowering of the pump in the well resulted in an increased well specific capacity to 4.4 L/s/m.</td>
<td>Hopper/Lotowater</td>
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<tr>
<td>2013 / 2014</td>
<td>Clemens Mills</td>
<td>Well rehabilitation of G17 only returned 15% of the well’s specific capacity of about 5 L/s/m.</td>
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<tr>
<td>August, 2014</td>
<td>Clemens Mills</td>
<td>A liner was installed in G6 to a depth of 44.3 m to increase the available drawdown in this well. The well was rehabilitated following liner installation.</td>
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<tr>
<td>Dec. 2015</td>
<td>Clemens Mills</td>
<td>Performance testing on G18 indicated similar to as-constructed.</td>
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Notes:
1) All casings were grouted into top of rock using positive displacement techniques.
2) Geophysical logs completed include: optical televiewer, gamma and conductivity.
   a) Caliper logs were completed for wells CMTW2-05 and PBTW1-05.
   b) Flow profile logging was completed at the Test Production Wells and at Test wells PBTW3-07, SMTW2-07, SMTW3-07 and SMTW4-08.
3) Static water levels as measured immediately prior to step testing.
4) Test Wells CMTW3-05, SMTW1-05, SMTW2-07, SMTW3-07 and NDTW1-08 were completed as bedrock monitoring well nests.

Golder Associates
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### Construction Details for Monitoring Wells

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*Golder Associates*
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<td>127.9</td>
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<td>Shades Mill Conservation Area</td>
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**Phase II**

**Golder Associates**
## Table A3
### Construction Details for Monitoring Wells

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<th>Easting</th>
<th>Northing</th>
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<th>Date Installed</th>
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<th>Screen ID</th>
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<th>Sand Pack (mbgs)</th>
<th>Geophysical Logs Completed</th>
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<td>22-Dec-08</td>
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**Note:**
1) Geophysical logs completed include optical televiewer, gamma and conductivity
## Table A4

### Drilling Results - Bedrock Formation Picks

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<th>Borehole</th>
<th>Elevation (m)</th>
<th>Overburden</th>
<th>Guelph Formation</th>
<th>Eramosa Formation - Reformatory Quarry Member</th>
<th>Eramosa Formation - Vinemount Member</th>
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<td></td>
<td>(masl) From (mgs)</td>
<td>To (mgs)</td>
<td>From (masl)</td>
<td>To (masl)</td>
<td>Thickness (m)</td>
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<td>300.7</td>
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**NOTE:**

1) Bottom depth of the Cabot Head Formation is based on the borehole depth.

---

Golder Associates
## Table A5
Summary of Step Pumping Tests

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<th>Well_ID</th>
<th>OBJ_NUM</th>
<th>Date Tested</th>
<th>Pumping Rates (m³/day)</th>
<th>Pumping Rates (L/s)</th>
<th>Duration</th>
<th>Static Level¹ (mbgs)</th>
<th>Phase</th>
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<td>CMTW1-05</td>
<td>9202045</td>
<td>13-Sep-05</td>
<td>327, 655, 982, 1,309</td>
<td>3.8, 7.6, 11.4, 15.1</td>
<td>8 hours</td>
<td>6.91</td>
<td>I</td>
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<td>9202047</td>
<td>8-Sep-05</td>
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<td>3.8, 7.6, 11.4, 15.1</td>
<td>8 hours</td>
<td>5.55</td>
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<td>15-Sep-05</td>
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<td>37.9, 50.5, 63.1, 75.7</td>
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<td>-0.38</td>
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**Notes:**

1) Static water levels as measured immediately prior to step testing for each well. For NDTW1-08, the value was measured prior to NDTW2-08 step test.

2) CMPW1-06 broke suction prior to the fourth step.

3) For the January 2009 test at NDPW1-08, the constant rate pumping test initiated immediately at end of fourth step at rate of 977 IGM (70.0 L/s).

4) NDPW1-08 was free flowing at the start of January 2009 test. Static level was estimated at 1 m above ground surface.

_Golder Associates_
## Table A6
### Step Pumping Test Results

<table>
<thead>
<tr>
<th>Test Wells</th>
<th>Step 1 (3.8 L/s or 327 m³/day)</th>
<th>Step 2 (7.6 L/s or 655 m³/day)</th>
<th>Step 3 (11.4 L/s or 982 m³/day)</th>
<th>Step 4 (15.1 L/s or 1,309 m³/day)</th>
<th>Step 5 (25.0 L/s or 2,160 m³/day)</th>
<th>Specific Capacity (L/s/m) (at end of test)</th>
<th>Phase</th>
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<td>Drawdown (m)</td>
<td>Drawdown (m)</td>
<td>Drawdown (m)</td>
<td>Drawdown (m)</td>
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<th>Step 2 (50.5 L/s or 4,366 m³/day)</th>
<th>Step 3 (63.1 L/s or 5,435 m³/day)</th>
<th>Step 4 (75.7 L/s or 6,540 m³/day)</th>
<th>Specific Capacity (L/s/m) (at end of test)</th>
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**NOTES:**
1) Static Water Levels measured immediately prior to step pumping test for each well.
2) Static water level value for NDTW1-08 was measured before NDTW2-08 step test.
3) The Step 4 pumping rate for PBTW2-06 was 1,256 m³/day (14.5 L/s).
4) CMPW1-06 broke suction at the fourth step.
5) Step rates for PBPW2-08 were as follows: Step 1 - 1,635 m³/day (18.9 L/s); Step 2 - 2,455 m³/day (28.4 L/s); Step 3 - 3,633 m³/day (41.9 L/s); and Step 4 - 5,237 m³/day (60.6 L/s).
6) NDPW1-08 was free flowing at start of the test. Static water level was estimated.
7) The Step 4 pumping rate for NDPW1-08 was 6,396 m³/day (74.0 L/s) in January 2009.
8) The Step 4 pumping rate for NDPW1-08 was 6,049 m³/day (70.0 L/s) in September 2009.

_Golder Associates_
### Table A7
Summary of Constant Rate Pumping Tests

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<th>Well_ID</th>
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<th>Pumping Test Description</th>
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<th>Duration</th>
<th>Pumping Rate (m³/day)</th>
<th>Pumping Rate (L/s)</th>
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**Notes:**

1) CMPW2-06, PBPW1-06 and CMPW1-06 were pumped together during the 28-day Constant Rate Test. Start times were staggered and all the wells stopped at the same time.

2) The January NDPW1-08 Test started immediately following the fourth step in the Step Pumping Test.

3) The January NDPW1-08 Test was ended early due to a generator failure and ice jams restricting flow of discharge water through culverts.

4) Prior to the September Test, a packer was installed in NDPW1-08 at the top of the Gasport Formation to isolate pumping to the deeper zone.

---

**Golder Associates**
### Table A8

#### Drawdown During Constant Rate Pumping Tests

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#### Monitoring Well Nests

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The table above lists the drawdown measurements during constant rate pumping tests performed on various wells. The drawdown at the end of each test is indicated for each well, with measurements taken during different phases of the study. The table includes information on monitoring well nests, which are essential for assessing the water level changes over time.
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### Table A8

**Drawdown During Constant Rate Pumping Tests**

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<th>PHASE II: Shades Mill (SMTW4-08) 3-Day Test</th>
<th>PHASE III: Can-Amera (PBFW2-08) 3-Day Test</th>
<th>PHASE IV: North Dumfries (NDPW1-08) 2-Day Test</th>
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**NOTES:**

- **M** = Manual water level monitoring.
- **E** = Electronic datalogger water level monitoring.
- **NR** = No clear response to pumping.

1. Water levels in these wells were also monitored as part of the Region’s Groundwater Monitoring Program.
2. As of July 2010, these wells have been incorporated into the Region’s Groundwater Monitoring Program.
3. Interference at MW91-03-01-2 during North Dumfries test due to South Guelph pumping test at GSTW1-08. Drawdown estimated based on recovery.
4. Drawdown at CMDW1-06 during the 28-day test, based on a manual measurement several days prior to end of test.
5. Well flowing prior to and after testing. Electronic data available when water level below Top of Casing.
6. In 2007 Well SM3A-93 was converted into the multi-level monitoring nest SM3ABC-07.
7. TSS = Total Suspended Solids monitoring.
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<td>30-Oct-07</td>
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<td>SM3C-07</td>
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<td>ODWS Parameters</td>
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<td>ODWS Parameters</td>
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<td>NDPW1-08</td>
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# Table A11
Inorganic Water Chemistry Results

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<th>Sampling Location</th>
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<th>SMTW1-05</th>
<th>CMTW3-05</th>
<th>CMTW2-05</th>
<th>CMPW1-06&lt;sup&gt;5&lt;/sup&gt;</th>
<th>CMPW2-06&lt;sup&gt;5&lt;/sup&gt;</th>
<th>PBPW1-06&lt;sup&gt;5&lt;/sup&gt;</th>
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<td>13-Sep-05</td>
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<tr>
<td>Alkalinity as CaCO₃ (mg/L)</td>
<td>30-500</td>
<td>219</td>
<td>254</td>
<td>226</td>
<td>228</td>
<td>225</td>
<td>232</td>
<td>232</td>
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<tr>
<td>Aluminium (mg/L)</td>
<td>0.1</td>
<td>&lt;0.005</td>
<td>0.005</td>
<td>0.092</td>
<td>0.011</td>
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<td>&lt;0.010</td>
<td>&lt;0.010</td>
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<td>Calcium (mg/L)</td>
<td>88.5</td>
<td>83.9</td>
<td>235</td>
<td>203</td>
<td>155</td>
<td>118</td>
<td>87</td>
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<td>Chloride (mg/L)</td>
<td>250</td>
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<td>12.2</td>
<td>11.8</td>
<td>28.8</td>
<td>11.5</td>
<td>8.82</td>
<td>13.5</td>
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<tr>
<td>Dissolved Organic Carbon (mg/L)</td>
<td>5</td>
<td>0.6</td>
<td>1.7</td>
<td>0.9</td>
<td>0.8</td>
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<td>0.8</td>
<td>0.7</td>
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<td>Hardness (mg/L)</td>
<td>80-100</td>
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<td>791</td>
<td>755</td>
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<td>Iron (mg/L)</td>
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<td>0.049</td>
<td>0.192</td>
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<td>Magnesium (mg/L)</td>
<td>29.7</td>
<td>24.5</td>
<td>49.5</td>
<td>60.3</td>
<td>52.3</td>
<td>43.4</td>
<td>32.4</td>
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<td>Manganese (mg/L)</td>
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<td>0.002</td>
<td>0.038</td>
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<td>0.008</td>
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<tr>
<td>Nitrate-N (mg/L)</td>
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<td>&lt;0.10</td>
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<td>&lt; 0.10</td>
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<td>pH (pH Units)&lt;sup&gt;4&lt;/sup&gt;</td>
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<td>7.45*</td>
<td>7.43*</td>
<td>6.99*</td>
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<td>7.62*</td>
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<td>Potassium (mg/L)</td>
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<td>0.88</td>
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<td>1.24</td>
<td>1.2</td>
<td>1.56</td>
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<td>Sodium (mg/L)</td>
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<td>9.34</td>
<td>8.4</td>
<td>9.8</td>
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<tr>
<td>Sulphate (mg/L)</td>
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<td>80.9</td>
<td>23.7</td>
<td>492</td>
<td>465</td>
<td>358</td>
<td>208</td>
<td>90.1</td>
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</table>

**NOTES:**
1) ODWS - Ontario Drinking Water Quality Standards, Objectives and Guidelines dated June 2006
2) MAC - Maximum Acceptable Concentration
3) AO/OG - Aesthetic Objective and/or Operational Guideline
4) * pH estimated due to exceeded holding time
5) Test Production Wells (CMPW1-06, CMPW2-06 and PBTW1-06) values are from samples collected at the end of the 28-day Pumping Test
6) Test Well SMTW4-08 values are from samples collected at the end of the 3-day Pumping Test.

- indicates parameter exceeds AO/OG
### Table A11

#### Inorganic Water Chemistry Results

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<th>SMTW3-07</th>
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<th>SMTW4-08</th>
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<th>NDTW2-08</th>
<th>NDPW1-08</th>
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<td>05-Mar-08</td>
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<td>14-Jan-09</td>
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#### Inorganic parameters

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<th>Phase III</th>
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<td>Alkalinity as CaCO₃ (mg/L)</td>
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<td>Aluminium (mg/L)</td>
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<tr>
<td>Calcium (mg/L)</td>
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<td>Chloride (mg/L)</td>
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<td>18.6</td>
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<tr>
<td>Dissolved Organic Carbon (mg/L)</td>
<td>5</td>
<td>1.1</td>
<td>&lt; 0.5</td>
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<tr>
<td>Hardness (mg/L)</td>
<td>80-100</td>
<td>1900</td>
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<td>Iron (mg/L)</td>
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<td>Magnesium (mg/L)</td>
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<td>Manganese (mg/L)</td>
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<tr>
<td>Nitrite-N (mg/L)</td>
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<td>Potassium (mg/L)</td>
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<td>Sodium (mg/L)</td>
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</tr>
<tr>
<td>Sulphate (mg/L)</td>
<td>500</td>
<td>1530</td>
<td>1300</td>
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#### NOTES:

1) ODWS - Ontario Drinking Water Quality Standards, Objectives and Guidelines dated June 2006
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5) Test Production Wells (CMPW1-06, CMPW2-06 and PBTW1-06) values are from samples collected at the end of the 28-day Pumping Test
6) Test Well SMTW4-08 values are from samples collected at the end of the 3-day Pumping Test.

- indicates parameter exceeds AO/OG
### Table A12
Isotope and Radionuclide Results

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<tr>
<th>Sampling Location</th>
<th>CMPW1-06</th>
<th>CMPW2-06</th>
<th>PBPW1-06</th>
<th>6699 CONCESSION 1 (9203311)</th>
<th>TW10-78</th>
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<td>δ¹⁸O (oxygen-18)</td>
<td>-9.87</td>
<td>-10.03</td>
<td>-10.2</td>
<td>-10.13</td>
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<td>δ²H (deuterium)</td>
<td>-69.34</td>
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<td>-68.72</td>
<td>-68.21</td>
<td>-66.76</td>
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<td>³H (tritium) (TU)</td>
<td>1.3 +/- 0.4</td>
<td>&lt;0.8 +/- 0.4</td>
<td>5.7 +/- 0.6</td>
<td>13.1 +/- 1.0</td>
<td>14.5 +/- 1.1</td>
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<td>δ³⁴S (sulphur-34)</td>
<td>26.61</td>
<td>29.08</td>
<td>24.56</td>
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<td>3.26</td>
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<tr>
<td>Gross Alpha (Bq/l)</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
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<tr>
<td>Gross Beta (Bq/l)</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
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<td>&lt;0.1</td>
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<tr>
<td>Tritium (Bq/l)</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
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FIGURES
Test Well Step Test Results

Cambridge East
IUS
Water Supply
Class EA

Notes:
1) Pumping rate shown is for each of the four steps in the Step Pumping Test.
2) Step 4 for PBTW2-06 was 1,267 m³/day, slightly less than for the other Step Tests.
3) The first step at CMTW2-05 was 20 minutes longer than the other tests.
Notes:
1) Pumping rates at PBPW2-08 were lower than at the other wells. They were as follows: Step 1 = 1,637 m³/day (18.9 L/s); Step 2 = 2,455 m³/day (28.4 L/s); Step 3 = 3,633 m³/day (37.9 L/s); and Step 4 = 5,237 m³/day (60.6 L/s).
2) CMPW1-06 broke suction at the fourth step so the test was ended after the third step.
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 5, PBPW1-06 started at 3,378 m$^3$/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.
NOTE:
1. PBOW1-06E (0.54) - Drawdown (m) at end of pumping test
2. (UP) - indicates increase in water level at this location
3. Gasport Formation Monitored Interval

The map depicts various water supply systems, including Municipal Supply Wells, Monitored Wells, Test Production Wells, Principal Highways, Major Roads, Local Roads, Parkway, Gasport Formation Bedrock, Drawdown contour line (m), Watercourse, Waterbody, ESAs, GRCA Provincially Significant Wetlands, and ESAs.

Legend:
- Municipal Supply Wells
- Monitored Wells
- Test Production Wells
- Principal Highway
- Major Roads
- Local Roads
- Parkway
- Gasport Formation Bedrock
- Drawdown contour line (m)
- Watercourse
- Waterbody
- ESAs
- GRCA Provincially Significant Wetlands

Study Area

Lake Ontario

Project: Cambridge East IUS Water Supply Class EA

Figure: A7

Base Data - MNRF LIO obtained 2016
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Datum: NAD 83 Projection: UTM Zone 17N
NOTE:
1. PBOW1-06E (0.54) - Drawdown (m) at end of pumping test
2. (UP)- indicates increase in water level at this location
3. Lower overburden monitored interval

LEGEND
- Municipal Supply Wells
- Test Production Wells
- Monitored Wells
- Principal Highway
- Major Roads
- Local Roads
- Railway
- Lower Overburden Drawdown Contour Line (m)
- Watercourse
- Waterbody
- ESAs
- GRCA Provincially Significant Wetlands

NOTE:
1. PBOW1-06E (0.54) - Drawdown (m) at end of pumping test
2. (UP)- indicates increase in water level at this location
3. Lower overburden monitored interval

REFERENCE
Base Data - MNRF LIO obtained 2016
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Datum: NAD 83 Projection: UTM Zone 17N
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PBPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.

Cambridge East
IUS
Water Supply
Class EA

Phase I 28-Day Pumping Test
CMOW2-06 Hydrographs

DRAWN: JLH | APPROVED: JAP | DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) | FIGURE: A9
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PBPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 5, PBOW2-06 started at 3,378 m$^3$/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.

1. Combined Pumping Rate
   - PBOW2A-06
   - PBOW2B-06
   - PBOW2C-06
   - PBOW2D-06
   - PBOW2E-06
   - PBOW2F-06

2. Combined Pumping Rate

Phase I 28-Day Pumping Test
PBOW2-06 Hydrographs
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Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 5, PBPW1-06 started at 3,378 m$^3$/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PBPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 5, PBPW1-06 started at 3,378 m$^3$/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.

Cambridge East
IUS
Water Supply
Class EA

Phase I 28-Day Pumping Test
Mill Creek Area Wells A
Hydrographs

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A14
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PBWP1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.

2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PBPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PBPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 5, PBPW1-06 started at 3,378 m$^3$/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.
Notes:
1) The 3-day constant rate test at SMTW4-08 took place between March 3-6, 2008 at a rate of 1,964 m$^3$/day (22.8 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).
Notes:
1) The 3-day constant rate test at PBTW2-08 took place between May 5-8, 2008 at a rate of 3,273 m$^3$/day (37.9 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).
LEGEND

- Monitoring Wells
- Municipal Supply Wells
- Test Production Wells
- Principal Highway
- Major Roads
- Local Roads
- Railway
- Gasport Formation Bedrock
  Drawdown contour line (m)
- Watercourse
- Waterbody
- ESAs
- GRCA Provincially Significant
  Wetlands

NOTE:
1. PBOW1-06 (0.54) - Drawdown (m) at end of pumping test
2. (UP) - indicates increase in water level at this location
3. (NR) - indicates no response

REFERENCE
Base Data - MNRF LIO obtained 2016
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Datum: NAD 83 Projection: UTM Zone 17N

JLH
JAP

G:\Projects\2005\05-1112-010_IUS_Groundwater_Waterloo\GIS\MXDs\Draft\Cambridge\Cambride_East_Class_EA_2016\FigureA23_PhaseII_PBPW2_08_GasportFormation.mxd

PHASE II PBPW2-08 3-DAY PUMPING TEST,
BEDROCK RESPONSE – GASPORT FORMATION

PROJECT
CAMBRIDGE EAST IUS WATER SUPPLY CLASS EA

NOTE:
1. PBOW1-06E (0.54) - Drawdown (m) at end of pumping test
2. (UP) - indicates increase in water level at this location
3. (NR) - indicates no response
Notes:
1) The 2-day constant rate test at NDPW1-08 took place between Jan 13-15, 2009 immediately following step testing at a rate of 6,396 m$^3$/day (74.0 L/s).
2) Testing took place on the open borehole.
3) Testing ended early due to generator failure and ice jams restricting flow of water through culverts.
4) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Cambridge East IUS
Water Supply Class EA

Phase III NDPW1-08 (2-Day) Pumping Test
Groundwater Elevation Monitoring

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A24
CAMBRIDGE EAST IUS WATER SUPPLY CLASS EA

PHASE II NDPW1-08 2-DAY PUMPING TEST, BEDROCK RESPONSE – GASPORT FORMATION

NOTE:
1. PBOW1-06E (0.54) – Drawdown (m) at end of pumping test
2. (UP) – indicates increase in water level at this location
3. Gasport Formation Monitored Interval
4. (NR) – indicates no response

REFERENCE
Base Data: MNRF LIO obtained 2016
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Datum: NAD 83 Projection: UTM Zone 17N

SCALE
1:30,000

LEGEND
Monitoring Wells
Municipal Supply Wells
Test Production Wells
Principal Highway
Major Roads
Railway
Gasport Formation Bedrock
Drawdown contour line (m)
Watercourse
Waterbody
ESAs
GRCA Provincially Significant Wetlands

NOTE:
1. PBOW1-06E (0.54) – Drawdown (m) at end of pumping test
2. (UP) – indicates increase in water level at this location
3. Gasport Formation Monitored Interval
4. (NR) – indicates no response

REFERENCE
Base Data: MNRF LIO obtained 2016
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Datum: NAD 83 Projection: UTM Zone 17N
Notes:
1) The 6-day constant rate test at NDPW1-08 took place between Sept 24-30, 2009, at a rate of 4,321 m³/day (50.0 L/s).
2) A packer was installed in NDPW1-08 and NDTW2-08 on Sept 15, 2009, to isolate the Gasport Formation from the Guelph Formation. During the test, NDPW1-08 was pumped below the packer.
3) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Phase III NDPW1-08 (6-Day) Pumping Test
Groundwater Elevation Monitoring

Cambridge East IUS Water Supply Class EA

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A26
PHASE II NDPW1-08 6-DAY PUMPING TEST, BEDROCK RESPONSE – GASPORT FORMATION

NOTE:
1. PBOW1-06E (0.54) - Drawdown (m) at end of pumping test
2. (UP) - indicates increase in water level at this location
3. Gasport Formation Monitored Interval
4. (NR) - indicates no response

REFERENCE
Base Data - MWOI v03 obtained 2016
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Datum: NAD 83 Projection: UTM Zone 17N

LEGEND
- Monitoring Wells
- Municipal Supply Wells
- Test Production Wells
- Principal Highway
- Major Roads
- Local Roads
- Railway
- Gasport Formation Bedrock
- Drawdown contour line (m)
- Watercourse
- Waterbody
- EAs
- GRCA Provincially Significant Wetlands

NOTE:
1. PBOW1-06E (0.54) - Drawdown (m) at end of pumping test
2. (UP) - indicates increase in water level at this location
3. Gasport Formation Monitored Interval
4. (NR) - indicates no response

ATTACHMENT A1
Field Methodology
1.0 INTRODUCTION

2.0 WELL DRILLING AND CONSTRUCTION

2.1 Drilling and Well Installation

2.1.1 Borehole Testing

FIGURES

Figure A1.1 Typical Test Well Schematic
Figure A1.2 Typical Test Production Well Schematic
Figure A1.3 Typical Bedrock Monitoring Well Nest Schematic
Figure A1.4 Typical Overburden Monitoring Well Nest Schematic
Figure A1.5 Typical Bedrock-Overburden Monitoring Well Nest Schematic – North Dumfries Monitors
1.0 INTRODUCTION

As part of the Integrated Urban System Groundwater Supply Optimization and Expansion Project (IUS Project), the Regional Municipality of Waterloo (the Region) is undertaking a municipal Class Environmental Assessment (EA) to identify the preferred alternative for developing additional municipal groundwater supply in Cambridge East. As part of the field studies supporting the Class EA, Golder Associates (Golder) undertook a field program to characterize the hydrogeological conditions in the vicinity of the Cambridge East Study Area. This Attachment (A1) of Appendix A of the Detailed Hydrogeological and Natural Environment Report (DHNR) provides details on the field methodologies used during this field program.

2.0 WELL DRILLING AND CONSTRUCTION

2.1 Drilling and Well Installation

Figure A1.1 shows the test well design. Drilling of the 152 mm (6-inch) diameter test wells typically consisted of:

- Drilling and installing a 254 mm (10-inch) temporary surface casing to 6 m depth;
- Drilling a 230 mm (9-inch) diameter borehole through the overburden and up to 3 m into competent bedrock;
- Drilling and installing a 152 mm (6-inch) steel casing through the overburden and up to 3 m into competent bedrock;
- Introduction of a cement-bentonite grout mixture into the well casing via tremmie pipe to seal the borehole annulus to surface using positive placement techniques;
- Advancement of a 152 mm (6-inch) diameter borehole through the Guelph and Gasport Formations, with the borehole terminated about 1 to 3 m into the underlying Cabot Head shale at depths of 120 m to 140 m below ground; and
- Collection of drilling cutting samples every 1.5 m of depth when possible. Photos of drill cuttings are presented in Attachment A2.

Figure A1.2 shows a schematic of a test production well. Drilling of the 305 mm (12-inch) diameter test production wells typically consisted of:

- Drilling and installing a 483 mm (19-inch) temporary surface casing to 6 m depth;
- Drilling and installing a 305 mm (12-inch) diameter steel casing through the overburden and up to 3 m into competent bedrock;
- Advancement of a 305 mm (12-inch) diameter borehole through the Guelph and Gasport Formations, with the borehole terminated about 1 to 3 m into the underlying Cabot Head shale at depths of 120 m to 140 m below ground; and
- Collection of drilling cutting samples every 1.5 m of depth when possible. Photos of drill cuttings are presented in Attachment A2.

Figures A1.3 through A1.5 present the designs of monitoring well nests installed in the bedrock and in the overburden for this project. Installation of the bedrock monitoring well nests typically consisted of:

- Installation of three 32 mm (1.25-inch) diameter PVC piezometers in existing 152 mm (6-inch) diameter bedrock test well open boreholes with steel casing set into competent bedrock. Design of screen intervals...
and lengths were based on drilling records and borehole geophysical testing. In general, well screens were set in the deep bedrock (Gasport formation), the intermediate bedrock and shallow bedrock (Guelph formation);

- Sand pack was extended 1.5 m below and above the screened sections. Bentonite pellets, introduced via tremmie pipe, sealed the borehole between the screened intervals in the bedrock using positive placement techniques; and

- Bentonite grout was introduced in the open borehole and inside the 152 mm steel casing to surface above shallowest bedrock piezometer;

Installation of the overburden monitoring well nests typically consisted of up to three monitoring wells at a distance of about 1 m in the deep intermediate and shallow overburden as follows:

- Each borehole was drilled using a 108 mm (4.25-inch) hollow stem auger. Overburden samples were obtained at 1.5 m intervals using a split spoon sampler in the deepest monitoring well drilled at each nested well site;

- A 51 mm (1.25-inch) PVC 10-slot PVC well screen was installed at each location and completed with schedule 40 PVC pipe; and

- Sand pack was extended at least 0.5 m below the well screen and 1.5 m above the top of the screen. 1.5 m of bentonite pellets (hole plug) were placed above the sand pack and bentonite grout was used to backfill the remaining annual space to within 1 m of ground surface. Installations were completed with a concrete collar and an above ground lockable protective steel casing for each well.

2.1.1 Borehole Testing
All boreholes were logged and the field and soil and rock samples were collected at 1.5 m intervals. Selected overburden samples were selected for grain-size analyses following the standard test method for Sieve Analysis of fine and coarse Aggregates, ASTM C136. In the bedrock, rock chips were collected and photographed. Grain-sized analyses and rock chip photos are included in Attachment A2.

Following drilling, geophysical logging was carried out by Golder geophysicists in the test wells, test production wells and bedrock monitoring wells. Geophysical probes were run on a wireline through the open portion of the borehole to measure different properties of the bedrock and water column. The geophysical logging included the following suites: stratigraphy (natural gamma and apparent conductivity) and structural properties (optical televiewer logging). A description of the borehole logging methods is described below.

Natural Gamma
The natural gamma log records the average natural gamma activity of the formation, and can be related to variations in lithology. For example, rock with higher clay content, such as shales, have higher natural gamma activity than limestones. Natural gamma logs were generally recorded twice in each borehole for QA/QC purposes and were smoothed using a 3-point moving average (boxcar) filter prior to display.

Apparent Conductivity
This borehole probe records the apparent conductivity of the rock mass surrounding the borehole using the inductive electromagnetic technique. The probe provides a radial bulk measurement of the material 0.1 m to 1.0 m from the borehole wall over a distance of 1.0 m. The measurement is unaffected by conductive borehole fluid or the presence of plastic casing. The conductivity logs were acquired at a 5 cm sampling interval at a logging speed of 3 m/min, and the gamma logs were acquired at a 2 cm sampling interval at a logging speed of 1.5 m/min. Logs were acquired on both down and up runs, and repeatability between runs was achieved. This log is generally used in conjunction with the natural gamma log to identify variations in lithology/stratigraphy. Apparent conductivity
logs were generally recorded twice in each borehole for QA/QC purposes. The natural gamma and inductive conductivity log data are presented alongside the stratigraphy on the borehole log records (Attachment A2).

**Optical Televiewer**

The optical televiewer generates a scanned image of the inside of the borehole wall with detail for resolving fractures as narrow as 0.1 mm and with a radial resolution of 1 degree. The recorded data is “oriented” with either a 3-component fluxgate magnetometer system for vertical boreholes in a nonmagnetic host or a 3-component tilt meter system for inclined holes. The recorded data can be post processed to orient to north or to high side within the borehole. Applications for this tool include inspecting casings for defects, characterization of fractures in either air or water-filled boreholes and, in combination with traditional core logging, can be used for mineralogy and foliation studies. The optical televiewer logs are interpreted to map the orientation and extent of fractures within a borehole.

**Flow Profiling**

Flow profile logging was performed on test wells and test production wells during step testing. This logging was conducted by personnel from Lotowater Ltd. A spinner tool was lowered into the well in advance of the test pump installation and was used to identify the primary zones of water production below the pump setting. The spinner tool is lowered to the bottom of the borehole where typically no groundwater inflows were encountered. The tool is then raised progressively to record the velocity of water moving up the borehole in response to test pumping. While the tool records actual water velocity, it is the relative velocity that provides the indication of the relative contribution from each of the water producing zones encountered within the borehole. The water velocity is seen to increase sharply where discrete fractures are contributing additional water, while a continuous increase over a broader vertical interval indicates a steady contribution of water over the same interval. Estimates of the actual quantities of groundwater production at each inflow zone can be made by relating the flow profile to the pumping rate of the well. The flow profiles are included in Attachment A2.
APPROXIMATE DEPTH BELOW GROUND SURFACE (m)

OVERBURDEN

GROUNDFACE

MINIMUM 60 cm STICK-UP

LOCKING SECURITY CAP

250 mm (10") DIAMETER TEMPORARY CASING

CEMENT - BENTONITE GROUT

150 mm (6") DIAMETER STEEL CASING

BEDROCK SURFACE

-200-300 cm PENETRATION CEMENTED INTO BEDROCK

BEDROCK

140 mm (5.5") DIAMETER OPEN HOLE THROUGH THE GUELPH-GASPORT FORMATION TO THE TOP OF SHALE

SHALE

REGION OF WATERLOO

TYPICAL TEST WELL SCHEMATIC

FIGURE A1.1
APPROXIMATE DEPTH BELOW GROUND SURFACE (m)

MINIMUM 40 cm STICK-UP

GROUND SURFACE

OVERBURDEN

406 mm (16") DIAMETER TEMPORARY CASING

CEMENT - BENTONITE GROUT

305 mm (12") DIAMETER STEEL CASING

LOCKING SECURITY CAP

BEDROCK SURFACE

-200-300 cm PENETRATION CEMENTED INTO BEDROCK

292 mm (11.5") DIAMETER OPEN HOLE THROUGH THE GUELPH-GASPORD FORMATION TO THE TOP OF SHALE

SHALE

REGION OF WATERLOO

TYPICAL TEST PRODUCTION WELL SCHEMATIC

FILE No. 05112010LAA12.dwg
PROJECT No. 05-1112-010 (1500) REV. A

SCALE AS SHOWN TITLE

DATE Sep. 17, 2012
DESIGN ADI

CAD KD
CHECK Jlh
REVIEW JAP

REGION OF WATERLOO FIGURE A1.2
TYPICAL BEDROCK MONITORING WELL NEST SCHEMATIC

REGION OF WATERLOO

FIGURE A1.3
TYPICAL OVERBURDEN MONITORING WELL NEST SCHEMATIC

REGION OF WATERLOO

FIGURE A1.4

LOCKING SECURITY CAP

MINIMUM 60 cm STICK-UP

GROUND SURFACE

HOLE PLUG

BENTONITE GROUT

150 cm HOLE PLUG

50 mm (2") DIAMETER FLUSH THREADED PVC PIPE

FILTER SAND

170 - 200 mm (6-3/4" to 8") DIAMETER BOREHOLE

305 cm (10') LONG SCREEN

DRILLED TO AUGER REFUSAL INTO TOP OF BEDROCK

OVERBURDEN

BEDROCK SURFACE

BEDROCK

MINIMUM 60 cm STICK-UP

GROUND SURFACE

HOLE PLUG

BENTONITE GROUT

150 cm HOLE PLUG

50 mm (2") DIAMETER FLUSH THREADED PVC PIPE

FILTER SAND

170 - 200 mm (6-3/4" to 8") DIAMETER BOREHOLE

305 cm (10') LONG SCREEN

DRILLED TO AUGER REFUSAL INTO TOP OF BEDROCK

OVERBURDEN

BEDROCK SURFACE

BEDROCK
**TYPICAL BEDROCK-OVERBURDEN MONITORING WELL NEST SCHEMATIC**

**NORTH DUMFRIES MONITORS**

**REGION OF WATERLOO**

**SCALE** AS SHOWN

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**FILE No.** 05112010LAA15.dwg

**PROJECT No.** 05-1112-010 (1500)
ATTACHMENT A2

Borehole Testing Records

- Borehole Logs with Geophysics
- Optical Televiewer Logs
- Grain-Size Analyses
- Rock Chip Photo Records
- Flow Profile Logs
- Driller’s Water Well Record
Dark dull brown DOLOMITE with some black mineralization on fracture/bedding planes, moderately indurated, fine crystalline, blocky to platy chips with strong petroliferous odour (Eramosa Member)

Fracture or void at 64.3 m depth

Becoming dark blackish-brown with sparse clean white mineral from 65.5 m

Becoming lighter brown

Bluish grey DOLOMITE, blocky white, crystalline, moderately indurated, weakly laminated, platy to blocky chips with strong petroliferous colour (Eramosa Member)

Fracture or void at 64.3 m depth

Becoming dark blackish-brown with sparse clean white mineral from 65.5 m

Becoming lighter brown

Grey DOLOMITE, crystalline, well indurated, weakly laminated, irregular blocky to tabular chips, smooth parting, sparse micro vugs (Amabel Fm)

Grey DOLOMITE, crystalline, well indurated, weakly laminated, irregular blocky to tabular chips, smooth parting, sparse micro vugs (Amabel Fm)

Grey DOLOMITE, crystalline, well indurated, weakly laminated, irregular blocky to tabular chips, smooth parting, sparse micro vugs (Amabel Fm)

Becoming fossiliferous and blocky grey colour by 88.3 m

Light-grayish-white DOLOMITE, fine grained, fossiliferous, vuggy (small), porous rock weakly laminated, blocky irregular chips (Amabel Fm)

Becoming fossiliferous and blocky grey colour by 88.3 m

Grey DOLOMITE, crystalline, well indurated, weakly laminated, irregular blocky to tabular chips, smooth parting, sparse micro vugs (Amabel Fm)

Becoming fossiliferous and blocky grey colour by 88.3 m

Light-grayish-white DOLOMITE, fine grained, fossiliferous, vuggy (small), porous rock weakly laminated, blocky irregular chips (Amabel Fm)

Becoming fossiliferous and blocky grey colour by 88.3 m

Grey DOLOMITE, crystalline, well indurated, weakly laminated, irregular blocky to tabular chips, smooth parting, sparse micro vugs (Amabel Fm)

Grey DOLOMITE, crystalline, well indurated, weakly laminated, irregular blocky to tabular chips, smooth parting, sparse micro vugs (Amabel Fm)
END OF BOREHOLE

Grey DOLOMITE, occasional fine sulphides, weakly laminated, no odour

Grey SHALE (Rochester Fm)

Grey DOLOMITE, occasional fine sulphides, weakly laminated, no odour

Dull greyish-brown at 124.9 m

Light brown and grey, vuggy from 111.3 m to 115.8 m depth

Becoming darker grey at 118.9 m depth

Several large vugs/fractures from 102.1 m to 111.3 m depth

Brown, mottled black with sulphides

END OF BOREHOLE
<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>(TOPSOIL) brown ORGANIC SILT, rootlets</td>
</tr>
<tr>
<td>0.61</td>
<td>Brown CLAY, with SANDY GRAVEL (TILL)</td>
</tr>
<tr>
<td>3.05</td>
<td>Brown SILTY SAND and GRAVEL (TILL) and trace cobbles, heterogeneous, moist, compact, subrounded to subangular gravel</td>
</tr>
<tr>
<td>14.83</td>
<td>Brown-grey SAND and GRAVEL, some cobbles, porous, fairly clean, angular to subrounded</td>
</tr>
<tr>
<td>20.04</td>
<td>Fine to coarse gravel from 15. m to 15.5 m depth</td>
</tr>
<tr>
<td>27.13</td>
<td>Medium brown, fine SAND, some coarse sand, uniform, homogeneous, loose</td>
</tr>
<tr>
<td>273.47</td>
<td>Fine to medium sand, trace cobbles and occasional boulder from 24.4 to 25.0 m depth</td>
</tr>
<tr>
<td>273.73</td>
<td>Brown-grey fine SAND and GRAVEL, some silty clay, very dense, heterogeneous (TILL)</td>
</tr>
<tr>
<td>272.01</td>
<td>Brown SILTY SAND and gravel grading to coarse gravel, heterogeneous</td>
</tr>
<tr>
<td>27.66</td>
<td>Buff brown DOLOMITE, fractured, moderately weathered, massive, fine grained (Guelph Fm)</td>
</tr>
<tr>
<td>270.18</td>
<td>Brown/greyish brown DOLOMITE, crystalline, weakly laminated, trace micro vugs, moderately to well indurated, blocky to platy chips (Guelph Fm)</td>
</tr>
<tr>
<td>30.48</td>
<td>Intermittent thin fractures from 32 m to 36.6 m depth</td>
</tr>
</tbody>
</table>

**Geophysical Record**

**Conductivity (mS/m):**

<table>
<thead>
<tr>
<th>CONDUCTIVITY (mS/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
</tr>
<tr>
<td>0.61</td>
</tr>
<tr>
<td>3.05</td>
</tr>
<tr>
<td>14.83</td>
</tr>
<tr>
<td>20.04</td>
</tr>
<tr>
<td>27.13</td>
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<tr>
<td>273.47</td>
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<tr>
<td>273.73</td>
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<tr>
<td>272.01</td>
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<tr>
<td>27.66</td>
</tr>
<tr>
<td>270.18</td>
</tr>
<tr>
<td>30.48</td>
</tr>
</tbody>
</table>

**Depth Scale:**

<table>
<thead>
<tr>
<th>DEPTH SCALE</th>
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<tbody>
<tr>
<td>0</td>
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<td>20</td>
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<tr>
<td>35</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>45</td>
</tr>
<tr>
<td>50</td>
</tr>
</tbody>
</table>

**Ground Surface:***

Intermittent thin fractures from 32 m to 36.6 m depth
Thin grey clay seam at 66.8 m depth
Blotchy grey DOLOMITE, fine crystalline, moderately indurated, weakly laminated, tabular to platy chips (Amabel Fm)

Dull, light grey from 74.7 m to 93.0 m depth
Micro-vugs starting at 79.2 m depth
Vuggy from 89.6 m to 88.4 m depth
Well indurated, some small vugs, trace fossils from 91.4 m to 105.2 m depth

Brown/greyish brown DOLOMITE, crystalline, weakly laminated, trace micro vugs, moderately to well indurated, blocky to platy chips (Guelph Fm)

Dark brown DOLOMITE trace clear calcite, crystalline, moderately indurated, blocky to platy chips with strong petroliferous odour (Eramosa Member)

Thin grey clay seam at 66.8 m depth

Micro-vugs starting at 79.2 m depth
Vuggy from 89.6 m to 88.4 m depth

Drill date: June 6 to June 13, 2006
Drill rig: Air Rotary
Drill contractor: Gerrits Drilling Ltd.

Location: N 4804173.7; E 559589.2
Datum: Geodetic
Becoming darker grey colour and weakly laminated
Trace fossils from 106.7 m to 111.3 m depth
Trace fine sulphides from 108.2 m to 109.7 m depth

Dark grey DOLOMITE, disseminated fine sulphides, platy to flaggy chips, crystalline contains thin shale lined fractures
Grey SHALE (Rochester Fm)

--- CONTINUED FROM PREVIOUS PAGE ---

Biotchy grey DOLOMITE, fine crystalline, moderately indurated, weakly laminated, tabular to platy chips (Amabel Fm)
Small fracture or vug at 103.3 m depth

Becoming darker grey colour and weakly laminated
Trace fossils from 106.7 m to 111.3 m depth
Trace fine sulphides from 108.2 m to 109.7 m depth

Dark grey DOLOMITE
Dull brownish-gray DOLOMITE, interbedded green, soft shale, black mottling, disseminated sulphides, thinly laminated, platy chips

END OF BOREHOLE
<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>GROUND SURFACE</td>
</tr>
<tr>
<td>10</td>
<td>Brown, moist, SILTY SAND</td>
</tr>
<tr>
<td>10.7</td>
<td>Bentonite</td>
</tr>
<tr>
<td>12.2</td>
<td>Brown, saturated SAND and GRAVEL, (coarse)</td>
</tr>
<tr>
<td>15.5</td>
<td>Becoming fine to coarse sand from 10.7 m to 12.2 m depth</td>
</tr>
<tr>
<td>15.5</td>
<td>Becoming medium sand from 15.5 m to 19.8 m depth</td>
</tr>
<tr>
<td>20</td>
<td>Becoming sandy gravel from 29 m to 30.5 m depth</td>
</tr>
<tr>
<td>29.5</td>
<td>Brown, saturated, fine to coarse SAND, some gravel</td>
</tr>
<tr>
<td>30.5</td>
<td>Beige/brown DOLOSTONE (Guelph Fm)</td>
</tr>
<tr>
<td>30.5</td>
<td>Grout</td>
</tr>
<tr>
<td>30.5</td>
<td>Sand</td>
</tr>
<tr>
<td>34.1</td>
<td>Screen</td>
</tr>
</tbody>
</table>

**GEOPHYSICAL RECORD**

- **GAMMA (cpsi)**
  - 295.73
  - 6.71
  - 7.88

- **CONDUCTIVITY (mS/m)**
  - 271.94
  - 30.50
  - 268.35

**PIEZOMETER OR STANDPIPE INSTALLATION**

- CBA
### BOREHOLE LOG OF: CMOW3-06

**PROJECT:** 05-1112-010(1000)  
**LOCATION:** N 4804866.4 ; E 558916.3  
**DRILLING DATE:** July 31 - August 3, 2006  
**DRILL RIG:** Air Rotary  
**DRILLING CONTRACTOR:** Gerrits Drilling Ltd.  
**DATUM:** Geodetic

#### SYMBOLIC LOG

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>238.34</td>
<td>Beige/brown DOLOSTONE (Guelph Fm)</td>
</tr>
<tr>
<td>246.74</td>
<td>Brown/black DOLOSTONE (Eramosa Member)</td>
</tr>
<tr>
<td>238.94</td>
<td>Grey/white DOLOSTONE (Amabel Fm)</td>
</tr>
</tbody>
</table>

--- CONTINUED FROM PREVIOUS PAGE ---

#### DEPTH SCALE

<table>
<thead>
<tr>
<th>Depth Scale</th>
<th>Metres</th>
</tr>
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<tr>
<td>70</td>
<td>75</td>
</tr>
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<td>80</td>
<td>85</td>
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</table>

#### GEOPHYSICAL RECORD

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Gamma (cps)</th>
<th>Conductivity (mS/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>238.34</td>
<td>40</td>
<td>55.70</td>
</tr>
<tr>
<td>246.74</td>
<td>60</td>
<td>64.10</td>
</tr>
</tbody>
</table>

--- CONTINUED NEXT PAGE ---

#### PIEZOMETER OR STANDPIPE INSTALLATION

- Screen
- Sand
- Beige/brown DOLOSTONE (Guelph Fm)
- Brown/black DOLOSTONE (Eramosa Member)
- Grey/white DOLOSTONE (Amabel Fm)

**LOGGED:** KS  
**CHECKED:**

**DEPT SCALE**  
1:250  
**MIS-HYD 003 05-1112-010.GPJ  GAL-MISS.GDT  4/23/07**
BOREHOLE LOG OF: CMOW3-06

PROJECT: 05-1112-010(1000)
LOCATION: N 4804866.4; E 558916.3
DRILLING DATE: July 31 - August 3, 2006
DRILL RIG: Air Rotary
DRILLING CONTRACTOR: Gerrits Drilling Ltd.

DEPTH SCALE METRES
DESCRIPTION
SYMBOLIC LOG
ELEV. DEPTH (m)
GAMMA (cps) CONDUCTIVITY (mS/m)
PIEZOMETER OR STANDPIPE INSTALLATION

100 Grey/white DOLOSTONE (Amabel Fm)
105 Grey SHALE (Rochester Fm)
110 DOLOSTONE
115 --- CONTINUED FROM PREVIOUS PAGE ---
120 Green/grey SHALE (Cabot Head Fm)
125 END OF BOREHOLE
130
135
140
145
150
Medium grey, blotchy finely crystalline DOLOMITE, increase in proportion of dark grey (Guelph Formation)

Light grey, blotchy finely crystalline DOLOMITE, small (<1 mm) vugs (Guelph Formation)

Medium grey, blotchy finely crystalline DOLOMITE, with small (<1 mm) vugs (Guelph Formation)

Medium grey, blotchy finely crystalline DOLOMITE, with small (<1 mm) vugs, light brown vuggy finely crystalline chips (weathered) (Guelph Formation)

Medium grey, blotchy finely crystalline DOLOMITE, sand size chips (Guelph Formation)

Medium grey, blotchy DOLOMITE and light brown vuggy dolomite (weathered) (Amabel Formation)

Medium grey, blotchy fine crystalline DOLOMITE, sand size chips (Amabel Formation)

No sample recovered

Rock pulverized by drilling action

--- CONTINUED FROM PREVIOUS PAGE ---

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<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>SYMBOLIC LOG</th>
</tr>
</thead>
<tbody>
<tr>
<td>No sample recovered</td>
<td></td>
</tr>
<tr>
<td>Rock pulverized by drilling action</td>
<td></td>
</tr>
</tbody>
</table>

--- CONTINUED FROM PREVIOUS PAGE ---

END OF BOREHOLE

<table>
<thead>
<tr>
<th>ELEV. (m)</th>
<th>GAMMA (cpm)</th>
<th>CONDUCTIVITY (mS/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
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</tr>
<tr>
<td>40</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>60</td>
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</tr>
<tr>
<td>80</td>
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</tr>
<tr>
<td>100</td>
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<tr>
<td>120</td>
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<td>140</td>
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<tr>
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<tr>
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<td></td>
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</tr>
<tr>
<td>200</td>
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</table>

<table>
<thead>
<tr>
<th>DEPTH SCALE</th>
<th>1 : 250</th>
</tr>
</thead>
<tbody>
<tr>
<td>META SCALE</td>
<td>Geodetic</td>
</tr>
</tbody>
</table>

PROJECT: 05-1112-010(1000)
LOCATION: N 4805353.2; E 558400.0
DRILLING DATE: May 8 to May 19, 2006
DRILL RIG: Air Rotary
DRILLING CONTRACTOR: Gerrits Drilling Ltd.

MIS-HYD 003 05-1112-010.GPJ GAL-MISS.GDT 4/23/07
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>SYMBOLIC LOG</th>
<th>ELEV.</th>
<th>GEOPHYSICAL RECORD</th>
<th>PIEZOMETER OR STANDPIPE INSTALLATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GROUND SURFACE</strong></td>
<td></td>
<td>0.00</td>
<td>301.64</td>
<td></td>
</tr>
<tr>
<td>Gravel, crushed, and soil (FILL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fine GRAVEL and coarse SAND, some fine sand and silt</td>
<td></td>
<td>4.88</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Fine GRAVEL and coarse SAND, trace fine to medium sand and trace silt</td>
<td></td>
<td>6.10</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>angular to subrounded gravel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light grey finely crystalline DOLOMITE, vugs (&lt;1 mm)</td>
<td></td>
<td>25.91</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>(Guelph Formation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light grey finely crystalline DOLOMITE, platy chips with uneven partings</td>
<td></td>
<td>32.61</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>(Guelph Formation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light brown finely crystalline DOLOMITE, few small (&lt;1 mm) vugs, rare</td>
<td></td>
<td>34.14</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>microstylolite (Guelph Formation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light grey finely crystalline DOLOMITE</td>
<td></td>
<td>38.10</td>
<td>0</td>
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<tr>
<td>Light grey finely crystalline DOLOMITE</td>
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<td>48.77</td>
<td>0</td>
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</tr>
<tr>
<td>Light grey finely crystalline DOLOMITE</td>
<td></td>
<td>52.97</td>
<td>0</td>
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</tbody>
</table>

**DEPTH SCALE**: 1 : 250

**PROJECT**: 05-1112-010(1000)

**LOCATION**: N 4804450.6 ; E 558967.1

**DRILLING DATE**: May 26 - June 7, 2006

**DRILL RIG**: Air Rotary

**DRILLING CONTRACTOR**: Gerrits Drilling Ltd.
Dark grey finely crystalline DOLOMITE, sand sized chips (Eramosa Member)

Blotchy white and medium grey, finely crystalline DOLOMITE, small (<1 mm) vugs (Amabel Formation)

Light brownish grey, finely crystalline DOLOMITE, small (<1 mm) vugs, rare microstylolite

No sample recovered
Rock pulverized by drilling action

--- CONTINUED FROM PREVIOUS PAGE ---

DRILLING DATE: May 26 - June 7, 2006
DRILL RIG: Air Rotary
DRILLING CONTRACTOR: Gerrits Drilling Ltd.
PROJECT: 05-1112-010(1000)
LOCATION: N 4804450.6 ;E 558967.1
ELEV.

DEPTH SCALE
METRES
50
55
60
65
70
75
80
85
90
95
100

CONTINUED NEXT PAGE

1/2 Diameter
Open Borehole
BOREHOLE LOG OF: CMPW2-06
PIEZOMETER OR STANDPIPE INSTALLATION

DRILLING DATE: May 26 - June 7, 2006
DRILL RIG: Air Rotary
DRILLING CONTRACTOR: Gerrits Drilling Ltd.

DEPTH SCALE

SYMBOLIC LOG

DESCRIPTION
ELEV. DEPTH (m) GAMMA (cps) CONDUCTIVITY (mS/m)

12" Diameter Open Borehole

END OF BOREHOLE

120.00

No sample recovered
Rock pulverized by drilling action

--- CONTINUED FROM PREVIOUS PAGE ---

MIS-HYD 003  05-1112-010.GPJ  GAL-MISS.GDT  4/23/07
DATUM: Geodetic
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Description</th>
<th>Symbolic Log</th>
<th>Geophysical Record</th>
<th>Conductivity (mS/m)</th>
<th>Depth Scale</th>
<th>Geoeophysical Record</th>
<th>Conductivity (mS/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Dark grey to light grey Dolomite, fine crystalline, strongly indurated, weakly laminated, uneven partings, angular to subangular chips, sparse relict fossils, non weathered (Guelph Fm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>- No odour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Grey Dolomite, medium crystalline, moderately indurated weakly to strongly laminated, flaggy to platy shape chips angular to subangular chips, few vugs, fossiliferous, smooth to uneven partings, non weathered (Guelph Fm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>Grey/brown color banded</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>Dark grey, strongly indurated platy chips</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>Grey/brown Dolomite, medium to coarse grained, weakly laminated, trace relict fossils, uneven partings, flaggy to tabular, angular to subangular chips, some vugs with fine size crystals (Amabel Fm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>Very vuggy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>Dark grey Dolomite, thinly laminated, fine crystalline, smooth to uneven parting, platy to flaggy shape chips, angular to subangular, few fossils (Amabel Fm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>Very vuggy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>95</td>
<td>Grey to Brown Dolomite, weakly laminated, medium crystalline bioclastic vuggy, medium induration (Amabel Fm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Very vuggy</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Grey SHALE (Rochester Fm)
Dull brown DOLOMITE, weakly laminated, medium crystalline bioclastic vuggy, medium induration (Amabel Fm) granular layer

Grey DOLOMITE, fine crystalline, medium to extremely vuggy (<1 mm), weakly indurated, platy to flaggy shape chips angular to subangular, non weathered (Amabel Fm)

- No odour

Fine size crystals lining vugs and joints

Grey SHALE (Rochester Fm)

END OF BOREHOLE
## BOREHOLE LOG OF: CMTW2-05

**DEPTH SCALE (METERS)**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ELEV. (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUND SURFACE</td>
<td>0.00</td>
</tr>
<tr>
<td>Loose, wet, heterogeneous, crushed rock, soil, wood (tree trunks), boulders and cobbles (FILL) - No odour</td>
<td>361.80</td>
</tr>
<tr>
<td>Loose, brown, homogeneous fine to medium SAND</td>
<td>5.51</td>
</tr>
<tr>
<td>Loose, brown-grey coarse GRAVEL and SAND, trace cobbles, angular to subrounded gravel, heterogeneous</td>
<td>267.70</td>
</tr>
<tr>
<td>Compact, clean homogeneous GRAVEL, angular to subrounded</td>
<td>10.69</td>
</tr>
<tr>
<td>Compact, heterogeneous SAND and GRAVEL</td>
<td>15.24</td>
</tr>
<tr>
<td>Loose, fairly homogeneous Silty fine SAND with gravel</td>
<td>10.76</td>
</tr>
<tr>
<td>Loose, heterogeneous SAND and GRAVEL, subangular to subrounded gravel</td>
<td>12.81</td>
</tr>
<tr>
<td>Compact, grey bluish, heterogeneous CLAY, GRAVEL and SAND, angular to subrounded (Stoney TILL)</td>
<td>281.96</td>
</tr>
<tr>
<td>Moderately weathered, fine grained light brown/yellow DOLOMITE (Guelph Fm)</td>
<td>258.13</td>
</tr>
<tr>
<td>Light dull greyish brown DOLOMITE with fine vugs, moderately indurated, irregular parting, blocky to platy chips (Guelph Fm)</td>
<td>269.15</td>
</tr>
<tr>
<td>Light dull brown DOLOMITE, moderately indurated, fine to medium crystalline, flaggy chips, smooth parting, few small (&lt; 1 mm) vugs, laminated (Guelph Fm)</td>
<td>263.70</td>
</tr>
<tr>
<td>Ground Surface</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**GEOPHYSICAL RECORD**

<table>
<thead>
<tr>
<th>SYMBOLIC LOG</th>
<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
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**PIEZOMETER OR STANDPIPE INSTALLATION**

- 6" Steel Casing
- 6" Steel Casing
- 6" Steel Casing

**LOGGED:**

- AI

**CHECKED:**

- AI

**PROJECT:** 05-1112-010(1000)

**LOCATION:** N 480452.2 ; E 558964.4

**DRILLING DATE:** November 1 to 7, 2005

**DRILL RIG:** Mud Rotary

**DRILLING CONTRACTOR:** Davidson Well Drilling

**DATUM:** Geodetic
With few vugs between 88.39 m and 89.92 m depth

--- CONTINUED FROM PREVIOUS PAGE ---

Grayish-brown DOLomite, dull, medium indurated, no vugs, fine crystalline, tabular to platy chips, smooth parting (Guelph Fm)

Poorly indurated from 53.34 m to 54.86 m depth

Brown DOLomite, fine crystalline, moderately indurated, tabular to platy chips, smooth parting (Guelph Fm)

Dark brown DOLomite, well indurated, non weathered, uniform texture, crystalline, blocky to tabular chips, smooth to bumpy parting (Eramosa Member)
- Strong petro odour
- Traces of clear and milky white calcite from 62.48 m to 67.06 m depth

Thinly laminated and moderately indurated from 67.06 m to 68.58 m depth, shale partings

Light brownish-grey DOLomite, (blotchy shades) medium crystalline, moderate induration (Guelph Fm)

Light whitish grey and fine grained from 71.02 m to 74.68 m depth

Grey DOLomite, moderately indurated, fine crystalline, thick, massive beds, platy to blocky chips, both smooth and irregular partings (Guelph Fm)

Trace brown relic of pellets or concretion <1 cm from 77.72 m to 79.25 m depth

With some light brown color and fossiliferous from 85.34 m to 86.87 m depth

With few vugs between 88.39 m and 89.92 m depth

Fractures from 90.83 m to 91.44 m depth
Vuggy from 91.44 m to 92.96 m depth

Fractures from 94.49 m to 96.01 m depth
Vuggy from 94.49 m to 100.60 m depth

CONTINUED NEXT PAGE
Grey/Brown DOLOMITE, well indurated
Few shell cast fossils from 103.60 m to 105.20 m depth

Dark grey DOLOMITE, medium to indurated crystalline, platy to tabular chips, smooth to pitted parting surface
(Guelph Fm)
Grey/Brown DOLOMITE, well indurated
Few shell cast fossils from 103.60 m to 105.20 m depth

Grey SHALE (Rochester Fm)
Darker grey DOLOMITE with slight greenish hue, moderately indurated, crystalline, thinly laminated, platy chips
Brown SHALE, moderately weathered, thinly laminated, fine grained

END OF BOREHOLE
Fractured rock with strong sulphur odour from 92.7 m to 93.0 m depth

Light grey DOLOMITE, well indurated, crystalline, platy chips, thinly to medium layered, faintly weathered, contains trace small vugs (Guelph Fm)

Light brownish-grey DOLOMITE, crystalline, thinly to medium bedded, platy to blocky chips, irregular parting (Guelph Fm)

Grey DOLOMITE slight bluish hue, well indurated, thinly to medium layered, flaggy chips, crystalline, smooth to uneven parting (Guelph Fm)

Less indurated, coarser grained, some vugs starting at 67.1 m depth

Coarse crystalline, fossiliferous, vuggy from 71.6 m to 76.2 m depth

Fractured rock at 71.9 m

Light greyish-brown DOLOMITE, coarse crystalline, moderately indurated tabular chips, smooth - uneven parting, trace secondary sulphide mineralization

Dark grey DOLOMITE, fine crystalline, well indurated with relict spheres, blocky to platy chips, smooth parting

Some small (< 1 mm) vugs from 82.3 m to 85.3 m depth

Fractured rock at 89.9 m to 91.4 m depth

Light grey DOLOMITE, vuggy, porous, moderately indurated, coarse crystalline, tabular to blocky chips (Amabel Fm)
### BOREHOLE LOG OF: CMTW3-05

**PROJECT:** 05-1112-010(1000)  
**LOCATION:** N 4805132.0 ;E 557560.0  
**DRILLING DATE:** November 9 and 11, 2005  
**DRILL RIG:** Mud Rotary  
**DRILLING CONTRACTOR:** Davidson Well Drilling  

**DEPTH SCALE**  
<table>
<thead>
<tr>
<th>METRES</th>
<th>DESCRIPTION</th>
<th>SYMBOLIC LOG</th>
<th>ELEV.</th>
<th>GEOPHYSICAL RECORD</th>
<th>PIEZOMETER OR STANDPIPE INSTALLATION</th>
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<tbody>
<tr>
<td>100</td>
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<td></td>
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<tr>
<td>105</td>
<td>Grey DOLOMITE, moderately indurated, fine crystalline, blocky to platy chips, smooth to irregular parting (Amabel Fm)</td>
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<tr>
<td></td>
<td>Vuggy from 99.1 m to 100.6 m depth</td>
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<tr>
<td></td>
<td>Fractured zone from 101.5 m to 101.8 m depth</td>
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<tr>
<td></td>
<td>Greyish-brown colour from 105.2 m to 108.2 m depth</td>
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<tr>
<td></td>
<td>Trace small (&lt; 2 mm) vugs from 109.7 m to 112.6 m depth</td>
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<tr>
<td></td>
<td>Dark brown, soft layer from 110.3 m to 110.5 m depth</td>
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<tr>
<td>110</td>
<td>Light grey DOLOMITE, moderately to well indurated, predominantly fine crystalline with thin coarse grained beds (Amabel Fm)</td>
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<tr>
<td>115</td>
<td>Dark grey DOLOMITE, moderately indurated, fine crystalline, platy to tabular chips, smooth parting, relict fossils (Amabel Fm)</td>
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<tr>
<td>120</td>
<td>Light grey DOLOMITE, moderately indurated, fine grained, tabular to platy chips (Amabel Fm)</td>
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<tr>
<td>125</td>
<td>Dark grey DOLOMITE, moderately indurated, fine crystalline, thinly to medium bedded, platy chips, smooth to uneven parting (Amabel Fm)</td>
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<tr>
<td>130</td>
<td>Light grey DOLOMITE, moderately indurated, fine grained, tabular to platy chips (Amabel Fm)</td>
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<tr>
<td>135</td>
<td>Grey SHALE (Rochester Fm)</td>
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<tr>
<td></td>
<td>Grey SHALE, poorly indurated, fine grained (Cabot Head Fm)</td>
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<tr>
<td>140</td>
<td>END OF BOREHOLE</td>
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</tbody>
</table>

**END OF BOREHOLE**  

**DEPTH SCALE**  

--- CONTINUED FROM PREVIOUS PAGE ---
### BOREHOLE LOG OF: HPOW1-06

**LOCATION:** N 4804394.6;E 558786.2  
**PROJECT:** 05-1112-010(1000)  
**DRILLING DATE:** August 22, 2006  
**DRILL RIG:** Direct Push with Continuous Scope  
**DRILLING CONTRACTOR:** Strata Soil Sampling Inc.

#### DEPTH SCALE

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<tr>
<th>DEPTH SCALE METRES</th>
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<td>GROUND SURFACE</td>
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<td>SANDY SILT</td>
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</table>

#### SYMBOLIC LOG

- SILT, some gravel
- Fine grained SILTY SAND, some gravel
- Medium grained SAND, some gravel, trace silt
- Fine to medium grained SAND, some silt, some fine gravel
- Fine SILTY SAND, trace fine gravel
- END OF BOREHOLE

#### DEPTH (m)

<table>
<thead>
<tr>
<th>SYMBOLIC LOG</th>
<th>ELEV.</th>
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</thead>
<tbody>
<tr>
<td>SILT, some gravel</td>
<td>0.13</td>
</tr>
<tr>
<td>Fine grained SILTY SAND, some gravel</td>
<td>2.69</td>
</tr>
<tr>
<td>Medium grained SAND, some gravel, trace silt</td>
<td>2.99</td>
</tr>
<tr>
<td>Fine to medium grained SAND, some silt, some fine gravel</td>
<td>5.63</td>
</tr>
<tr>
<td>Fine SILTY SAND, trace fine gravel</td>
<td>7.33</td>
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</tbody>
</table>

#### GEOPHYSICAL RECORD

- GAMMA (cps)
- CONDUCTIVITY (mS/m)

#### PIEZOMETER OR STANDPIPE INSTALLATION

- B
- A

#### LOGGED: JUH  CHECKED: AI

---

**Remark:**

- Drilling Date: August 22, 2006
- Drilling Rig: Direct Push with Continuous Scope
- Drilling Contractor: Strata Soil Sampling Inc.
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<th>DEPTH (m)</th>
<th>DESCRIPTION</th>
<th>SYMBOLIC LOG</th>
<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Moist to wet, dark brown, clayey SAND and GRAVEL, some silt</td>
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</tr>
<tr>
<td>5.18</td>
<td>Wet, brown, subangular to subrounded GRAVEL and coarse SAND, some fine sand, trace silt</td>
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<tr>
<td>8.84</td>
<td>Brown to grey brown, SILT with fine sand, pebbles, trace clay, trace gravel (TILL)</td>
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<tr>
<td>13.72</td>
<td>Brown to grey brown, GRAVEL with sand, coarse, trace silt</td>
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<tr>
<td>16.76</td>
<td>Stiff, brown to grey brown, SILTY CLAY, trace sand, trace gravel</td>
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<tr>
<td>22.86</td>
<td>Increase gravel content with depth, increase clay content with depth</td>
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<tr>
<td>25.91</td>
<td>Grey, sandy CLAY with gravel, some coarse sand, trace silt</td>
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<tr>
<td>27.81</td>
<td>Brown to grey brown, DOLOSTONE, porous, massive, blocky to tabular rock chips (Guelph Formation)</td>
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<tr>
<td>32.19</td>
<td>Light brown, DOLOSTONE, minor porosity with thin black laminations, crystalline, blocky to tabular rock chips</td>
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</tr>
<tr>
<td>39.00</td>
<td>Fracture at 39m depth</td>
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</tbody>
</table>
Dark brown, DOLOSTONE, massive, crystalline, minor porosity, blacky rock chips with irregular partings (Eramosa Member)

Hydrocarbon odour detected during drilling, oily sheen noted on discharge water

Becoming darker brown to black with depth

Fracture at 65.5m depth

Grey to dark grey mottled, DOLOSTONE, porous, coarse grained, massive bedding (Amabel Formation)

Colour variations from brown to dark grey

Large fracture at 78m depth

Fractured rock from 81.6m to 81.9m depth
Grey to dark grey mottled, DOLOSTONE, porous, coarse grained, massive bedding (Amabel Formation)

Vug/fracture at 103m and 107.8m depth

Dark grey DOLOSTONE with grey shale, thinly laminated (Rochester Formation)

Dull brown to grey brown DOLOSTONE with black speckled appearance, trace sulphide mineral present

Grey to green SHALE, soft, thinly laminated (Cabot Head Formation)

END OF BOREHOLE

109.73
111.56
114.30
194.36
192.53
190.09
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<th>DEPTH SCALE</th>
<th>DESCRIPTION</th>
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<td>E</td>
<td>D</td>
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<td>Moist, brown, silty coarse SAND, some gravel</td>
<td>4.98</td>
<td>202.07</td>
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<tr>
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<td>Moist, brown, silty fine to medium SAND, some gravel</td>
<td>18.83</td>
<td>201.50</td>
<td>80</td>
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<tr>
<td>15</td>
<td>Moist, grey SILTY CLAY</td>
<td>15.46</td>
<td>260.57</td>
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<td>Moist, brown, medium SAND</td>
<td>17.88</td>
<td>260.23</td>
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<td>25</td>
<td>Moist, brown, coarse SAND and GRAVEL</td>
<td>2.56</td>
<td>225.69</td>
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<tr>
<td>30</td>
<td>Moist, grey / green, coarse SAND to GRAVEL</td>
<td>23.77</td>
<td>224.48</td>
<td>80</td>
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<tr>
<td>35</td>
<td>Grey DOLOSTONE (Guelph Formation)</td>
<td>31.99</td>
<td>267.16</td>
<td>80</td>
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<td>Grey / tan DOLOSTONE</td>
<td>34.44</td>
<td>203.83</td>
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<td>45</td>
<td>Tan DOLOSTONE</td>
<td>42.06</td>
<td>206.19</td>
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<tr>
<td>Light grey DOLOSTONE</td>
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<td>115.82</td>
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<td>20 40 60 80</td>
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<tr>
<td>Grey DOLOSTONE (with black specks), green shale (Cabot head Formation)</td>
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<td>116.43</td>
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<td>10 20 30 40</td>
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<td>END OF BOREHOLE</td>
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<td>118.43</td>
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**DEPTH SCALE**

- 100
- 110
- 120
- 130
- 140
- 150

**ELEV.**

- 20
- 40
- 60
- 80

**DRILLING DATE:** November 10 - December 22, 2008

**DRILL RIG:** Formost DR-12 Air Rotary

**DRILLING CONTRACTOR:** Gerrits Drilling

**PROJECT:** 05-1112-010(1900)

**LOCATION:** N 4803775.5; E 561220.1

**DATUM:** Geodetic

**LOGGED:** BH

**CHECKED:** AI
Soft, brown to black, sandy soil with organics, becoming stony with depth (TOPSOIL)

Coarse to medium SAND and GRAVEL, sub-angular gravel

- Wet below 1.5 m depth

Red-brown, silty fine SAND, uniform

Wet, clean, coarse SAND and GRAVEL, uniform

Compact, grey-brown, sandy SILT with pebbles, trace clay (TILL)

- Heterogeneous layer of sand and gravel between 6.1 m and 6.9 m depth

Grey SILTY CLAY with pebbles

Wet, clean, medium to coarse SAND and GRAVEL

Grey, gravelly SILT with fine sand (TILL)

END OF BOREHOLE
<table>
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<tr>
<th>DEPTH SCALE (m)</th>
<th>DESCRIPTION</th>
<th>SYMBOLIC LOG</th>
<th>ELEV. DEPTH (m)</th>
<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
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<td>299.27</td>
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<tr>
<td>0.00</td>
<td>Black soil, organic, with rootlets (TOPSOIL)</td>
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<td>0.30</td>
<td>Red-brown, fine SAND, some organics</td>
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<td>299.27</td>
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<tr>
<td>0.51</td>
<td>Brown, fine SAND and SILT, some gravel, trace organics</td>
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<td>299.27</td>
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<tr>
<td>1.20</td>
<td>Wet at 1.2 m depth</td>
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<td>299.27</td>
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<tr>
<td>1.37</td>
<td>Loose to compact, moist to wet, light brown, silty fine SAND with stones</td>
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<td>299.27</td>
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<tr>
<td>3.66</td>
<td>Wet, brown, heterogeneous, coarse SAND and GRAVEL with intermittent fine sand lenses</td>
<td></td>
<td>299.27</td>
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<tr>
<td>6.71</td>
<td>Grey-brown, SILT with fine sand and pebbles (TILL)</td>
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<td>299.27</td>
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<tr>
<td>8.53</td>
<td>END OF BOREHOLE</td>
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<td>299.27</td>
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**BOREHOLE LOG OF: NDOW5-08**

**DEPTH SCALE**
- Metres
- Metres

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<td>Black, organic TOPSOIL</td>
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<td>Loose to compact, moist to wet, brown, heterogeneous, silty SAND with gravel</td>
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<td>2.41</td>
<td>- Becoming sandier, and less cohesive with depth, wet at 2.4m depth</td>
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<tr>
<td>2.90</td>
<td>Compact, grey-brown, SILT with pebbles, trace clay (TILL)</td>
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<td>8.53</td>
<td>END OF BOREHOLE</td>
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**ELEV. SYMBOLIC LOG**

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**ELEV. DEPTH**

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**GEOPHYSICAL RECORD**

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<th>GAMMA (cps)</th>
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**PIEZOMETER OR STANPIPE INSTALLATION**

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</tbody>
</table>

**PROJECT:** 05-1112-010(1900)

**LOCATION:** N 4805018.4 ; E 563380.0

**DRILLING DATE:** November 18, 2008

**DRILL RIG:** Geoprobe 6620 DT

**DRILLING CONTRACTOR:** CMT Engineering

**DATUM:** Geodetic

**DEPTH SCALE DN:** 1 : 50

**MIS-HYD 003 05-1112-010.GPJ GAL-MISS.GDT 26/7/11 RJ**
**BOREHOLE LOG OF: NDPW1-08**

**LOCATIONS:** N 4804072.2;E 562219.2

**DATE:** December 20, 2008

**DRILL RIG:** Formost DR-24 Air Rotary

**DRILLING CONTRACTOR:** Gerrits Drilling Ltd.

**PROJECT:** 05-1112-010(1900)

**LOCATION:** 05-1112-010.GPJ

**LOGGED:** BH

**CHECKED:** AI

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<table>
<thead>
<tr>
<th>DEPTH SCALE</th>
<th>DESCRIPTION</th>
<th>SYMBOLIC LOG</th>
<th>ELEV.</th>
<th>GEOPHYSICAL RECORD</th>
<th>PIEZOMETER OR STANDPIPE INSTALLATION</th>
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**DEPTH SCALE BH**

**CONTINUED NEXT PAGE**

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**GOLDEN ASSOCIATES**

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**MIS-HYD 003 05-1112-010.GPJ GAL-MISS.GDT 26/7/11 RJ**
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<tr>
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<th>DESCRIPTION</th>
<th>SYMBOLIC LOG</th>
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<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
<th>PIEZOMETER OR STANDPIPE INSTALLATION</th>
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### Borehole Log of: NDPW1-08

**Location:** N 4804072.2; E 562219.2

**Drilling Date:** December 20, 2008

**Drill Rig:** Formost DR-24 Air Rotary

**Drilling Contractor:** Gerrits Drilling Ltd.

**Project:** 05-1112-010(1900)

**Location:** N 4804072.2; E 562219.2

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<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Description</th>
<th>Elevation</th>
<th>Geophysical Record</th>
<th>Piezometer or Standpipe Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Tan/light grey, Dolostone, fine crystalline (Amabel Formation)</td>
<td>193.81</td>
<td>Gamma (cps)</td>
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<td>105</td>
<td>END OF BOREHOLE</td>
<td>106.88</td>
<td>Conductivity (mS/m)</td>
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**Depth Scale:**

- 100 m
- 105 m
- 110 m
- 115 m
- 120 m
- 125 m
- 130 m
- 135 m
- 140 m
- 145 m
- 150 m

**Geophysical Record:**

- Gamma (cps)
- Conductivity (mS/m)

**Piezometer or Standpipe Installation:**

- Open Hole

**Other Details:**

- **Drilling Contract:** Gerrits Drilling Ltd.
- **Drilling Rig:** Formost DR-24 Air Rotary
- **Drilling Date:** December 20, 2008
- **Location:** N 4804072.2; E 562219.2
- **Project:** 05-1112-010(1900)
- **Drilling Contractor:** Gerrits Drilling Ltd.
<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>0.00</td>
<td>Brown to dark brown, medium to coarse SAND, some gravel</td>
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<tr>
<td>5.18</td>
<td>Moist, brown to grey, GRAVEL, some medium to coarse sand</td>
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<tr>
<td>8.23</td>
<td>Moist, brown grey, medium to coarse SAND, some gravel</td>
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<td>11.28</td>
<td>Moist, dark brown, medium to fine SAND, some silt</td>
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<td>14.33</td>
<td>Moist, dark brown/grey, SILTY CLAY, trace fine sand</td>
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<tr>
<td>17.37</td>
<td>Moist, dark brown, silty fine to medium SAND, trace clay</td>
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<tr>
<td>18.90</td>
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<tr>
<td>20.40</td>
<td>Light grey, DOLOSTONE, sub-angular, small amount vugs, no odour (Guelph Formation)</td>
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<tr>
<td>23.45</td>
<td>Dark grey, DOLOSTONE, platy chips, sub-angular, fine crystalline, no odour</td>
</tr>
<tr>
<td>24.99</td>
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<td>28.60</td>
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<tr>
<td>29.55</td>
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<td>45.00</td>
<td>Light brown</td>
</tr>
<tr>
<td>50.00</td>
<td>Light brown / grey</td>
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</table>

**GEOGRAPHICAL RECORD**

- **DEPTH SCALE BH**
- **LOGGED:** BH
- **CHECKED:** AI

**PIEZOMETER OR STANDPIPE INSTALLATION**

- Cement-bentonite Grout
- 10" Diameter Borehole
- Open Borehole

**DRILLING DATE:** October 3-8, 2008
**DRILL RIG:** DR-24 Air Rotary
**DRILLING CONTRACTOR:** Gerrits Drilling Ltd.
Mix of light grey / tan, DOLOSTONE, fine crystalline, petroleum odour (Eramosa Member)

Black, DOLOSTONE, platy chips, sub-angular, fine crystalline, petroleum odour

Black, DOLOSTONE, fine crystalline, petroleum odour (Eramosa Member)

Mix of black and dark grey

Tan / light grey, DOLOSTONE, fine crystalline, no odour (Amabel Formation)

Tan / dark grey

Light / dark grey

Light grey

Light / dark grey

Platy chips, fracture at 77 m depth

Light grey to dark grey

Light / dark grey

Dark / light grey

Light / dark grey

Dark grey
--- CONTINUED FROM PREVIOUS PAGE ---

Tan / light grey, DOLOSTONE, fine crystalline, no odour (Amabel Formation)

Darker grey

Mix of light and dark grey, medium hard, DOLOSTONE, fine crystalline, no odour,
Light grey, tan, crushed, DOLOSTONE, fine crystalline, no odour

Tan, crushed, DOLOSTONE, green/red SHALE, fine crystalline, no odour (Cabot Head Formation)

END OF BOREHOLE

115.03

119.62
With cobbles from 32.0 m to 23.6 m depth
Grey SILTY SAND and GRAVEL, heterogeneous (TILL)
Brown GRAVEL and SAND, trace silt, heterogeneous, fairly clean, dense, angular to subrounded gravel
Grey CLAY with SAND, heterogeneous, stiff (TILL)
Trace gravel from 30.0 m to 30.5 m depth
Predominantly coarse gravel from 11.3 m to 11.7 m depth
Greyish-brown fine SAND, loose, clean, homogeneous
Grey SILTY SAND and GRAVEL, heterogeneous, (TILL)
With clay from 7.0 m to 7.3 m depth
dGrey and GRAVEL, little silt, heterogeneous, subangular to subrounded gravel
Brown, GRAVELLY SILT, trace clay, heterogeneous, wet, moderate weathered (TILL)
Medium brown SILTY CLAY, some sand, some gravel, fairly uniform, weathered
Grey SAND and GRAVEL, little silt, heterogeneous, subrounded gravel
White clay from 7.0 m to 7.3 m depth
Grey SAND and GRAVEL, heterogeneous, fairly clean, dense, angular to subrounded gravel
With cobbles from 32.0 m to 23.6 m depth
Grayish-brown DOLOMITE, fine grained, blocky to platy chips, irregular parting, uniform, medium indurated (Guelph Fm)
<table>
<thead>
<tr>
<th>DEPTH SCALE (m)</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Grayish brown DOLOMITE, fine grained, blocky to platy chips, irregular parting, uniform, medium indurated (Guelph Fm)</td>
</tr>
<tr>
<td></td>
<td>Vuggy rock from 50.3 m to 53.3 m depth</td>
</tr>
</tbody>
</table>

55
Darker, dull brown from 54.6 m to 56.7 m depth

60
Dark brown DOLOMITE, crystalline, thickly bedded, platy to blocky chips, moderately indurated with strong petroliferous odour (Eramosa Member)

66
Trace sulphides at 65.2 m depth

69
Relict peloids/fossils from 67.1 m to 71.6 m depth

75
With micro-vugs from 73.2 m to 80.8 m depth

85
Small fracture at 83.8 m depth

90
Fossiliferous (coral) porous rock from 85.3 m to 111.3 m depth

95
Crinoids, peloids and shell fossils from 88.4 m to 89.9 m depth

Dull light grey from 89.9 m to 99.1 m depth

100
Fracture or vug (30 cm thick) at 98.5 m depth
Dull, light brownish grey blotchy, crystalline, platy to blocky chips (Amabel Fm)

Very vuggy (porous) from 100.6 m to 111.3 m depth

Grey DOLOMITE, crystalline, weakly laminated, moderately indurated, smooth parting, no odour (Amabel Fm)

Grey SHALE (Rochester Fm)

Brown DOLOMITE with green shale stringers, mottled black, contains disseminated fine sulphides
Sparse sulphides from 121.9 m to 123.4 m depth

Grey SHALE, soft (Cabot Head Fm)

END OF BOREHOLE
Grey CLAYEY SILT, trace pebbles and gravel, heterogeneous, 0.5 cm to 1 cm subangular (TILL)

Greyish brown and friable rock from 48.8 m to 51.8 m depth

Beige GRAVELLY SAND, little silt, contains broken dolostone, subangular gravel, heterogeneous

Trace fossils (coral) from 41.2 to 42.7

Buff brown DOLOMITE, fine grained, poorly indurated, contains small vugs, tabular to blocky chips (Guelph Fm)

Grey to brown, medium SAND, trace GRAVEL, loose, fairly uniform

Some silt becoming present by 28.9 m

Brown, fine to medium SAND, trace gravel, silt, moist, loose to compact, subangular to subrounded, fairly uniform

Brown CLAYEY SILT, trace coarse sand, little gravel, firm to stiff, moist, heterogeneous, 0.5 cm to 1 cm subangular (TILL)

Grey, fine to medium SAND, trace silt, wet, homogeneous

Medium brown, coarse SAND and GRAVEL, 0.5 cm to 1 cm subrounded, compact

Grayish brown and friable rock from 48.8 m to 51.8 m depth

White, fine to medium SAND, trace gravel, silt, moist, loose to compact, subangular to subrounded, fairly uniform

Brown to grey CLAYEY SILT, trace coarse sand, little gravel, firm to stiff, moist, heterogeneous, 0.5 cm to 1 cm subangular (TILL)

Grey CLAYEY SILT, trace pebbles and gravel, heterogeneous, 0.5 cm to 1 cm subangular (TILL)

Grey CLAYEY SILT, trace pebbles and gravel, heterogeneous, 0.5 cm to 1 cm subangular (TILL)

Grey to brown, medium SAND, trace GRAVEL, loose, fairly uniform

Grey to brown, medium SAND, trace silt, wet, homogeneous

Greyish brown and friable rock from 48.8 m to 51.8 m depth

Grey CLAYEY SILT, trace coarse sand, little gravel, firm to stiff, moist, heterogeneous, 0.5 cm to 1 cm subangular (TILL)
**Bentonite**

- Dark grey from 73.2 m to 77.7 m depth
- Weakly laminated, platy to flaggy chips, greyish brown from 77.7 m to 85.3 m depth

**Grey DOLOMITE, fine crystalline, well to moderately indurated, blocky and irregular chips**

- 
  - From 89.9 m to 93.0 m depth
  - Vuggy after 94.5 m depth
  - Large vugs from 96.0 m to 100.6 m depth

**Fractured rock from 54.0 m to 54.9 m depth**

- Contains trace fine disseminated sulphides from 54.0 m to 61.0 m depth

**Buff brown DOLOMITE, fine grained, poorly indurated, contains small vugs, tabular to blocky chips**

- Becoming crystalline at 51.8 m depth

**Grey DOLOMITE, fine crystalline, well to moderately indurated, blocky to flaggy chips**

- From 61.0 m to 73.1 m depth

**DOLOMITE, fine crystalline, well indurated, contains relict fossils**

- (Amabel Fm)

**Sand**

- Dull, grey with some fossils (crinoids and coral) from 61.0 m to 73.1 m depth
- Dark grey from 73.2 m to 77.7 m depth
- Weakly laminated, platy to flaggy chips, greyish brown from 77.7 m to 85.3 m depth
- With some brown dolomite from 89.9 m to 93.0 m depth
- Vuggy after 94.5 m depth
- Large vugs from 96.0 m to 100.6 m depth

**Screen CBA**
Dull Brown DOLOMITE, mottled black, moderately indurated, tabular to platy chips, with trace disseminated sulphides

Grey DOLOMITE, fine crystalline, well to moderately indurated, blocky to flaggy chips (Amabel Fm)

Large fracture or vug at 103.3 m depth
Fractures (0.15 cm thick) at 104.4 m depth
Brown colour from 105.2 m to 106.7 m depth

Grey DOLOMITE, fine crystalline, moderately indurated, blocky to flaggy chips, thinly laminated, uniform texture (Amabel Fm)
Trace disseminated sulphides from 112.8 m to 114.3 m depth

Grey SHALE (Rochester Fm)
Dull Brown DOLOMITE, mottled black, moderately indurated, tabular to platy chips, with trace disseminated sulphides

Green SHALE, soft, becoming grey at 128 m depth (Cabot Head Fm)
Dark brown shale, weakly indurated

END OF BOREHOLE
### Description

- **Medium brown silty SAND, trace fine gravel**
- **Medium brown SILT, some clay**
- **SAND and fine angular GRAVEL with minor silt**
- **Light brown SILT, trace sand and trace fine gravel, gravel is angular**
- **Fine to medium SAND, trace silt**
- **Light brown SILT, trace sand and fine gravel**
- **Light brown SILTY fine SAND**
- **Medium brown SILTY fine SAND**
- **Medium brown SILTY fine SAND**
- **Light brown fine crystalline DOLOMITE, small vugs (< 1 cm) with crystalline lining, fossil (Guelph Formation)**

### Geophysical Record

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Gamma (cps)</th>
<th>Conductivity (mS/m)</th>
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### Borehole Log Details

- **Project:** 05-1112-010(1000)
- **Location:** N 4806229.1; E 558217.2
- **Drilling Date:** June 29 to July 14, 2006
- **Drill Rig:** Air Rotary
- **Drilling Contractor:** Gerrits Drilling Ltd.

### Symbolic Log

- **Open Borehole**
- **12" Diameter Casing**
- **12" Steel Cement**
- **12" Diameter Casing**

### MISTY LOG 003 05-1112-030.GPJ  GAL-MISS.GDT  4/23/07

### Datum

- **Geodetic**

### Depth Scale

- **1:250**
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<td>DESCRIPTION</td>
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<tr>
<td>GAMMA (cps)</td>
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<tr>
<td>ELEV. DEPTH (m)</td>
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</table>

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Light grey to blotchy finely crystalline DOLOMITE, botches are medium grey and light grey to white, rare vug (< 3 mm) with crystalline lining and fossil coral (Guelph Formation)

Medium grey blotchy finely crystalline DOLOMITE, increase in proportion of medium grey

No sample recovered
Rock pulverized by drilling action

12" Diameter
## BOREHOLE LOG OF: PBPW1-06

**PIEZOMETER OR STANDPIPE INSTALLATION**

**DRILLING DATE:** June 29 to July 14, 2006

**DRILL RIG:** Air Rotary

**DRILLING CONTRACTOR:** Gerrits Drilling Ltd.

### SYMBOLIC LOG

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<th>DESCRIPTION</th>
<th>ELEV. DEPTH (m)</th>
<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
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<tbody>
<tr>
<td>No sample recovered</td>
<td>138.70</td>
<td>179.49</td>
<td></td>
</tr>
<tr>
<td>Rock pulverized by drilling action</td>
<td>138.70</td>
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12" Diameter

**PROJECT:** 05-1112-010(1000)

**LOCATION:** N 4806229.1; E 558217.2

**LOGGED:**

**CHECKED:**

**DATUM:** Geodetic
**RECORD OF DRILLHOLE: PBPW2-08**

**DRILLING DATE:** April 14-18, 2008

**DRILL RIG:** Air Rotary Foremost D-24

**DRILLING CONTRACTOR:** Gerrits Drilling

**PROJECT:** 05-1112-010(1010)

**LOCATION:** N 4805910.8 ; E 557478.2

**INCLINATION:** -90°  **AZIMUTH:** --

**DEPTH SCALE:**

**GROUND SURFACE**

<table>
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<th>Symbol</th>
<th>Type</th>
<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>306.85</td>
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<table>
<thead>
<tr>
<th>ELEV. DEPTH (m)</th>
<th>SAMPLES</th>
<th>GEOPHYSICAL RECORD</th>
</tr>
</thead>
<tbody>
<tr>
<td>306.85</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

**DESCRIPTION**

- **Dry, brown, fine SAND, trace to some silt**
- **Brown, fine to medium SAND, trace fine gravel**
- **Wet, dark brown, gravelly SAND, medium to coarse sand, fine gravel**
- **Most to wet, dark brown, sandy SILT**
- **Most to wet, dark brown, GRAVEL and fine sandy SILT, gravel fine to medium grained, sub-rounded to sub-angular**
- **Less gravel at 16.8-18.3 m depth**
- **Brown, fine to coarse GRAVEL, sub-rounded to sub-angular, trace silty sand**
- **Brown, medium SAND, trace gravel**
- **Brown, SILT, some fine to coarse gravel and fine sand**
- **Brown, gravelly fine SAND, trace silt**
- **Yellowish brown to light brown DOLOSTONE, medium crystalline, some iron staining, trace calcite (29-30.5 m) (GUELPH FORMATION)**
- **Greyish brown colour at 30.5-33.5 m depth**
- **Whitish brown colour, slightly porous at 33.5-36.6 m depth**
- **Brown to dark brown DOLOSTONE, fine to medium crystalline, slightly to moderately porous**
- **Light grey DOLOSTONE, white mottling, finely crystalline, moderately to highly porous (AMABEL FORMATION)**

**NOTES**

- Cement Grout
- 457 mm Dia Steel Casing (0-6m)
- 300 mm Dia Steel Casing (6-25.26 m)
- 300 mm Dia Stee Casing (25.26-128 m)

**INSTRUMENTATION**

- **DEPTH SCALE**
- **MIS-GEO 001  05-1112-010.GPJ  GAL-MISS.GDT  2/9/09**

**CONTINUED NEXT PAGE**
**DESCRIPTION**

- Greyish brown DOLOSTONE, coarsely crystalline, slightly to moderately porous (AMABEL FORMATION)
- Very highly porous and fossiliferous at 57.9-61 m depth
- Dary grey DOLOSTONE, while mottling, finely crystalline, slightly porous
- Becoming light grey at 68.6 m depth
- Becoming highly porous at 71.6 m depth
- Greyish brown DOLOSTONE, finely to coarsely crystalline

**GEOPHYSICAL RECORD**

<table>
<thead>
<tr>
<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
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<tr>
<td>80</td>
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<tr>
<td>120</td>
<td>90</td>
</tr>
<tr>
<td>160</td>
<td>120</td>
</tr>
</tbody>
</table>

**SAMPLES**

- **NUMBER**
- **BLOWS/0.3m**
- **TYPE**

--- CONTINUED FROM PREVIOUS PAGE ---

--- CONTINUED NEXT PAGE ---
### RECORD OF DRILLHOLE: PBPW2-08

**LOCATION:** N 4805910.8 ; E 557478.2

**DRILLING DATE:** April 14-18, 2008

**DRILL RIG:** Air Rotary Foremost D-24

**DRILLING CONTRACTOR:** Gerrits Drilling

#### SYMBOLIC LOG

<table>
<thead>
<tr>
<th>ELEV. (m)</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Grey DOLOSTONE, some brown motting, coarsely crystalline, moderately porous Large fracture at 100.3 m depth</td>
</tr>
<tr>
<td>105</td>
<td>Air Rotary Open Hole</td>
</tr>
<tr>
<td>110</td>
<td>100 mm Dia Open Hole (29.26 - 128 m)</td>
</tr>
<tr>
<td>115</td>
<td>120 mm Dia Open Hole (29.26 - 128 m)</td>
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<td>125 mm Dia Open Hole (29.26 - 128 m)</td>
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<td>125</td>
<td>END OF BOREHOLE 120.00</td>
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#### SAMPLES

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<th>BLOWS/0.3m</th>
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<td>84</td>
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#### GEOPHYSICAL RECORD

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<th>GAMMA (cps)</th>
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<tr>
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<tr>
<td>120</td>
<td>90</td>
</tr>
<tr>
<td>160</td>
<td>120</td>
</tr>
</tbody>
</table>

**NOTES**

- CONTINUED FROM PREVIOUS PAGE —

**INCLINATION:** -90°  **AZIMUTH:** --

**DEPTH SCALE**

1 : 250
With medium to coarse sand and gravel from 29.0 m to 26.3 m depth

TOPSOIL
Brown CLAYEY fine SAND with some gravel, heterogeneous, low moisture (TILL)

Few cobbles at 3.1 m depth

Sandy clay (TILL) from 3.1 m to 9.1 m depth

Medium brown SILTY fine SAND and trace clay and coarse sand, fairly uniform

Increasing clay content from 12.2 m depth

Medium brown CLAY, stiff, homogeneous

Medium brown fine SAND, homogeneous, fairly clean

With gravel from 25.9 m to 26.5 m depth

With medium to coarse sand and gravel from 29.0 m to 26.3 m depth

SAND and GRAVEL with intermittent fine sand, heterogeneous, medium brown, angular to subrounded gravel

With cobbles from 31.4 m to 32 m depth

Medium brown DOLOMITE, moderately weathered, fine grained, irregular parting, blocky to tabular chips (Guelph Formation)

Small fracture at (~7 mm) at 41.5 m depth

Dull, buff, medium brown DOLOMITE, fine grained, few crystallized vugs, blocky chips, uneven parting (Guelph Formation)

Dull grey/greyish-brown DOLOMITE, dense, crystalline, fossiliferous (coral) with dense interbedded cherty dolomite, blocky chips (Guelph Formation)
Light grey DOLOMITE, crystalline, well indurated with micro vugs, platy to blocky chips, weakly laminated (Amabel Formation)

227.48 90.83

Coral from 86.9 m to 88.4 m depth

52.11 89.24

Dull grey/greyish-brown DOLOMITE, dense, crystalline, fossiliferous (coral) with dense interbedded cherty dolomite, blocky chips (Guelph Formation)

fossiliferous (coral) from 53.3 m to 56.4 m depth

50.33 89.00

Predominantly grey DOLOMITE with brown/blotchy grey-brown beds, well indurated, massive, irregular parting, blocky to irregular chips, crystalline with occasional fossiliferous beds

--- CONTINUED FROM PREVIOUS PAGE ---

GAMMA (cps) CONDUCTIVITY (mS/m)

GEOPHYSICAL RECORD

DEPTH SCALE

METRES

DATUM: Geodetic
--- CONTINUED FROM PREVIOUS PAGE ---

**DESCRIPTION**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Light grey DOLOMITE, crystalline, well indurated with micro vugs, platy to blocky chips, weakly laminated (Amabel Formation)</td>
</tr>
<tr>
<td>105</td>
<td>Light brown DOLOMITE, fine grained, tabular to irregular chips, moderately indurated, vugs, bioclastic beds, porous rock</td>
</tr>
<tr>
<td>110</td>
<td>Fossiliferous from 109.7 m to 112.8 m depth</td>
</tr>
<tr>
<td>115</td>
<td>Large vugs from 112.8 m to 117.3 m depth</td>
</tr>
<tr>
<td>120</td>
<td>Grey DOLOMITE, platy chips, crystalline, well indurated, weakly laminated, smooth parting, sparse micro-vugs</td>
</tr>
<tr>
<td>125</td>
<td>Trace white mineral (calcium) from 125 m to 128.0 m depth</td>
</tr>
<tr>
<td>130</td>
<td>Grey SHALE (Rochester Formation)</td>
</tr>
<tr>
<td>135</td>
<td>Dark grey DOLOMITE, shale partings, crystalline, weakly laminated, platy chips, moderately laminated, trace sulphides</td>
</tr>
<tr>
<td>140</td>
<td>Becoming dull brown, mottled at 138.4 m depth</td>
</tr>
</tbody>
</table>

**END OF BOREHOLE**
**RECORD OF DRILLHOLE: PBTW3-07**

**PROJECT:** 05-1112-010(1010)  
**DRILLING DATE:** December 18-20, 2007  
**LOCATION:** N 4805907.7; E 557466.3  
**INCLINATION:** -90°  
**AZIMUTH:** --  
**DRILL RIG:** Air Rotary  
**DRILLING CONTRACTOR:** Gerrits Drilling  
**DATUM:** Geodetic

### SYMBOLIC LOG

<table>
<thead>
<tr>
<th>ELEV.</th>
<th>DEPTH (m)</th>
<th>SAMPLES</th>
<th>GEOPHYSICAL RECORD</th>
</tr>
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<tr>
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<td>GAMMA (cps)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2000</td>
</tr>
</tbody>
</table>

**DESCRIPTION**
- **GROUND SURFACE**
  - Brown, fine SAND, homogeneous
  - **Coarse SAND**
  - Firm, brown, CLAYEY SILT with coarse gravel, some angular cobbles (TILL)
  - **Coarse SAND and GRAVEL with some clay (TILL)**
    - Sub-rounded to angular gravel
- **Loose, brown, SILT, trace sand, trace gravel (TILL)**
- **Coarse SAND and GRAVEL**
- **Brown, fine SAND, trace silt, heterogeneous**
- **Medium to coarse SAND, some rock fragments (Limestone)**
- **TOP OF BEDROCK**
  - Light brown to yellow brown, DOLOSTONE, sugary texture, with some minor iron staining, sub-angular to platy rock chips (Guelph Formation)
  - Becomes grey-brown
  - With some calcite mineralization
  - Becomes light brown to cream colour with minor laminations along bedding planes and trace calcite
- **Brown to dark brown, DOLOSTONE, faint petroliferous odour, some black staining**
  - With fossils and calcite crystals
- **Dark grey to grey, DOLOSTONE, mottled, some calcite fossils**

**NOTES**

- Cement
- Bentonite
- Grout
- **10" Dia. Steel Casing (0-6m)**
- **6" Dia. Steel Casing (0-29.2m)**

**DEPTH SCALE**

- 0.00
- 10.00
- 20.00
- 30.00
- 40.00
- 50.00

**CONTINUED NEXT PAGE**
Air Rotary

16
17
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46
47
48

- Dark grey to grey, DOLOSTONE, mottled, some calcite fossils
  - Becoming grey/white, vuggy porosity, fossils and calcite mineralization
  - Becoming white dolostone, light grey mottling, vuggy porosity, medium crystalline fossiliferous
  - Fracture at 60.05m, 60.48-60.79m
- More frequent lamination
- Large fracture, sulphur odour at 76.64-79.55m
- Large fracture at 79.86-81.08m
- Becoming dark grey, mottled appearance
- Fracture, sulphur odour in discharge water at 81.69m
- Vugs present with calcite mineralization at 82.6m
- Becoming light brown at 85.04m
- Light grey to white to light brown mottled, with occasional vugs at 85.34m
- Fracture at 90.83m
- Grading to darker grey at 92.05m
- Fractures at 94.18-94.49m, 95.4m, 96.32m and 97.32m

--- CONTINUED FROM PREVIOUS PAGE ---

--- CONTINUED NEXT PAGE ---
**RECORD OF DRILLHOLE: PBTW3-07**

**PROJECT:** 05-1112-010(1010)

**LOCATION:** N 4805907.7; E 557466.3

**INCLINATION:** -90°  **AZIMUTH:** --

**DRILLING DATE:** December 18-20, 2007  **DATUM:** Geodetic

**DRILL RIG:** Air Rotary  **DRILLING CONTRACTOR:** Gerrits Drilling

--- CONTINUED FROM PREVIOUS PAGE ---

<table>
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<tr>
<th>DESCRIPTION</th>
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<th>ELEV. DEPTH (m)</th>
<th>TYPE</th>
<th>BLOWS/0.3m</th>
<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
</tr>
</thead>
</table>
| - Large fracture at 99.67-100.28m  
- Dark grey to grey, DOLOSTONE, mottled, some calcite fossils  
- Fracture, dark grey with minor iron staining, large vugs at 100.89m  
- Fracture at 101.5m and 102.1m | | 100 | WS | | |
| - Grading to light brown at 107.3m | | 105 | WS | | |
| - Becoming light grey to light brown at 111.25m | | 110 | WS | | |
| - Light grey motled dolostone, vuggy, fossiliferous with calcite mineralization | | 115 | WS | | |
| - Mottled light grey to dark grey dolostone with occasional vugs | | 120 | WS | | |
| - Grading to dark grey at 128m | | 125 | WS | | |
| Hard, grey to dark brown, SHALE, platy chips  
(Sulphide) at 131.7m  
(Soil, green, SHALE)  
(Cabot Head Formation) | | 130 | WS | | |
| END OF BOREHOLE | | 135 | WS | | |

--- INCLINATION: -90°            AZIMUTH: ---

**NOTES**

**WATER LEVELS**

**INSTRUMENTATION**

**SYMBOLIC LOG**

**ELEV.**

**DEPTH**

**(m)**

**RECORD OF DRILLHOLE: PBTW3-07**

**PROJECT:** 05-1112-010(1010)

**LOCATION:** N 4805907.7; E 557466.3

**INCLINATION:** -90°  **AZIMUTH:** --

**DRILLING DATE:** December 18-20, 2007  **DATUM:** Geodetic

**DRILL RIG:** Air Rotary  **DRILLING CONTRACTOR:** Gerrits Drilling

--- CONTINUED FROM PREVIOUS PAGE ---

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>SYMBOLIC LOG</th>
<th>ELEV. DEPTH (m)</th>
<th>TYPE</th>
<th>BLOWS/0.3m</th>
<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
</tr>
</thead>
</table>
| - Large fracture at 99.67-100.28m  
- Dark grey to grey, DOLOSTONE, mottled, some calcite fossils  
- Fracture, dark grey with minor iron staining, large vugs at 100.89m  
- Fracture at 101.5m and 102.1m | | 100 | WS | | |
| - Grading to light brown at 107.3m | | 105 | WS | | |
| - Becoming light grey to light brown at 111.25m | | 110 | WS | | |
| - Light grey motled dolostone, vuggy, fossiliferous with calcite mineralization | | 115 | WS | | |
| - Mottled light grey to dark grey dolostone with occasional vugs | | 120 | WS | | |
| - Grading to dark grey at 128m | | 125 | WS | | |
| Hard, grey to dark brown, SHALE, platy chips  
(Sulphide) at 131.7m  
(Soil, green, SHALE)  
(Cabot Head Formation) | | 130 | WS | | |
<p>| END OF BOREHOLE | | 135 | WS | | |</p>
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>SYMBOLIC LOG</th>
<th>ELEV.</th>
<th>GEOPHYSICAL RECORD</th>
<th>PIEZOMETER OR STANDPIPE INSTALLATION</th>
</tr>
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<tbody>
<tr>
<td>GROUND SURFACE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GRAVELLY silt, (FILL)</td>
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<td></td>
</tr>
<tr>
<td>Coarse gravelly SAND</td>
<td></td>
<td>0.76</td>
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</tr>
<tr>
<td>Fine SAND, some gravel</td>
<td></td>
<td>1.83</td>
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</tr>
<tr>
<td>Coarse SAND and GRAVEL</td>
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<td>2.74</td>
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<tr>
<td>Medium-grained SAND and GRAVEL, some silt</td>
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<td>3.35</td>
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<tr>
<td>Fine SAND and GRAVEL, little silt</td>
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<td>4.72</td>
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<tr>
<td>Fine SANDY SILT, some silt</td>
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<tr>
<td>Fine grained SAND, some silt</td>
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<td>CLAY</td>
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<td>SAND, some fine gravel, trace silt</td>
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<td>8.22</td>
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<td>GRAVEL and coarse-grained SAND</td>
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<tr>
<td>Fine grained SAND</td>
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<tr>
<td>Coarse SAND and GRAVEL</td>
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<td>10.36</td>
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<tr>
<td>Coarse SAND</td>
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<td>13.42</td>
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# BOREHOLE LOG OF: PLOW2-06

**PROJECT:** 05-1112-010(1000)  
**LOCATION:** N 480671.4 ; E 559066.4  
**DRILLING DATE:** August 18 and 22, 2006  
**DRILL RIG:** Direct Push with Continuous Scope  
**DRILLING CONTRACTOR:** Strata Soil Sampling Inc.

## Depth Scale

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Symbolic Log</th>
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<tbody>
<tr>
<td>0.00</td>
<td>GROUND SURFACE</td>
</tr>
<tr>
<td>1.20</td>
<td>SANDY SILT, trace gravel</td>
</tr>
<tr>
<td>3.43</td>
<td>GRAVEL and fine SAND, little silt</td>
</tr>
<tr>
<td>3.65</td>
<td>GRAVEL and medium to coarse-grained SAND</td>
</tr>
<tr>
<td>3.65</td>
<td>Fine to medium grained SAND, some fine gravel</td>
</tr>
<tr>
<td>6.85</td>
<td>Fine grained SAND and SILT</td>
</tr>
<tr>
<td>8.84</td>
<td>Fine to medium grained SAND, little gravel</td>
</tr>
<tr>
<td>10.20</td>
<td>SILTY CLAY</td>
</tr>
<tr>
<td>12.20</td>
<td>CLAY</td>
</tr>
<tr>
<td>12.21</td>
<td>Fine CLAYEY SAND</td>
</tr>
<tr>
<td>293.76</td>
<td>Medium grained SAND and GRAVEL</td>
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<tr>
<td>304.76</td>
<td>END OF BOREHOLE</td>
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</table>

## Geophysical Record

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<tr>
<th>ELEV. GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
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<td>10</td>
<td>20</td>
</tr>
<tr>
<td>30</td>
<td>40</td>
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## Piezometer or Standpipe Installation

- **C**  
- **B**  
- **A**

**Datum:** Geodetic

**Logged:** JUH  
**Checked:** AI
DRILLING RECORD

**Hole Plug** (115.8-118.5m)

**Caved in Rock** (128.3-134.7m)

**Open Hole**

**DOLOSTONE**

**SHALE**

**END OF BOREHOLE**

Note:

--- CONTINUED FROM PREVIOUS PAGE ---

DRILLING CONTRACTOR: Gerrits Drilling (For piezometer installation)

--- SHEET 3 OF 3 ---
## RECORD OF DRILLHOLE: SMOW1ABC-08

**DEPTH SCALE**

<table>
<thead>
<tr>
<th>METRES</th>
<th>DESCRIPTION</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>GROUND SURFACE</td>
</tr>
<tr>
<td>2</td>
<td>Compact, wet to saturated, brown, sandy SILT to silty SAND, some gravel, trace clay and boulders (TILL)</td>
</tr>
<tr>
<td>4</td>
<td>Compact, heterogeneous, wet, brown, silty SAND, some gravel, trace clay and boulders (TILL)</td>
</tr>
<tr>
<td>6</td>
<td>Compact, wet to saturated, brown, sandy SILT to silty SAND, some gravel, trace clay and boulders (TILL)</td>
</tr>
<tr>
<td>8</td>
<td>Loose, saturated, brown, fine to medium SAND, some gravel, trace cobbles</td>
</tr>
<tr>
<td>10</td>
<td>Medium to coarse sand and gravel with some iron staining at 10.91m, Very stiff, brown, CLAYEY SILT (TILL)</td>
</tr>
<tr>
<td>12</td>
<td>Saturated, brown/grey, GRAVEL, some cobbles</td>
</tr>
<tr>
<td>14</td>
<td>Saturated, grey, fine SAND and SILT, some gravel, trace clay</td>
</tr>
<tr>
<td>16</td>
<td>Dense, saturated, grey, silty SAND, some gravel and cobbles, trace boulders and clay</td>
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<td>18</td>
<td>Brown, DOLOSTONE, fractured</td>
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</table>

**GEOPHYSICAL RECORD**

<table>
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<tr>
<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
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**NOTES**

- WATER LEVELS
- INSTRUMENTATION
- GEOPHYSICAL RECORD

**PROJECT:** 05-1112-010(1010)  
**LOCATION:** N 4803478.9; E 558969.6

---

**DRILLING DATE:** February 12-14, 2008  
**DRILL RIG:** CME-75 Auger Rig  
**DRILLING CONTRACTOR:** All-Terrain  
**DATUM:** Geodetic  
**INCLINATION:** -90°  
**AZIMUTH:** --

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**SYMBOLIC LOG**

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### RECORD OF DRILLHOLE: SMOW1ABC-08

**LOCATION:** N 4803478.9 ; E 558969.6  
**INCLINATION:** -90°  
**AZIMUTH:** ---  
**DRILLING DATE:** February 12-14, 2008  
**DRILL RIG:** CME-75 Auger Rig  
**DRILLING CONTRACTOR:** All-Terrain  
**PROJECT:** 05-1112-010(1010)  
**LOCATION:** N 4803478.9 ; E 558969.6  
**DATUM:** Geodetic

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<tr>
<th>SYMBOLIC LOG</th>
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<th>SPARKS</th>
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**INSTRUMENTATION:**
- **CONDUCTIVITY:** 40, 80, 120, 160 mS/m
- **GAMMA:** 30, 60, 90, 120 cps

**PROJECT:** 05-1112-010(1010)

**LOGGED:** KS  
**CHECKED:** AI
**BOREHOLE LOG OF: SMTW1-05**

**LOCATION:** N 45°58'72.6 W 55°52'58.3

**DRILLING DATE:** August 9 to 12, 2005

**DRILL RIG:** Mud Rotary

**DRILLING CONTRACTOR:** Davidson Well Drilling

**DATUM:** Geodetic

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<th>DEPTH (m)</th>
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<th>ELEV</th>
<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
<th>PIEZOMETER OR STANDPIPE INSTALLATION</th>
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<tr>
<td>0</td>
<td>GROUND SURFACE</td>
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<td>292.77</td>
<td>0.00</td>
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<tr>
<td>2</td>
<td>COBLES and large GRAVEL, light brown, poorly graded (heterogeneous), slickensided, compact</td>
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<td></td>
</tr>
<tr>
<td>5</td>
<td>SAND and GRAVEL, some cobles, loose, brown to grey, heterogeneous</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>SAND and GRAVEL, some clayey (2-3 cm thick), brown with grey clay, heterogeneous, loose</td>
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<tr>
<td>20</td>
<td>Grey COLOMITE, trace weathering, moderately indurated, no colour, angular to subangular rock fragments (Guelph Fm)</td>
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<tr>
<td>25</td>
<td>COLOMITE, thin-brown, platy, crystalline, subangular to angular (Guelph Fm)</td>
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<td></td>
<td>21.00</td>
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<tr>
<td>30</td>
<td>COLOMITE, thin-brown, crystalline, grey (6 cm thick), angular to subangular fragments, few porosity, no colour, non weathered (Guelph Fm)</td>
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<tr>
<td>35</td>
<td>Becoming lighter in colour and more brittle</td>
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<tr>
<td>40</td>
<td>Light grey, with small (&lt;1 mm) mica, fine grained, porous</td>
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<tr>
<td>45</td>
<td>Less greyish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>Light brown, with mica, friable, no colour</td>
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</tbody>
</table>

**DEEP SCALE**

1:250

**LOGGED:** AI

**CHECKED:**

---

**Golder Associates**
BOREHOLE LOG OF: SMTW1-05

-- CONTINUED FROM PREVIOUS PAGE --

100

- COLOCITE. Bluish-grey with light haloes. Biotite, crystalline, small <1 mm veins. Some luster, non-weathered, angular to subangular tabular chips, laminated (Amabel Fm).
- Becoming darker bluish-grey color and less waxy.
- Trace of secondary calcium fillings.

105

- COLOCITE. Bluish-grey, crystalline, non-weathered, tabular chips, angular to subangular chip fragments, friable hard rock (Amabel Fm).

110

- Becomes dark grey color, massive texture, no apparent fossils.

115

- Grey SHALE, Fractured Formation.
- COLOCITE, Brown-grey, crystalline with some soft green layers, laminated, flaky shale chips, angular to subangular, trace secondary sulphide mineralization.

120

- Veins fracture SHALE, tan, green, thinly laminated.
- Grey-greenish SHALE, variably inclined.
- Cabot Head Fm.

END OF BOREHOLE

DEPTH SCALE

1:250

Golder Associates
LOGGED: AI
CHECKED:
Loose, to medium dense, dry, light brown, fine SAND, trace fine gravel, well sorted

Compact, wet, grey/brown silty SAND and GRAVEL (TILL)
- Sub-angular to sub-rounded gravel, heterogeneous
  With cobbles from 3.4 m to 5.8 m depth

Wet, grey SAND and GRAVEL
- Sub-angular to sub-rounded gravel, heterogeneous

Brown DOLOSTONE, fine crystalline, well indurated, blocky to platy rock chips, no odour, effervesces weakly in hydrochloric acid (Guelph Formation)

Becoming lighter, buff brown colour

Becoming fossiliferous at 36.6 m depth
With greyish blotches at 38.1 m depth

Grey DOLOSTONE, finely crystalline, moderately indurated, blocky rock chips with irregular partings, no odour, fossiliferous, with some pine hole size vugs, effervesces weakly in hydrochloric acid

Bentonite Grout (0-13.4m)
6" Steel Casing (0-16.8m)

Hole Plug (13.4-15m)

Sand (15-30.5m)
Screen (21.3-24.4m)

Hole Plug (30.5-43.9m)

Sand (43.9-64m)
Screen (46.7-62.5m)
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ELEV. DEPTH (m)</th>
<th>BLOWN/0.3m</th>
<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey DOLOSTONE, finely crystalline, with irregular partings, no odour, fossiliferous, with some pine hole size vugs, effervesces weakly in hydrochloric acid</td>
<td>59.44</td>
<td>31</td>
<td>80</td>
<td>120</td>
</tr>
<tr>
<td>Blotchy, grey DOLOSTONE, fine crystalline, blocky to platy chips</td>
<td>60</td>
<td>37</td>
<td>80</td>
<td>120</td>
</tr>
<tr>
<td>Buff, light brown DOLOSTONE, platy rock chips, weakly laminated, sparse pinhole size vugs, trace fossils (Crinoid Stem) (Amabel Formation) Becomes light greyish-brown at 74.4 m depth</td>
<td>71.63</td>
<td>45</td>
<td>80</td>
<td>120</td>
</tr>
<tr>
<td>Becomes light grey at 80.8 m depth</td>
<td>80</td>
<td>60</td>
<td>80</td>
<td>120</td>
</tr>
<tr>
<td>Grey DOLOSTONE, with trace translucent white flakes, with some small vugs, finely crystalline, blocky to platy rock chips, effervesces weakly in hydrochloric acid (Amabel Formation) With some brown after 88.4 m depth</td>
<td>85.34</td>
<td>64</td>
<td>80</td>
<td>120</td>
</tr>
<tr>
<td>Becomes grey at 94.5 m depth, no noticeable translucent white flakes</td>
<td>95</td>
<td>70</td>
<td>80</td>
<td>120</td>
</tr>
<tr>
<td>Crystallined vugs from 97.5 m to 99.1 m depth</td>
<td>100</td>
<td>73</td>
<td>80</td>
<td>120</td>
</tr>
</tbody>
</table>
--- CONTINUED FROM PREVIOUS PAGE ---

Grey DOLOSTONE, with trace translucent white flakes, with some small vugs, finely crystalline, blocky to platy rock chips, effervesces weakly in hydrochloric acid (Amabel Formation)

Becoming darker grey at 109.4 m depth

Dark grey DOLOSTONE with intermittent thin laminations of grey shale, crystalline (Rochester Formation)

Dull greyish-brown DOLOSTONE with trace sulphides

Black specks on dolostone, with some fine sulphides, layers of bright green shale, soft from 123.4 m to 124.1 m depth

END OF BOREHOLE

Screen (94.5-109.7m)

Hole Plug (112.6-124.2m)
**Sample Details**

**Location:** N 48°28'66.6"E 55°58'41.7"  
**Drilling Date:** August 20-23, 2007  
**Drill Rig:** Air Rotary  
**Drilling Contractor:** Gerrits Drilling Ltd.

### Depth Range |
**Elevation:** 50 - 100 m  
**SYMBOLIC LOG**

#### Depth Scale

<table>
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<tr>
<th>Depth Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 - 55 m</td>
<td>Light whitish brown DOLOSTONE, finely crystalline, moderately porous, trace crystallined vugs (up to 2 mm diameter), some calcite crystals (Guelph Formation)</td>
</tr>
<tr>
<td>55 - 60 m</td>
<td>Fracture at 58.52 m depth</td>
</tr>
<tr>
<td>60 - 65 m</td>
<td>Dark blackish brown DOLOSTONE, finely crystalline, slightly porous, trace calcite crystals (Eramosa Formation)</td>
</tr>
<tr>
<td>65 - 70 m</td>
<td>Fracture at 64.92 m depth</td>
</tr>
<tr>
<td>70 - 75 m</td>
<td>Brown-grey DOLOSTONE, finely to medium crystalline, slightly porous (Amabel Formation)</td>
</tr>
<tr>
<td>75 - 80 m</td>
<td>Whish grey DOLOSTONE, medium crystalline, slightly porous (Amabel Formation)</td>
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<tr>
<td>80 - 85 m</td>
<td>Fracture at 72.54 m depth</td>
</tr>
<tr>
<td>85 - 90 m</td>
<td>Becoming darker grey</td>
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<tr>
<td>90 - 95 m</td>
<td>Fracture at 77.42 m depth</td>
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<tr>
<td>95 - 100 m</td>
<td>Whish grey colour at 79.25-81.38 m depth</td>
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<tr>
<td></td>
<td>Becoming darker grey</td>
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<td></td>
<td>Fracture at 82.91 m depth</td>
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### Geophysical Record

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<td>30 80 120 160</td>
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<tr>
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<td>30 60 90 120</td>
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</tbody>
</table>

### Notes

- **Screen:** (48.8-57.9m) |
- **Hole Plug:** (59.3-73.3m) |
- **Sand:** (73.3-91.4m) |
- **Screen:** (76.2-86.4m) |
- **Hole Plug:** (91.4-94.5m) |
- **Hole Plug & Gravel:** (94.5-117.5m)
**PROJECT:** 05-1112-010(1000)  
**LOCATION:** N 4802866.6 ; E 558417.6  
**INCLINATION:** -90°  
**AZIMUTH:** --  

**DRILLING DATE:** August 20-23, 2007  
**DATUM:** Geodetic  
**DRILL RIG:** Air Rotary  
**DRILLING CONTRACTOR:** Gerrits Drilling Ltd.  

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### SYMBOLIC LOG

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### SAMPLES

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### GEOPHYSICAL RECORD

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<th>CONDUCTIVITY (mS/m)</th>
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<td>120</td>
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Grey DOLOSTONE, medium crystalline, moderately porous (Amabel Formation)

 Becoming darker grey

Fossiliferous at 103.63-105.16 m depth

Interbedded DOLOSTONE and SHALE (Amabel Formation)

Grey SHALE (Rochester Formation)

Interbedded DOLOSTONE and SHALE (Amabel Formation)

Brown SHALE, very finely crystalline, sulfide minerals

Green SHALE (Cabot Head Formation)

END OF BOREHOLE
### Record of Drillhole: SMTW4ABC-08

#### Drilling Date: February 14-18, 2008

**Drill Rig:** Air Rotary  
**Drilling Contractor:** Gerrits Drilling

### Instrumentation

- **Inclination:** -90°  
- **Azimuth:** --

### Geophysical Record

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<thead>
<tr>
<th>Depth (m)</th>
<th>Gamma (cps)</th>
<th>Conductivity (mS/m)</th>
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</thead>
<tbody>
<tr>
<td>40 80 120 160</td>
<td>30 60 90 120</td>
<td></td>
</tr>
</tbody>
</table>

### Geotechnical Description

- **Ground Surface:** Moist, dark brown, SILTY CLAY, some organics (rootlets), trace coarse sand. Becoming moist at 4.57 m.
- **0.00 to 3.10 m:** Dry, brown to light brown, fine to coarse gravel.
- **3.10 to 4.40 m:** Trace clay at 4.57-7.62 m.
- **4.40 to 19.81 m:** Trace fine gravel at 19.81-20.34 m.
- **19.81 to 28.96 m:** Moderately porous at 27.43-28.96 m.
- **28.96 to 30.48 m:** Fracture at 28.96 m; Brown layer at 28.96-30.48 m.
- **30.48 to 35.10 m:** Medium crystalline and moderately porous at 39.62-41.15 m.
- **35.10 to 48.77 m:** Moderately porous at 48.77-50.29 m.

### Details

- **ELEV.:**
- **NUMBER:**
- **SYMBOLIC LOG:**
- **DEPTH:**
- **DESCRIPTION:**
- **SAMPLES:**
- **DRILLING DATE:** February 14-18, 2008
- **DRILL RIG:** Air Rotary
- **DRILLING CONTRACTOR:** Gerrits Drilling
- **SAMPLES:**
- **NUMBER:**
- **BLOWS/0.3m:**
- **TYPE:**
- **GEOPHYSICAL RECORD:**
  - **CONDUCTIVITY (mS/m):**
  - **GAMMA (cps):**

### Notes

- **Ground Surface:** Moist, dark brown, SILTY CLAY, some organics (rootlets), trace coarse sand. Becoming moist at 4.57 m.

### Additional Details

- **Drill Rig:** Air Rotary
- **Drilling Contractor:** Gerrits Drilling
- **Sample Numbers:**
- **Blasting Points:**
- **Well Plug Areas:**
- **Hole Plug (0-22.9m):** Bentonite Grout
- **Hole Plug (22.9-24.4m):**
- **Sand (24.4-35.1m):**
- **Screen (30.5-33.5m):**
- **Hole Plug (35.1-48.8m):**
- **Sand (48.8-64m):**

### Additional Information

- **Project:** 05-1112-010(1010)
- **Location:** N 4803334.3; E 559025.9
- **Depth Scale:**
- **Datum:** Geodetic
- **Logged by:** JH
- **Checked by:** ADI
- **Instrumentation:**
- **Geophysical Record:**
  - **Conductivity (mS/m):**
  - **Gamma (cps):**

### Contained Next Page
### RECORD OF DRILLHOLE: SMTW4ABC-08

**PROJECT:** 05-1112-010(1010)  
**LOCATION:** N 480334.3 E 559025.9  
**INCLINATION:** -90°  
**AZIMUTH:** --  
**DRILLING DATE:** February 14-18, 2008  
**DATUM:** Geodetic  
**DRILL RIG:** Air Rotary  
**DRILLING CONTRACTOR:** Gerrits Drilling  

#### SYMBOLIC LOG

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<th>SYMBOLIC LOG</th>
<th>ELEV. (m)</th>
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<tbody>
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<td>-- CONTINUED FROM PREVIOUS PAGE --</td>
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<tr>
<td>BLOWN/0.3m</td>
<td>SAMPLES</td>
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<td>CONDUCTIVITY (mS/m)</td>
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<tr>
<td>40</td>
<td>80</td>
<td>120</td>
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</table>
| 50 | Brown, DOLOSTONE, finely crystalline, slightly porous (Guelph Formation)  
Becoming medium crystalline at 51.82 m, some iron staining  
Greyish brown at 57.91-59.44 m and 60.96 m, some lamination  
Dark brown, DOLOSTONE, medium crystalline, calcite crystals at 64.01-65.53 m  
Dark brown to black, DOLOSTONE, finely crystalline, calcite crystals, petrolierous odour (Eramosa Formation)  
Fossils at 79.25-80.27 m and 85.34-86.87 m  
Brownish grey colour at 82.30-91.44 m  
Fracture at 84.43 m  
Large amount of water encountered from 90.63-92.96 m  
Light brown colour from 94.49-96.01 m  
Fracture at 95.4 m  
Light grey to light brown, DOLOSTONE, white/grey motting, finely crystalline, slightly porous (Amabel Formation)  
Fossils from 97.54-99.06 m |
| 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
| -- CONTINUED NEXT PAGE -- | Sand (48.9-64m)  
Screen (59.3-62.5m)  
Hole Plug (64.67-10m)  
Hole Plug & Gravel (67.1-88.4m)  
Hole Plug (68.4-91.4m)  
Screen (94.5-109.7m) |
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<th>SYMBOL</th>
<th>CCD LOG</th>
<th>ELEV.</th>
<th>DEPTH (m)</th>
<th>BLOWS/0.3m</th>
<th>TYPE</th>
<th>GAMMA (cps)</th>
<th>CONDUCTIVITY (mS/m)</th>
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<td>Grey, DOLOSTONE, white mottling, more coarsely crystalline, moderately porous. (Amabel Formation) Fracture at 104.24 m</td>
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<td>105</td>
<td>Light grey layer from 106.68-109.73 m, calcite crystals</td>
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<td>110</td>
<td>Calcite from 112.78-114.30 m and 117.35-118.87 m</td>
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<td>115</td>
<td>Interbedded grey DOLOSTONE and grey to brown SHALE, some white mottling, platy chips. Calcite at 121.31 m</td>
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<td>120</td>
<td>Black specks from 123.44-124.97 m and 126.49-127.71 m</td>
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<td>125</td>
<td>Green, SHALE, black specks, sulphide minerals</td>
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**Description:**
- **Grey, DOLOSTONE, white mottling:** More coarsely crystalline, moderately porous (Amabel Formation).
- **Light grey layer:** From 106.68-109.73 m, containing calcite crystals.
- **Calcite:** From 112.78-114.30 m and 117.35-118.87 m.
- **Interbedded grey DOLOSTONE and grey to brown SHALE:** With some white mottling and platy chips. Calcite at 121.31 m.
- **Black specks:** From 123.44-124.97 m and 126.49-127.71 m.
- **Green, SHALE:** Contains black specks and sulphide minerals.

**Geophysical Record:**
- **Conductivity (mS/m):**
- **Gamma (cps):**

**Notes:**
- **Screen:** (94.5-109.7 m)
- **Sand:** (91.4-12.8 m)
- **Hole Plug:** (112.8-115.8 m)
- **Hole Plug & Gravel:** (115.8-128 m)
GEOPHYSICAL RECORD OF BOREHOLE  CMOW1-06

PROJECT  IUS Project, Cambridge East  UTM EASTING  558725.647
PROJECT NO.  05-1112-010  UTM NORTING  4805314.228
CLIENT  Regional Municipality of Waterloo  LOG REFERENCE  Ground Surface
LOCATION  Cambridge - Portuguese Club  GROUND SURFACE  305.901 masl
LOG DATE  June 29, 2006 / July 7, 2006  BOREHOLE DEPTH  126.8 m
LOGGED BY  RF  CASING DEPTH  35.0 m
DRILL METHOD  Air Rotary  BOREHOLE DIAMETER  152.4 mm

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<th>Depth (m)</th>
<th>Optical Image</th>
<th>Natural Gamma (cps)</th>
<th>Apparent Conductivity (mS/m)</th>
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# Geophysical Record of Borehole CMOW3-06

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<td>UTM NORTHING</td>
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<td>Ground Surface</td>
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<td>LOCATION</td>
<td>Cambridge - South Saginaw</td>
<td>GROUND SURFACE</td>
<td>302.44 masl</td>
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<td>LOG DATE</td>
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<td>BOREHOLE DEPTH</td>
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<td>DRILL METHOD</td>
<td>Air Rotary</td>
<td>BOREHOLE DIAMETER</td>
<td>152.4 mm</td>
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## Borehole Log

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<tr>
<th>Depth (m)</th>
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<th>Natural Gamma (cps)</th>
<th>Apparent Conductivity (mS/m)</th>
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Image of borehole log with depth markers in intervals of 4.0 meters, showing optical image, natural gamma, and apparent conductivity readings.
### GEOPHYSICAL RECORD OF BOREHOLE CMTW1-05

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<td>DRILL METHOD</td>
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**Geophysical Record of Borehole CMTW3-05**

### Project Information
- **Project No.**: 05-1112-010
- **Location**: Cambridge - Burnett Ave.
- **Client**: Regional Municipality of Waterloo
- **Log Date**: February 14, 2006 / July 3, 2006
- **Logged By**: ADI/GRB
- **Drill Method**: Mud Rotary

### Log Data
- **Casing Depth**: 64.0 m
- **Borehole Depth**: 140.5 m
- **Casing Diameter**: 152.4 mm
- **Ground Surface Depth**: 313.59 masl

### Geophysical Data
- **UTM Easting**: 557559.897
- **UTM Northing**: 4805180.595
- **Log Reference**: Ground Surface

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### Graphical Data

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<th>Apparent Conductivity</th>
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**GEOPHYSICAL RECORD OF BOREHOLE  NDTW2-08**

**PROJECT**  IUS Project, Cambridge East  
**PROJECT NO.**  05-1112-010  
**CLIENT**  Regional Municipality of Waterloo  
**LOCATION**  Clyde Park, Clyde, ON  
**LOG DATE**  October 24, 2008  
**LOGGED BY**  BB  
**DRILL METHOD**  Air Rotary  

**UTM EASTING**  562219.742  
**UTM NORTING**  4804075.713  
**GROUND SURFACE**  Ground Surface  
**BOREHOLE DEPTH**  115.52 m  
**CASING DEPTH**  22.9 m  
**BOREHOLE DIAMETER**  152.4 mm

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<th>Optical Image</th>
<th>Natural Gamma (cps)</th>
<th>Apparent Conductivity (mS/m)</th>
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<td>180°</td>
<td>15.0</td>
<td>20</td>
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<tr>
<td>15.0</td>
<td>270°</td>
<td>20.0</td>
<td>15</td>
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**GEOPHYSICAL RECORD OF BOREHOLE**  
**PBOW1-06**

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<td>0-25 mS/m</td>
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**PROJECT**  
IUS Project, Cambridge East

**PROJECT NO.**  
05-1112-010

**CLIENT**  
Regional Municipality of Waterloo

**LOCATION**  
Cambridge - Concession 1

**LOG DATE**  
July 4, 2006

**LOGGED BY**  
GRB

**DRILL METHOD**  
Air Rotary

**UTM EASTING**  
559285.847

**UTM NORTING**  
4806058.192

**LOG REFERENCE**  
Ground Surface

**GROUND SURFACE**  
308.205 masl

**BOREHOLE DEPTH**  
126.5 m

**CASING DEPTH**  
35.35 m

**BOREHOLE DIAMETER**  
152.4 mm
<table>
<thead>
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<td>0 25 mS/m</td>
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GEOPHYSICAL RECORD OF BOREHOLE  PBTW2-06

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<th>UTM EASTING</th>
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<td>LOG REFERENCE</td>
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<td>LOCATION</td>
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<td>GROUND SURFACE</td>
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<td>June, 2006</td>
<td>BOREHOLE DEPTH</td>
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<td>RF</td>
<td>CASING DEPTH</td>
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<td>DRILL METHOD</td>
<td>Air Rotary</td>
<td>BOREHOLE DIAMETER</td>
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<th>Apparent Conductivity</th>
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PROJECT: IUS Project, Cambridge East
PROJECT NO.: 05-1112-010
CLIENT: Regional Municipality of Waterloo
LOCATION: Cambridge, Can-Amera Parkway
LOG DATE: February 11-12, 2008
LOGGED BY: BB
DRILL METHOD: Air Rotary

UTM EASTING: 557466.339
UTM NORHTING: 4805907.686
LOG REFERENCE: Ground Surface
GROUND SURFACE: 308.587 masl
BOREHOLE DEPTH: 133.2 m
CASING DEPTH: 29.2 m
BOREHOLE DIAMETER: 152.4 mm

Depth 1m:200m

<table>
<thead>
<tr>
<th>Depth</th>
<th>Optical Image</th>
<th>Natural Gamma</th>
<th>Apparent Conductivity</th>
<th>Caliper</th>
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GEOPHYSICAL RECORD OF BOREHOLE  SM3A-93

PROJECT  IUS Project, Cambridge East  UTM EASTING  557938.02
PROJECT NO.  05-1112-010  UTM NORTHING  4803409.841
CLIENT  Regional Municipality of Waterloo  LOG REFERENCE  Ground Surface
LOCATION  Cambridge, Shades Mill  GROUND SURFACE  296.065 masl
LOG DATE  August 30, 2007  BOREHOLE DEPTH  137.0 m
LOGGED BY  WEM  CASING DEPTH  24.26 m
DRILL METHOD  Logged in 1993  BOREHOLE DIAMETER  152.4 mm

<table>
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<tr>
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<th>Optical Image</th>
<th>Natural Gamma</th>
<th>Apparent Conductivity</th>
<th>Caliper</th>
</tr>
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<tbody>
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<td>0 100</td>
<td>0 25</td>
<td>15 cm 20</td>
</tr>
</tbody>
</table>

Depth 1m-200m

0.0 4.0 8.0 12.0 16.0 20.0 24.0 28.0 32.0
## Geophysical Record of Borehole SMTW1-05

**Project:** IUS Project, Cambridge East  
**Project No.:** 05-1112-010  
**Client:** Regional Municipality of Waterloo  
**Location:** Cambridge, Shades Mill  
**Log Date:** July 6, 2006  
**Logged By:** GRB  
**Drill Method:** Mud Rotary

**Utm Easting:** 558520.3  
**Utm Northing:** 4806372.55  
**Log Reference:** Ground Surface  
**Ground Surface:** 292.77 masl  
**Borehole Depth:** 120.4 m  
**Casing Depth:** 21.03 m  
**Borehole Diameter:** 152.4 mm

### Depth Measurements

<table>
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<tr>
<th>Depth</th>
<th>Optical Image</th>
<th>Natural Gamma</th>
<th>Apparent Conductivity</th>
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</thead>
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<tr>
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<td>0 cps 100</td>
<td>0 mS/m 25</td>
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<tr>
<td>35.0</td>
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LEGEND

SYMBOL  BOREHOLE  SAMPLE  DEPTH(ft)
  ⬤  CMOW1-08  45.0 - 60.0
LEGEND

SYMBOL BOREHOLE SAMPLE DEPTH(ft)

CMOW1-06 100.0 - 107.0
GOLDEN ASSOCIATES

Legend

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<th>Sample</th>
<th>Depth(ft)</th>
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<td>CMOW2-06</td>
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</table>

Project Number: 05-1112-010
Checked By: 
Golder Associates 
Date: 06-Mar-07
GOLDEN ASSOCIATES

LEGEND

SHELL BOREHOLE SAMPLE DEPTH(ft)

CMOW2-06 17.0 - 21.0

Project Number: 05-1112-010

Checked By: Golder Associates

Date: 28-Feb-07
LEGEND

SYMBOL   BOREHOLE SAMPLE   DEPTH(ft)

•    CMCW2-06  80.0 - 94.0
LEGEND

SYMBOL BOREHOLE SAMPLE DEPTH(ft)

• PBOW1-06 60.0 - 100.0
LEGEND

SYMBOL  BOREHOLE  SAMPLE  DEPTH(R)

•  PBOW1-06  105.0 - 113.0
LEGEND

SYMBOL: •
BOREHOLE: PBOW2-06
SAMPLE: 15.0 - 30.0
LEGEND

SYMBOL   BOREHOLE    SAMPLE    DEPTH (ft)

*                    Pbow2-06    80.0 - 95.0
GRAIN SIZE DISTRIBUTION

Size of openings, inches U.S. Sieve size, meshes/inch

PERCENT FINER THAN

GRAN SIZE, mm

COBBLE | COARSE | FINE | COARSE | MEDIUM | FINE | SILT AND CLAY SIZES
SIZE | GRAVEL SIZE | SAND SIZE | FINE | GRAINED

LEGEND

SYMBOL | BOREHOLE | SAMPLE | DEPTH(ft)
• | PBOW2-06 | 105.0 - 115.0

Project Number: 05-1112-010
Checked By:                 Golder Associates
Date: 01-Mar-07
LEGEND

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<th>BOREHOLE</th>
<th>SAMPLE</th>
<th>DEPTH(m)</th>
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<tbody>
<tr>
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<td>PLOW1-08</td>
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<td>4.30 - 4.90</td>
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GRAIN SIZE DISTRIBUTION

Size of openings, inches U.S. Sieve size, meshes/in.

0 100 90 80 70 60 50 40 30 20 10 5 1

PERCENT FINER THAN

GRAN SIZE, mm

COBBLE CLAYE FINE CLAYE MEDIUM FINE Silt and clay sizes

SIZE GRAVEL SIZE SAND SIZE

LEGEND

SYMBOL BOREHOLE SAMPLE DEPTH (m)

- PLOW1-08 - 6.70 - 7.90

Project Number: 05-1112-010

Checked By: Golder Associates Date: 24-Oct-06
**LEGEND**

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**LEGEND**

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<th>DEPTH(m)</th>
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LEGEND

SYMBOL    BOREHOLE SAMPLE    DEPTH (m)
•          PLOW2-06          8.50 - 10.10

Project Number: 05-1112-010
Checked By: [Signature]
Golder Associates
GRAIN SIZE DISTRIBUTION

LEGEND

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<th>BOREHOLE SAMPLE</th>
<th>DEPTH(m)</th>
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Date: 31-Mar-08
Project Number: 05-1112-010
Checked By: Golder Associates
Date: 31-Mar-08
LEGEND

SYMBOL  BOREHOLE  SAMPLE  DEPTH(m)

•  SMOW1A-08  17.00 - 18.00
LEGEND

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Project Number: 05-1112-010 (1900)
Checked By: Golder Associates  Date: 09-Jul-09
## SOIL SIEVE ANALYSIS

Initial weight of dry sample \( = 1050.3 \text{(g)} \)

### COARSE SIEVING

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<tr>
<th>SIEVE</th>
<th>CUM. MASS RETAINED (g)</th>
<th>% RETAINED</th>
<th>PARTICLE SIZE (mm)</th>
<th>% PASSING</th>
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### HYDROMETER BACK SIEVING

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<th>CUM. MASS RETAINED (g)</th>
<th>% RETAINED</th>
<th>PARTICLE SIZE (mm)</th>
<th>% PASSING</th>
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**Project Number**: 05-1112-010  
**Project Task**: 1900  
**Sample Number**: NDOW1-08-E  
**Checked By**: E  
**Depth Units**: Imperial  
**Testing Date**: 09/07/2009 4:05:03 PM  
**Tested By**: Sieve - AS  
**LabID**: 09-134

---

*Golder Associates*
LEGEND

SYMBOL  MW  SAMPLE  DEPTH(ft)

•  NDOWZ-08-D  D  46.0 - 56.0
SOIL SIEVE ANALYSIS

Initial weight of dry sample = 1186.8(g)

### COARSE SIEVING

<table>
<thead>
<tr>
<th>SIEVE</th>
<th>CUM. MASS RETAINED (g)</th>
<th>% RETAINED</th>
<th>PARTICLE SIZE(mm)</th>
<th>% PASSING</th>
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### HYDROMETER BACK SIEVING

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<th>PARTICLE SIZE(mm)</th>
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**Golder Associates**

---

Project Number 05-1112-010
Project Task 1900
Sample Number NDOWZ-08-D
Checked By D

Depth 56
Units Imperial
Testing Date 09/07/2009 4:10:07 PM
Tested By Sieve - AS
LabID 09-135
### SOIL SIEVE ANALYSIS

Initial weight of dry sample: 663.9(g)

### COARSE SIEVING

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| SIEVE  | CUM. MASS RETAINED (g) | % RETAINED | PARTICLE SIZE (mm) | % PASSING |

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Project Number: 05-1112-010  
Project Task: NDOWZ-08-E  
Sample Number: E  
Checked By:  

Depth Units: 15 Imperial  
Testing Date: 09/07/2009  
Tested By: LabID  

Golder Associates
## SOIL SIEVE ANALYSIS

Initial weight of dry sample = 513.8(g)

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<th>% PASSING</th>
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Golder Associates
## SOIL SIEVE ANALYSIS

Initial weight of dry sample = 909.6 (g)

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### HYDROMETER BACK SIEVING

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Golder Associates
GRAN SIZE DISTRIBUTION

Size of openings, inches  U.S.S Sieve size, meshes/inch

PERCENT FINER THAN

GRAIN SIZE, mm

COBBLE  COARSE  FINE  COARSE  MEDIUM  FINE  SILT AND CLAY SIZES
SIZE  GRAVEL SIZE  SAND SIZE  FINE GRAINED

LEGEND

SYMBOL  MW  SAMPLE  DEPTH(ft)
•  NDTWI-08-D  D  48.0 - 58.0

Project Number: 05-1112-010 (1900)
Checked By: ___________________________ Golder Associates  Date: 10-Jul-09
SOIL SIEVE ANALYSIS

Initial weight of dry sample = 418 (g)

**COARSE SIEVING**

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**HYDROMETER BACK SIEVING**

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Golder Associates
CMOW1-06

TOP: 32.6 m BGS

End of Hole 126.7 m BGS

CMOW2-06

TOP: 28.7 m BGS

End of Hole 121.20 m BGS

CMOW3-06

TOP: 30.5 m BGS

End of Hole 123.1 m BGS
## Table A2.1

### Test Well Water Bearing Zones

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<th>Location</th>
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<td>85.3 to 86.9</td>
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Golder Associates
## Table A2.1
Test Well Water Bearing Zones

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<tr>
<td></td>
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<td>87.7 to 90.5</td>
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</table>

**NOTE:** Water producing zones were determined from drill action, noticeable increases observed in water discharge, and by rough water discharge measurements.
## Table A2.2
Bedrock Flow Interval Summary for Cambridge East Test Wells

<table>
<thead>
<tr>
<th>Hydrostratigraphic Unit Description</th>
<th>Depth of Flow Intervals (mbgs) and % Flow Contribution (Approximate)</th>
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<tbody>
<tr>
<td></td>
<td>CMPW2-06</td>
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<tr>
<td>Guelph Formation</td>
<td>No Flow</td>
</tr>
<tr>
<td>Eramosa - Reformatory Quarry</td>
<td>No Flow</td>
</tr>
<tr>
<td>Eramosa - Vinemount</td>
<td>No Flow</td>
</tr>
<tr>
<td>Goat Island</td>
<td>No Flow</td>
</tr>
<tr>
<td>Upper Gasport</td>
<td>No Flow</td>
</tr>
<tr>
<td>Middle Gasport</td>
<td>98-112m (100% of Flow)</td>
</tr>
<tr>
<td>Lower Gasport (including Rochester / Irondequoit / Rockway / Merritton Formations)</td>
<td>No Flow</td>
</tr>
</tbody>
</table>

Notes:
Source: Dynamic Flow Profiling
Notes:
Measurement point: Top of casing 0.70m above ground
Unable to collect data above 76m at 800 & 1000 usgpm steps
due to binding of flow tool cable

REGION OF WATERLOO
Cedarbrook Well
Flow Distribution Profile
August 16, 2006
Lotowater
Reference: 006-095
06/08/17
Notes:
Measurement Datum: Top of casing 0.50m above ground

REGION OF WATERLOO
Portuguese Club Well
Flow Distribution Profile
August 14, 2006
Lotowater
Reference: 006-095
Figure 1
06/08/15
Notes:
Measurement point: Can-America Pkwy Well
Approximate pump se Top of casing 0.90m above ground
Could not get tool below 105.1 m, possible bridge
Static water level = 7.43m btc

REGION OF WATERLOO
Can-America Pkwy Well
Flow Distribution Profile
February 6, 2008
Lotowater
Reference: 006-105
08/02/07
**Can-America Pkwy Well**

Flow Rate: 3.15 L/s  
50 usgpm

Casing Diameter: 6 in (nominal)  
0.1524 m

Theoretical Max V: 0.17 m/s

Reference Elev: Top of casing (0.90 m above ground)

Botom of casing: 30.5 mbtc

TD: 133.1 mbtc

Test Start: 2/6/2008 11:30

Test Stop: 2/6/2008 13:30

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Depth (m)</th>
<th>Velocity* (m/s)</th>
<th>% of Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>345</td>
<td>105.15</td>
<td>0.06</td>
<td>37%</td>
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<td>340</td>
<td>103.63</td>
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* Calibrated tool speed
Can-America Pkwy Well

006-105

Flow Rate: 6.31 L/s
          100 usgpm
Casing Diameter: 6 in (nominal)
          0.1524 m
Theoretical Max V: 0.35 m/s
Reference Elev: Top of casing (0.90 m above ground)
Bottom of casing: 30.5 m
TD: 133.1 m

Test Start: 2/6/2008 13:30
Test Stop: 2/6/2008 15:30

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Depth (m)</th>
<th>Velocity* (m/s)</th>
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<tr>
<td>115</td>
<td>35.05</td>
<td>0.35</td>
<td>101%</td>
</tr>
</tbody>
</table>

* Calibrated tool speed

Reference: 006-105 2/12/2008
Can-America Pkwy Well

006-105

Flow Rate: 9.46 L/s
         150 usgpm
Casing Diameter: 6 in (nominal)
                0.1524 m
Theoretical Max V: 0.52 m/s
Reference Elev: Top of casing (0.90 m above ground)
Bottom of casing: 30.5 m
TD: 133.1 m

Test Start: 2/6/2008 15:30
Test Stop: 2/6/2008 17:30

<table>
<thead>
<tr>
<th>Depth (ft)</th>
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* Calibrated tool speed
### Can-America Pkwy Well

**006-105**

- **Flow Rate:** 12.62 L/s (200 usgpm)
- **Casing Diameter:** 6 in (nominal) or 0.1524 m
- **Theoretical Max V:** 0.69 m/s
- **Reference Elev.:** Top of casing (0.90 m above ground)
- **Bottom of casing:** 30.5 m
- **TD:** 133.1 m

**Test Data:**
- **Test Start:** 2/6/2008 17:30
- **Test Stop:** 2/6/2008 19:30

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*Calibrated tool speed

Reference: 006-105  2/12/2008
Notes:
Measurement point: Top of casing 0.54m above ground

REGION OF WATERLOO
Witmer Park Well
Flow Distribution Profile
August 10, 2006
Lotowater
Reference: 006-095
06/08/14
Date of Test: 9/18/2007
Measurement Point: top of casing
Well Diameter: 150 mm

REGION OF WATERLOO
East Cambridge
SM TW2-07
Lotowater Technical Services Inc.  Figure 1
Reference: 006-105  07/09/20
Well Flow Profile

Project Number: 006-105  
Well Name: SM TW2-07  
Date Logged: 9/18/2007  
Logged By: Nathan Schmitt

Measuring Point: top of casing
Flow Rate: 11.36 L/s  
Casing Diameter: 150 mm  
Theoretical Max V: 0.64 m/s

Test Start:  
Test Stop:  
Bottom of Casing: m
TD: 124.1 m  
Pump inlet: 16.2 m  
SWL: 5.8 m  
PWL: m

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* Calibrated tool speed

Tool calibration based on Mar 14, 2006 LTS pit calibration (Jeff Neuman)

Reference: 147-005  
3/5/2008
**Well Flow Profile**

Project Number: 006-105  
Well Name: SM TW2-07  
Date Logged: 9/18/2007  
Logged By: Nathan Schmitt  
Measuring Point: top of casing  
Flow Rate: 15.14 L/s  
Casing Diameter: 150 mm  
Theoretical Max V: 0.86 m/s  

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* Calibrated tool speed

Tool calibration based on Mar 14, 2006 LTS pit calibration (Jeff Neuma)

Reference: 147-005  
3/15/2008
Date of Test: 9/20/2007
Measurement Point: top of casing
Flow Rate: 15.15 L/s
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* Calibrated tool speed

Test calibration based on Mar 14, 2006 LTS pit calibrations (Jeff Neuman)
Notes:
Date of Test: 3/3/2008
Measurement Point: top of casing
Flow Rate: 22.73 L/s
Well Diameter: 150 mm

REGION OF WATERLOO
East Cambridge
SMTW4-08
Lotowater Technical Services Inc. Figure 1
Reference: 006-105 08/03/04
## Well Flow Profile

**Project Number:** 006-105  
**Well Name:** SMTW4-08  
**Date Logged:** 3/3/2008  
**Logged By:** Jeff Neuman  
**Measuring Point:** Top of casing, 0.80m above ground surface  
**Flow Rate:** 22.73 L/s  
**Casing Diameter:** 150 mm  
**Theoretical Max V:** 1.29 m/s  
**Test Start:** 13:00  
**Test Stop:** 14:00  
**Bottom of Casing:** 28.0 m  
**TD:** 129.5 m  
**Pump inlet:** 26.2 m  

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</table>

* Calibrated tool speed

Tool calibration based on Mar 14, 2006 LTS pit calibration (Jeff Neuman)

Reference: 006-105  
Reference: 006-105  

3/5/2008
# Well Flow Profile

**Project Number:** 006-105  
**Well Name:** SMTW4-08  
**Date Logged:** 3/3/2008  
**Logged By:** Jeff  
**Measuring Point:** Top of casing, 0.80m above ground surface  
**Flow Rate:** 22.73 L/s  
**Casing Diameter:** 150 mm  
**Theoretical Max V:** 1.29 m/s  
**Test Start:** 14:00  
**Test Stop:** 15:00  
**Bottom of Casing:** 28.0 m  
**TD:** 129.5 m  
**Pump inlet:** 26.2 m  
**SWL:**  
**PWL:**  

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Depth (m)</th>
<th>Velocity* (m/s)</th>
<th>% of Flow</th>
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</table>

* Calibrated tool speed

Tool calibration based on Mar 14, 2006 LTS pit calibration (Jeff Neuman)
Flow Distribution Profile

Flow Rate = 15.6 L/s

Notes:
Measurement point: Top of Casing
Test Date: October 20, 2008
Flow measurements taken by Gerrits Well Drilling Inc.

REGION OF WATERLOO
NDTW1-08 (Clyde Park)
Flow Distribution Profile

Project: 05-1112-010 08-01-2010
Notes:
Measurement point: Top of Casing
Test Date: October 16, 2008
Flow measurements taken by Gerrits Well Drilling Inc.

REGION OF WATERLOO
NDTW2-08 (Clyde Park)
Flow Distribution Profile

Flow Rate = 15.6 L/s
## Well Record

**Well Record Number**: A032285

### Instructions for Completing Form
- For use in the Province of Ontario only. This document is a permanent legal document. Please retain for future reference.
- All Sections must be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- All measurements shall be reported to 1/10 of a metre.
- Please print clearly in blue or black ink only.

### Log of Overburden and Bedrock Materials (see Instructions)

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most common material</th>
<th>Other materials</th>
<th>General Description</th>
<th>Depth From To</th>
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<tr>
<td>Brown</td>
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<td>Grey</td>
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### Hole Diameter

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<tr>
<td>111’ 405’ 6”</td>
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### Water Record

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### Test of Well Yield

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<th>Recovery</th>
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<td>Time/Water Level (min)</td>
<td>Time/Water Level (min)</td>
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<td>Duration of pumping</td>
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<td>First water level of pumping (meters)</td>
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<td>Recommended pump depth (meters)</td>
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<td>Recommended pump rate (lpm)</td>
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<td>If flowing with pump rate (lpm)</td>
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<tr>
<td>If pumping exceeds (lpm)</td>
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### Method of Construction

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<td>Shoveling</td>
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<td>Rotary (reverse)</td>
<td>Digging</td>
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<tr>
<td>Rotary (conventional)</td>
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<td>Air percussion</td>
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<td>Air Shoveling</td>
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### Water Use

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<th>Domestic</th>
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<td>Other</td>
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### Final Status of Well

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<th>Water Recharge</th>
<th>Observation well</th>
<th>Test Hole</th>
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<tr>
<td></td>
<td>Recharge well</td>
<td>Abandoned, irreparable</td>
<td>Abandoned, poor quality</td>
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<td></td>
<td></td>
<td>Abandoned, (other)</td>
<td>Replacement well</td>
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### Well Contractor/Technician Information

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<tr>
<th>Name of Well Contractor</th>
<th>Well Contractor's License No.</th>
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<tbody>
<tr>
<td>N. DENSON Well Drilling Limited</td>
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### Location of Well

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

### Ministry Use Only

<table>
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<tr>
<th>Data Source</th>
<th>Date Received</th>
<th>Ministry of</th>
<th>Remarks</th>
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<td>Package delivered</td>
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<td>Date Delivered</td>
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<td>Date of Inspection</td>
<td>YY DD</td>
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<th>Date of Completion</th>
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<td>1494 NORTH ST., WINDHAM, ONTARIO, NO. 4</td>
<td>May 2005</td>
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CETTE FORMULE EST DISPOZABLE EN FRANÇAIS

CONTRACTOR'S COPY MINISTRY'S COPY WELL OWNER'S COPY
### Well Record

**Well Owner's Information and Location of Well Information**

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<td>Last Name</td>
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<td>Province/Postal Code/Telephone Number (include area code)</td>
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<td>Region</td>
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### Log of Overburden and Bedrock Materials (see instructions)

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<tr>
<th>General Colour</th>
<th>Most common material</th>
<th>Other Materials</th>
<th>General Description</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown Clay</td>
<td></td>
<td></td>
<td></td>
<td>0-6</td>
</tr>
<tr>
<td>Brown Gravel</td>
<td></td>
<td></td>
<td></td>
<td>6-10</td>
</tr>
<tr>
<td>Grey Clay</td>
<td></td>
<td></td>
<td></td>
<td>20-45</td>
</tr>
<tr>
<td>Green Clay</td>
<td></td>
<td></td>
<td></td>
<td>45-100</td>
</tr>
<tr>
<td>Brown Fine Sand</td>
<td></td>
<td></td>
<td></td>
<td>100-115</td>
</tr>
<tr>
<td>Grey Limestone</td>
<td>Shale</td>
<td></td>
<td>Soft, Fractured</td>
<td>115-116</td>
</tr>
<tr>
<td>Brown Fine Sand</td>
<td></td>
<td></td>
<td></td>
<td>116-134</td>
</tr>
<tr>
<td>Grey Limestone</td>
<td></td>
<td></td>
<td></td>
<td>134-470</td>
</tr>
</tbody>
</table>

### Construction Record

<table>
<thead>
<tr>
<th>Inside Diameter</th>
<th>Material</th>
<th>Wall Thickness</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 ft.</td>
<td>Fiberglass</td>
<td>198</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td>Steel</td>
<td>2' + 2'</td>
<td></td>
</tr>
</tbody>
</table>

### Water Record

<table>
<thead>
<tr>
<th>Water Sample</th>
<th>Kind of Water</th>
<th>Other</th>
<th>Gas/Other</th>
<th>Sulphur</th>
<th>Fresh</th>
<th>Salty</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fresh</td>
<td></td>
<td>Gas</td>
<td>Sulphur</td>
<td>Fresh</td>
<td>Salty</td>
<td>Others</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Test of Well Yield

<table>
<thead>
<tr>
<th>Pumping test method</th>
<th>Draw Down</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump intake rate (ft/min)</td>
<td>Time</td>
<td>Water Level (Meters)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Final water level and pumping rate (ft/min)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Recommended pump depth</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Recommended pump rate</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>If flowing give rate (ft/min)</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

### Drilling and Sealing Record

<table>
<thead>
<tr>
<th>Depth</th>
<th>Material and type (berthelton sandy, red cement stony etc.)</th>
<th>Volume/Record (cubic meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Cement Slurry</td>
<td></td>
</tr>
</tbody>
</table>

### Method of Construction

<table>
<thead>
<tr>
<th>Casing tool</th>
<th>Casing (conventional)</th>
<th>Casing (reverse)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diamond</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drilling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Water Use

<table>
<thead>
<tr>
<th>Domestic</th>
<th>Stock</th>
<th>Irigation</th>
<th>Public Supply</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industral</td>
<td></td>
<td>Municpal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coding &amp; air conditioning</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Final Status of Well

<table>
<thead>
<tr>
<th>Water Sample</th>
<th>Water Use</th>
<th>Water Quality</th>
<th>Water Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Recharge well</td>
<td>Abandoned, insufficient supply</td>
<td>Dewatering</td>
</tr>
<tr>
<td></td>
<td>Observation well</td>
<td>Abandoned, non-quality</td>
<td>Replacement well</td>
</tr>
<tr>
<td>Total hole</td>
<td>Test Hole</td>
<td>Abandoned, non-quality</td>
<td>Replacement well</td>
</tr>
</tbody>
</table>

### Well Contractor/Technician Information

<table>
<thead>
<tr>
<th>Name of Well Contractor</th>
<th>Well Contractor's Licence No.</th>
<th>Business Address (street name, number, city etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAVIDSON WELL DRILLING LIMITED</td>
<td>1447</td>
<td>117 NORTH ST, WILMINGTON, ONT. N6G 2W0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of Well Technician (last name, first name)</th>
<th>Well Technician's Licence No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>KEVIN GARY</td>
<td>156</td>
</tr>
</tbody>
</table>

### Location of Well

- Lot line
- BUCKET ST.

### Audit No.

<table>
<thead>
<tr>
<th>Audit No.</th>
<th>Date of Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>241435</td>
<td>11/18</td>
</tr>
</tbody>
</table>

### Water Well Owner's Information

<table>
<thead>
<tr>
<th>Name of Water Well Owner</th>
<th>Water Well Owner's Licence No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Data Source

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Date Received</th>
<th>Date of Inspection</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>YY MM DD</td>
<td></td>
</tr>
</tbody>
</table>

### Ministry Use Only

<table>
<thead>
<tr>
<th>Ministry Use Only</th>
<th>Contractor's Copy</th>
<th>Ministry's Copy</th>
<th>Well Owner's Copy</th>
</tr>
</thead>
</table>
**Ontario Ministry of the Environment**

**Well Record**

**Regulation 901 Ontario Water Resources Act**

**PAGE 1 of 2**

**Well Owner’s Information and Location of Well Information**

**Water region:**
- **City:** Cambridge
- **Site/Compartment/Block/Tract etc.:**
- **GPS Reading:**
  - **NAD Zone:** 83
  - **Eastings:** 5153814
  - **Northings:** 7806881
- **Unit Make/Model/Mode of Operation:**
  - **General:***
  - **Number:**
    - **Unit Make:**
    - **Model:**
    - **Year:**
- **Diffusion (specify):**

**Log of Overburden and Bedrock Materials (see Instructions)**

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most common material</th>
<th>Other Materials</th>
<th>General Description</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>Clay</td>
<td>Stones</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Grey</td>
<td>Clay</td>
<td>Stones</td>
<td>-</td>
<td>16</td>
</tr>
<tr>
<td>Grey</td>
<td>gravel</td>
<td>soil</td>
<td>-</td>
<td>27</td>
</tr>
<tr>
<td>Grey</td>
<td>clay</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Grey</td>
<td>limestone</td>
<td>broken</td>
<td>-</td>
<td>151</td>
</tr>
<tr>
<td>Grey</td>
<td>sand</td>
<td>gravel</td>
<td>-</td>
<td>240</td>
</tr>
</tbody>
</table>

**Hole Diameter**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Diameter (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8 x 4</td>
</tr>
<tr>
<td>140</td>
<td>6 2/8</td>
</tr>
<tr>
<td>240</td>
<td>4 2/8</td>
</tr>
</tbody>
</table>

**Construction Record**

- **Insides diam:**
  - 8 x 4
- **Material:** concrete
- **Wall thickness:** 188
- **Depth:** 140

**Casing**

<table>
<thead>
<tr>
<th>Inside diam</th>
<th>Material</th>
<th>Wall thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 x 4</td>
<td>Concrete</td>
<td>188</td>
</tr>
</tbody>
</table>

**Screen**

- **Outside diam:**
  - Pokered
- **Casing:**
  - 8 x 4
- **Slotted:**
  - 8 x 4
- **Plastic:**
  - 8 x 4
- **Concrete:**
  - 8 x 4
- **Galvanized:**
  - 8 x 4

**Plugging and Sealing Record**

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Material (bentonite slurry, read cement slurry etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>140</td>
<td>Cement</td>
</tr>
</tbody>
</table>

**Method of Construction**

- **Drill:**
  - Rotary (air)
  - Rotary (reverse)

**Water Use**

- **Domestic:**
  - Industrial
  - Commercial
  - Public supply
  - Not used
  - Water supply
  - Irrigation

**Final Status of Well**

- **Well:**
  - Recharge well
  - Observation well
  - Abandoned, insufficient supply
  - Abandoned, poor quality
  - Replacement well

**Well Contractor/Technician Information**

- **Name of Well Contractor:**
  - David K. M. Drilling Limited
- **Well Contractor’s Licence No.:**
  - 1737
- **Business Address:**
  - 49 Nor’West Rd., Wingham, ON, N0G 2L0
- **Name of Well Technician (first name, last name):**
  - K. Kim
  - L. Brown
- **Well Technician’s Licence No.:**
  - 9027
- **Date:**
  - MAR 1 20
  - June 1 20

**Location of Well**

- **Distance from road, lot line, and building:**
- **Property:**
- **Recharge well:**
- **Observation well:**
- **Abandoned, insufficient supply:**
- **Abandoned, poor quality:**
- **Replacement well:**

**Well Use Only**

- **Casting depth:**
  - 0
- **Water level:**
  - 140
- **Storage:**
  - 240

**Pumping Test Method**

- **Pump intake set:**
  - 140
- **Pumping rate:**
  - 140 (gpm)
- **Duration of pumping:**
  - 140
- **Final water level:**
  - 140
- **Screen:**
  - 140
- **Slotted:**
  - 140
- **Plastic:**
  - 140
- **Concrete:**
  - 140
- **Galvanized:**
  - 140

**Open hole:**

- **Gore:**
  - 140
- **Depth:**
  - 240

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

**Auditor:**

- **Auditor No.:** 41147
- **Date:**
  - 20
- **Was the well owner’s information package delivered?**
  - Yes

**Ministry Use Only**

- **Date:**
  - MAR 1 20
  - June 1 20
- **Remarks:**
  - Well Recharge Number

**Well Owner’s Copy:**

- **Contractor’s Copy:**
  - Ministry’s Copy
- **Well Owner’s Copy:**
  - This form is disponible en français
## Instructions for Completing Form

- For use in the Province of Ontario only. This document is a permanent legal document. Please retain for future reference.
- All Sections must be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- All metre measurements shall be reported to 1/10th of a metre.
- Please print clearly in blue or black ink only.

## Well Owner's Information and Location of Well Information

### General Colour
- Stone
- Gravel
- Clay
- Sand, Gravel
- Stones
- Limestone
- Shale

## Log of Overburden and Bedrock Materials (see instructions)

<table>
<thead>
<tr>
<th>General Description</th>
<th>Depth From</th>
<th>Depth To</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>395</td>
<td></td>
</tr>
</tbody>
</table>

## Construction Record

### Water Record
- Kind of Water: Fresh
- Source: GSI, Saline
- Other: Gas, Sulphur, Minerals

### Test of Well Yield

<table>
<thead>
<tr>
<th>Pumping test method</th>
<th>Draw Down</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (min)</td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td>Water Level (metres)</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

### Screen
- After test of well yield, water was clear and sediment free
- Other, spotter

## Method of Construction
- Cable Tool
- Air percussion
- Rotary (reverse)

## Water Use
- Domestic
- Industrial
- Public Supply
- Other

## Final Status of Well
- Water Supply: Recharge well
- Observation well: Abandoned, insufficient supply
- Test Hole: Abandoned, poor quality

## Well Contractor/Technician Information
- Name of Well Contractor: DAVIDSON WELL DRILLING LIMITED
- Name of Well Contractor (last name, first name): DAVIDSON R

## Location of Well
- Location: CLYDE RD.

## Audit No
- 241416

## Date of Construction
- 17-37

## Ministry Use Only
- Date Received: MAR 14 2006
- Date of Inspection: MMM DD YYYY
- Well Record Number: 241416

## Contractor's Copy
- Ministry of the Environment
Well.Tag.Numbel

Ministry of
the Environment

~ Ontario

Well Record

JiJL ~:B~Z61l,) -~ 3

Regulation 903 Ontario Water Resources Act

A 026013

Instructions for Completing Form

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· For use in the Province of Ontario


only. This document is a permanent legal

· All Sections must be completed in

page.! of .!

this form.

full to avoid delays in processing. Further instructions and explanations are available on the back of

· Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416"235-6203.

· All metre measurements shall be reported to 1/10lh of a metre.
· Please print clearly in blue or black ink only.

Well Owner's Information and Location of Well Information

First Name Last Name
Region of Waterl 0

County/DistricUMunicipality

Township/CitylT ownNillage

Kitchener

Well Location (County/DistricUMunicipality)

Addres~ of

Lot3

Region of Waterioo
RR#/Street Number/Name

Preston Tract

Unit Make/Model

Most common material

Other Materials

('ø.ir
C,L/r

~

Metres
To

0

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Construction Record

Diameter

Inside
diam

Centimetres

9~

thickness
centimetres

~.ó /tiI.9P jb..t1

Test of Well Yield
Depth

Wall

Material

æntimetrs

Metres

From

Water Record

I ~ Steel 0 Fibreglass

o Plastic 0 Concrete
o

b..9S"~ "rO..95

30.3/

Duration of pumping

Galvanized

o

Gas o

o

Other:

Salty

i!"m .
o

Gas

o

Other:

iåF~e~h

Gas

o

Other:

Final water level end

of puri'19. 31tetres

o Plastic 0 Concrete

o Minerals

o Sulphur
o Minerals

Steel

o Fibreglass

o Plastic 0 Concrete
Galvanized

Salty

o Minerals

Outside
diam

o

Steel

o Fibreglass

o

~Iear and .sediment free

S,;.gi

ig Annular space

eoth set at - Metrs Matenal and tye (bentonite sluir, neat æment slurr) etc.

0

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Ce'h?t:1J7

26.6t

2

12 .4~

3

26.71:

3

11. 9~

4

26. 8~ 4

o Abandonment
Volume Placed
(cubic metres)

O#~I

5
10

ttres min)
If flowing give rate -

15
20
25
30

(litres/min)

~openhoie

To

2

Reco~:ended pump

If pumping discontin-

and Sealing Record

Plugging

12. T

ued, give reason.

40
¡til.

)" AA

1.89
1 7?

5

metres

rate. 7ãO

No.

No Casing or Screen

ONo

32

depth.

Galvanized

o Other, specify

From

Shallow Deep
Recommendeá pump

o Plastic OConcrete

After test of well yield, water was

Chlorinated 0 Yes

Slot

Recommended pump

typeh '1V1

l,

Screen

.~ F~e~h . D Sul~h~r .
o

\

o Galvanized
o

o

1i31"m .
o

Salty

o

o Sulphur

8.72
26.4 B 1

-.hrs + _ min

o Steel 0 Fibreglass

JS...¡ç ~Fresh

Level

Metrs

min

Pump intake 1~ at - Static
(metres)
Level
Pumping rate - ,
1
(litres/min)37 86

water tQund / Kind of Water

at Metres

Time Water

pump

To

Recovery
Time Water Level
Metres
min

Draw Down

Pumping test method

Casing

1b~'/6

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C)

r/Ü6-l" 6:V r;:

. )

Metres
Tn

i=mm

r'Ll I.J 'J c.,Ay

Hole Diameter
Depth
From

Deoth

General Description

S"/?- T

S//fr

~-

Differentiated, specify

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~G.,( S/'b

~7/.
,

Mode of Operation: 0 Undifferentiated XJ Averaged

magellan

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6k
~AJ
.~

4

Site/CompartmenUBlocklract etc.

GPS Reading

General Colour

Concession

50
60

902

'7.03
'7.07
''7 , i:
7.16
7.20
7.24
)7 ?'7
7.28

1.22
0.92
n. "I:
0.38
0.27

10
15

20
25
30
40
50 :i AQ
60

n ni:

9.77

Location of Well
well from road, lot line, and building.

In diagram below show distances of

Indicate north by arrow.

3c¡v

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,

~ )

,

~Rotary (air)
RotaryTool
(conventional)
Ii Cable

Air percussion
o

Boring

o

Diamond

o

o

Jetting

DOther

o

Dnving

Digging

Water Use
o

Domestic

OStqck
o Irrigation

D Public Supply

o Commercial

DNotused

Uu. of

o Cooling & air conditioning

Audit No.

Z
D Abandoned, (Other)

i~ VVaterSupply

D Unfinished

In Test Hole Fi Abandoned, poor quality

o Dewatering
n Replacement well

I L l.tb

rE/7.. WèL- Cii;~C"-y
j)/vLL/AJL
BMdd7/tree~r,

package delivered?

Well 3¿:Õo~icence No.

N~f Well Technician (i~me, first name)

~S 'Té:-Vé"
Sig:hf Technicia;~.2 .. . - .. X
X . .:/..A¿./ -i'P.ú ,A./¿;¿I.. A _ A""
Contractor's Copy 0

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Dale SUbm~ MM.¡,

yyy

DYes ONo

MM
i

DO
I

Ministry Use Only
Contractor

Data Source
Date Received

Well Technic~~~e No.

Date Well co:?lë ~ dl;
Date Delivered

Was the well owner's information

.

"50GE (09/03)

34704

Well Contractor/Technician Information- ,;:3iu. OF

N~f Well Contractor

~

'"

DOther

Final Status of Well
D Recharge well
o Observation well D Abandoned, insuffcient supply

~~

3

ftrtJfuè~e
C6""br ìcle.

o Industrial

~unicipal

:2

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Method of Construction

.

o Rotary (reverse)

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yy
I

Remarks

DO' Date of Inspection

MM

yy

MM
i

I

DO
I

Well Record Number

.~ .. l"~
Ministry's Copy 0 Well Owner's Copy 1S

Cette formu/e est disponib/e en français


**Well Record**

**Regulation 903 Ontario Water Resources Act**

**Well Tag Number:** A026005

**Region of Waterloo**

**Address of Well Location (County/District/Municipality):**

**Mailing Address (Street Name/Number, RR, Lot, Concession):** 150 Fredrick St

**Region of Waterloo**

**Town of Cambridge**

**City/Town/Village:** Kitchener

**Province:** Ontario

**Postal Code:** N2G 4J3

**Telephone Number (inside area code):** 519-575-4550

**Log of Overburden and Bedrock Materials (see instructions):**

- Brown Sand
- Gravel
- Grey Silt
- Shand/Boulder Layers
- Layered Blue/Green Limestone

**Test of Well Yield:**

- After test of well yield, water was:
  - Chiorinated: Yes
  - Fresh: Yes
  - Sulphur: Yes
  - Other: No

- Water recorder:
  - Depth:
    - From: 6.48
    - To: 9.6
  - Depth (metres):
    - 0
  - Diameter:
    - 3.48
  - Material:
    - Steel
  - Inside diameter (centimetres):
    - 0.952
  - Wall thickness (centimetres):
    - 0.8
  - Casing:
    - Inside diameter (metres):
      - 0.9
    - Wall thickness (metres):
      - 0.8
  - Pumping test method:
    - Pump intake set at - (metres):
      - 34
    - Pumping rate - (litres/min):
      - 786
    - Duration of pumping - 2 hrs
    - Final water level and pumping rate - 6.54
  - Recommended pump type:
    - 8.10
  - Recommended pump depth:
    - 34 metres

**Drilling and Sealing Record:**

- Inside diameter (metres):
  - 0.9
- Wall thickness (metres):
  - 0.8
- Casing:
  - Inside diameter (metres):
    - 0.9
  - Wall thickness (metres):
    - 0.8
- Pumping test method:
  - Pump intake set at - (metres):
    - 34
  - Pumping rate - (litres/min):
    - 786
  - Duration of pumping - 2 hrs
  - Final water level and pumping rate - 6.54
- Recommended pump type:
  - 8.10
- Recommended pump depth:
  - 34 metres

**Location of Well:**

- Cedar Brook Cr.
- 60 m

**Well Contractor/Technician Information:**

- **Name of Well Contractor:**
  - Jerry Well Drilling Inc.
- **Water Technician License No.:** 3746

- **Signature of Technician/Owner:**
  - Jerry Well Drilling Inc.
- **Water Technician License No.:** 3746

**Plugging and Sealing Record:**

- Depth set at:
  - From: 6
  - To: 9.6
- Material and type (bentonite slurry, neat cement slurry, etc.):
  - Volume placed (cubic metres):
    - 0.42

- **Method of Construction:**
  - Rotary (air)
  - Driving
- **Type of Drilling:**
  - Industrial
  - Municipal

**Water Use:**

- Domestic
- Irrigation
- Public Supply
- Other

**Final Status of Well:**

- Water supply:
  - Recharge well
  - Unfinished
  - Abandoned
  - Other
- **Test hole:**
  - Unfinished
  - Abandoned
- **Replacement well:**
  - Replacement well

**Regulation 903 Ontario Water Resources Act**

**Well Contractor/Technician Information:**

- **Name of Well Contractor:**
  - Jerry Well Drilling Inc.
- **Water Technician License No.:** 3746

- **Signature of Technician/Owner:**
  - Jerry Well Drilling Inc.
- **Water Technician License No.:** 3746

**Instructions for Completing Form:**

- Please print clearly in blue or black ink only.
- All metre measurements shall be reported to 1/10th of a metre.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- All sections must be completed in full to avoid delays in processing.
- Further instructions and explanations are available on the back of this form.
- For use in the Province of Ontario only. This document is a permanent legal document. Please retain for future reference.
### Well Information

**Region of Waterloo**

- **Street Name**: 150 Frederick St
- **Township/City/Town Village**: Kitchener
- **Province**: Ontario
- **Postal Code**: N2G 4L3
- **Telephone Number**: 519-575-4550
- **Address**: 55220 Preston Tract

**Log of Overburden and Bedrock Materials**

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Depth (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown Sand</td>
<td>Boulders</td>
<td>0</td>
</tr>
<tr>
<td>Grey Sand</td>
<td>Limestone</td>
<td>6.71</td>
</tr>
<tr>
<td>Grey Sand/Gravel</td>
<td>Limestone</td>
<td>28.95</td>
</tr>
<tr>
<td>Brown/Grey Limestone</td>
<td>Layered</td>
<td>41.15</td>
</tr>
</tbody>
</table>

**Test Hole Information**

- **Type**: Open hole
- **Depth**: 42.06
- **Location**: 138.68

### Construction Record

<table>
<thead>
<tr>
<th>Hole Diameter</th>
<th>Depth (M)</th>
<th>Diameter (Cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>45.72</td>
<td>138.68</td>
</tr>
</tbody>
</table>

### General Description

- **Material**: Steel
- **Wall thickness (mm)**: 0.952 + 0.50 = 42.06
- **Screen**: Steel, Plastic, Concrete, Galvanized
- **Well Diameter**: 60.00
- **Well Yield**: 8.50

### Water Record

- **Kind of Water**: Fresh Water
- **Water Level**: 21.12 m
- **Duration of pumping**: 2 hours
- **Final Water Level**: 18.62 m
- **Recommended pump type**: Shallow well
- **Recommended Pump Depth**: 42 metres
- **Recommended pump rate**: 8750 litres/min
- **Recommended screen**: 20 cm

### Pumping Test Method

- **Pump intake set at**: 42 metres
- **Pumping rate**: 8750 litres/min
- **Duration**: 2 hours
- **Final Water Level**: 18.62 m
- **Recommended pump type**: Shallow well
- **Recommended Pump Depth**: 42 metres
- **Recommended pump rate**: 8750 litres/min
- **Recommended screen**: 20 cm

### Test of Well Yield

- **Pump rate**: 42 litres/min
- **Duration**: 2 hours
- **Final Water Level**: 18.62 m
- **Recommended pump type**: Shallow well
- **Recommended Pump Depth**: 42 metres
- **Recommended pump rate**: 8750 litres/min
- **Recommended screen**: 20 cm

### Pumping Test Method

- **Pump intake set at**: 42 metres
- **Pumping rate**: 8750 litres/min
- **Duration**: 2 hours
- **Final Water Level**: 18.62 m
- **Recommended pump type**: Shallow well
- **Recommended Pump Depth**: 42 metres
- **Recommended pump rate**: 8750 litres/min
- **Recommended screen**: 20 cm

### Water Use

- **Domestic**: 8.50
- **Industrial**: 8.50
- **Public Supply**: 8.50
- **Municipal**: 8.50
- ** Cooling & Air Conditioning**: 8.50

### Method of Construction

- **Cable Tool**: Rotary (air)
- **Rotary (conventional)**
- **Rotary (reverse)**
- **Boring**

### Water Use

- **Domestic**: 8.50
- **Industrial**: 8.50
- **Public Supply**: 8.50
- **Municipal**: 8.50
- ** Cooling & Air Conditioning**: 8.50

### Location of Well

- **Axial No.**: Z 34680
- **Date Well Completed**: YYYY MM DD
- **Date Delivered**: YYYY MM DD
- **Well Owner's Information**: Name of Well Technician (last name), Contractor's (first name)

### Well Contractor/Technician Information

- **Name of Well Contractor**: Gerrits Well Drilling Inc.
- **Well Contractor's Licence No.**: T 2964
- **Business Address**: (street number, city)

### Ministry Use Only

- **Date Issued**: YYYY MM DD
- **Date ReIssued**: YYYY MM DD

### Remarks

- **Well Status**: Abandoned, (Other)
- **Well Location**: 150 Frederick St
- **Well Tag Number**: A026020

---

Cette formule est disponible en français.
Well Owner's Information and Location of Well Information

First Name Last Name: Brown, Bro'r

GPS Reading: 5529729, 6850305

Address of Well Location: Cambridge, Preston

Well Information:
- General Colour: Brown
- Most common Material: Topsoil
- General Description: Silt, Gravel

Test of Well Yield:
- Pumping test method: No.
- Pumping rate: 0.556 litres/min
- Duration of pumping: 0.556 hours
- Final water level end: 35.0 metres
- Recommended pump:
- Diameter: 0.14 metres
- Kind of Water: Gravel
- Water Level: 126.79 metres

Location of Well:
- Name of Well Contractor: Lunney, Gerri
- Name of Technician: Ahri
- Business Address: 150 Fredrick St., Kitchener, ON N2G 4J3
- Telephone Number: 1-888-396-9355

Well Record
- Date of Inspection: YYYY MM DD
- Date Received: YYYY MM DD
- Date Delivered: YYYY MM DD
- Method of Construction: Other
- Water Use: 0.14 metres

Well Contractor/Technician Information:
- Ministry Use Only
- Name of Well Contractor: Lunney, Gerri
- Name of Technician: Ahri
- Telephone Number: 1-888-396-9355

Ministry of the Environment
Regulation 903 Ontario Water Resources Act
### Well Owner's Information and Location of Well Information

<table>
<thead>
<tr>
<th>County/District/Municipality</th>
<th>Township/City/Town/Village</th>
<th>Province</th>
<th>Postal Code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ontario</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Address of Well Location (County/District/Municipality)</th>
<th>Township</th>
<th>RR#/Street Number/Name</th>
<th>City/Town/Village</th>
<th>Site/Compartment/Block/Tract etc.</th>
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</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

### General Colour

- Grey
- Limestone
- Brown
- Limestone
- Grey
- Limestone
- Brown
- Limestone
- Grey
- Limestone

### Log of Overburden and Bedrock Materials (see instructions)

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most common material</th>
<th>Other Materials</th>
<th>General Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey</td>
<td>Limestone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>Limestone</td>
<td></td>
<td></td>
</tr>
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<td></td>
</tr>
<tr>
<td>Grey</td>
<td>Limestone</td>
<td></td>
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</tr>
</tbody>
</table>

### Water Record

- Water source: [kind of water]

### Test of Well Yield

- Pumping test method: [method used]
- Draw down: [time in minutes, recovery]
- Pump intake set at: [level in metres]
- Duration of pumping: [time in minutes]
- Final water level end of pumping: [level in metres]
- Recommended pump type: [type and make, model number]
- Recommended pump depth: [level in metres]
- Pumping rate: [rate in litres per minute]
- Flowing give rate: [rate in litres per minute]
- Pumping discontinues, give reason.

### Plugging and Sealing Record

- Annular space: [size in centimetres]
- Abandonment: [size in centimetres]
- Method of Construction: [method used]
- Water Use: [type of water usage]

### Final Status of Well

- Water Supply: [source of water]
- Observation well: [type of well]
- Test hole: [status of hole]

### Well Contractor/Technician Information

- Name of Well Contractor: [name and contact information]
- Name of Well Technician: [name and contact information]
- Signature of Technician/Contractor: [signature and date]

---

*This form is available in French.*
Well Tag Number (Place sticker and print number below)

Well Record
Regulation 903 Ontario Water Resources Act

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Instructions for Completing Form

County/District/Municipality

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Green Shale

Other Materials

Plugging and Sealing Record

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<tr>
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<th>Material and type (berdvlsh slurry, neat cement slurry etc.)</th>
<th>Volume Placed (litres/metre)</th>
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Method of Construction

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<tr>
<th>Cased Tpo</th>
<th>Rotary (air)</th>
<th>Diamond</th>
<th>Digging</th>
<th>Air percussion</th>
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Water Use

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<td>Replacement well</td>
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Well Record
Regulation 903 Ontario Water Resources Act

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Green Shale

Other Materials

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Water Use

<table>
<thead>
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Final Status of Well

<table>
<thead>
<tr>
<th>Water Supply</th>
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<td></td>
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<tbody>
<tr>
<td>Business Address (street name, number, city etc.)</td>
<td></td>
</tr>
</tbody>
</table>

Well Owner's Copy
Observation Well Construction

- A, B, C - CG

Top of Bedrock @ 107 ft.

- Hole Plug (155)
- Crusher Sand (145' - 201')
- Hole Plug (201 - 230)
- Rock Fill (230 - 303')
- Hole Plug (303 - 323')
- Crusher Sand (323 - 410')
- Hole Plug (410 - 415')
- Rock Fill (415 - 416')

- Bottom to 115' = Rock Fill
- 115' to 410 = Hole Plug
- 410' to 323' = Crusher Sand - Piece B Screen from 335' to 395'
- 323' to 230' = Hole Plug
- 230' to 261 = Hole Plug
- 261 to 185 = Crusher Sand - Piece B Screen from 160' to 190'
- 185' to 185 = Hole Plug
- 185 to 115 = Crusher Sand - Piece B Screen from 120 to 130'
- 115' to 107 = Hole Plug
- 107' to 0 = Bedrock Surface

306.52 0.62
**Well Record**

**Region of Waterloo**

**Well Owner’s Information and Location of Well Information**

- **First Name**
- **Last Name**
- **Mailing Address** (Street Number/Name, RR, Lot, Concession)
- **Postal Code**
- **Telephone Number** (include area code)

**Address of Well Location**

- **RR#/Street Number/Name**
- **City/Town/Village**
- **Province**
- **Postal Code**

**Log of Overburden and Bedrock Materials (see instructions)**

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most common material</th>
<th>Other Materials</th>
<th>General Description</th>
<th>Depth</th>
<th>Metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>BROWN</td>
<td>Topsoil</td>
<td></td>
<td></td>
<td>0</td>
<td>1.82</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Water Record**

- **Water Source**
- **Kind of Water**

<table>
<thead>
<tr>
<th>Water Source</th>
<th>Kind of Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

**Construction Record**

<table>
<thead>
<tr>
<th>Inside diameter</th>
<th>Material</th>
<th>Wall thickness</th>
<th>Depth</th>
<th>Metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Steel</td>
<td>0.588</td>
<td>0</td>
<td>4.57</td>
</tr>
<tr>
<td></td>
<td>Plastic/Concrete</td>
<td></td>
<td></td>
<td></td>
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</table>

**Plugging and Sealing Record**

<table>
<thead>
<tr>
<th>Plugging method</th>
<th>Casing</th>
<th>Screen</th>
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<tbody>
<tr>
<td></td>
<td>Open</td>
<td>Open</td>
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</table>

**Water Use**

- **Well Use**
- **Well Use**

<table>
<thead>
<tr>
<th>Water Use</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Location of Well**

- **Acid No.**
- **Well Tag Number**
- **Date Well Completet**

**Well Contractor/Technician Information**

- **Name of Well Contractor**
- **Well Contractor’s Licence No.**
- **Business Address** (street name, number, city, etc.)

---

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Observation Well Construction

CM0012: A, B, C, D

- Grand Surface
- Cement - Bentonite Grout
- Bentonite - Grout
- "Top of Bentonite"
- 6" casing to 980 ft.
- Sand (91 to 116)
- Hole Plug (116 - 147)
- Sand (117 - 192)
- Hole Plug (192 - 292)
- Sand (292 - 367)
- Hole Plug (367 - 377)
- Rock Fill 3.5 ft.
- TD 397.5 ft.

Bottom to 377 ft. = Rock Fill.
377 to 367 = Hole Plug.
367 to 292 = Filter Sand. Piezo 'A' Screen from 362 to 362 ft.
292 to 192 = Hole Plug.
192 to 147 = Filter Sand. Piezo 'B' Screen from 157 to 187 ft.
147 to 116 = Hole Plug.
116 to 91 = Filter Sand. Piezo 'C' Screen from 101 to 111 ft.
91 to 88 = Hole Plug.
88 to 0 ft. = Bentonite Grout.
Ontario
Ministry of the Environment

Regulation 903 Ontario Water Resources Act

Well Record

Well Tag Number (Place sticker and print number below)

A032036

Instructions for Completing Form

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- All Sections must be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- All metre measurements shall be reported to 1/10th of a metre. Please print clearly in blue or black ink only.

Well Owner's Information and Location of Well Information

Region of Waterloo

Ontario

Kitchener

Well Location (County/District/Municipality)

Addressee of Well Location (County/District/Municipality)

Telephone Number (include area code)

Log of Overburden and Bedrock Materials (see instructions)

Black Topsoil

Brown Clay

Gravel Sand, Boulders

Sand

Well Tag Number (Place sticker and print number below)

Well Record Number

Test of Well Yield

Pumping test method

Duration of pumping

Practical water level and of pumping

Recommended pump type

Recommended pump depth

Recommended pump rate

If pumping discontinued, give reason.

Location of Well

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

In Disaster below show show distance of well from road, lot line, and building. Indicate north by arrow.

Audit No.

Z 56831

Date Well Completed

Survey

Ministry Use Only

Date Source

Contractor

Well Contractor's Licence No.

Remarks

Well Record Number

Contractor/Well Owner's Copy

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- All Sections must be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Help Desk (Toll Free) at 1-888-396-9355.
- For use in the Province of Ontario only. This document is a permanent legal document. Please retain for future reference.

---

**Well Owner’s Information and Location of Well Information**

- **Name of Well Technician** (last name, first name)
- **Well Technician’s Business Address** (street name; number, city etc.)
- **Name of Well Contractor**
- **Well Contractor’s Licence No.**
- **Name of Well Owner**
- **First Name**
- **Address of Well Location** (County/District/Municipality)
- **RR# / Street Number / Name**
- **Easting**
- **Northing**
- **Latitude**
- **Longitude**
- **Level of Ground**
- **Well Tag Number** (Place sticker and print number below)
- **Well Record Number**

---

**Log of Overburden and Bedrock Materials (see instructions)**

- **General Colour**
- **Most common material**
- **Other Materials**
- **Other Materials**

---

**Hole Diameter**

- **Depth (metres)**
- **Diameter (centimetres)**

---

**Construction Record**

- **Material**
- **Wall thickness (centimetres)**

---

**Test of Well Yield**

- **Pumping test method**
- **Draw Down (metres)**
- **Recovery (metres)**
- **Static level (metres)**
- **Final water level (metres)**
- **Time (minutes)**

---

**Location of Well**

- **Location Diagram**
- **Location of Well**
- **Distance of well from road, building, creek...**

---

**Well Contractor/Technician Information**

- **Name of Well Contractor**
- **Well Contractor’s Licence No.**
- **Business Address** (street name; number, city etc.)
- **Easting**
- **Northing**
- **Latitude**
- **Longitude**
- **Well Tag Number** (Place sticker and print number below)
- **Well Record Number**

---

**Well Owner’s Copy**
### Well Record

**Well Teq:** A032038

#### Well Owner's Information and Location of Well Information
- **First Name Last Name:** Lunney
- **Well Owner's Information:**
  - **GPS Reading:** 558916, 489486
  - **Province:** Ontario
  - **RR#/Street Number/Name:** 56-17
  - **City/Town/Village:** Kitchener
  - **Township/City/Town/Parish:** 1
  - **County/District/Municipality:** Waterloo
  - **Region of Water:** Brown Sand
  - **Limestone:** Grey Limestone
  - **Gravel:** Sand
  - **Shale:** Brown, Hard, Dark Layers
- **Mode of Operation:** Undifferentiated
- **Long Status of Well:** Open hole

#### Well Record

- **Well Test:**
  - **Pumping test method:**
    - **Draw Down:**
      - **Depth:** Metres
      - **Time:** Hours
      - **Water Level:** Metres
    - **Recovery:**
      - **Depth:** Metres
      - **Time:** Hours
      - **Water Level:** Metres

- **Plugging and Sealing Record:**
  - **Method of Construction:**
    - **Casing:**
      - **Material:** Steel
      - **Thickness:** 0.556
      - **Slot No.:** 0
      - **Screen:**
        - **Material:** Steel
        - **Thickness:** 0.556
        - **Slot No.:** 0
  - **Cement:**
    - **Volume Placed:** (cubic metres)

- **Location of Well:**
  - **Address:**
    - **Street:** 56-17
    - **City:** Kitchener
    - **Province:** Ontario
    - **ZIP Code:**
    - **Telephone Number:**

- **Well Contractor:**
  - **Name:** Gerrits Drilling & Eng. Ltd.
  - **Well Driller's Licence No.:** 3406

- **Date Well Completed:**
  - **Date:** 08/2006

- **Ministry Use Only:**
  - **Date Delivered:**
  - **Date of Inspection:**
  - **Date Well Completed:**
  - **Data Delivered:**
  - **Well Record Number:**

- **Data Source:**
  - **Contractor:**
  - **Well Record Number:**

- **Remainder:**
  - **Well Driller's Licence No.:**
  - **Well Driller’s Licence No.:**

---

**Note:** This document is a permanent legal document. Please retain for future reference.

---

**Ministry of the Environment**

---

**Well Owner's Copy**

---

**Region of Water:**
- Brown Sand
- Limestone
- Grey Limestone
- Gravel
- Shale

**Mode of Operation:**
- Undifferentiated

**Long Status of Well:**
- Open hole

**Pumping test method:**
- **Draw Down:**
  - **Depth:** Metres
  - **Time:** Hours
  - **Water Level:** Metres
- **Recovery:**
  - **Depth:** Metres
  - **Time:** Hours
  - **Water Level:** Metres

**Plugging and Sealing Record:**
- **Method of Construction:**
  - **Casing:**
    - **Material:** Steel
    - **Thickness:** 0.556
    - **Slot No.:** 0
    - **Screen:**
      - **Material:** Steel
      - **Thickness:** 0.556
      - **Slot No.:** 0
  - **Cement:**
    - **Volume Placed:** (cubic metres)

**Location of Well:**
- **Address:**
  - **Street:** 56-17
  - **City:** Kitchener
  - **Province:** Ontario
  - **ZIP Code:**
  - **Telephone Number:**

**Well Contractor:**
- **Name:** Gerrits Drilling & Eng. Ltd.
- **Well Driller's Licence No.:** 3406

**Date Well Completed:**
- **Date:** 08/2006

**Ministry Use Only:**
- **Date Delivered:**
- **Date of Inspection:**
- **Date Well Completed:**
- **Data Delivered:**
- **Well Record Number:**

**Data Source:**
- **Contractor:**
- **Well Record Number:**

**Remainder:**
- **Well Driller's Licence No.:**
- **Well Driller’s Licence No.:**
A: Screen from 255' to 355'
B: Screen from 160' to 180'
C: Screen from 124' to 134'

All pipe and screen is 5.08 cm diameter PVC
Well Tag Number: A026412

Ontario Ministry of the Environment

Well Record
Regulation 903 Ontario Water Resources Act

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- All metre measurements shall be reported to 1/10th of a metre.
- Please print clearly in blue or black ink only.

Well Owner's Information and Location of Well Information

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name (First Name)</td>
<td></td>
</tr>
<tr>
<td>Name (Last Name)</td>
<td></td>
</tr>
<tr>
<td>Mailing Address (Street Name)</td>
<td></td>
</tr>
<tr>
<td>Province</td>
<td>Ontario</td>
</tr>
<tr>
<td>Township</td>
<td></td>
</tr>
<tr>
<td>Contact Phone</td>
<td></td>
</tr>
</tbody>
</table>

Log of Overburden and Bedrock Materials (see instructions)

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most common material</th>
<th>General Description</th>
<th>Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey Limestone</td>
<td></td>
<td></td>
<td>43.89</td>
</tr>
<tr>
<td>Brown Limestone</td>
<td></td>
<td></td>
<td>54.55</td>
</tr>
<tr>
<td>Grey Limestone</td>
<td></td>
<td></td>
<td>61.87</td>
</tr>
<tr>
<td>Green Shale</td>
<td></td>
<td></td>
<td>125.57</td>
</tr>
<tr>
<td>Grey Shale</td>
<td></td>
<td></td>
<td>125.88</td>
</tr>
</tbody>
</table>

Hole Diameter

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Diameter (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
</tr>
<tr>
<td>0.00</td>
<td>125.57</td>
</tr>
<tr>
<td>1.25</td>
<td>126.49</td>
</tr>
</tbody>
</table>

Construction Record

<table>
<thead>
<tr>
<th>Material</th>
<th>Wall Thickness (m)</th>
<th>Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Plastic</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Concrete</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Galvanized</td>
<td></td>
<td>7</td>
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</table>

Water Record

<table>
<thead>
<tr>
<th>Water Level</th>
<th>Draw Down Time (min)</th>
<th>Recovery Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pumping</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test of Well Yield

<table>
<thead>
<tr>
<th>Pumping Test Method</th>
<th>Draw Down Water Level</th>
<th>Recovery Water Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumping rate (l/min)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of pumping (hr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final water level of pumping (m)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended pump type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended pump depth (m)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended pump rate (l/min)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If flowing give valve rating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If pumping discontinued, give reason</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Location of Well

<table>
<thead>
<tr>
<th>Source</th>
<th>Date Well Completed</th>
<th>Date Delivered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Well Contractor/Technician Information

<table>
<thead>
<tr>
<th>Name of Well Contractor</th>
<th>Well Contractor's Licence No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Address</td>
<td></td>
</tr>
<tr>
<td>Name of Well Technician</td>
<td>Well Technician's Licence No.</td>
</tr>
<tr>
<td>Signature of Technician</td>
<td>Date Submitted</td>
</tr>
</tbody>
</table>

Well Owner's Copy

Ministry Use Only

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Contractor</th>
<th>Date Received</th>
<th>Date of Inspection</th>
<th>Remarks</th>
<th>Well Record Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Observation Well Construction

PAW 1 - B, C - 06

- Sand-Bentonite Sand
- 1" Steel Casing
- Bentonite Grout
- Top of Grouting @ 113' 6"
- 3" casing to 116' 11"
- Hole Plug
- 400' hole Plug
- Gravel/Sand
- Hole Plug
- 400'
- Rock Fill
- Rock Fill
- TDR Weber

Bottom to 378' - Rock Fill

378' to 368' - Hole Plug
368' to 356' - Other Sand - Piece 'A' Screen from 298 to 388' 0" 356' to 333' - Other Sand - Piece 'A' Screen from 298 to 388' 0"
333' to 331' - Gravel/Sand
331' to 193.5' - Hole Plug
193.5' to 153.5' - 6.15% Sand - Piece 'B' Screen from 158' to 178' 0"
153.5' to 136' - Hole Plug
136' to 111' - Other Sand - Piece 'C' Screen from 121' to 131.9' 0"
111' to 109' - Hole Plug
109' to 0' - Bentonite Sand
Well Record

Regulation 903 Ontario Water Resources Act

Well Tag Number: A026012

Well Owner's Information and Location of Well Information

County/District/Municipality: Wellington

Provincial Region/Zone: 2

Latitude/Longitude: N44°01'21.6" W80°35'38.7"

Region of Use: Ontario

Well: Deep Well

Method of Construction: Rotary (reverse)

Drill Rig: megellan

Well Record Number: 813-1559281511

GPS Reading: 81 14 50

City/Town/Neighbourhood: Grand Valley

Water Well Help Desk: 1-888-396-9355

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Well Owner's Copy

Cette formule est disponible en français
**Well Tag Number:** A026012

---

**Ministry Use Only**

- **MIN:**
- **CON:**
- **LOT:**
- **CON:**

---

**Well Owner's Information and Location of Well Information**

- **Name of Well Technician:** Qastname, First Name
- **Address of Well Location:** Kitchener, Ontario
- **RR#/Lot:** 150 Frederick St.
- **Provincial Court Number:** 443
- **Postal Code:** N5G 4J3
- **Telephone Number:**

---

**Well Log**

- **Region of Water Use:**
- **Well Location (County/District/Municipality):** Wellington
- **Well Tag Number:** ON026012
- **Lot:** 1
- **Concession:** 0
- **Site/Compartment/Block/Tract:**

---

**Log of Overburden and Bedrock Materials (see instructions)**

- **General Colour:** Brown, Clay
- **Most common material:** Sand
- **Other Materials:**

---

**Water Record**

- **Depth:** 0
- **To:** 22.68
- **Diameter:** 7.67

---

**Construction Record**

<table>
<thead>
<tr>
<th>Depth (metres)</th>
<th>Material</th>
<th>Wall Thickness (centimetres)</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Steel</td>
<td>0.635</td>
<td>0</td>
<td>19.81</td>
</tr>
<tr>
<td>Screen</td>
<td>Concrete</td>
<td>0.60</td>
<td>0</td>
<td>19.81</td>
</tr>
</tbody>
</table>

---

**Pumping Well Yield**

- **Pump Intake:** (metres)
- **Duration of pumping:** (hours)
- **Final water level and pumping rate:** (litres/min)
- **Recommended pump type:**
- **Recommended pump depth:** (metres)
- **Recommended pump rate:** (litres/min)
- **If flowing:**
- **Recommended pump rate:** (litres/min)
- **If discontinuing:**
- **recommended pump rate:** (litres/min)

---

**Method of Construction**

- **Cable Tool:**
- **Rotary (conventional):**
- **Rotary (reverse):**

---

**Well Contractor/Technician Information**

- **Name of Well Contractor/Technician:** Morriss, R
- **Well Contractor's Licence No.:** 22

---

**Well Owner's Copy**
Well Owner's Information and Location of Well Information

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region of Waterloo</td>
<td>Wellington</td>
</tr>
<tr>
<td>County/District/Municipality</td>
<td>Township/City/Town/Village: Kitchener</td>
</tr>
<tr>
<td>Postal Code</td>
<td>Ontario: N2G 4J3</td>
</tr>
<tr>
<td>Street Address</td>
<td>150 Fredrick St.</td>
</tr>
<tr>
<td>City/Town/Village</td>
<td>Puslinch</td>
</tr>
<tr>
<td>Telephone Number</td>
<td>(486)6666</td>
</tr>
<tr>
<td>Authority</td>
<td>RRA/Street Name/Number</td>
</tr>
<tr>
<td>GPS Reading</td>
<td>North</td>
</tr>
<tr>
<td>Utility Make/Model</td>
<td>Water Well</td>
</tr>
<tr>
<td>Model of Operation</td>
<td>Unflagged</td>
</tr>
</tbody>
</table>

Log of Overburden and Bedrock Materials (see instructions)

<table>
<thead>
<tr>
<th>Layer</th>
<th>Most common material</th>
<th>General Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>Clay</td>
<td>Most common material</td>
</tr>
<tr>
<td>Brown</td>
<td>Sand</td>
<td>Boulders</td>
</tr>
<tr>
<td>Grey</td>
<td>Clay</td>
<td>Till</td>
</tr>
<tr>
<td>Grey</td>
<td>Gravel</td>
<td>Others, specify</td>
</tr>
</tbody>
</table>

Test of Well Yield

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water level</td>
<td>0</td>
</tr>
<tr>
<td>Draw Down</td>
<td>3.04</td>
</tr>
<tr>
<td>Recovery</td>
<td>3.04</td>
</tr>
<tr>
<td>Pumping test method</td>
<td>Draw Down</td>
</tr>
<tr>
<td>Water level</td>
<td>8.62</td>
</tr>
<tr>
<td>Pump intake set at</td>
<td>0.635</td>
</tr>
<tr>
<td>Pumping rate</td>
<td>2</td>
</tr>
<tr>
<td>Duration of pumping</td>
<td>2</td>
</tr>
<tr>
<td>Final water level at end of pumping</td>
<td>3.04</td>
</tr>
<tr>
<td>Recommended pump type</td>
<td>4</td>
</tr>
<tr>
<td>Recommended pump depth</td>
<td>5</td>
</tr>
<tr>
<td>Recommended pump rate</td>
<td>5</td>
</tr>
<tr>
<td>Throttling rate</td>
<td>10</td>
</tr>
<tr>
<td>If pumping discontinued, give reason</td>
<td>10</td>
</tr>
</tbody>
</table>

Well Owner's Copy

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**Ontario Ministry of the Environment**

**Well Record**

**Regulation 903 Ontario Water Resources Act**

**Page 1 of 2**

---

**Well Owner’s Information and Location of Well Information**

- **Region of Waterloo**
- **Well Owner’s Information and Location of Well**
  - **First Name:**
  - **Last Name:**
  - **Making Address (Street Number/Name, RR, Lot, Concession):**
  - **Province:**
  - **Phone Number (include area code):**
  - **Township:**
  - **Lot:**
  - **Concession:**
  - **Name of Well Contractor:**
  - **Well Contractor’s Licence No.:**

**Log of Overburden and Bedrock Materials (see instructions)**

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most Common Material</th>
<th>Other Material</th>
<th>General Description</th>
<th>Depth</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown Sand</td>
<td>Clay, Stones</td>
<td></td>
<td></td>
<td>0</td>
<td>6.096</td>
</tr>
<tr>
<td>Brown Clay</td>
<td></td>
<td></td>
<td></td>
<td>3.05</td>
<td>6.096</td>
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<tr>
<td>Brown Sand</td>
<td></td>
<td></td>
<td></td>
<td>6.096</td>
<td>9.144</td>
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<tr>
<td>Brown Clay</td>
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<td>Grey Sand</td>
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<td>12.192</td>
<td>19.81</td>
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<tr>
<td>Grey Sand</td>
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<td>19.81</td>
<td>21.33</td>
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<tr>
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<td>23.47</td>
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<tr>
<td>Grey Sand</td>
<td></td>
<td></td>
<td></td>
<td>23.47</td>
<td>29.26</td>
</tr>
</tbody>
</table>

---

**Location of Well**

- **Region:**
- **Mailing Address (Street Number/Name, RR, Lot, Concession):**
- **City/Town/NAG:**
- **Region:**
- **Ministry Use Only:**

---

**Method of Construction**

- **Final Status of Well:**
  - **Package delivered?:**
  - **Date Delivered:**

---

**Well Owner’s Copy**

Cette formule est disponible en français.
Well Owner's Information and Location of Well Information

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most common material</th>
<th>Other Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey/Brown</td>
<td>Limestone</td>
<td></td>
</tr>
<tr>
<td>Grey</td>
<td>Limestone</td>
<td></td>
</tr>
<tr>
<td>Grey/Brown</td>
<td>Limestone</td>
<td></td>
</tr>
<tr>
<td>Grey</td>
<td>Limestone</td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>Limestone</td>
<td></td>
</tr>
<tr>
<td>Grey</td>
<td>Limestone</td>
<td></td>
</tr>
<tr>
<td>Grey/Brown</td>
<td>Limestone</td>
<td></td>
</tr>
<tr>
<td>Grey</td>
<td>Limestone</td>
<td></td>
</tr>
</tbody>
</table>

---

Well Owner's Copy

---

Well Tag Number (Place sticker and print number below)

---

Well Record

---

Regulation 903 Ontario Water Resources Act

---

Ministry Use Only

---

Instructions for Completing Form

---

For use in the Province of Ontario only. This document is a permanent legal document. Please retain for future reference.

---

All Sections must be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.

---

Questions regarding completing this application can be directed to the Water Well Help Desk (Toll Free) at 1-888-396-8885.

---

Gette formule est disponible en français

---

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---

Ministry Use Only

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Well Owner's Copy

---

Cet formulaire est disponible en français.
Instructions for Completing Form

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- All Sections must be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Help Desk (Toll Free) at 1-888-396-9355.
- All Sections must be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Please print clearly in blue or black ink only.

Well Tag Number (Place sticker and print number below)

Well Record
Regulation 903 Ontario Water Resources Act

Well Owner's information and Location of Well Information

First Name
Last Name
Mailing Address (Street Name/Number, RR, Lot, Concession)

County/District/Municipality
Township/City/Town/Village
Province
Postal Code
Telephone Number

Business Address (street name, number, city... etc.),
Signature of Technician/Contractor

Well Name

Log of Overburden and Bedrock Materials (see instructions)

General Colour
Most common material
Other Materials

Test of Well Yield

Pumping test method

Draw Down
Recovery

Time
Water Level
Time
Water Level

Pump intake set at - (metres)
Pumping rate - (litres/min)
Duration of pumping - (hrs)
Final water level end of pumping - (metres)
Recommended pump type
Recommended pump depth - (metres)
Recommended pump rate - (litres/min)
Flowing give rate - (litres/min)
If pumping discontinued, give reason.

No Casing or Screen

Water Record

Kind of Water
Water found at:

m Fresh
Gas
Silty
Minerals
Gas
Fresh
Minerals
Gas
Silty

Water Use

Regulation 903 Ontario Water Resources Act

Method of Construction

Cable Tool
Rotary (air)
Rotary (reverse)
Drilling

Environnement

Well Contractor/Technician Information

Name of Well Contractor
Well Contractor's Licence No.

Business Address (street name, number, city etc.)

Name of Well Technician (last name, first name)

Well Technician's Licence No.

Signature of Technician/Contractor
Date Submitted

Well Owner's Copy

Ontario Ministry of the Environment
**Well Record**

**Well Tag Number**: A026006

**Regulation**: 903 Ontario Water Resources Act

---

**Well Owner's Information and Location of Well Information**

- **First Name Last Name**: Smith, John
- **Address of Well Location**: 123 Elm St, Kitchener, Ontario
- **Telephone Number**: (555) 123-4567

---

**Log of Overburden and Bedrock Materials (see instructions)**

<table>
<thead>
<tr>
<th>Hole Diameter</th>
<th>Material</th>
<th>General Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 in</td>
<td>Sand</td>
<td>Clear and sediment free</td>
</tr>
<tr>
<td>10 in</td>
<td>Clay</td>
<td>Clear and sediment free</td>
</tr>
</tbody>
</table>

---

**Construction Record**

- **Well Diameter**: 8 in
- **Wall Thickness**: 0.588 in

---

**Pumping and Sealing Record**

<table>
<thead>
<tr>
<th>Depth (metres)</th>
<th>Diameter (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.05</td>
</tr>
<tr>
<td>3.05</td>
<td>0.29</td>
</tr>
<tr>
<td>7.07</td>
<td>0.02</td>
</tr>
<tr>
<td>19.88</td>
<td>0.10</td>
</tr>
</tbody>
</table>

---

**Well Record - Draw Down**

- **Draw Down Metres**: 0.05
- **Draw Down Time (min)**: 30
- **Draw Down Rate (litres/min)**: 5

---

**Well Record - Recovery**

- **Recovery Metres**: 0.05
- **Recovery Time (min)**: 30
- **Recovery Rate (litres/min)**: 5

---

**Well Record - Draw Down**

- **Draw Down Metres**: 0.05
- **Draw Down Time (min)**: 30
- **Draw Down Rate (litres/min)**: 5

---

**Well Record - Recovery**

- **Recovery Metres**: 0.05
- **Recovery Time (min)**: 30
- **Recovery Rate (litres/min)**: 5

---

**Location of Well**

- **Address**: 123 Elm St, Kitchener, Ontario
- **Telephone Number**: (555) 123-4567

---

**Well Owner's Copy**

*Cette formule est disponible en français*
**Well Owner's Copy**

**Regulation 903 Ontario Water Resources Act**

---

**Well Owner's Information and Location of Well Information**

- **First Name:** [Redacted]
- **Last Name:** [Redacted]
- **Address:** 150 Frederick St., Kitchener, ON N2G 4O3
- **City:** [Redacted]
- **Postal Code:** [Redacted]
- **Telephone Number:** [Redacted]

**Log of Overburden and Bedrock Materials (see instructions)**

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most common material</th>
<th>Other Materials</th>
<th>General Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown Sand</td>
<td>Clay, Stones</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Clay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Sand</td>
<td>Gravel, Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grey Sand</td>
<td>Silt</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Construction Record**

- **Inside diameter:** 0.588 m
- **Wall thickness:** 0.5 m
- **Depth:** 14.02 m

---

**Pumping Test Method**

- **Draw Down:** 1 m
- **Recovery:** 1 m

---

**Method of Construction**

- **Cable Test:** Diamond
- **Rotary (conventional):** Diamond
- **Rotary (reverse):** Diamond

---

**Method of Construction**

- **Cable Test:** Diamond
- **Rotary (conventional):** Diamond
- **Rotary (reverse):** Diamond

---

**Well Owner's Copy**

- **Well Tag Number:** [Redacted]
- **Date:** [Redacted]

---

**Well Contractor/Technician Information**

- **Name:** [Redacted]
- **Business Address (street name, number, city etc.):** [Redacted]

---

**Well Owner's Information and Location of Well Information**

- **Region of Waterloo**
- **County/District/Municipality:** Wellington
- **Township:** East Gwillimbury
- **Lot:** [Redacted]
- **Concession:** [Redacted]

---

**General Description**

- **Spillage:** [Redacted]
- **Remarks:** [Redacted]
Ontario

Well Record

Instructions for Completing Form:
- For use in the Province of Ontario only. This document is a permanent legal document. Please retain for future reference.
- All Sections must be completed. Failure to complete this section may result in rejection of application.
- Questions regarding completion of this application can be directed to the Water Well Management Coordinator at 416-235-6400.

Well Owner's Information and Location of Well Information

County\District\Municipality: (current)
Address of Well Location (Community, Township, Etc.): (current)
Phone Number: (current)

Log of Overburden and Bedrock Materials (see instructions)

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Mask controls</th>
<th>Other Material</th>
<th>General Description</th>
<th>Depth</th>
<th>Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEN SANDS</td>
<td></td>
<td></td>
<td></td>
<td>0.6</td>
<td>10.7</td>
</tr>
<tr>
<td>BEN SANDS</td>
<td></td>
<td></td>
<td></td>
<td>0.6</td>
<td>10.7</td>
</tr>
</tbody>
</table>

Plugging and Sealing Record

<table>
<thead>
<tr>
<th>Depth From</th>
<th>Date</th>
<th>Method</th>
<th>Well Diameter</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6</td>
<td>2005-07-10</td>
<td>Concreting</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>0.6</td>
<td>2005-07-10</td>
<td>Screwing</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>0.6</td>
<td>2005-07-10</td>
<td>Cementing</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>0.6</td>
<td>2005-07-10</td>
<td>Screwing</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Location of Well

Method of Construction

<table>
<thead>
<tr>
<th>Type</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>Screwing</td>
</tr>
<tr>
<td>Screwing</td>
<td>Screwing</td>
</tr>
<tr>
<td>Screwing</td>
<td>Screwing</td>
</tr>
<tr>
<td>Screwing</td>
<td>Screwing</td>
</tr>
</tbody>
</table>

Well Completion Information

<table>
<thead>
<tr>
<th>Date of Completion</th>
<th>Well Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-07-10</td>
<td>6</td>
</tr>
</tbody>
</table>

Well Drilled by

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Well Record Number

<table>
<thead>
<tr>
<th>Well Number</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>053780</td>
<td>2005-07-10</td>
</tr>
</tbody>
</table>

Water Well Management Coordinator

<table>
<thead>
<tr>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>416-235-6400</td>
</tr>
</tbody>
</table>
**Ontario**

**Well Record**

**Well ID:** A053781

**Well Location:** 40-53-5 W2

**Well Type:** 00

**Owner's Information and Location of Well Information**

- **Well Number:** A053781
- **Owner:** A053781
- **Location:** 40-53-5 W2

**Well Log and Geotechnical Information**

### Log of Overburden and Screen Materials (see instructions)

**General Order:** Sand

<table>
<thead>
<tr>
<th>Overburden/Screen Material</th>
<th>Depth (m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sand</strong></td>
<td>0.25-0.106</td>
<td></td>
</tr>
</tbody>
</table>

### Well Characteristics

- **Total Depth:** 0.106 m
- **Screen:** 0.25-0.106 m

### Construction Record

- **Completion Method:** None
- **Screen:** None

### Plugging and Sealing Record

- **Plugging:** None
- **Sealing:** None

### Well Information

- **Well Number:** A053781
- **Owner:** A053781
- **Location:** 40-53-5 W2

**Notes:**

- **Plugging:** None
- **Sealing:** None

---

**Location of Well:**

- **Water Source:** Groundwater
- **Distance:** 0.106 m
- **Screen:** None

**Well Completion:**

- **Method of Completion:** None
- **Screen:** None

**Well Construction Information:**

- **Well Type:** 00
- **Owner:** A053781
- **Location:** 40-53-5 W2

---

**Well Log and Geotechnical Information:**

- **Overburden:** Sand
- **Screen:** None

---

**Well Completion:**

- **Method of Completion:** None
- **Screen:** None

**Well Construction Information:**

- **Well Type:** 00
- **Owner:** A053781
- **Location:** 40-53-5 W2
**Well Tag No.:** A053781  
**Province:** ON

**Well Owner's Information**

- **First Name:**  
- **Last Name / Organization:**  
- **E-mail Address:**  
- **Postal Code:** N2H 4J3

**Well Location**

- **Address:**  
- **City:**  
- **Postal Code:** N2H 4J3

**Surrounding Geographical Information**

- **Latitude:**  
- **Longitude:**  
- **Ownership:**

**Well Details**

- **Drilled:**
- **Reused:**
- **Abandoned:**
- **Producing:**
- **Screen:**
- **Water Use:**
- **Hydrology:**
- **Method of Construction:**
- **Volume:**

**Well Yield Testing**

- **Date:**
- **Volume:**
- **Time:**
- **Water Level:**
- **State Level:**
- **Recovery:**

**Well Details**

- **Well details:**
- **Meters:**
- **Temperature:**
- **Depth:**
- **Diameter:**

**Well Contractor and Well Technician Information**

- **Business Name:**
- **Business Address:**
- **Well Driller:**
- **Well Driller's License No.:**

**Well Records**

- **Date Package Delivered:**
- **Date Work Completed:**
- **Ministry Use Only:**

**Comments:**
Abandonment of 1.5" PVC well PLOW2-06-B

4" surface casing removed

Bentonite chips 6.72 0.5

Natural 0.5 0.0

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

Well Location

Mailing Address (Street Number/Name)
158 Frederick St 7th Floor Waterloo
Ontario N2L 5J3 6195754152

Property Address: 158 Frederick St, 7th Floor, Waterloo, ON N2L 5J3

Municipality: Waterloo

Water Level

Tolerance: 5" 2.0 1.0

Measurements recorded in: Metric

All measurements from ground level.

Annular Space

Depth Set at (m/f)
From
To
Type of Segment Used (Material and Type)
Volume Recorded (m³/ft³)

Method of Construction

Well Use

Calcite Tool
Diamond
Rotary (Convex) Jigging
Rotary (Reverse) Drilling
Drilling
Jetting
Other, specify

Public
Commercial
Domestic
Municipal
Recreational
Livestock
Test Hole
Monitoring
Ingestion
Cooking & Air Conditioning
Industrial
Other, specify

Casing Record - Casing

Open Hole CR Material (Galvanized Pipe, Concrete, Plastic, Steel)
Well Thickness (cm)
Depth (m/ft)

Wells Supply
Replenishment Well
Test Hole
Recharge Well
Developer Well
Observation and/or Monitoring Hole
Alteration (Construction)
Abandoned, Insufficient Supply
Abandoned, Poor Water Quality
Abandoned, other, specify

Status of Well

Water found at Depth
Kind of Water
Future: Unaffected
Depth (m/ft)

Water found at Depth
Kind of Water
Future: Unaffected
Gas
Other, specify

Water found at Depth
Kind of Water
Fresh: Unaffected
Gas
Other, specify

Water found at Depth
Kind of Water
Fresh: Unaffected
Gas
Other, specify

Hole Diameter

Water Details

Ministry of the Environment

Well Record

Regulation 903 Ontario Water Resources Act

Well Owner's Information

First Name
E-mail Address

Region of Waterloo
Municipality: Waterloo
Province: Ontario
Postal Code: N2L 3J4

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

Well Contractor and Well Technician Information

Business Name of Well Contractor: WELI Initiatives Ltd
Business Address (Street Number/Name): 107 Town Line Rd Orangeville
Ontario L9V 2Z9

Well Contractor's License No. 721
Municipality: Orangeville
Province: Ontario
Postal Code: L9V 2Z9

Bus/Telephone No. (inc. area code): 519-846-8289

Well Technician's License No. 12345678901234567890

Comments:

Well owner's Information package dabei

Date Package Delivered: 2011-01-15

Date Work Completed: 2011-01-15

Ministry Use Only

Audit No. 2159327

Ministry's Copy

© Queen's Printer for Ontario, 2004
**BOREHOLE LOG OF: PLGW2-06**

**LOCATION:** N 49°09'57" W 2°30'39.4"

**DRILLING DATE:** August 13, 2006

**DRILLING:** Direct Push with Continuous Suction

**DRILLING CONTRACTOR:** Sten-Gut Sampling Inc.

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>Ground Surface</td>
</tr>
<tr>
<td>2.0</td>
<td>Sand and gravel</td>
</tr>
<tr>
<td>4.0</td>
<td>gravel and fine sand, some gravel</td>
</tr>
<tr>
<td>6.0</td>
<td>gravel and medium to coarse gravel</td>
</tr>
<tr>
<td>7.5</td>
<td>Fine to medium gravel, some fine sand</td>
</tr>
<tr>
<td>9.5</td>
<td>Fine to coarse gravel, some fine sand</td>
</tr>
<tr>
<td>12.0</td>
<td>Medium to coarse sand, some gravel</td>
</tr>
<tr>
<td>15.0</td>
<td>sand and gravel</td>
</tr>
<tr>
<td>19.0</td>
<td>End of Borehole</td>
</tr>
</tbody>
</table>

**GEOLOGICAL RECORD**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Diameter (mm)</th>
<th>Conductivity (mS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>280</td>
<td>0.1</td>
</tr>
<tr>
<td>4.0</td>
<td>280</td>
<td>0.1</td>
</tr>
<tr>
<td>6.0</td>
<td>280</td>
<td>0.1</td>
</tr>
<tr>
<td>7.5</td>
<td>280</td>
<td>0.1</td>
</tr>
<tr>
<td>9.5</td>
<td>280</td>
<td>0.1</td>
</tr>
<tr>
<td>12.0</td>
<td>280</td>
<td>0.1</td>
</tr>
<tr>
<td>15.0</td>
<td>280</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**GEO-METRY**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>A</td>
</tr>
<tr>
<td>2.0</td>
<td>B</td>
</tr>
<tr>
<td>4.0</td>
<td>C</td>
</tr>
<tr>
<td>6.0</td>
<td>D</td>
</tr>
<tr>
<td>7.5</td>
<td>E</td>
</tr>
<tr>
<td>9.5</td>
<td>F</td>
</tr>
<tr>
<td>12.0</td>
<td>G</td>
</tr>
<tr>
<td>15.0</td>
<td>H</td>
</tr>
</tbody>
</table>

**LOGGED:** [Signature]

**CHECKED:** [Signature]
**Ontario Ministry of the Environment**

**Well Tag Number (Enter and print number below)**

A 046-0-77

**Regulation 903 Ontario Water Resources Act**

**Well Record**

---

**Log of Overburden and Bedrock Materials (see instructions)**

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most common material</th>
<th>Other materials</th>
<th>General Description</th>
<th>Depth</th>
<th>Area To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>3.1</td>
<td>5.74</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>N 43° 37' 245' W 079° 31' 894'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Hole Diameter**

<table>
<thead>
<tr>
<th>Depth From</th>
<th>Depth To</th>
<th>Diameter Centimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7.32</td>
<td>80</td>
</tr>
</tbody>
</table>

---

**Water Record**

<table>
<thead>
<tr>
<th>Kind of Water</th>
<th>m</th>
<th>Gas</th>
<th>Other</th>
<th>m</th>
<th>Gas</th>
<th>Other</th>
<th>m</th>
<th>Gas</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td></td>
<td>Fresh</td>
<td>Sulphur</td>
<td></td>
<td>Fresh</td>
<td>Sulphur</td>
<td></td>
<td>Fresh</td>
<td>Sulphur</td>
</tr>
<tr>
<td>Saturated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manganese</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Construction Record**

<table>
<thead>
<tr>
<th>Inside diam Centimeters</th>
<th>Material</th>
<th>Wall thickness Centimeters</th>
<th>Depth From</th>
<th>Depth To</th>
</tr>
</thead>
<tbody>
<tr>
<td>381</td>
<td>Steel</td>
<td>Galvanised</td>
<td>0.25</td>
<td>0.54</td>
</tr>
<tr>
<td></td>
<td>Fibreglass</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Test of Well Yield**

<table>
<thead>
<tr>
<th>Pumping test method</th>
<th>Draw Down Time Water Level</th>
<th>Recovery Time Water Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mesures</td>
<td>Mesures</td>
</tr>
<tr>
<td></td>
<td>0.25</td>
<td>7.32</td>
</tr>
</tbody>
</table>

---

**Pumping rate**

<table>
<thead>
<tr>
<th>Pumping rate (t/min)</th>
<th>Final water level of pumping</th>
<th>Recommended pump rate (t/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

---

**Location of Well**

In diagrams below show distances of well from road, lot line, and building impede view by yours.

---

**Well Contractor/Technician Information**

**Well Tag Number**

A 046-0-77

**Signature of Technician**

F. P. Penix

**Ministry Use Only**

**Data Source**

**Well Number**

72 41

**Remarks**

Wall Number Report
Well Owner's Information

First Name: Gerri
Last Name: ts

Region of Waterloo
Mailing Address (Street Name/Number, RR):
C. Box 128, 150 Frederick St.
Business Address (Street No./Name, number, RR):
C. Box 128, 150 Frederick St.
Business Name of Well Contractor:
Gerriers Drilling Co.

Well Owner's Information

Well Record

Regulation 903 Ontario Water Resources Act

Well Tag No. A 051739

Part A Construction and/or Major Alteration of a Well

Address of Well Location (Street Name/Number, RR):
C. Box 128, 150 Frederick St.
Province:
Ontario
City/Town/Village:
Humby

Business Name of Well Contractor:
Gerriers Drilling Co.

Well Owner's Information

Well Record

Regulation 903 Ontario Water Resources Act

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Regulation 903 Ontario Water Resources Act

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C. Box 128, 150 Frederick St.
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Ontario
City/Town/Village:
Humby

Business Name of Well Contractor:
Gerriers Drilling Co.
Well Owner's Information

First Name Last Name

Region of Waterloo

Municipality Kitchener

Well Address (Street Number/Name, RR)

Provincal ON Postal Code N2G 4J3 Telephone No. (inc. area code)

Part A Construction and/or Major Alteration of a Well

Address of Well Location (Street Number/Name, RR)

Wellington

County/District/Municipality

City/Town/Village

Provinclal ON Postal Code

OTM Coordinates

Zone

Easting

Northing

GPS Unit Make

Model

Mode of Operation: Undifferentiated: X Averaged

Overburden and Bedrock Materials (see instructions on the back of this form)

General Colour

Most Common Material

Other Materials

- Brown Sand

- Brown Sand

- Grey/Brown Limestone

- Grey Limestone

- Green Shale

- [Other, specify]

- [Other, specify]

- [Other, specify]

- [Other, specify]

- [Other, specify]

Annuil Space/Abandonment Sealing Record

Depth Set at (Metres) Volume Placed (Cubic Metres)

Type of Sealant Used

Depth Set at (Metres)

Water Yield Testing

Check box if all test of well yield, water was:

Clear and sand free

Cannot develop to sand-free state

Pumping test discontinued, gave reason

Pumping test method

Pump idles set at (Metres)

Pumping rate (L/min)

Duration of pumping

Initial water level end of pumping

Recommended pump type

Recommended pump rate (L/min)

Recommended pump depth

Water Level (Metres)

Recovery

Time (min)

Time (min)

Static Level

Draw Down

Recharge Well

Volume Placed

10.36

100.9

8.71

8.63

3

4

5

19

18.1

8.88

20

21

19

20

18.0

20.8

25

30

40

50

60

118.4

118.1

118.1

9.73

8.51

8.33

8.16

8.08

7.97

7.88

7.73

7.68

7.48

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**Well Record**

**Well Tag No.** AO56884

**Region of Waterloo**

**Name of Well Contractor**

**Address of Well Location**

**Date Submitted (yyyy/mm/dd)**

---

**Part A: Construction and Major Alteration of a Well**

**Address of Well Location**

**Province**

**Date Received (yyyy/mm/dd)**

**Business Address**

**City/Town/Village**

**UTM Coordinates**

**Zone**

**Zone Name**

**Zone Code**

**UTM Easting**

**UTM Northing**

**UTM Code**

**UTM Zone**

**UTM Zone Name**

**UTM Zone Code**

**GPS Unit Make**

**Model**

**GPS Unit Make**

**Model**

**UTM Easting**

**UTM Northing**

**UTM Zone**

**UTM Zone Name**

**UTM Zone Code**

**UTM Zone**

**UTM Zone Name**

**UTM Zone Code**

---

**Previously drilled 150mm diameter well.**

---

**Annuar Space/Abandonment Sealing Record**

**Depth Set at (Metres)**

**Type of Sealant Used**

**Volume Placed (Cubic Metres)**

---

**Method of Construction**

**Water Use**

---

**Status of Well**

---

**Location of Well**

---

**Well Contractor and Well Technician Information**

---

**Well Owner’s Copy**

---
**Overburden and Bedrock Materials/Abandonment Sealing Record**

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most Common Material</th>
<th>Other Materials</th>
<th>General Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>Sand</td>
<td>Gravel</td>
<td>Dry</td>
</tr>
<tr>
<td>Brown/Grey</td>
<td>Limestone/Dolostone</td>
<td>Layers</td>
<td>Wet</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depth (m/ft)</th>
<th>From</th>
<th>To</th>
<th>Cement</th>
<th>1.52</th>
</tr>
</thead>
</table>

**Annuar Space**

<table>
<thead>
<tr>
<th>Depth Set at (m/ft)</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6.7</td>
<td>7.03</td>
</tr>
</tbody>
</table>

**Method of Construction**

- Rotary (Conventional)
- Driving
- Digging
- Air percussion
- Other, specify

<table>
<thead>
<tr>
<th>Well Use</th>
<th>Commercial</th>
<th>Not Cred</th>
<th>Municipal</th>
<th>Not Cred</th>
<th>Not Cred</th>
<th>Not Cred</th>
<th>Not Cred</th>
<th>Not Cred</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Construction Record - Casing**

<table>
<thead>
<tr>
<th>Inside Diameter (inch)</th>
<th>Depth (m/ft)</th>
<th>Wall Thickness (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.48</td>
<td>0.952</td>
<td>+0.55 29.26</td>
</tr>
<tr>
<td>30.48</td>
<td></td>
<td>29.26</td>
</tr>
</tbody>
</table>

**Construction Record - Screen**

<table>
<thead>
<tr>
<th>Outside Diameter (inch)</th>
<th>Depth (m/ft)</th>
<th>Slot No.</th>
</tr>
</thead>
</table>

**Water Details**

<table>
<thead>
<tr>
<th>Water found at Depth (m/ft)</th>
<th>Kind of Water</th>
<th>Fresh</th>
<th>Untested</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>88</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Well Owner and Well Technician Information**

- Business Name: Drilling & Engineering Ltd.
- Business Address: 2515 1st Line, R.R. #1, Guelph, Ontario LION 1G0

**Map of Well Location**

Please provide a map below following instructions on the back.

**Well Contracgter and Well Technician Information**

- Business Name of Well Contractor: Drilling & Engineering Ltd.
- Well Contractor’s License No.: 3406
- Well Technician’s License No.: 2848
- Business Address (Street Number/Name): 2515 1st Line, R.R. #1, Guelph, Ontario LION 1G0
# Well Record

**Well Tag No:** A051677  
**Well Data:** SMTW-08  
**Well Location:** 400 Clyde Rd  
**Well Owner's Information:** Wellington  
**Province:** Ontario  
**Postal Code:** A051677  

### Overburden and Bedrock Materials

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most Common Material</th>
<th>Other Materials</th>
<th>General Description</th>
<th>Depth (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>Sand</td>
<td>Stones</td>
<td>0</td>
<td>16.76</td>
</tr>
<tr>
<td>Grey</td>
<td>Silt</td>
<td>Sand</td>
<td>16.7622.25</td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>Clay</td>
<td>Sand &amp; Limestone</td>
<td>22.2324.99</td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>Shale</td>
<td></td>
<td>24.99127.71</td>
<td></td>
</tr>
</tbody>
</table>

### Annular Space/Abandonment Sealing Record

- **Depth Set at:** 0  
- **Volume Filled:** 0.20

### Method of Construction

- **Type of Sealant:** Cement (hole dia. 25.4 cm)
- **Volume Filled:** 0.20

### Annular Space/Abandonment Sealing Record

- **Method of Construction:** Sand
- **Type of Sealant Used:** Sand
- **Volume Filled:** 0.20

### Results of Well Yield Testing

- **Volume:** 0.20
- **Water Level:** 16.76

### Status of Well

- **Method of Construction:** Sand
- **Type of Sealant Used:** Sand
- **Volume Filled:** 0.20

### Location of Well

- **Method of Construction:** Sand
- **Type of Sealant Used:** Sand
- **Volume Filled:** 0.20

### Water Details

- **Water found at Depth:** 29  
  - **Kind of Water:** Not Tested  
  - **Screen Used:** No

- **Water found at Depth:** 106  
  - **Kind of Water:** Not Tested  
  - **Screen Used:** No

### Casing Used

- **Casing:** Galvanized
- **Screen:** Galvanized

### Casing and Well Details

- **Depth of the Hole:** 15.71
- **Well Diameter:** 128.02
- **Well Thickness:** 4.77

### Well Contractor and Well Technician Information

- **Business Name:** Gerrits Drilling & Eng. Ltd
- **Well Contractor's Licence No.:** 3406
- **Business Address:** RR1 Grand Valley

### Ministry Use Only

- **Audit No.:** 75933  
- **Well Contractor No.:** 2009
## Well Owner's Information

<table>
<thead>
<tr>
<th>First Name</th>
<th>Last Name / Organization</th>
<th>E-mail Address</th>
<th>Province</th>
<th>Postal Code</th>
<th>Telephone No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional Municipality of Waterloo</td>
<td>Ministry of the Environment</td>
<td></td>
<td>ON</td>
<td>N1K 4J5</td>
<td></td>
</tr>
</tbody>
</table>

## Well Location

- Address: 456 Frederick St. 4th Floor, Kitchener, ON
- Province: Ontario
- Postal Code: N1K 4J5
- Telephone No.: (area code) 315 617-4444

### General Information

- **Well Tag No.:** A073946
- **Well Record No.:** 073946
- **Regulation:** 903 Ontario Water Resources Act
- **Page:** 1

## General Colour

- Most Common Material: Sand, silt
- Other Materials: Clay, sands, gravel, pebbles

## Overburden and Bedrock Materials/Abandonment Sealing Record

- **General Description:**
  - Depth: 0.8 ft
  - Color: Brown, silt

## Annular Space

- **Depth:**
  - Set at (m): 0.0
  - Type: Bentonite

## Method of Construction

- **Well Use:**
  - Type: Water Supply

## Well Record

- **Measurements recorded in:** Metric
- **Ended:** 3.81

## Well Owner's Information

- **First Name:**
- **Last Name:**
- **Organization:**
- **E-mail Address:**
- **Province:**
- **Postal Code:**
- **Telephone No.:**

## Well Location

- **Address of Well Location:**
- **City/Township:**
- **Municipality:**
- **Postal Code:**

## Construction Record - Casing

- **Depth (m):**
  - From: 0.0
  - To: 3.81

## Construction Record - Screen

- **Depth (m):**
  - From: 0.0
  - To: 3.81

## Water Details

- **Water found at Depth:**
  - Kind of Water: Fresh
  - Untested

## Well Contractor and Well Technician Information

- **Business Name of Well Contractor:**
- **Business Address (Street Name/Number):**
- **Province:**
- **Postal Code:**
- **Business E-mail Address:**

## Well Record Information

- **Ministry of the Environment:**
- **Well Tag No.:** A073946
- **Well Record No.:** 073946
- **Regulation:** 903 Ontario Water Resources Act
- **Page:** 1

## Well Owner's Information

- **First Name:**
- **Last Name:**
- **Organization:**
- **E-mail Address:**
- **Province:**
- **Postal Code:**
- **Telephone No.:**

## Well Location

- **Address of Well Location:**
- **City/Township:**
- **Municipality:**
- **Postal Code:**

## General Colour

- **Most Common Material:**
- **Other Materials:**

## Overburden and Bedrock Materials/Abandonment Sealing Record

- **General Description:**
  - Depth: 0.8 ft
  - Color: Brown, silt

## Annular Space

- **Depth:**
  - Set at (m): 0.0
  - Type: Bentonite

## Method of Construction

- **Well Use:**
  - Type: Water Supply

## Well Record

- **Measurements recorded in:** Metric
- **Ended:** 3.81

## Well Owner's Information

- **First Name:**
- **Last Name:**
- **Organization:**
- **E-mail Address:**
- **Province:**
- **Postal Code:**
- **Telephone No.:**

## Well Location

- **Address of Well Location:**
- **City/Township:**
- **Municipality:**
- **Postal Code:**

## General Colour

- **Most Common Material:**
- **Other Materials:**

## Overburden and Bedrock Materials/Abandonment Sealing Record

- **General Description:**
  - Depth: 0.8 ft
  - Color: Brown, silt
### Well Owner's Information
- **First Name**: [Redacted]
- **Last Name**: [Redacted]
- **Organization**: Regional Municipality of Waterloo

### Well Location
- **Address of Well Location**: Shade's Mills Conservation Area - 156 Avenue Road
- **County/Division/Municipality**: Waterloo

### Coordinates
- **UTM Coordinates**: [Redacted]

### Well Owner's Information
- **Address of Mailing Address**: [Redacted]
- **City**: Cambridge
- **Province**: Ontario

### Well Information
- **UTM X**: [Redacted]
- **UTM Y**: [Redacted]
- **Latitude**: [Redacted]
- **Longitude**: [Redacted]

### UTM Zone Details
- **Zone Easting**: [Redacted]
- **Zone Northing**: [Redacted]

### General Description
- **Depth (m)**: 9.94
- **Depth (ft)**: 32.7
- **Type of Sealant Used**: [Redacted]

### Annular Space
- **Volume Placed (m³)**: [Redacted]

### Construction Record - Casing
- **Inside Diameter (inch)**: [Redacted]
- **Material (Plastic, Galvanized, Steel)**: PVC
- **Wall Thickness (mm)**: [Redacted]

### Status of Well
- **Water Supply**: [Redacted]
- **No Recharge Well**: [Redacted]
- **No Deep Irrigation**: [Redacted]

### Method of Construction
- **Cable Tool**: [Redacted]
- **Rotary (Conventional)**: [Redacted]
- **Rotary (Reverse)**: [Redacted]
- **Auger**: [Redacted]
- **Air percussion**: [Redacted]
- **Other, specify**: [Redacted]

### Draw Down
- **After test of well yield, water was:** [Redacted]
- **Flowing**:
  - Rate (GPM): [Redacted]
  - Duration (min): [Redacted]

### Well Production
- **Recommended pump rate**:
  - Flowing: [Redacted]
  - Static: [Redacted]

### Water Details
- **Water found at Depth (m)**:
  - Kind of Water: [Redacted]
  - Depth (m): [Redacted]
  - Diameter (mm): [Redacted]

### Water Quality
- **Recommended pump rate**: [Redacted]
- **Well production rate**: [Redacted]

### Map of Well Location
- **Well Tag No.**: A 073947
- **Well Record**: Regulation 903 Ontario Water Resources Act

---

**Well Owner's Copy**

---

**Comments**: [Redacted]
Well Record
Regulation 903 Ontario Water Resources Act
Page 1 of 1

Well Tag No. A 073948

Well Location
Address of Well Location: 450 Avenue Road, Waterco, Waterloo, Ontario
Township: Shadhe's Mills Conservation Area
UTM Coordinates: NAD 83

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

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most Common Material</th>
<th>Other Materials</th>
<th>General Description</th>
<th>Depth (m/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>Silt</td>
<td>Sand</td>
<td></td>
<td>3.81</td>
</tr>
<tr>
<td>Brown</td>
<td>Sandy Silt in Silt</td>
<td>Sand</td>
<td></td>
<td>4.45</td>
</tr>
<tr>
<td>Brown</td>
<td>Sand</td>
<td>Sand</td>
<td></td>
<td>9.45</td>
</tr>
<tr>
<td>Brown</td>
<td>clayey Silt</td>
<td>Sand</td>
<td></td>
<td>10.97</td>
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<tr>
<td>Brown</td>
<td>Sand</td>
<td>Sand</td>
<td></td>
<td>11.43</td>
</tr>
<tr>
<td>Brown</td>
<td>Silt</td>
<td>Sand</td>
<td></td>
<td>12.19</td>
</tr>
</tbody>
</table>

Annular Space
Type of Sealant Used: Sand, gravel, clay, silt
Volume Placed: 0

Method of Construction
<table>
<thead>
<tr>
<th>Inside Diameter (Size)</th>
<th>Hole Diameter (Size)</th>
<th>Depth Set at (m/ft)</th>
<th>Type of Sealant Used</th>
<th>Volume Placed</th>
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</thead>
<tbody>
<tr>
<td>PVC</td>
<td></td>
<td>0.4</td>
<td>Public</td>
<td>0</td>
</tr>
<tr>
<td>PVC</td>
<td></td>
<td>0.6</td>
<td>Sand</td>
<td>0</td>
</tr>
</tbody>
</table>

Well Use
<table>
<thead>
<tr>
<th>Inside Diameter (Size)</th>
<th>Hole Diameter (Size)</th>
<th>Well Diameter (m/ft)</th>
<th>Status of Well</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC</td>
<td></td>
<td>0.4</td>
<td>Water Supply</td>
</tr>
</tbody>
</table>

Water Details
Water found at Depth: Kind of Water: Fresh, Untested
Depth (m/ft): 0.0

Status of Well
<table>
<thead>
<tr>
<th>Inside Diameter (Size)</th>
<th>Hole Diameter (Size)</th>
<th>Water Level (m/ft)</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC</td>
<td></td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Well Contractor and Well Technician Information

Well Owner's Copy

Regulation 903 Ontario Water Resources Act
Figure 1: Proposed Multi-level Observation Well Site
Cambridge, Ontario
**Well Record**

**Regulations 903 Ontario Water Resources Act**

**Well Tag No.** (Place Sticker and/or Print Below) A051729

**Address**

**Property Information**

- **Address:**
- **City:** North Dumfries
- **Province:** Ontario
- **Postal Code:**

**Overburden and Bedrock Materials/Abandonment Sealing Record**

- **General Colour:**
- **Most Common Material:**
- **Other Materials:**

- **General Description:**

- **Depth (m/ft):**

**Annular Space**

- **Depth Set at:** (m/ft)
- **Type of Sealant Used:** (Material and Type)
- **Volume Recorded:** (m³/ft³)

**Results of Well Yield Testing**

- **Time (min):**
- **Water Level (ft):**
- **Water Level (m):**
- **If pumping discontinued, give reason:**
- **Pump intake set at:** (m/ft)
- **Pumping rate (l/min / GPM):**
- **Duration of pumping:**
- **Final water level end of pumping (m/ft):**
- **If flowing yield rate (l/min / GPM):**
- **Well Test of well yard, water was:**
- **Other, specify:**

**Method of Construction**

- **Well Use:**
- **Public:**
- **Commercial:**
- **Domestic:**
- **Municipal:**
- **Not used:**
- **Drilling:**
- **Construction:**
- **Livestock:**
- **Drainage:**
- **Leaking:**
- **Test Hole:**
- **Disastering:**
- **
- **Cooling & Air Conditioning:**
- **Other, specify:**

**Construction Record - Casing**

- **Inside Diameter (m/ft):**
- **Material:** (Galvanized, Fiberglass, Concrete Pipe, Steel)
- **Wall Thickness (mm):**
- **Depth (m/ft):**

**Well Contractor and Well Technician Information**

- **Garritts Drilling & Engineering Ltd.:** 21854 10th Line, B.R. 1, Grand Valley, Ontario LON 1G0
- **Business Telephone No.:**
- **Fax No.:**
- **Name of Well Contractor/Source (Last Name, First Name):**
- **Well Contractor’s Licence No.:** 3406

**Map of Well Location**

Please provide a map below following instructions on the back.

**For Well Owners: Information Received Package Mailed 2007/10/21**

- **Well Owner’s Information Package: Date Mailed:**
- **Date Package Delivered:**
- **Date Package Mailed:**

**Ministry Use Only**

- **Audit No.:** 793634
- **Date Submitted:**
- **Date Mailed:**
- **Date Audit Completed:**

**Ministry’s Copy**

© Queen’s Printer for Ontario, 2007
Multi-Level Piezometer Installation
for well NDTW1-08

Ground Surface

Steel Casing # 6"

70 to 74 ft.

74 to 100 ft.

79 ft. (24.1 m)

8 ft. Screen: 85 to 95 ft.

Hole Plug: 100 to 138 ft.

Filter Sand: 138 to 175 ft.

145 to 170 ft.

B' Screen: 175 to 253 ft.

Hole Plug

175 to 253 ft.

Filter Sand:

253 to 328 m

260 to 320 ft.

A' Screen

328 to 376 ft.

Hole Plug

TD: 376 ft.

Piezo 'A' Screen from 260 to 320 ft.

Piezo 'B' Screen from 145 to 170 ft.

Piezo 'C' Screen from 85 to 95 ft.
**Well Record**

**Regulation 903 Ontario Water Resources Act**

**Well Information**

- **Well Number:** A071564
- **Print Below:** 4971564
- **Location:** 150 Frederick Street, Guelph, ON, N1H 4X7

**Well Owner's Information**

- **First Name:**
- **Last Name:**
- **Organization:**
- **E-mail Address:**
- **Well Constructed by Well Owner:**
- **Mailing Address:**
- **Provincial:**
- **Postal Code:**
- **Telephone No. (incl. area code):**

**Well Location**

- **Township:** North Dumfries
- **Lot:** 6
- **Concession:** 10

**County/District/Municipality**

- **Waterloo:**
- **City/Town/Village:** Clyde
- **Province:** Ontario
- **Postal Code:**

**Overburden and Bedrock Materials/Abandonment Sealing Record**

- **General Description:**
- **Depth (m):** From 0 To 12.80
- **Depths (m):** From 0 To 19.82
- **Depths (m):** From 19.82 To 21.64
- **Depths (m):** From 21.64 To 106.68

**Annular Space**

- **Depth Set at (m):** From 0 To 21.64
- **Portland Cement:**
  - Material: Sand
  - Volume Placed: 3.09
- **Depth Set at (m):** From 0 To 24.68
- **Portland Cement:**
  - Material: Gravel
  - Volume Placed: 0.841

**Method of Construction**

- **Well Use:**
- **Construction Record - Casing:**
  - **Inside Diameter (cm):** 40
    - **Steel:**
      - Material: Open Hole Casing, Sand, Gravel, Steel
      - **Open Hole:**
        - **Depth:** 0.09 m
        - **Width:** 25 m
      - **Depth:** 30.48 m
      - **Width:** 24.68 m
      - **Depth:** 30.48 m
      - **Width:** 106.6 m

**Well Details**

- **Water Details:**
  - **Water found at Depth:**
    - **Depth:** 27 m
      - **Temperature:** 21.64
      - **Diameter:** 61.0
      - **Other, specify:**
    - **Temperature:** 48 m
      - **Diameter:** 21.64
      - **Diameter:** 41.0
      - **Diameter:** 30.5

**Construction Record - Screen**

- **Outside Diameter (cm):**
- **Material:**
- **Slot No.:**
- **Depth:** From To 0 To 21.64
- **Depth:** From To 0 To 24.68
- **Depth:** From To 0 To 106.6

**Well Contractor and Well Technician Information**

- **Business Name:** Gerrits Drilling & Eng. Ltd.
- **Well Contractor’s License No.:**
- **Business Address:**
  - **Province:** ON
  - **Postal Code:** L0G 100
  - **Business E-mail Address:**

**Comments:**

- **Date Package Delivered:** 2009.08.15
- **Audit No.:** Z93630
- **Received:** MAR 04, 2010
- **Date Work Completed:** 2009.08.15
- **Ministry Use Only:**

**Map of Well Location**

- **Package marked 2009/08/15**

---

**Well Information**

- **Print Below:**
- **Location:**
- **Well Number:**
- **Print Below:**
- **Well Information:**
- **Well Owner's Information:**
- **Well Location:**
- **County/District/Municipality:**
- **UTM Coordinates:**
- **Overburden and Bedrock Materials/Abandonment Sealing Record:**
- **Annular Space:**
- **Method of Construction:**
- **Construction Record - Casing:**
- **Well Details:**
- **Construction Record - Screen:**
- **Well Contractor and Well Technician Information:**
- **Comments:**
- **Map of Well Location:**
## Well Record

**Regulation 603 Ontario Water Resources Act**

### Address of Well Location
- **Street Name:** Gore/Village Deep Multi Level
- **Street Number:** A 051658
- **Postal Code:** 051658

### General Information
- **Twps:** North D Commies
- **Rgs:** 6
- **Sct:** 10
- **County/District/Municipality:** Waterloo
- **City/Town/Village:** Clyde
- **Municipal Plan and Sublot Number:** Other
- **Province:** Ontario
- **Postal Code:** Other

### Overburden and Bedrock Materials/Abandonment Sealing Record

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most Common Material</th>
<th>Other Materials</th>
<th>General Description</th>
<th>Depth (m) From</th>
<th>Depth (m) To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Loam</td>
<td></td>
<td></td>
<td></td>
<td>0.31</td>
<td>0.31</td>
</tr>
<tr>
<td>Brown Sand</td>
<td></td>
<td></td>
<td></td>
<td>0.31</td>
<td>0.31</td>
</tr>
<tr>
<td>Brown Sand</td>
<td></td>
<td></td>
<td></td>
<td>0.31</td>
<td>0.31</td>
</tr>
<tr>
<td>Brown Gravel</td>
<td></td>
<td></td>
<td></td>
<td>29.06</td>
<td>29.06</td>
</tr>
<tr>
<td>Brown Clay</td>
<td></td>
<td></td>
<td></td>
<td>15.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Brown Gravel</td>
<td></td>
<td></td>
<td></td>
<td>19.06</td>
<td>19.06</td>
</tr>
<tr>
<td>Brown Lime</td>
<td></td>
<td></td>
<td></td>
<td>22.81</td>
<td>22.81</td>
</tr>
<tr>
<td>Green Shale</td>
<td></td>
<td></td>
<td></td>
<td>26.71</td>
<td>26.71</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>116.56</td>
<td>116.87</td>
</tr>
</tbody>
</table>

### Annular Space

<table>
<thead>
<tr>
<th>Depth Below (m) (m)</th>
<th>Type of Sealant Used</th>
<th>Volume Placed (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.56</td>
<td>Bentonite Slurry</td>
<td>0.22</td>
</tr>
</tbody>
</table>

### Method of Construction

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Type of Sealant Used</th>
<th>Volume Placed (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.56</td>
<td>Bentonite Slurry</td>
<td>0.22</td>
</tr>
</tbody>
</table>

### Construction Record - Casing

<table>
<thead>
<tr>
<th>Inside Diameter (m)</th>
<th>Casing Material</th>
<th>Wall Thickness (m)</th>
<th>Depth (m)</th>
<th>Status of Well</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.24</td>
<td>Steel</td>
<td>0.18</td>
<td>+0.45</td>
<td>27.34</td>
</tr>
</tbody>
</table>

### Construction Record - Screen

<table>
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<tr>
<th>Outside Diameter (m)</th>
<th>Material</th>
<th>Screen Slot</th>
<th>Depth (m)</th>
<th>Status of Well</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.24</td>
<td>Steel</td>
<td></td>
<td>27.34</td>
<td>116.87</td>
</tr>
</tbody>
</table>

### Well Details

<table>
<thead>
<tr>
<th>Water Found at Depth (m)</th>
<th>Fresh X</th>
<th>Other, specify</th>
<th>Depth (m)</th>
<th>Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.0</td>
<td></td>
<td></td>
<td>0</td>
<td>6.56</td>
</tr>
<tr>
<td>110.0</td>
<td></td>
<td></td>
<td>5.56</td>
<td>27.34</td>
</tr>
</tbody>
</table>

### Well Contractor and Well Technician Information

- **Business Name:** Gerrits Drilling & Engineering Ltd.
- **Address:** 21515410th Line, R.R. 6, Grand Valley, Ontario LON 1G0
- **Provincial Number:** 215154
- **Municipality:** Other
- **Phone Number:** 905-402-1111
- **Fax Number:** 905-402-1111
- **Well Driller's Licence No.:** 2569
- **Well Technician's Licence No.:** 2569

### Well Yield Testing

- **Draw Down Time (min):** 10
- **Recovery Time (min):** 15
- **Draw Down Water Level (m):** 15
- **Recovery Water Level (m):** 25

### Results of Well Yield Testing

- **Time (min):** 10
- **Water Level (m):** 15
- **Pumping Rate (l/min):** 20
- **Recommended Pump Rate (l/min):** 20
- **Well Production (l/min):** 40
- **Discharged:** Yes

### Map of Well Location

- **Map:** see attached

---

**Gerrit Drilling & Engineering Ltd.**

**Grand Valley, Ontario LON 1G0**
NDOW1D-08
Regulation 903 Ontario Water Resources Act

Well Record

Address of Well Location (Street Number/Name)

County/District/Municipality
Waterloo

Township
North Dumfries

UTM Coordinates

Northing
NAD 1983 North American Datum 1983

Easting

4804727

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

General Colour
Black

Loam

Moist Common Material
Gravel

Other Materials

General Description

Depth (m/ft) From To

0 0.31

0.31 9.06

9.06 15.00

15.00 17.50

Annular Space

Depth Set at (m/ft)

From To

Type of Sealant Used

Volume Placed

(m/ft³)

0 5.56 Bentonite Slurry

0.21

Results of Well Yield Testing

After test of well yield water was

Clear and sand free

Other, specify

Time (min)

Draw Down

Recovery

Static Level

1

Water Level (m/ft)

Time (min)

Water Level (m/ft)

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping

Final water level end of pumping

If rowing give rate (l/min / GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min / GPM)

Well production (l/min / GPM)

Dissipated?

10

15

50

50

10

5

4

3

2

2

1

4

5

3

2

20

20

25

25

30

30

40

40

60

60

Yes

No

Map of Well Location

Please provide a map below following instructions on the back.

See Attached

Well Contractor and Well Technician Information

Business Name
Gerrits Drilling & Engineering Ltd.

Provincial Registration License No.
215154

Business Address
Grand Valley, Ontario LON 1G0

Province
Postal Code
Business E-mail Address

Bus. Telephone No. (inc. area code)

Well Technician's License No.
2964

Name of Well Technician (Last Name, First Name)
Steve Gerrits

Comments:

Package Mailed 2008/10/30

Well owner's information package delivered

Date Package Delivered

2008 10 30

Well Work Completed

2008 10 29

Audit No.
Z 93627

Ministry Use Only

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Well T: A051653

NDOW1E-08
Well Record
Regulation 903 Ontario Water Resources Act

Address of Well Location (Street Number/Name)

County/District/Municipality
Waterloo

UTM Coordinates
Zone: 20S
Easting: 439,074
Northing: 4,560,266

General Description
Depth (m): 0.31

Water Details

Outside Diameter (inch)
Plastic, Coated or Steel

Depth (m): 5.625

Well Contractor and Well Technician Information
Dwight Wells Drilling & Engineering Ltd.
711732-010
Grand Valley, Ontario LON 1G0

Water found at Depth
7.81 (m): Gas

Water found at Depth
5 (m): Gas

Water found at Depth
5 (m): Fresh

Well technician’s information package delivered
2008-11-18

Package mailed
2008-11-18

Ministry Use Only
Audit No: Z93628

Ministry’s Copy

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### Multi-Level -- XXXX Golf Course

#### Well Tag M

- **Tag Number**: A 051707
- **Well Record**: NDOW2ABC-08
- **Regulation 503 Ontario Water Resources Act**
- **Date**: Page 1 of 1

#### Address of Well Location (Street Number/Name)
- North Dumfries
- Waterloo
- Ontario

#### Coordinates
- **UTM Coordinates**: Zone X Y Z
- **Zone**: X
- **Easting**: Y
- **Northing**: Z

#### Overburden and Bedrock Materials/Abandonment Sealing Record

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most Common Material</th>
<th>Other Materials</th>
<th>General Description</th>
<th>Depth (m)</th>
<th>Soil Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>Loan</td>
<td></td>
<td></td>
<td>0</td>
<td>3.04</td>
</tr>
<tr>
<td>Brown Sand</td>
<td>Gravel</td>
<td></td>
<td></td>
<td>3.04</td>
<td>4.25</td>
</tr>
<tr>
<td>Brown Gravel</td>
<td>Sand, Clay</td>
<td></td>
<td></td>
<td>4.26</td>
<td>10.97</td>
</tr>
<tr>
<td>Brown Gravel</td>
<td></td>
<td></td>
<td></td>
<td>10.97</td>
<td>22.55</td>
</tr>
<tr>
<td>Grey</td>
<td>limestone</td>
<td></td>
<td></td>
<td>22.55</td>
<td>26.21</td>
</tr>
<tr>
<td>Grey</td>
<td>Limestone</td>
<td></td>
<td></td>
<td>26.21</td>
<td>31.08</td>
</tr>
<tr>
<td>Green Shale</td>
<td></td>
<td></td>
<td></td>
<td>31.08</td>
<td>115.82</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>115.82</td>
</tr>
</tbody>
</table>

#### Annular Space

<table>
<thead>
<tr>
<th>Depth Set at (m)</th>
<th>Type of Sealant Used</th>
<th>Volume Placed (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>6.4</td>
<td>Bentonite Slurry</td>
</tr>
</tbody>
</table>

#### Method of Construction

- **Cable Tool**: X
- **Rolling (Conventional)**: X
- **Rotary (Reversible)**: X
- **Boring**: X
- **Air percussion**: X
- **Other, specify**: X

#### Well Use

- **Public**: X
- **Domestic**: X
- **Livestock**: X
- **Industrial**: X
- **Other, specify**: X
- **Comercial**: X
- **Municipal**: X
- **Not used**: X
- **Draining**: X
- **Desilting**: X
- **Dewatering**: X
- **Drinking Water**: X
- **Cooling & Air Conditioning**: X
- **Construction Monitoring**: X

#### Construction Record - Casing

<table>
<thead>
<tr>
<th>Inside Diameter (mm)</th>
<th>Depth (m)</th>
<th>Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From</td>
<td>To</td>
</tr>
<tr>
<td>15.24</td>
<td>.188</td>
<td>+0.5 31.69</td>
</tr>
</tbody>
</table>

#### Open Hole

- **Depth (m)**: 31.69 116.43

#### Construction Record - Screen

<table>
<thead>
<tr>
<th>Outside Diameter (mm)</th>
<th>Material</th>
<th>Depth (m)</th>
<th>Screen No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plastic, Garnetted Steel</td>
<td>From</td>
<td>To</td>
</tr>
</tbody>
</table>

#### Water Details

<table>
<thead>
<tr>
<th>Water at Depth (m)</th>
<th>Kind of Water</th>
<th>Fresh/Untested</th>
<th>Depth (m)</th>
<th>Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>43.28</td>
<td>Gas</td>
<td>Fresh</td>
<td>0</td>
<td>6.4</td>
</tr>
<tr>
<td>66.14</td>
<td>Gas</td>
<td>Fresh</td>
<td>6.4</td>
<td>31.69</td>
</tr>
<tr>
<td>98.8</td>
<td>Gas</td>
<td>Fresh</td>
<td>31.69</td>
<td>116.43</td>
</tr>
</tbody>
</table>

### Results of Well Yield Testing

<table>
<thead>
<tr>
<th>Draw Down</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (min)</td>
<td>Water Level (mm)</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Map of Well Location

- **MONITOR WELL**: X
- **NOT TESTED**: X

Map of Well Location

Please provide a map below following instructions on the back.

### SEE ATTACHED

#### Well Contractor and Well Technician Information

- **Name**: Gerrits Drilling & Engineering Ltd.
- **Municipality**: Grand Valley, Ontario LON 1G0
- **Telephone No.**: 215154 10th Line, B.I. #1
- **Business E-mail Address**: M3406

#### Permit Information

- **Province**: Ontario
- **Postal Code**: X

#### Well Details

<table>
<thead>
<tr>
<th>Date</th>
<th>Package Mailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008/12/11</td>
<td>Yes</td>
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</table>

#### Well Records

- **Date**: 2008/12/11

#### Ministry Use Only

- **Audit No.**: Z 936336
- **Ministry's Copy**: APR 14 2009

#### Queen's Printer for Ontario, 2003

<table>
<thead>
<tr>
<th>Well owner's information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Package Delivered: 2008/12/11</td>
</tr>
<tr>
<td>Date Work Completed: 2008/12/10</td>
</tr>
</tbody>
</table>
**NDow2 ABC - 08 Construction**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 90</td>
<td>Bentonite Grout</td>
</tr>
<tr>
<td>90 - 98</td>
<td>Hole Plug</td>
</tr>
<tr>
<td>98 - 134.5</td>
<td>Filter Sand</td>
</tr>
<tr>
<td>134.5 - 157.5</td>
<td>Hole Plug</td>
</tr>
<tr>
<td>157.5 - 197</td>
<td>Filter Sand</td>
</tr>
<tr>
<td>197 - 270</td>
<td>Hole Plug</td>
</tr>
<tr>
<td>270 - 355</td>
<td>Filter Sand</td>
</tr>
<tr>
<td>355 - 382</td>
<td>Hole Plug</td>
</tr>
<tr>
<td>382 - 446</td>
<td>End of Hole</td>
</tr>
</tbody>
</table>

Piezo 'A' 285 to 345 ft

Piezo 'B' 165 to 190 ft

Piezo 'C' 111 to 129 ft

APR 14 2009

C-3406
293633
### Overburden and Bedrock Materials/Abandonment Sealing Record

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most Common Material</th>
<th>Other Materials</th>
<th>General Description</th>
<th>Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Loam</td>
<td>Gravel</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>Brown Sand</td>
<td>Gravel</td>
<td></td>
<td></td>
<td>3.12</td>
</tr>
<tr>
<td>Brown Gravel</td>
<td>Sand, Clay</td>
<td></td>
<td></td>
<td>4.37</td>
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<tr>
<td>Brown Sand</td>
<td></td>
<td></td>
<td></td>
<td>11.25</td>
</tr>
<tr>
<td>Brown Gravel</td>
<td></td>
<td></td>
<td></td>
<td>23.12</td>
</tr>
<tr>
<td>Grey Limestone</td>
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<td></td>
<td></td>
<td>26.87</td>
</tr>
</tbody>
</table>

### Annular Space

<table>
<thead>
<tr>
<th>Depth Set at (mH2O)</th>
<th>Type of Sealant Used (Material and Type)</th>
<th>Volume Placed (m3/H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Bentonite Slurry</td>
<td>0.23</td>
</tr>
</tbody>
</table>

### Method of Construction

<table>
<thead>
<tr>
<th>Inside Diam (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.25</td>
</tr>
</tbody>
</table>

### Well Use

<table>
<thead>
<tr>
<th>Well Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial</td>
</tr>
</tbody>
</table>

### Construction Record - Grazing

<table>
<thead>
<tr>
<th>Outside Diam (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material (Plastic, Galvanized, Steel)</th>
<th>Slope No.</th>
<th>Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic Galvanized</td>
<td>10</td>
<td>28.75</td>
</tr>
</tbody>
</table>

### Water Details

<table>
<thead>
<tr>
<th>Water found at Depth</th>
<th>Kind of Water</th>
<th>Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Fresh</td>
<td>6.56</td>
</tr>
</tbody>
</table>

### Construction Record - Screen

<table>
<thead>
<tr>
<th>Outside Diam (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water found at Depth</th>
<th>Kind of Water</th>
<th>Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Fresh</td>
<td>28.75</td>
</tr>
</tbody>
</table>

### Well Contractor and Well Technician Information

- **Gerrits Drilling & Engineering Ltd.**
- **Grand Valley, Ontario, LON 1G0**
- **Phone**: 2406
- **Email**: info@gerritsdrilling.ca

**Well Technician**: Steve Gerrits

**Signature**: [Signature]

**Date Submitted**: 2008/11/15

**Package Mailed**: 2008/11/15

**Ministry Use Only**

**Audit No.** 93626

**Date Package Delivered**: 2008/11/15

**Date Work Completed**: 2008/11/15

**Package Mailed**: 2008/11/15

**Ministry’s Copy**
Well Record
Regulation 903 Ontario Water Resources Act
Page 1 of 1

Address of Well Location (Street Number/Name)
Towmip

County/District/Municipality
Waterloo

UTM Coordinates
NAD 83

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

<table>
<thead>
<tr>
<th>General Colour</th>
<th>Most Common Material</th>
<th>Other Materials</th>
<th>General Description</th>
<th>Depth (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Loam</td>
<td>Gravel</td>
<td>Clay, Sand</td>
<td>0.063</td>
<td>0.312</td>
</tr>
</tbody>
</table>

Method of Construction
- Capsule Tool
- Rotary (Conventional)
- Rotary (Reversing)
- Boring
- Air percussion

Well Use
- Public
- Domestic
- Irrigation
- Industrial
- Commercial
- Municipal
- Water Supply
- Replacement Well
- Test Hole
- Irrigation
- Abandoned

Construction Record - casing
Inside Diameter (inch)
5.25
Material (Unbonded, Galvanized, Concrete, Plastic, Steel)
Plastic
Wall Thickness (inch)
Sch 40
Depth (ft)
5.12

Construction Record - Screen
Outside Diameter (inch)
5.25
Material (Unbonded, Galvanized, Screen, Plastic, Steel)
Plastic, Galvanized
Slot No.
Depth (ft)
3.12

Well Contractor and Well Technician Information
Gerrits Drilling & Engineering Ltd.
34154 Township Rd RR 4
Grand Valley, Ontario LON 1G0

Ministry's Copy
Master Well Record for Cluster Well Construction
Regulation 903 Ontario Water Resources Act

Page 1

Master Well Owner’s and Land Owner’s Information

First Name

Last Name

E-mail Address

Mailing Address (Street Number/Name, RR)

Postal Code

Telephone Number (inc. area code)

Location and Construction of the Master Well in the Cluster

Address of Well Location (Street Number/Name, RR)

County/District/Municipality

Township

City/Town/Village

UTM Coordinates

Zone, Easting

Northing

UTM Zone

GPI Unit Make

Model

Mode of Operation

Overburden and Bedrock Materials (see instructions on the back of this form)

General Description

Depth (Metres)

From

To

Blown Topsoil

Silt

Sand

Dense Tuffs

Dense Silt

Dense Shale

Dense Granite

0

9

3.9

8.5

10

Construction Details

Inside Diameter (Centimetres)

154

Material

Plastic

Wall Thickness

0.9

Depth (Metres)

From

To

Annular Space/Abandonment Sealant Record

Depth Set at (Metres)

To

Type of Sealant Used

Chip

Volume Used (Kibic/Metres)

<1

Water Details

Water found at Depth

Metres

Gas

Kind of Water

Water found at Depth

Metres

Gas

Kind of Water

Water found at Depth

Metres

Gas

Kind of Water

Water found at Depth

Metres

Gas

Kind of Water

Unasplied

Yes

No

If no provision made

Date Master Well Completed

2008 11/19

Cluster Information (Please also fill out the additional Cluster Well Information for Well Construction for each parcel of land and cluster)

Total Wells in Cluster

2

Total Wells on this Property

2

Location of Well Cluster

Land Use Map must be provided as an attachment no larger than legal size (8.5” x 11”). Sketches are not allowed.

Check box to confirm detailed map is provided as per Section 11.1.3

Consent to release additional information concerning the cluster to the Director upon request

Ontario Ministry of the Environment

Well Contractor and Well Technician Information

Business Name of Well Contractor

Environment Canada

Well Contractor’s Licence No

7 3 1 6 1 0

Business Address (Street No./Name, number, RR)

Municipality

Province

Postal Code

Business Telephone Number

Business E-mail Address

Well Technician’s Licence No

Signature of Technician

Date Submitted

Date Submitted

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### Well Tag No. for Master Well

**A077561**

### Property Owner's Information

<table>
<thead>
<tr>
<th>First Name</th>
<th>Last Name</th>
<th>Mailing Address (Street No./Name, RR)</th>
<th>Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAGAUL</td>
<td>WATERLOO</td>
<td>150 FREDERICK ST</td>
<td>WATERLOO</td>
</tr>
</tbody>
</table>

### Cluster Well Information

<table>
<thead>
<tr>
<th>Lot</th>
<th>Concession</th>
<th>Township</th>
<th>County/District/Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>9</td>
<td>MILLWIND</td>
<td>WATERLOO</td>
</tr>
</tbody>
</table>

### Address of Well Location (Street Name/Number, RR)

- **City/Town/Village**: CLYDE
- **Province**: Ontario
- **Postal Code**: N5G 453
- **GPS Unit Make**: GNSS
- **Model**: ETGEY
- **Unit Mode of Operation**: Averaged
- **Unclassified**: Differentiated

### Well Data

<table>
<thead>
<tr>
<th>Well #</th>
<th>Zone</th>
<th>Northing</th>
<th>Easting</th>
<th>UTM Coordinates</th>
<th>Full Depth of Hole (m)</th>
<th>Hole Diameter (cm)</th>
<th>Method of Construction</th>
<th>Casing Material</th>
<th>Casing Length (m)</th>
<th>Screen Length (m)</th>
<th>Screen Interval (m)</th>
<th>Screen Material</th>
<th>Static Water Level (m)</th>
<th>Abandonment Sealant Used</th>
<th>Comments</th>
<th>Date of Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>117562026034803606</td>
<td>910</td>
<td>DENLING PLASTIC</td>
<td>7.6 7.6 9</td>
<td></td>
<td></td>
<td>BEARFORS CHIP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2009/11/18</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1175625994803607</td>
<td>310</td>
<td>DENLING PLASTIC</td>
<td>1.5 1.5 3</td>
<td></td>
<td></td>
<td>BEARFORS CHIP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2009/11/18</td>
<td></td>
</tr>
</tbody>
</table>

### Well Contractor and Well Technician Information

- **Name of Well Contractor**: [Last Name], [First Name]
- **Business Address (Street No./Name, RR)**: 1011 INDUSTRIAL C35 UNIT 1
- **Municipality**: WATERLOO
- **Province**: ON
- **Well Contractors Licence No.**: [License Number]
- **Business E-mail Address**: GOLDEN@GOLDEN
- **Name of Well Technician**: [Last Name], [First Name]
- **Well Technician's Licence No.**: [License Number]
- **Date Submitted**: 2009/11/18

### Well Information Registration

- **Date First Well in Cluster Constructed**: 2009/11/18
- **Date Last Well in Cluster Constructed**: 2009/11/18
- **Date Inspected**: 2009/11/20

### Remarks

- **Audit No.**: 02064
- **Remarks**: [Note]

---

*Ministry's Copy*
## Master Well Record for Cluster Well Construction

### Master Well Owner's and Land Owner's Information
- **Name:** FREDERICK
- **Municipality:** WATERLOO
- **Province:** ON
- **Postal Code:** N2B 4J3
- **Telephone No. (incl. area code):** 519 757 5400

### Location and Construction of the Master Well in the Cluster
- **Address of Well Location (Street Number/Name, RR):** WATERLOO
- **UTM Coordinates Zone, Easting, Northing:** 1756264 4980392
- **UTM Zone, UTM Zone:** 8 3

### Overburden and Bedrock Materials (see instructions on the back of this form)

<table>
<thead>
<tr>
<th>Colour</th>
<th>Material</th>
<th>General Description</th>
<th>Depth (Metres) From</th>
<th>Depth (Metres) To</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLOWY TOPSOIL</td>
<td>LOOSE</td>
<td>0.3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>BLACK SILT</td>
<td>SANDY</td>
<td>3.3</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>BROWN STONES</td>
<td>VARIOUS</td>
<td>6.7</td>
<td>6.7</td>
<td></td>
</tr>
</tbody>
</table>

### Construction Details
- **Inside Diameter (Centimetres):** 2.54
- **Outside Diameter (Centimetres):** 3.3

### Water Details
- **Water found at Depth:** Kind of Water
  - Kind of Water: Gas
  - Kind of Water: Soil
  - Kind of Water: Sulphur
  - Kind of Water: Minerals
  - Kind of Water: Gas
  - Kind of Water: Soil
  - Kind of Water: Sulphur
  - Kind of Water: Minerals
  - Kind of Water: Gas
  - Kind of Water: Soil
  - Kind of Water: Sulphur
  - Kind of Water: Minerals
  - Kind of Water: Gas
  - Kind of Water: Soil
  - Kind of Water: Sulphur
  - Kind of Water: Minerals

### Annular Space/Abandonment Sealing Record
- **Depth Set at:** 0.3
- **Type of Sealant Used (Material and Type):** CEMENT
- **Volume Used (Cubic Metres):** 2.1

### Cluster Information
- **Total Wells in Cluster:** 2
- **Location of Well Cluster:**
  - Detailed Map must be provided as an attachment no larger than legal size (8.5" x 14"), Sketches are not allowed.
  - Check box to confirm detailed map is provided as per Section 11.1.1 (3)
  - Consent to release additional information concerning the cluster to the Director upon request.

### Well Contractor and Well Technician Information
- **Well Contractor:** CMT INC
- **Well Technician:** DOWE INC
- **Business Address:** 101 INDUSTRIAL CLS Unit WATERLOO
- **Business E-mail Address:** NOEMAIL
- **Telephone No.:** 519 757 7777
- **Well Technician License No.:** 31453
- **Signature of Technician:** DOWE INC
- **Date Submitted:** 05/11/06

### Remarks
- **Date Received:** 11/06/06
- **Date of Inspection:** 11/06/06

---

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Cluster Well Information for Cluster Well Construction
Regulation 903 Ontario Water Resources Act
Page 1 of 1

Property Owner's Information

<table>
<thead>
<tr>
<th>First Name</th>
<th>Last Name</th>
<th>Mailing Address (Street No./Name, RR)</th>
<th>Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGIONAL</td>
<td>MUNICIPALITY OF WATERLOO</td>
<td>150 FREDERICK ST.</td>
<td>WATERLOO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Province</th>
<th>Postal Code</th>
<th>E-mail Address</th>
<th>Telephone No. (Inc. area code)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>N2G 4S3</td>
<td></td>
<td>519 751 4400</td>
</tr>
</tbody>
</table>

Cluster Well Information

<table>
<thead>
<tr>
<th>Address of Well Location at (Street Number/Name, RR)</th>
<th>Lot Concession Township</th>
<th>County/District/Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLYDE</td>
<td>6</td>
<td>WATERLOO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>City/Town/Village</th>
<th>Province</th>
<th>GPS Unit Make</th>
<th>GPS Model</th>
<th>GPS Unit Mode of Operation</th>
<th>Undifferentiated</th>
<th>Averaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLYDE</td>
<td>Ontario</td>
<td>CALM</td>
<td>ETEK</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Number</th>
<th>UTM Coordinates E/N</th>
<th>Full Depth of Hole (metres)</th>
<th>Hole Diameter (cm)</th>
<th>Method of Construction</th>
<th>Casing Material</th>
<th>Casing Length (metres)</th>
<th>Screen Interval (metres) From</th>
<th>To</th>
<th>Annual Rate (litres/day)</th>
<th>Abandonment Depth (metres)</th>
<th>Abandonment Season Used</th>
<th>Comments</th>
<th>Date of Completion (yyyy/mm/dd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175620457803924</td>
<td>6.7</td>
<td>10</td>
<td>DAVINCE</td>
<td>PLASTIC</td>
<td>5.1</td>
<td>5.1</td>
<td>6.7</td>
<td></td>
<td>3/8 CHIP</td>
<td></td>
<td>2008/11/30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5620454803722</td>
<td>2.4</td>
<td>10</td>
<td>DAVINCE</td>
<td>PLASTIC</td>
<td>9</td>
<td>9</td>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
<td>2008/11/30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Well Contractor and Well Technician Information

<table>
<thead>
<tr>
<th>Business Name of Well Contractor</th>
<th>Business Address (Street No./Name, RR)</th>
<th>Municipality</th>
<th>Province</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM ENG</td>
<td>1011 INDUSTRIAL CRES UNIT 1</td>
<td>WATERLOO</td>
<td>ON</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Contractor's Licence No.</th>
<th>Well Contractor's E-mail Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1234567890</td>
<td><a href="mailto:cmeng@goldenonet.net">cmeng@goldenonet.net</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Technician's Name</th>
<th>Well Technician's E-mail Address</th>
<th>Date Submitted (yyyy/mm/dd)</th>
<th>Signature of Technician</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAVID</td>
<td></td>
<td>11/21/2006</td>
<td></td>
</tr>
</tbody>
</table>

Ministry Use Only

<table>
<thead>
<tr>
<th>Audit No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>02063</td>
<td></td>
</tr>
</tbody>
</table>

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## Well Record

**Well Tag No.:** A 077560  
**NDOW-08**  
**Regulation 903 Ontario Water Resource Act**  
**Page of**

### Well Owner's Information
- **First Name:**
- **Last Name / Organization:**
- **E-mail Address:**
- **Well Constructed by Well Owner:**
- **Mailing Address (Street Name):**
- **Municipality:**
- **Province:**
- **Postal Code:**
- **Telephone No. (incl. area code):**

### Well Location
- **Address of Well Location (Street Number):**
- **Township:**
- **Lot:**
- **Concession:**
- **County / District / Municipality:**
- **City / Town / Village:**
- **Municipal Plan and Subdivision Number:**
- **UTM Coordinates (Zone, Easting, Northing):**
- **NAD:**
- **Other:**

### Overburden and Bedrock Materials / Abandonment Sealing Record
- **General Description:**
- **Depth (ft):**

### Annular Space
- **Depth (ft):**
- **Type of Sealing Used (Material and Type):**
- **Volume Placed (cft):**

### Method of Construction
- **Cable Tool:**
- **Rotary (Conventional):**
- **Rotary (Reverse Lead):**
- **Boring:**
- **Air Percussion:**
- **Other:**

### Well Use
- **Public:**
- **Commercial:**
- **Domestic:**
- **Not Used:**
- **Dewatering:**
- **Source:**
- **Monitoring:**
- **Cooling & Air Conditioning:**

### Construction Record - Drilling
- **Inside Diameter (Inch):**
- **Open Hole Off Material (Calibrated, Boring, Concrete, Peck, Steel):**
- **Wall Thickness (Inch):**
- **Depth (ft):**

### Construction Record - Screening
- **Outside Diameter (Inch):**
- **Material (Plastic, Galvanized, Steel):**
- **Slot No.:**
- **Depth (ft):**

### Water Details
- **Water found at Depth (ft):**
- **Kind of Water:**
- **Is Fresh:**
- **Uncontaminated:**
- **Depth (ft):**
- **Diameter (Inch):**

### Results of Well Yield Testing
- **Draw Down:**
- **Recovery:**
- **Clear and Sand Free:**
- **Other, Specify:**
- **Time (min):**
- **Water Level (ft):**
- **Time (min):**
- **Water Level (ft):**

### Construction Record - Casing
- **Status of Well:**
- **Water Supply:**
- **Replacement Well:**
- **Test Hole:**
- **Recharge Well:**
- **Dewatering Well:**
- **Observation and/or Monitoring:**
- **Abandoned:**
- **Abandoned, Poor Water Quality:**
- **Abandoned, Other, Specify:**
- **Other:**

### Water Contractor and Well Technician Information
- **Name:**
- **License No.:**
- **Business Address (Street Number):**
- **City:**
- **Province:**
- **Postal Code:**
- **Business E-mail Address:**

### Map of Well Location
- **Map:**

---

**Ministry Use Only**
- **Audit No.:**
- **Date Work Completed:**

**Ministry's Copy**

---
ATTACHMENT A3
Permits to Take Water (PTTWs)
September 8, 2005

The Regional Municipality of Waterloo
150 Frederick Street
Kitchener, Ontario, N2G 4J3
Canada

RE: 8 Wells (Pinebush Well A and B, Clemens Mill Well B, C, D and E, Shades Mill Well A and B)
Permit Number 6223-6ERJQG

Att: Eric Hodgin

Please find attached a Permit to Take Water which authorizes the withdrawal of water in accordance with the application for this Permit to Take Water dated July 18, 2005 and signed by Eric Hodgin.

This permit expires on July 30, 2006.

Please reference Table A for the permitted rates and amounts. Monitoring is now a requirement, please reference Sections 3 and 4 for the water taking and monitoring conditions.

Take notice that in issuing this Permit to Take Water, terms and conditions pertaining to the taking of water and to the results of the taking have been imposed. The terms and conditions have been designed to allow for the development of water resources, while providing reasonable protection to existing water users and users.

Yours truly,

[Signature]
Paul Odom

Ontario
Supervisor, Water Resources
West Central Region

File Storage Number: AP28 WAWA
Pursuant to Section 34 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

The Regional Municipality of Waterloo
150 Frederick Street
Kitchener, Ontario, N2G 4J3
Canada

For the water taking from: 8 drilled wells (Pinebush Wells A and B, Clemens Mill Wells B, C, D and E, Shades Mill Wells A and B)

Located at:
In road allowance in front of 2310 Townline Road
Cambridge, Regional Municipality of Waterloo

100 Arthur Fach Drive (Wtmer Park)
Cambridge, Regional Municipality of Waterloo

870 Townline Road
Cambridge, Regional Municipality of Waterloo

Road Allowance behind 60 Cedarbrook Court
Cambridge, Regional Municipality of Waterloo

Adjacent to 922 Stonebrook Road
Cambridge, Regional Municipality of Waterloo

Behind 808 Burnett Avenue
Cambridge, Regional Municipality of Waterloo

360 - 640 Clyde Road
Cambridge, Regional Municipality of Waterloo

1062 Clyde Road
North Dumfries, Regional Municipality of Waterloo
For the purposes of this Permit, and the terms and conditions specified below, the following definitions apply:

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34, OWRA.

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

(c) "Ministry" means Ontario Ministry of the Environment.

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

(e) "Permit" means this Permit to Take Water No. 5220-6EXQKY including its Schedules, if any, issued in accordance with Section 34 of the OWRA.

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

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

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

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated July 18, 2005 and signed by Eric Hodgins, and all Schedules included in this Permit.

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

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

1.4 This Permit is not transferable to another person.

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

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

2. General Conditions and Interpretation

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

2.2 Other Approvals
The issuance of, and compliance with this Permit, does not:
(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the Ontario Water Resources Act, and the Environmental Protection Act, and any regulations made thereunder; or
(b) limit in any way the authority of the Director or a Provincial Officer to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

2.3 Information
The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Officer to prosecute any person in relation to the information, shall not be construed as:
(a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or
(b) acceptance by the Ministry of the information's completeness or accuracy.

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

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

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

3. Water Takings Authorized by This Permit

3.1 Expiry
This Permit expires on July 30, 2006. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted
The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.
3.3 Each pumping test shall be limited to a maximum duration of 12 hours not to exceed the stated maximum rate of 1,000 litres per minute (220 GPM) as indicated in Table A.
4. **Monitoring**

4.1 **Notification to Well Owners**
Prior to commencement of each pumping test, the Permit Holder shall identify all wells within the area of the anticipated potential cone of influence, or within 1km of the test site, whichever is greater. At least 24 hours prior to beginning each pumping test, the Permit Holder shall provide written notification to the owners of the wells identified within the potential cone of influence. The notification shall include the expected date, time and duration of the pumping test, and a contact telephone number that may be used to report any interferences with water supplies.

4.2 **Measuring Water Depths**
To establish baseline conditions, well depths and depths to water levels for identified representative wells in the area of the water taking shall be recorded by the Permit Holder. During the pumping test, water levels in the identified wells shall be recorded. The pumping test must be of sufficient duration to accurately predict the long term impacts of the proposed water taking. Water levels in the identified wells shall continue to be monitored beyond the water taking period until at least 85% recovery is achieved.

5. **Impacts of the Water Taking**

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

5.2 **Restoration of Water Supply**
Where the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of doing so.

5.3 **Siltation control measures** shall be installed at the discharge site(s) and shall be sufficient to control the volumes. Continuous care shall be taken to properly maintain the siltation control devices.

5.4 **Local residents** who have domestic wells within 1km of the pumping well must be made aware
of the potential of well interference as the result of this testing.

5.5 Temporary water supplies must be provided to those well users whose wells are affected by the taking.

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

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

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

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.
In accordance with Section 100 of the *Ontario Water Resources Act*, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the *Ontario Water Resources Act*, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

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

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

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

And the Notice should be signed and dated by the appellant.

This notice must be served upon:

**The Secretory**  
Environmental Review Tribunal  
2300 Yonge Street, 12th Floor  
Toronto, Ontario M4P 1A4

**AND**

**The Director, Section 34**  
Ministry of Environment  
12th Floor  
110 King St W  
Hamilton ON L8P 4T7  
Fax: (905)521-7320

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

- by telephone at (416) 314-4600
- by fax at (416) 314-4505
- by e-mail at www.ert.gov.on.ca

Dated at Hamilton this 8th day of September, 2005.

Paul Odom  
Director, Section 34  
July 27, 2006

The Regional Municipality of Waterloo
6th Floor - 150 Frederick Street
Kitchener, Ontario
N2G 4J3

RE: Cambridge East IUS test wells
City of Cambridge
Regional Municipality of Waterloo
Permit Number 5514-6S3QNG

Dear Sir/Madam:

Please find attached a Permit to Take Water which authorizes the withdrawal of water in accordance with the application for this Permit to Take Water dated May 9, 2006 and signed by Jim Robinson.

This Permit expires on May 1, 2007.

Please reference Table A for the permitted rates and amounts. Monitoring is now a requirement under Ontario Regulation 387/04, please reference that Regulation and Section 4 of this Permit for monitoring requirements.

Take notice that in issuing this Permit to Take Water, terms and conditions pertaining to the taking of water and to the results of the taking have been imposed. The terms and conditions have been designed to allow for the development of water resources, while providing reasonable protection to existing water uses and users.

Yours truly,

[Signature]

Paul Odom
West Central Region

File Storage Number: AP28 CAWA
Pursuant to Section 34 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

The Regional Municipality of Waterloo
6th Floor - 150 Frederick Street
Kitchener, Ontario
N2G 4J3

For the water taking from:
Located at: Three Drilled Wells (CMPW01-06, CMPW02-06 and PBPW01-06)
Municipal Road Allowance behind 60 Cedarbrook Court
Cambridge, Regional Municipality of Waterloo
870 Townline Road
Cambridge, Regional Municipality of Waterloo
Road Allowance in front of 2310 Townline Road
Cambridge, Regional Municipality of Waterloo

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

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34, OWRA.

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

(c) "Ministry" means Ontario Ministry of the Environment.

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

(e) "Permit" means this Permit to Take Water No. 5514-6S3QNG including its Schedules, if any, issued in accordance with Section 34 of the OWRA.

(f) "Permit Holder" means The Regional Municipality of Waterloo.
(g) "OWRA" means the Ontario Water Resources Act, R.S.O. 1990, c. O. 40, as amended.

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

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated May 9, 2006 and signed by Jim Robinson, and all Schedules included in this Permit.

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

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

1.4 This Permit is not transferable to another person.

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

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

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

2. General Conditions and Interpretation

2.1 Inspections
The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the Environmental Protection Act, R.S.O. 1990, the Pesticides Act, R.S.O. 1990, or the Safe Drinking Water Act, S. O. 2002.
2.2 Other Approvals
The issuance of, and compliance with this Permit, does not:

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the Ontario Water Resources Act, and the Environmental Protection Act, and any regulations made thereunder; or

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

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

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

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

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

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

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

3. Water Takings Authorized by This Permit

3.1 Expiry
This Permit expires on May 1, 2007. No water shall be taken under authority of this Permit after the expiry date.
3.2 Amounts of Taking Permitted
The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.

### Table A

<table>
<thead>
<tr>
<th>Source Name / Description</th>
<th>Source Type</th>
<th>Taking Specific Purpose</th>
<th>Taking Major Category</th>
<th>Max. Taken per Minute (litres)</th>
<th>Max. Num. of Hrs. Taken per Day</th>
<th>Max. Taken per Day (litres)</th>
<th>Max. Num. of Days Taken per Year</th>
<th>Zone/ Easting/ Northing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  CMPW01-06</td>
<td>Well</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
<td>3,785</td>
<td>24</td>
<td>5,451,000</td>
<td>40</td>
<td>17 556433 4695290</td>
</tr>
<tr>
<td>2  CMPW02-06</td>
<td>Well</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
<td>3,785</td>
<td>24</td>
<td>5,451,000</td>
<td>40</td>
<td>17 556665 4604462</td>
</tr>
<tr>
<td>3  PBPW01-06</td>
<td>Well</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
<td>3,785</td>
<td>24</td>
<td>5,451,000</td>
<td>40</td>
<td>17 556631 4606882</td>
</tr>
</tbody>
</table>

Total Taking: 16,353,000

3.3 The Permit is valid between the date of issue and May 1, 2007 for a total of 40 days.

4. Monitoring


4.2 The Permit Holder shall initiate stream flow and surface water level monitoring, at least daily, for one week prior to the start-up of the pumping test and should continue, at least daily, for two weeks following the cessation of pumping. Spot measurements and continuous flow monitoring and temperature data should be collected at the locations identified in the Addendum - "Test Well Installations and Monitoring Program Category 3 Permit to Take Water Application for Long Term Pumping Tests, Cambridge East- IUS Project", prepared by Golder Associates Ltd. (Reference: 05-1112-010(1000)), dated July 20, 2006.

4.3 The Permit Holder shall monitor daily water takings using a flow meter installed on each test production well. In addition, the dates, times, pumping rates and amount taken shall be recorded. A log book of the pumping dates, rates and duration of water taking and all monitoring data recorded (unless data loggers are used) must be kept on site for the duration of the pumping test and monitoring for inspection by Ministry of the Environment staff. The water taking records shall be submitted to the Director as stipulated by O. Reg. 387/04.
4.4 This Permit only allows the taking of the ground water for pumping test purposes and does not approve directly or indirectly the discharge of any contaminants into the natural environment or the Region of Waterloo municipal sewer system.

5. Impacts of the Water Taking

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

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

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

6. Director May Amend Permit
The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the Ontario Water Resources Act, Section 100 (4).
The reasons for the imposition of these terms and conditions are as follows:

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

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

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.
In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

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

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

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

This notice must be served upon:

The Secretary  
Environmental Review Tribunal  
2300 Yonge Street, Suite 1700  
Toronto, Ontario M4P 1E4

AND

The Director, Section 34  
Ministry of the Environment  
12th Floor  
119 King St W  
Hamilton ON L8P 4Y7  
Fax: (905) 521-7820

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

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

Dated at Hamilton this 27th day of July, 2006.

[Signature]

Paul Odom  
Director, Section 34  
Ontario Water Resources Act, R.S.O. 1990
Schedule A

This Schedule "A" forms part of Permit To Take Water 5514-6S3QNG, dated July 27, 2006.
September 7, 2006

The Regional Municipality of Waterloo
6th Floor - 150 Frederick Street
Kitchener, Ontario
N2G 4J3

RE: Cambridge East IUS test wells
City of Cambridge
Regional Municipality of Waterloo
Permit Number 0458-6TDH4X

Dear Sir/Madam

Please find attached a Permit to Take Water which authorizes the withdrawal of water in accordance with the application for this Permit to Take Water dated May 9, 2006 and signed by Jim Robinson. This permit amends and supercedes Permit to Take Water No. 5514-6S3QNG issued on July 27, 2006.

This Permit expires on May 1, 2007.

Please reference Table A for the permitted rates and amounts. Monitoring is now a requirement under Ontario Regulation 387/04, please reference that Regulation and Section 4 of this Permit for monitoring requirements.

Take notice that in issuing this Permit to Take Water, terms and conditions pertaining to the taking of water and to the results of the taking have been imposed. The terms and conditions have been designed to allow for the development of water resources, while providing reasonable protection to existing water uses and users.

Yours truly,

[Signature]

Paul Odom
Supervisor, Water Resources
West Central Region
AMENDED PERMIT TO TAKE WATER
Ground Water
NUMBER 0458-6TDH4X

Pursuant to Section 34 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To
Take Water is hereby issued to:

The Regional Municipality of Waterloo
6th Floor - 150 Frederick Street
Kitchener, Ontario
N2G 4J3

For the water taking from:
Located at:
Three Drilled Wells (CMPW01-06, CMPW02-06 and PBPW01-06)
Municipal Road Allowance behind 60 Cedarbrook Court
Cambridge, Regional Municipality of Waterloo

870 Townline Road
Cambridge, Regional Municipality of Waterloo

100 Arthur Fach Drive (Witmer Park)
Cambridge, Regional Municipality of Waterloo

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

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the
OWRA for the purposes of section 34, OWRA.

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

(c) "Ministry" means Ontario Ministry of the Environment.

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

(e) "Permit" means this Permit to Take Water No. 0458-6TDH4X including its Schedules, if any,
Issued in accordance with Section 34 of the OWRA.

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

(g) "OWRA" means the Ontario Water Resources Act, R.S.O. 1990, c. O. 40, as amended.
the Environmental Protection Act, and any regulations made thereunder; or

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

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

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

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

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

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

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

3. Water Takings Authorized by This Permit

3.1 Expiry
This Permit expires on May 1, 2007. No water shall be taken under authority of this Permit after the expiry date.

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

<table>
<thead>
<tr>
<th>Source Name / Description</th>
<th>Source Type:</th>
<th>Taking Specific Purpose:</th>
<th>Taking Major Category:</th>
<th>Max. Taken per Minute (litres):</th>
<th>Max. Num. of Hrs Taken per Day:</th>
<th>Max. Taken per Day (litres):</th>
<th>Max. Num. of Days Taken per Year:</th>
<th>Zone/ Easting/ Northing:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPW01-06</td>
<td>Well Drilled</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
<td>3,785</td>
<td>24</td>
<td>5,451,000</td>
<td>40</td>
<td>668433 4805230</td>
</tr>
<tr>
<td>CMPW02-06</td>
<td>Well Drilled</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
<td>3,785</td>
<td>24</td>
<td>5,451,000</td>
<td>40</td>
<td>668965 4804462</td>
</tr>
<tr>
<td>PEPW01-06</td>
<td>Well Drilled</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
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<td>24</td>
<td>5,451,000</td>
<td>40</td>
<td>668301 4805562</td>
</tr>
<tr>
<td>Total Taking:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16,532,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.3 The Permit is valid between the date of issue and May 1, 2007 for a total of 40 days.

4. Monitoring


4.2 The Permit Holder shall initiate stream flow and surface water level monitoring, at least daily, for one week prior to the start-up of the pumping test and should continue, at least daily, for two weeks following the cessation of pumping. Spot measurements and continuous flow monitoring and temperature data should be collected at the locations identified in the Addendum - "Test Well Installations and Monitoring Program Category 3 Permit to Take Water Application for Long Term Pumping Tests, Cambridge East- IUS Project", prepared by Golder Associates Ltd. (Reference: 05-1112-010(1000)), dated July 20, 2006.

4.3 The Permit Holder shall monitor daily water takings using a flow meter installed on each test production well. In addition, the dates, times, pumping rates and amount taken shall be recorded. A log book of the pumping dates, rates and duration of water taking and all monitoring data recorded (unless data loggers are used) must be kept on site for the duration of the pumping test and monitoring for inspection by Ministry of the Environment staff. The water taking records shall be submitted to the Director as stipulated by O. Reg. 387/04.

4.4 This Permit only allows the taking of the ground water for pumping test purposes and does not approve directly or indirectly the discharge of any contaminants into the natural environment or the Region of Waterloo municipal sewer system.

5. Impacts of the Water Taking
5.1 Notification
The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6050.

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

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

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

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

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

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

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.
In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

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

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

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

This notice must be served upon:

The Secretary
Environmental Review Tribunal
2300 Yonge Street, Suite 1700
Toronto, Ontario M4P 1E4

AND

The Director, Section 34
Ministry of the Environment
12th Floor
119 King St W
Hamilton ON L8P 4Y7
Fax: (905) 521-7830

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

by telephone at (416) 314-4600  by fax at (416) 314-4505  by e-mail at www.ert.gov.on.ca

This Permit cancels and replaces Permit Number 5514-6S3QNG, issued on 2006/07/27.

Dated at Hamilton this 7th day of September, 2006.

Paul Odom
Director, Section 34
Ontario Water Resources Act, R.S.O. 1990
Schedule A

This Schedule “A” forms part of Permit To Take Water 0458-6TDH4X, dated September 7, 2006.
September 17, 2007

The Regional Municipality of Waterloo
150 Frederick St
Kitchener, Ontario
N2G 4J3

RE: Cambridge East Additional Testing - IUS Project
City of Cambridge
Regional Municipality of Waterloo
Permit Number 8518-76HNTQ

Dear Sir/Madam:

Please find attached a Permit to Take Water which authorizes the withdrawal of water in accordance with the application for this Permit to Take Water dated June 25, 2007 and signed by Jim Robinson.

This Permit expires on December 31, 2007.

Please reference Table A for the permitted rates and amounts. Monitoring is now a requirement under Ontario Regulation 387/04, please reference that Regulation and Section 4 of this Permit for monitoring requirements.

Take notice that in issuing this Permit to Take Water, terms and conditions pertaining to the taking of water and to the results of the taking have been imposed. The terms and conditions have been designed to allow for the development of water resources, while providing reasonable protection to existing water uses and users.

Yours truly,

[Signature]

Paul Odom
West Central Region

File Storage Number: AP28 CAWA
Pursuant to Section 34 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

The Regional Municipality of Waterloo
150 Frederick St
Kitchener, Ontario, N2G 4J3

For the water taking from:
Five drilled wells (SMTW2-07, SMPW1-07, SMTW3-07, PBTW3-07, PBPW2-07)

Located at:
Lot 5, Concession 12, North Dumfries
Cambridge, Regional Municipality of Waterloo

Lot 3, Concession 12, North Dumfries
Cambridge, Regional Municipality of Waterloo

Lot 3, Concession 3 Beasley's Lower Block
Cambridge, Regional Municipality of Waterloo

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

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34, OWRA.

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

(c) "Ministry" means Ontario Ministry of the Environment.

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

(e) "Permit" means this Permit to Take Water No. 8518-76HNTQ including its Schedules, if any, issued in accordance with Section 34 of the OWRA.

(f) "Permit Holder" means The Regional Municipality of Waterloo.
"OWRA" means the Ontario Water Resources Act, R.S.O. 1990, c. O. 40, as amended.

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

TERMS AND CONDITIONS

1. Compliance with Permit
   1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated June 25, 2007 and signed by Jim Robinson, and all Schedules included in this Permit.
   1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.
   1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.
   1.4 This Permit is not transferable to another person.
   1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.
   1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.
   1.7 The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change. A change in ownership in the property shall cause this Permit to be cancelled.

2. General Conditions and Interpretation
   2.1 Inspections
   The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the Environmental Protection Act, R.S.O. 1990, the Pesticides Act, R.S.O. 1990, or the Safe Drinking Water Act, S. O. 2002.
   2.2 Other Approvals
   The issuance of, and compliance with this Permit, does not:
   (a) relieve the Permit Holder or any other person from any obligation to comply with any other
applicable legal requirements, including the provisions of the *Ontario Water Resources Act*, and the *Environmental Protection Act*, and any regulations made thereunder; or

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

2.3 Information

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

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

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

2.4 Rights of Action

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

2.5 Severability

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

2.6 Conflicts

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

3. Water Takings Authorized by This Permit

3.1 Expiry

This Permit expires on **December 31, 2007**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted

The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.
3.3 Notwithstanding the individual numbers of days identified in Table A, water taking under the authorization of this Permit may occur simultaneously but shall only occur for a maximum total of 15 days between the date of issue and December 31, 2007.

3.4 Notwithstanding Table A, water taking under the authorization of this permit shall not occur at wells SMPW1-07, PBTW3-07 and PBPW2-07 until water well records for these three proposed wells are submitted to the Director and receipt of those records is acknowledged.

4. Monitoring


4.2 The Permit Holder shall measure water levels on a continuous basis in the private well located at 6518 Gore Road, Puslinch, Ontario, subject to the owner's permission. The water levels shall be monitored prior to, during and two weeks after completion of the
pumping test in Clyde Road Area.

4.3 The Permit Holder shall monitor daily water takings using a flow meter installed on each test and production well. In addition, the dates, times, pumping rates and amount taken shall be recorded. A log book of the pumping dates, rates and duration of water taking and all monitoring data record (unless data loggers are used) must be kept on site for inspection by Ministry of the Environment staff during water taking. The water taking records shall be submitted to the Director by January 31, 2008.

4.4 The Permit only allows the taking of the ground water for pumping test purpose and does not approve directly or indirectly the discharge of any contaminants into the natural environment or the Region of Waterloo/municipal sewer system.

5. Impacts of the Water Taking

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

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

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

6. Director May Amend Permit
The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the Ontario Water Resources Act, Section 100 (4).
The reasons for the imposition of these terms and conditions are as follows:

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

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

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.
In accordance with Section 100 of the **Ontario Water Resources Act**, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the **Ontario Water Resources Act**, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

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

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

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

This notice must be served upon:

The Secretary  
Environmental Review Tribunal  
2300 Yonge Street, Suite 1700  
Toronto, Ontario M4P 1E4

AND

The Director, Section 34  
Ministry of the Environment  
12th Floor  
119 King St W  
Hamilton ON L8P 4V7  
Fax: (905)521-7820

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

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

Dated at Hamilton this 17th day of September, 2007.

[Signature]  
Paul Odom  
Director, Section 34  
**Ontario Water Resources Act**, R.S.O. 1990
Schedule A

This Schedule "A" forms part of Permit To Take Water 8518-76HNTQ, dated September 17, 2007.
Pursuant to Section 34 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

The Regional Municipality of Waterloo  
150 Frederick St  
Kitchener, Ontario, N2G 4J3

For the water taking from:  
Three drilled wells (PBTW3-07, PBPW2-08, SMTW4-08)

Located at:  
Lot 2, Concession 12, N. Dumfries  
Cambridge, Regional Municipality of Waterloo

Lot 3, Concession Beasley's Lower Block  
Cambridge, Regional Municipality of Waterloo

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

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34, OWRA.

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

(c) "Ministry" means Ontario Ministry of the Environment.

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

(e) " Permit" means this Permit to Take Water No. 3311-7AYQF9 including its Schedules, if any, issued in accordance with Section 34 of the OWRA.

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

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

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

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated January 9, 2008 and signed by Jim W. Robinson, and all Schedules included in this Permit.

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

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

1.4 This Permit is not transferable to another person.

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

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

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

2. General Conditions and Interpretation

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

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

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the Ontario Water Resources Act, and the Environmental Protection Act, and any regulations made thereunder; or

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

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

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

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

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

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

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

3. Water Takings Authorized by This Permit

3.1 Expiry
This Permit expires on **July 31, 2008**. No water shall be taken under authority of this Permit after the expiry date.

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

<table>
<thead>
<tr>
<th>Source Name / Description:</th>
<th>Source: Type:</th>
<th>Taking Specific Purpose:</th>
<th>Taking Major Category:</th>
<th>Max. Taken per Minute (litres):</th>
<th>Max. Num. of Hrs Taken per Day:</th>
<th>Max. Taken per Day (litres):</th>
<th>Max. Num. of Days Taken per Year:</th>
<th>Zone/Easting/Northing:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Can-Amera Well #PBTW3-07</td>
<td>Well Drilled</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
<td>4,546</td>
<td>24</td>
<td>6,547,000</td>
<td>6</td>
<td>17 557469 4805901</td>
</tr>
<tr>
<td>2 Can-Amera Well #PBPW2-08</td>
<td>Well Drilled</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
<td>4,546</td>
<td>24</td>
<td>6,547,000</td>
<td>6</td>
<td>17 557469 4805901</td>
</tr>
<tr>
<td>3 Shades Mill Well #SMTW4-08</td>
<td>Well Drilled</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
<td>4,546</td>
<td>24</td>
<td>6,547,000</td>
<td>6</td>
<td>17 557469 4805901</td>
</tr>
</tbody>
</table>

Total Taking: 6,547,000

3.3 Notwithstanding the individual numbers of days identified in Table A, water taking under the authorization of this Permit shall not occur simultaneously and the taking is for a maximum total of 8 days between the date of issue and July 31, 2008.

3.4 Notwithstanding Table A, water taking under the authorization of this permit shall not occur at wells PBPW2-08 and SMTW4-08 until water well records (draft) for these two proposed wells are submitted to the Director and receipt of those records is acknowledged.

4. Monitoring


4.2 The Permit Holder shall measure water levels on a continuous basis in the private well located at 6518 Gore Road, Puslinch, Ontario, subject to the owner's permission. The water levels shall be monitored prior to, during and two weeks after completion of the pumping test at Well #SMTW4-08.

4.3 The Permit Holder shall monitor daily water takings using a flow meter installed on each test and production well. In addition, the dates, times, pumping rates and amount taken shall be recorded. A log book of the pumping dates, rates and duration of water taking
and all monitoring data record (unless data loggers are used) must be kept on site for inspection by Ministry of the Environment staff during water taking. The water taking records shall be submitted to the Director by December 31, 2008.

4.4 The Permit only allows the taking of the ground water for pumping test purpose and does not approve directly or indirectly the discharge of any contaminants into the natural environment or the Region of Waterloo/municipal sewer system.

5. Impacts of the Water Taking

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

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

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

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

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

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.
2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.
In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

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

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

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

This notice must be served upon:

The Secretary
Environmental Review Tribunal
2300 Yonge Street, Suite 1700
Toronto, Ontario M4P 1E4

The Director, Section 34
Ministry of the Environment
12th Floor
119 King St W
Hamilton ON L8P 4Y7
Fax: (905)521-7820

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

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

Dated at Hamilton this 22nd day of January, 2008.

Paul Odom
Director, Section 34
Ontario Water Resources Act, R.S.O. 1990
Schedule A

This Schedule “A” forms part of Permit To Take Water 3311-7AYQF9, dated January 22, 2008.
October 9, 2008

Regional Municipality of Waterloo
150 Frederick St
Kitchener, Ontario
N2E 4J3

Dear Sir/Madam:

RE: 1220 Village Rd
North Dumfries, Regional Municipality of Waterloo
Permit Number ****

Please find attached a Permit to Take Water which authorizes the withdrawal of water in accordance with the application for this Permit to Take Water dated September 26, 2008 and signed by Jim Robinson.

This Permit expires on November 30, 2008. Authorized rates and amounts are indicated on Table A.

Ontario Regulation 387/04 requires all water takers to report daily water taking amounts to the WTRS electronic database at: http://www.ene.gov.on.ca/envison/water/pttw.htm, if no water is taken in that year then that information must also be entered. Please reference that Regulation and Section 4 of this Permit for monitoring requirements.

Please also note Condition 1.4 specifically indicates that this Permit is not transferable to another party. If the property is sold or the taking is to be used by another party, they will need to apply for their own Permit, as this Permit will not be valid. Any queries regarding a change in owner/operator should be made to the Permit to Take Water Evaluator at the above address.

Take notice that in issuing this Permit to Take Water, terms and conditions pertaining to the taking of water and to the results of the taking have been imposed. The terms and conditions have been designed to allow for the development of water resources, while providing reasonable protection to existing water uses and users.

Yours truly,
Carl Slater
Manager
West Central Region

File Storage Number: AP28 NDWA
Pursuant to Section 34 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

Regional Municipality of Waterloo  
150 Frederick St  
Kitchener, Ontario  
N2E 4J3

For the water taking from: Two drilled bedrock wells  
(Well NDTW1/08 and Well NDTW2/08)

Located at: 1220 Village Rd  
North Dumfries, Regional Municipality of Waterloo

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

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34, OWRA.

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

(c) "Ministry" means Ontario Ministry of the Environment.

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

(e) "Permit" means this Permit to Take Water No. 3808-7K9PSS including its Schedules, if any, issued in accordance with Section 34 of the OWRA.

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

(g) "OWRA " means the Ontario Water Resources Act, R.S.O. 1990, c. O. 40, as amended.
You are hereby notified that this Permit is issued subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated September 26, 2008 and signed by Jim Robinson, and all Schedules included in this Permit.

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

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

1.4 This Permit is not transferable to another person.

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

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

2. General Conditions and Interpretation

2.1 Inspections

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

2.2 Other Approvals

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

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the Ontario Water Resources Act, and the Environmental Protection Act, and any regulations made thereunder; or

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

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

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

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

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

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

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

3. Water Takings Authorized by This Permit

3.1 Expiry
This Permit expires on November 30, 2008. No water shall be taken under authority of this Permit after the expiry date.

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

<table>
<thead>
<tr>
<th>Source Name / Description</th>
<th>Source Type</th>
<th>Taking Specific Purpose</th>
<th>Taking Major Category</th>
<th>Max. Taken per Minute (litres)</th>
<th>Max. Num. of Hrs Taken per Day</th>
<th>Max. Taken per Day (litres)</th>
<th>Max. Num. of Days Taken</th>
<th>Max. Num. of Zones/ Easting/ Northing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well NDTW1/08</td>
<td>Drilled</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
<td>2,271</td>
<td>8</td>
<td>1,080,000</td>
<td>2</td>
<td>17 552290 4804421</td>
</tr>
<tr>
<td>Well NDTW2/08</td>
<td>Drilled</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
<td>2,271</td>
<td>8</td>
<td>1,080,000</td>
<td>2</td>
<td>17 552232 4803970</td>
</tr>
<tr>
<td>Total Taking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2,160,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.3 Notwithstanding the individual numbers of days identified in Table A, water taking under the authorization of this Permit shall not occur simultaneously and the taking is for a maximum total of 16 hours between the date of issue and November 30, 2008.

4. Monitoring

4.1 Notification to Well Owners
Prior to commencement of the pumping test, the Permit Holder shall identify all wells within the area of the anticipated potential cone of influence, or within 500 metres of the test site, whichever is greater. At least 24 hours prior to beginning the pumping test, the Permit Holder shall provide written notification to the owners of the wells identified within the potential cone of influence. The notification shall include the expected date, time and duration of the pumping test, and a contact telephone number that may be used to report any interferences with water supplies.

4.2 Measuring Water Depths
To establish baseline conditions, well depths and depths to water levels for identified representative wells in the area of the water taking shall be recorded by the Permit Holder. During the pumping test, water levels in the identified wells shall be recorded. The pumping test must be of sufficient duration to accurately predict the long term impacts of the proposed water taking. Water levels in the identified wells shall continue to be monitored beyond the water taking period until at least 85% recovery is achieved.


4.4 The Permit Holder shall monitor daily water takings using a flow meter installed on each test and production well. In addition, the dates, times, pumping rates and amount taken
shall be recorded. A log book of the pumping dates, rates and duration of water taking and all monitoring data record (unless data loggers are used) must be kept on site for inspection by Ministry of the Environment staff during water taking. The water taking records shall be submitted to the Director by December 31, 2008.

4.5 The Permit only allows the taking of the ground water for pumping test purpose and does not approve directly or indirectly the discharge of any contaminants into the natural environment.

5. Impacts of the Water Taking

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

5.2 Restoration of Water Supply
Where the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of doing so.

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

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

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

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

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing,
conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.
In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

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

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

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

This notice must be served upon:

The Secretary
Environmental Review Tribunal
655 Bay Street, 15th Floor
Toronto ON
MSG 1E5

AND

The Director, Section 34
Ministry of the Environment
12th Floor
119 King St W
Hamilton ON L8P 4Y7
Fax: (905) 521-7820

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

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

Dated at Hamilton this 9th day of October, 2008.

Carl Slater
Director, Section 34
Ontario Water Resources Act, R.S.O. 1990
December 15, 2008

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

Dear Sir/Madam

RE: 1220 Village Road, Clyde
North Dumfries, Regional Municipality of Waterloo
Permit Number 2860-7MCMMT

Please find attached a Permit to Take Water which authorizes the withdrawal of water in accordance with the application for this Permit to Take Water dated November 13, 2008 and signed by Jim Robinson.

This Permit expires on February 28, 2009. Authorized rates and amounts are indicated on Table A.

Ontario Regulation 387/04 requires all water takers to report daily water taking amounts to the WTRS electronic database at: http://www.ene.gov.on.ca/envisiion/water/pttw.htm, if no water is taken in that year then that information must also be entered. Please reference that Regulation and Section 4 of this Permit for monitoring requirements.

Please also note Condition 1.4 specifically indicates that this Permit is not transferable to another party. If the property is sold or the taking is to be used by another party, they will need to apply for their own Permit, as this Permit will not be valid. Any queries regarding a change in owner/operator should be made to the Permit to Take Water Evaluator at the above address.

Take notice that in issuing this Permit to Take Water, terms and conditions pertaining to the taking of water and to the results of the taking have been imposed. The terms and conditions have been designed to allow for the development of water resources, while providing reasonable protection to existing water uses and users.

Yours truly,
Lou-Ann Comacchio
Water Supervisor (A)
West Central Region

File Storage Number: AP28 NOWA
Pursuant to Section 34 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

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

For the water taking from:
One bedrock well (NDPW1-08)

Located at:
1220 Village Road, Clyde
North Dumfries, Regional Municipality of Waterloo

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

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34, OWRA.

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

(c) "Ministry" means Ontario Ministry of the Environment.

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

(e) "Permit" means this Permit to Take Water No. 2860-7MCMMT including its Schedules, if any, issued in accordance with Section 34 of the OWRA.

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

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

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

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated November 13, 2008 and signed by Jim Robinson, and all Schedules included in this Permit.

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

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

1.4 This Permit is not transferable to another person.

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

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

2. General Conditions and Interpretation

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

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

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the Ontario Water Resources Act, and the Environmental Protection Act, and any regulations made thereunder; or

(b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.
2.3 Information
The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Office to prosecute any person in relation to the information, shall not be construed as:

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

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

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

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

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

3. Water Takings Authorized by This Permit

3.1 Expiry
This Permit expires on February 28, 2009. No water shall be taken under authority of this Permit after the expiry date.

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

<table>
<thead>
<tr>
<th>Source Name / Description</th>
<th>Source Type</th>
<th>Taking Specific Purpose</th>
<th>Taking Major Category</th>
<th>Max. Taken per Minute (litres)</th>
<th>Max. Num. of Hrs Taken per Day</th>
<th>Max. Taken per Day (litres)</th>
<th>Max. Num. of Days Taken</th>
<th>Zonal Easting/ Northing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well NDFV1-08</td>
<td>Well Drilled</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
<td>4,546</td>
<td>24</td>
<td>6,546,240</td>
<td>7</td>
<td>17 562222 4804976</td>
</tr>
</tbody>
</table>

Total Taking: 6,546,240

3.3 Notwithstanding the Maximum Number of Days Taken identified in Table A, the taking is for a total of less than 7 days (not consecutive) between the date of issue and February 28, 2009.

4. Monitoring

4.1 Notification to Well Owners
Prior to commencement of the pumping test, the Permit Holder shall identify all wells within the area of the anticipated potential cone of influence, or within 500 metres of the test site, whichever is greater. At least 24 hours prior to beginning the pumping test, the Permit Holder shall provide written notification to the owners of the wells identified within the potential cone of influence. The notification shall include the expected date, time and duration of the pumping test, and a contact telephone number that may be used to report any interferences with water supplies.

4.2 Measuring Water Depths
To establish baseline conditions, well depths and depths to water levels for identified representative wells in the area of the water taking shall be recorded by the Permit Holder. During the pumping test, water levels in the identified wells shall be recorded. The pumping test must be of sufficient duration to accurately predict the long term impacts of the proposed water taking. Water levels in the identified wells shall continue to be monitored beyond the water taking period until at least 85% recovery is achieved.

4.3 The Permit Holder shall implement the ground and surface water monitoring plan outlined in the document “Category 2 Permit to Take Water for Pumping Test: North Dumfries Testing Program - RMOW IUS Project”, prepared by Golder Associates Ltd. (Reference: 05-1112-010 (1900)), dated November 10, 2008.

4.4 The Permit Holder shall measure water levels on a continuous basis in the private well located at 6518 Gore Road, Puslinch, Ontario, subject to the owner’s permission. The water levels shall be monitored prior to, during and two weeks after completion of the pumping test.
4.5 In addition to the requirements imposed by section 9 of O. Reg. 387/04, and as authorized by subsection 34(6) of the *Ontario Water Resources Act*, the Permit Holder shall do the following: maintain a record of all water takings that includes the date, times, rates and total measured amounts of water pumped per day for each day that water is taken under the authorization of this Permit; keep all required records current and available at or near the site of the taking; and produce those records for the inspection of a Provincial Officer immediately upon his or her request.

4.6 The Permit only allows the taking of the ground water for pumping test purpose and does not approve directly or indirectly the discharge of any contaminants into the natural environment.

5. Impacts of the Water Taking

5.1 Notification
The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6050.

5.2 Restoration of Water Supply
Where the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of doing so.

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

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

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

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.
In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

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

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

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

This notice must be served upon:

The Secretary  
Environmental Review Tribunal  
655 Bay Street, 15th Floor  
Toronto ON  
M5G 1E5

AND

The Director, Section 34  
Ministry of the Environment  
12th Floor  
119 King St W  
Hamilton ON L8P 4Y7  
Fax: (905)521-7820

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

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

Dated at Hamilton this 17th day of December, 2008.

[Signature]

Lou-Ann Cornacchio  
Director, Section 34  
Ontario Water Resources Act , R.S.O. 1990
Pursuant to Section 34 of the *Ontario Water Resources Act*, R.S.O. 1990, this Permit To Take Water is hereby issued to:

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

For the water taking from: Well NDPW1-08
Located at: Lot 6, Concession 10  
North Dumfries, Regional Municipality of Waterloo

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

**DEFINITIONS**

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34, OWRA.

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

(c) "Ministry" means Ontario Ministry of the Environment.

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

(e) "Permit" means this Permit to Take Water No. 5351-7VBNWA including its Schedules, if any, issued in accordance with Section 34 of the OWRA.

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

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

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

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated July 17, 2009 and signed by Amy Domaratzki, and all Schedules included in this Permit.

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

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

1.4 This Permit is not transferable to another person.

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

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

2. General Conditions and Interpretation

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

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

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the Ontario Water Resources Act, and the Environmental Protection Act, and any regulations made thereunder; or

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

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

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

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

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

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

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

3. Water Takings Authorized by This Permit

3.1 Expiry
This Permit expires on November 30, 2009. No water shall be taken under authority of this Permit after the expiry date.

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

<table>
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<tr>
<th>Source Name / Description:</th>
<th>Source: Type:</th>
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<th>Max. Taken per Minute (litres):</th>
<th>Max. Num. of Hrs Taken per Day:</th>
<th>Max. Taken per Day (litres):</th>
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<tbody>
<tr>
<td>1 NDPW1-08</td>
<td>Well Drilled</td>
<td>Pumping Test</td>
<td>Miscellaneous</td>
<td>4,546</td>
<td>24</td>
<td>6,546,240</td>
<td>7</td>
<td>17 562222</td>
</tr>
</tbody>
</table>

**Total Taking:** 6,546,240

3.3 Notwithstanding the Maximum Number of Days of Taking identified in Table A, the taking is for a total of less than 7 days (not consecutive) between the date of issue and November 30, 2009.

3.4 The Permit only allows the taking of the ground water for pumping test purposes and does not approve directly or indirectly the discharge of excess groundwater or any contaminants into the natural environment.

4. Monitoring

4.1 Notification to Well Owners
Prior to commencement of the pumping test, the Permit Holder shall identify all wells within the area of the anticipated potential cone of influence, or within 500 metres of the test site, whichever is greater. At least 24 hours prior to beginning the pumping test, the Permit Holder shall provide written notification to the owners of the wells identified within the potential cone of influence. The notification shall include the expected date, time and duration of the pumping test, and a contact telephone number that may be used to report any interferences with water supplies.

4.2 Measuring Water Depths
To establish baseline conditions, well depths and depths to water levels for identified representative wells in the area of the water taking shall be recorded by the Permit Holder. During the pumping test, water levels in the identified wells shall be recorded. The pumping test must be of sufficient duration to accurately predict the long term impacts of the proposed water taking. Water levels in the identified wells shall continue to be monitored beyond the water taking period until at least 85% recovery is achieved.

4.3 In addition to the requirements imposed by section 9 of O. Reg. 387/04, and as authorized by subsection 34(6) of the *Ontario Water Resources Act*, the Permit Holder shall do the following: maintain a record of all water takings that includes the date, times, rates and total measured amounts of water pumped per day for each day that water is taken under the authorization of this Permit; keep all required records current and available at or near the site of the taking; and produce those records for the inspection of...
a Provincial Officer immediately upon his or her request.

4.4 The Permit Holder shall implement the ground and surface water monitoring plan outlined in the document "Category 2 Permit to Take Water for Pumping Test: North Dumfries Testing Program - RMOW IUS Project", prepared by Golder Associates Ltd. (Reference: 05-1112-010 (1900)), dated July 13, 2009.

4.5 The Permit Holder shall measure water levels on a continuous basis in a private well located at 6518 Gore Road, Puslinch, Ontario, subject to the owner's permission. The water levels shall be monitored prior to, during and two weeks after completion of the pumping test.

5. **Impacts of the Water Taking**

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

5.2 **Restoration of Water Supply**
Where the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of doing so.

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

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

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

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.
In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

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

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

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

This notice must be served upon:

The Secretary  
Environmental Review Tribunal  
655 Bay Street, 15th Floor  
Toronto ON  
M5G 1E5

AND

The Director, Section 34  
Ministry of the Environment  
12th Floor  
119 King St W  
Hamilton ON L8P 4Y7  
Fax: (905)521-7820

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

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

Dated at Hamilton this 27th day of August, 2009.

Belinda Koblik  
Director, Section 34  
Ontario Water Resources Act, R.S.O. 1990
ATTACHMENT A4

Step Testing

- Drawdown Versus Elapsed Time Plots
- Aqtesolv Analyses
Cambridge East Water Supply
Class EA

Test Production Well
Step Test Results -
Drawdown Versus Log Time

NOTES:
1) Step testing of CMPW1-06, CMPW2-06 and PBPW1-06 took place between June to August 2005
PBPW2-08 was step tested on April 19, 2006
2) Step test rates for PBPW2-08 were as follows: Step 1 at 3,633 m³/day, Step 2 at 5,447 m³/day, Step 3 at 5,633 m³/day, and Step 4 at 5,257 m³/day

+ Step 1 - 3,633 m³/day
X Step 3 - 5,447 m³/day
O Step 2 - 4,377 m³/day
▲ Step 4 - 6,540 m³/day

DRAWN: JLH | APPROVED: JAP | DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) | FIGURE: A4.1
Step Test Results - Drawdown Versus Log Time

Pinebush
Water Supply
Class EA

NOTES
1) The step test at PBTW1-05 took place on Sept 15, 2005. The step test at PBTW2-06 occurred on June 7, 2006, while the PBTW3-07 step test was on Feb 9, 2006.
2) Step 4 at PBTW2-06 was at a rate of 1,257 m³/day (141 L/s).

Cambridge East
Water Supply
Class EA

DRAWN: JLH | APPROVED: JAP | DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) | FIGURE: A4.2
Clemens Mills
Step Test Results -
Drawdown Versus Log Time

Cambridge East
Water Supply
Class EA

NOTE:
1) The step test at CMTW1-05 took place on Sept 13, 2005. The step tests at CMTW2-05 and CMTW3-05 occurred on Nov 18 and 23, 2005, respectively.

- 1 10 100
- Elapsed Time (min)
- Observed Drawdown (m)

- CMTW1-05
- CMTW2-05
- CMTW3-05

• Step 1 - 327 m³/day
• Step 2 - 655 m³/day
• Step 3 - 982 m³/day
• Step 4 - 1,395 m³/day
NOTE:
1) The step test at SMTW1-05 took place on Sept 16, 2005. The step test at SMTW2-07 and SMTW3-07 occurred on Sept 19 and 20, 2007, respectively. The test at SMTW4-08 was conducted on Feb 27, 2008.

Cambridge East Water Supply
Class EA

Shades Mills
Step Test Results -
Drawdown Versus Log Time

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A4.4
NOTES
1. The step test at NDTW1-08 and NDTW2-08 took place on Oct 16 and 20, 2006, respectively. The first step test at NDPW1-08 took place on Jan 15, 2008 on an open borehole. The second NDPW1-08 test was on Sept 23, 2008 on a packered borehole open over the Gasport formation.
2. Step 4 at NDPW1-08 in January was at a rate of 6,386 m³/day (74 L/s) and at a rate of 6,449 m³/day (74 L/s) in September.

Cambridge East Water Supply
Class EA

Clyde
Step Test Results - Drawdown Versus Log Time

DRAWN: JLH | APPROVED: JAP | DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) | FIGURE: A4.5
**PROJECT INFORMATION**

Company: Golder Associates  
Client: RMOW  
Project: 05-1112-010  
Location: Pinebush (Townline Roundabout)  
Test Well: PBTW1-05  
Test Date: 15 September 2005

**AQUIFER DATA**

Saturated Thickness: 85.6 m  
Anisotropy Ratio (Kz/Kr): 1.

**WELL DATA**

<table>
<thead>
<tr>
<th>Pumping Wells</th>
<th>Observation Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Name</td>
<td>X (m)</td>
</tr>
<tr>
<td>PBTW1-05</td>
<td>558317.2</td>
</tr>
</tbody>
</table>

**SOLUTION**

Aquifer Model: Confined  
Solution Method: Theis (Step Test)  

\[
T = 645.6 \text{ m}^2/\text{day} \\
Sw = -7.378 \\
P = 2. \\
S = 1.6E-5 \\
C = 0. \text{ min}^2/\text{m}^5 \]
PBTW2-06 STEP TEST
Data Set: C:\Users\JHancox\Desktop\Cambridge East\Aqtesolv\PBTW2-06.aqt
Date: 04/20/16
Time: 14:40:33

PROJECT INFORMATION
Company: Golder
Client: RMOW
Project: 05-1112-010
Location: Pinebush
Test Well: PBTW2-06
Test Date: June 7, 2006

AQUIFER DATA
Saturated Thickness: 96. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA
Pumping Wells | Observation Wells
Well Name | X (m) | Y (m) | Well Name | X (m) | Y (m)
--- | --- | --- | --- | --- | ---
PBTW2-06 | 558219.6 | 4806227.2 | PBTW2-06 | 558219.63 | 4806227.2

SOLUTION
Aquifer Model: Confined
Solution Method: Theis (Step Test)
T = 1173.3 m²/day
Sw = 0.
P = 2.
S = 0.0005
C = 0. min²/m⁵
PBPW1-06 STEP TEST (THEIS)

PROJECT INFORMATION

Company: Golder Associates Ltd.
Client: Region of Waterloo
Project: 05-1112-010
Location: Cambridge
Test Well: PBPW2-06
Test Date: August 16, 2006

AQUIFER DATA

Saturated Thickness: 96.62 m
Anisotropy Ratio (Kz/Kr): 1

WELL DATA

Pumping Wells | Observation Wells
Well Name | X (m) | Y (m) | Well Name | X (m) | Y (m)
PBPW1-06 | 558217.221 | 4806229.103 | + PBPW1-06 | 558217.221 | 4806229.103

SOLUTION

Aquifer Model: Confined
T = 688. m²/day
Sw = -8.062
P = 2

Step Test Model: Jacob-Rorabaugh
Time (t) = 1 min

Rate (Q) in cu. m/min

Solution Method: Theis (Step Test)

S = 1.6E-5
C = 0.1229 min²/m²

s(t) = -0.2079Q + 0.1229Q²

W.E. = 707. % (Q from last step)
PBTW3-07 STEP TEST

PROJECT INFORMATION

Company: Golder Associates
Client: RMOW
Project: 05-1112-010 (1010)
Location: Clemens Mill (Can Amera)
Test Well: PBTW3-07
Test Date: February 6, 2008

AQUIFER DATA

Saturated Thickness: 103.5 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

<table>
<thead>
<tr>
<th>Pumping Wells</th>
<th>Observation Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Name</td>
<td>X (m)</td>
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<tr>
<td>PBTW3-07</td>
<td>557466.3</td>
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</tbody>
</table>

SOLUTION

Aquifer Model: Confined
Solution Method: Theis (Step Test)

\[
T = 97.75 \text{ m}^2/\text{day}
\]
\[
S = 5.699 \times 10^{-6}
\]
\[
P = 2
\]
Step Test Model: Jacob-Rorabough
\[
s(t) = 1.646Q + 3.626Q^2.
\]
$S = 10^{-5}, C = 0.377 \text{ min}^2/\text{m}^5 \rightarrow T = 287 \text{ m}^3/\text{d}, S_w = -6.52$

PBPW2-08 Step Test (April 30, 2008)

Analysis by Christopher J. Neville
S.S. Papadopulos & Associates, Inc
February 23, 2011
CMTW1-05 STEP TEST
Data Set:  C:\Users\JHancox\Desktop\Cambridge East\Aqtesolv\CMTW1-05.aqt
Date: 04/21/16  Time: 13:55:38

PROJECT INFORMATION
Company:  Golder Associates
Client:  RMOW
Project:  05-1112-010
Location:  Clemens Mills (Portuguese Club)
Test Well:  CMTW1-05
Test Date:  Sept 13, 2005

AQUIFER DATA
Saturated Thickness:  95.7 m
Anisotropy Ratio (Kz/Kr):  1.

WELL DATA
<table>
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<th>Pumping Wells</th>
<th>Observation Wells</th>
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<tr>
<td>Well Name</td>
<td>X (m)</td>
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<tr>
<td>CMTW1-05</td>
<td>558402.6</td>
</tr>
</tbody>
</table>

SOLUTION
Aquifer Model:  Confined
Solution Method:  Theis (Step Test)

\[
\begin{align*}
T &= 535. \text{ m}^2/\text{day} \\
S &= 1.915E-7 \\
C &= 1.949 \text{ min}^2/\text{m}^5 \\
P &= 2. 
\end{align*}
\]
Analysis by Christopher J. Neville
S.S. Papadopulos & Associates, Inc
February 23, 2011
CMTW2-05 STEP TEST

Data Set: C:\Users\JHancox\Desktop\Cambridge East\Aqtesolv\CMTW2-05.aqt
Date: 04/21/16 Time: 14:08:42

PROJECT INFORMATION

Company: Golder Associates
Client: RMOW
Project: 05-1112-010
Location: Clemens Mill (Cedarbrook Crt)
Test Well: CMTW2-05
Test Date: Nov. 18, 2005

AQUIFER DATA

Saturated Thickness: 87.3 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

<table>
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<tr>
<th>Pumping Wells</th>
<th>Observation Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Name</td>
<td>X (m)</td>
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<tr>
<td>CMTW2-05</td>
<td>558964.4</td>
</tr>
</tbody>
</table>

SOLUTION

Aquifer Model: Confined
Solution Method: Theis (Step Test)

\[
T = 645 \text{ m}^2/\text{day}
\]
\[
Sw = -6.822
\]
\[
P = 2
\]

\[
S = 1.427 \times 10^{-5}
\]
\[
C = 1.153 \text{ min}^2/\text{m}^5
\]
$S = 10^{-5}, \ C = 0.083 \text{ min}^{-2}/\text{m}^5 \rightarrow T = 905 \text{ m}^3/\text{d}, \ S_w = -7.92$
CMTW3-05 STEP TEST

Data Set: C:\Users\JHancox\Desktop\Cambridge East\Aqtesolv\CMTW3-05.aqt
Date: 04/21/16          Time: 14:16:26

PROJECT INFORMATION
Company: Golder Associates
Client: RMOW
Project: 05-1112-010
Location: Clemens Mill (Burnett Ave)
Test Well: CMTW3-05
Test Date: Nov 23, 2005

AQUIFER DATA
Saturated Thickness: 97.5 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

<table>
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<tr>
<th>Pumping Wells</th>
<th>Observation Wells</th>
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<tbody>
<tr>
<td>Well Name</td>
<td>X (m)</td>
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<tr>
<td>CMTW3-05</td>
<td>557559.9</td>
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</table>

SOLUTION
Aquifer Model: Confined
T = 178.8 m²/day
Sw = -7.891
P = 2

Solution Method: Theis (Step Test)
S = 1.0E-6
C = 1.303 min²/m⁵
**PROJECT INFORMATION**

Company: Golder Associates  
Client: RMOW  
Project: 05-1112-010  
Location: Shades Mill  
Test Well: SMTW1-05  
Test Date: Sept 8, 2005

**AQUIFER DATA**

Saturated Thickness: 160.5 m  
Anisotropy Ratio (Kz/Kr): 1.

**WELL DATA**

<table>
<thead>
<tr>
<th>Pumping Wells</th>
<th>Observation Wells</th>
</tr>
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<tbody>
<tr>
<td><strong>Well Name</strong></td>
<td><strong>X (m)</strong></td>
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<tr>
<td>SMTW1-05</td>
<td>0</td>
</tr>
</tbody>
</table>

**SOLUTION**

Aquifer Model: Confined  
Solution Method: Theis (Step Test)  
\[ T = 110 \text{ m}^2/\text{day} \]  
\[ Sw = -4.606 \]  
\[ P = 2 \]  
\[ S = 0.0001328 \]  
\[ C = 2.259 \text{ min}^2/\text{m}^5 \]
**PROJECT INFORMATION**

Company: Golder Associates Ltd  
Client: RMOW  
Project: 05-1112-010  
Location: Shades Mill  
Test Well: SMTW2-07  
Test Date: September 18, 2007

**AQUIFER DATA**

Saturated Thickness: 105. m  
Anisotropy Ratio (Kz/Kr): 1.

**WELL DATA**

<table>
<thead>
<tr>
<th>Pumping Wells</th>
<th>X (m)</th>
<th>Y (m)</th>
<th>Observation Wells</th>
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<td>Well Name</td>
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<td>Well Name</td>
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<tr>
<td>SMTW2-07</td>
<td>557668.7</td>
<td>4802637.6</td>
<td>SMTW2-07</td>
</tr>
</tbody>
</table>

**SOLUTION**

Aquifer Model: Confined  
Solution Method: Theis (Step Test)  

\[ T = 78. \text{ m}^2/\text{day} \]  
\[ S = 0.0001617 \]  
\[ C = 2.553 \text{ min}^2/\text{m}^5 \]  
\[ P = 2. \]  
Step Test Model: Jacob-Rorabaugh  
\[ s(t) = 1.738Q + 2.553Q^2. \]
SMTW3-07 STEP TEST

PROJECT INFORMATION

Company: Golder Associates Ltd
Client: RMOW
Project: 05-1112-010
Location: Shades Mill
Test Well: SMTW3-07
Test Date: September 20, 2007

AQUIFER DATA

Saturated Thickness: 92. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

<table>
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<tr>
<th>Well Name</th>
<th>X (m)</th>
<th>Y (m)</th>
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<tbody>
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<table>
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<th>Well Name</th>
<th>X (m)</th>
<th>Y (m)</th>
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<tbody>
<tr>
<td>SMTW3-07</td>
<td>0</td>
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</table>

SOLUTION

Aquifer Model: Confined
Solution Method: Theis (Step Test)

\[ T = 84.49 \text{ m}^2/\text{day} \]
\[ Sw = -7.1 \]
\[ P = 2. \]

Step Test Model: Jacob-Rorabaugh

\[ s(t) = -2.532Q + 1.303Q^2. \]
SMTW4-08 STEPTEST
Data Set: C:\Users\JHancox\Desktop\Cambridge East\Aqtesol\SMTW4-08.aqt
Date: 04/20/16  Time: 22:37:49

PROJECT INFORMATION
Company: Golder Associates
Client: RMOW
Project: 05-1112-010
Location: Cambridge
Test Well: SMTW4-08
Test Date: February 29, 2009

AQUIFER DATA
Saturated Thickness: 102. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA
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<th>Observation Wells</th>
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<tbody>
<tr>
<td>Well Name</td>
<td>X (m)</td>
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<tr>
<td>SMTW4-08</td>
<td>559023</td>
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</tbody>
</table>

SOLUTION
Aquifer Model: Confined
\[ T = 333. \text{ m}^2/\text{day} \]
\[ S_w = -6.236 \]
\[ P = 2. \]
Solution Method: Theis (Step Test)
\[ S = 1.0 \times 10^{-5} \]
\[ C = 0.51 \text{ min}^2/\text{m}^5 \]
NDTW1-08 STEP TEST
Data Set: C:\Users\JHancox\Desktop\Cambridge East\Aqtesolv\NDTW1-08.aqt
Date: 04/21/16 Time: 23:16:39

PROJECT INFORMATION
Company: Golder Associates
Client: RMOW
Project: 05-1112-010 (1900)
Location: North Dumfries Park
Test Well: NDTW1-08
Test Date: October 20, 2008

AQUIFER DATA
Saturated Thickness: 82.5 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA
Pumping Wells
<table>
<thead>
<tr>
<th>Well Name</th>
<th>X (m)</th>
<th>Y (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDTW1-08</td>
<td>562366.8</td>
<td>4804125.2</td>
</tr>
</tbody>
</table>

Observation Wells
<table>
<thead>
<tr>
<th>Well Name</th>
<th>X (m)</th>
<th>Y (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDTW1-08</td>
<td>562366.8</td>
<td>4804125.2</td>
</tr>
</tbody>
</table>

SOLUTION
Aquifer Model: Confined
Solution Method: Theis (Step Test)

\[ T = 450 \text{ m}^2/\text{day} \]
\[ S_w = -5.192 \]
\[ P = 2 \]
\[ S = 0.0005 \]
\[ C = 1.963 \text{ min}^2/\text{m}^5 \]
NDTW2-08 STEP TEST

Data Set: C:\Users\JHancox\Desktop\Cambridge East\Aqtesolv\NDTW2-08.aqt
Date: 04/21/16
Time: 23:18:04

PROJECT INFORMATION

Company: Golder Associates
Client: RMOW
Project: 05-1112-010 (1900)
Location: North Dumfries Park
Test Well: NDTW2-08
Test Date: October 16, 2008

AQUIFER DATA

Saturated Thickness: 87.8 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

<table>
<thead>
<tr>
<th>Pumping Wells</th>
<th>Observation Wells</th>
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<tbody>
<tr>
<td>Well Name</td>
<td>X (m)</td>
</tr>
<tr>
<td>NDTW2-08</td>
<td>562219.7</td>
</tr>
</tbody>
</table>

SOLUTION

Aquifer Model: Confined
Solution Method: Theis (Step Test)
\[ T = 443.2 \text{ m}^2/\text{day} \]
\[ Sw = -6.805 \]
\[ P = 2 \]
\[ S = 8.0E-5 \]
\[ C = 1.149 \text{ min}^2/\text{m}^5 \]
Figure A4.22

NDPW1-08 Step Test (January 13, 2009) - Unpackered

\[ S = 10^{-5} \rightarrow T = 0.51 \text{ m}^2/\text{min}, \quad S_w = -11.24 \]

\[
\begin{align*}
T &= 0.5077 \text{ m}^2/\text{min} \\
S &= 10^{-5} \\
S_w &= -11.244 \\
C &= 0.3612 \text{ m/(m}^3/\text{min})^2 \\
P &= 2.0
\end{align*}
\]

Analysis by Christopher J. Neville
S.S. Papadopulos & Associates, Inc
February 23, 2011
$S = 10^{-5} \rightarrow T = 0.35 \text{ m}^2/\text{min} (510 \text{ m}^2/\text{d}), S_w = -6.28$
ATTACHMENT A5
Private Well Inventories
Base Data - MNR LIQ, obtained 2009
Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator   Datum: NAD 83   Coordinate System: UTM Zone 17
Imagery: ERSI World Mosaic

LEGEND
- Monitoring Wells (not including IUS wells)
- Private Well
- Mini-Piezometer
- Surface Water Level Station
- Municipal Supply Wells
- Test Production/Test Wells
- Test Wells
- IUS Project Overburden
- Monitoring Wells
- Railway
- Watersource
- Water
- Provincially Significant Wetlands
- Bog
- Fen
- Marsh
- Swamp
- ESA
- Municipalities
- 1km Buffer around Test Supply Wells
- 500m Buffer around Test Supply Wells

REFERENCE
Base Data: MRIL LIQ, updated 2009
Preparation: Golden Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17
Imagery: ERSI World Mosaic

PRIVATE WELL INVENTORY (Northern Area)
PRIVATE WELL INVENTORY (Southern Area)

LEGEND
- Monitoring Wells (not including IUS wells)
- Private Well
- Mini-Piezometer
- Surface Water Level Station
- Municipal Supply Wells
- Test Production/Test Wells
- Test Wells
- IUS Project Overburden Monitoring Wells
- Railway
- Watershed
- Provincially Significant Wetlands
- Bog
- Fen
- Marsh
- Swamp
- ESAs
- Municipalities
- 1km Buffer around Test Supply Wells
- 500m Buffer around Test Supply Wells

REFERENCE

Base Data: MNR/L.G. collected 2009
Produced: Golden Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17
Imagery: ESRI World Imagery

Scale: 1:10,000

Cambridge East Water Supply
CLASS ENVIRONMENTAL ASSESSMENT
PRIVATE WELL INVENTORY (Southern Area)

FACTORS
- Study Area
- Key
- Base Map
- Reference

Map prepared by Golden Associates Ltd
Cambridge, Ontario
17 Sep. 2012
17 Sep. 2012
<table>
<thead>
<tr>
<th>OBJ_NUM</th>
<th>Golder / Lotowater ID</th>
<th>UTM Easting</th>
<th>UTM Northing</th>
<th>Source UTM Coordinates</th>
<th>Last Name</th>
<th>Address</th>
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<td>AVE-3</td>
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<td>Golder Handheld GPS</td>
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<td>6505226</td>
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Golder Associates
### Table A5.1

**Cambridge East Private Well Inventory - Well Locations**

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<th>OBJ_NUM</th>
<th>Golder / Lotowater ID</th>
<th>UTM Easting</th>
<th>UTM Northing</th>
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<th>Last Name</th>
<th>Address</th>
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**Wells Outside of the 1 km radius, Used for Monitoring**

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**Abandoned Wells**

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Golder Associates
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<td>in wishing well on S side of house</td>
<td>DOMESTIC, STOCK</td>
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<td>11.58</td>
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<td>to NW of house</td>
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<td>inside house, in basement</td>
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Golder Associates
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<td>1000545</td>
<td>DW-CLUB WELL</td>
<td>on W side of Club building</td>
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<td>26-Sep-95</td>
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<td>9200728</td>
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<td>on E side of house, down grassy</td>
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Wells Outside 1 km Radius Used for Monitoring

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<th>Comments From Owner</th>
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<td>9203303</td>
<td>in front of barn</td>
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<td>on N side of house, beside shrine</td>
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<td>6710783</td>
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<td>1000936</td>
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<td>in garden in front of house (E side)</td>
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Abandoned Wells

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<tbody>
<tr>
<td>6503571</td>
<td>AVE-17</td>
<td>abandoned; old well not located</td>
<td>DOMESTIC</td>
<td>15-Apr-72</td>
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<td>new owner does not know where old well located</td>
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<td>ROBERT INGRAM</td>
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<td>below decorative well on front lawn</td>
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<td>1706 CLYDE RD</td>
<td>front, beside driveway</td>
<td>10 yrs</td>
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Golder Associates
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<td>4803945</td>
<td>DAVID BRODHAGEN</td>
<td>1726 CLYDE RD</td>
<td>front, side of house</td>
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<td>drilled</td>
<td>good</td>
<td>Not Home</td>
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<td>4803641</td>
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<td>MILLER</td>
<td>1745 CLYDE RD</td>
<td>behind left side of house</td>
<td>46 yrs</td>
<td>33.5</td>
<td>good</td>
<td>high iron</td>
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<td>9251188</td>
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<td>7 yrs</td>
<td>24.4</td>
<td>good</td>
<td>well is overflowing</td>
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<td>1 yr</td>
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<td>good</td>
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<td>19 yrs</td>
<td>12.5</td>
<td>drilled</td>
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<td>15 ANGUS CRT</td>
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<td>VERONICA DEIGNAN</td>
<td>1769 ANGUS CRT</td>
<td>front lawn, corner of house</td>
<td>18 yrs</td>
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<td>1 LANGFORD DR</td>
<td>JOANNE TUDISCO</td>
<td>1 LANGFORD DR</td>
<td>front garden near front door</td>
<td>45 yrs</td>
<td>14.6</td>
<td>good</td>
<td>Not Home (May have new well by front door)</td>
<td></td>
</tr>
<tr>
<td>6506418</td>
<td>RW2</td>
<td>2 LANGFORD DR</td>
<td>-</td>
<td>DONALD MOORE</td>
<td>2 LANGFORD DR</td>
<td>-</td>
<td>20 yrs</td>
<td>10.1</td>
<td>-</td>
<td>-</td>
<td>Not home, notice delivered, well not located</td>
</tr>
<tr>
<td>6810754</td>
<td></td>
<td>3 LANGFORD DR</td>
<td>-</td>
<td>MICHAEL BANCARZ</td>
<td>3 LANGFORD DR</td>
<td>-</td>
<td>24 yrs</td>
<td>10.4</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>6507866</td>
<td>4803731</td>
<td>562133</td>
<td>4 LANGFORD DR</td>
<td>EMILIO BAZON</td>
<td>4 LANGFORD DR</td>
<td>front lawn, under pine tree</td>
<td>24 yrs</td>
<td>11.0</td>
<td>drilled</td>
<td>-</td>
<td>Not Home</td>
</tr>
<tr>
<td>6507868</td>
<td>4803803</td>
<td>562251</td>
<td>5 LANGFORD DR</td>
<td>HOWARD HILL</td>
<td>5 LANGFORD DR</td>
<td>front lawn, corner of house</td>
<td>24 yrs</td>
<td>9.5</td>
<td>-</td>
<td>-</td>
<td>good water</td>
</tr>
<tr>
<td>562315</td>
<td>4803764</td>
<td>6 LANGFORD DR</td>
<td>-</td>
<td>JOHN MAGLIOCCO</td>
<td>6 LANGFORD DR</td>
<td>front lawn, corner beside porch</td>
<td>-</td>
<td>drilled</td>
<td>-</td>
<td>Not Home</td>
<td></td>
</tr>
<tr>
<td>6506428</td>
<td>-</td>
<td>7 LANGFORD DR</td>
<td>-</td>
<td>SHAWN SCHMITZ</td>
<td>7 LANGFORD DR</td>
<td>-</td>
<td>20 yrs</td>
<td>9.8</td>
<td>-</td>
<td>-</td>
<td>Not home, notice delivered, well not located</td>
</tr>
<tr>
<td>6505967</td>
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<td>8 LANGFORD DR</td>
<td>-</td>
<td>MICHAEL MELDRUM</td>
<td>8 LANGFORD DR</td>
<td>-</td>
<td>22 yrs</td>
<td>11.9</td>
<td>-</td>
<td>-</td>
<td>Not Home, Well not located</td>
</tr>
<tr>
<td>6505762</td>
<td></td>
<td>10 LANGFORD DR</td>
<td>-</td>
<td>DAVID PIMENTEL</td>
<td>10 LANGFORD DR</td>
<td>-</td>
<td>23 yrs</td>
<td>9.1</td>
<td>-</td>
<td>-</td>
<td>Not Home, Well not located</td>
</tr>
<tr>
<td>6506189</td>
<td></td>
<td>12 LANGFORD DR</td>
<td>-</td>
<td>ALAN LITTLE</td>
<td>12 LANGFORD DR</td>
<td>-</td>
<td>21 yrs</td>
<td>11.3</td>
<td>-</td>
<td>-</td>
<td>Not Home, Well not located</td>
</tr>
<tr>
<td>6506244</td>
<td>4803877</td>
<td>562248</td>
<td>14 LANGFORD DR</td>
<td>BRIAN WIECHERS</td>
<td>14 LANGFORD DR</td>
<td>front lawn</td>
<td>21 yrs</td>
<td>9.8</td>
<td>drilled</td>
<td>-</td>
<td>Not Home</td>
</tr>
<tr>
<td>6506243</td>
<td>RW1</td>
<td>562291</td>
<td>4803917</td>
<td>ROBERT SELLECK</td>
<td>16 LANGFORD DR</td>
<td>front lawn</td>
<td>21 yrs</td>
<td>10.1</td>
<td>drilled</td>
<td>good</td>
<td>house # 519-620-2349</td>
</tr>
<tr>
<td>6506848</td>
<td>-</td>
<td>17 LANGFORD DR</td>
<td>-</td>
<td>GIORGIO LUNGHI</td>
<td>17 LANGFORD DR</td>
<td>-</td>
<td>18 yrs</td>
<td>11.3</td>
<td>-</td>
<td>-</td>
<td>Not home, notice delivered, well not located</td>
</tr>
<tr>
<td>562336</td>
<td>4803962</td>
<td>18 LANGFORD DR</td>
<td>-</td>
<td>ROORDINK TERVEILD</td>
<td>18 LANGFORD DR</td>
<td>front lawn</td>
<td>20 yrs</td>
<td>drilled</td>
<td>good</td>
<td>issues with bacteria</td>
<td></td>
</tr>
<tr>
<td>6506420</td>
<td></td>
<td>20 LANGFORD DR</td>
<td>-</td>
<td>BRIAN KLEINSTEUBER</td>
<td>20 LANGFORD DR</td>
<td>front lawn</td>
<td>20 yrs</td>
<td>10.1</td>
<td>drilled</td>
<td>good</td>
<td>good water, owners cell 519-223-1588</td>
</tr>
<tr>
<td>6506893</td>
<td></td>
<td>22 LANGFORD DR</td>
<td>-</td>
<td>WILLIAM HEWITT</td>
<td>22 LANGFORD DR</td>
<td>front lawn</td>
<td>18 yrs</td>
<td>12.2</td>
<td>drilled</td>
<td>good</td>
<td>good water, high in iron</td>
</tr>
<tr>
<td>562837</td>
<td>4803870</td>
<td>562819</td>
<td>3 CLYDEBANK DR</td>
<td>JOHN LEVAC</td>
<td>1 CLYDEBANK DR</td>
<td>backyard</td>
<td>1 yr</td>
<td>17.4</td>
<td>drilled</td>
<td>good</td>
<td>old well went dry, good water (OLD ID: 6506153)</td>
</tr>
<tr>
<td>6505769</td>
<td></td>
<td>2 CLYDEBANK DR</td>
<td>-</td>
<td>LUIS RESENDES</td>
<td>2 CLYDEBANK DR</td>
<td>-</td>
<td>23 yrs</td>
<td>16.8</td>
<td>drilled</td>
<td>-</td>
<td>Not home, notice delivered, well not located</td>
</tr>
<tr>
<td>6505970</td>
<td>3 CLYDEBANK DR</td>
<td>-</td>
<td>JULIE CRANHAM-WILSON</td>
<td></td>
<td>3 CLYDEBANK DR</td>
<td>front lawn in flower bed</td>
<td>-</td>
<td>13.7</td>
<td>drilled</td>
<td>-</td>
<td>Not home, notice delivered, well not located</td>
</tr>
<tr>
<td>6506345</td>
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<td>4 CLYDEBANK DR</td>
<td>-</td>
<td>MARGARET SNYDER</td>
<td>4 CLYDEBANK DR</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Not home, notice delivered, well not located</td>
</tr>
<tr>
<td>6506419</td>
<td></td>
<td>5 CLYDEBANK DR</td>
<td>-</td>
<td>KIM CUERRIER</td>
<td>5 CLYDEBANK DR</td>
<td>-</td>
<td>20 yrs</td>
<td>36.0</td>
<td>-</td>
<td>-</td>
<td>Not home, notice delivered, well not located</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 CLYDEBANK DR</td>
<td>-</td>
<td>WALTER MURPHY</td>
<td>6 CLYDEBANK DR</td>
<td>appears to be in front lawn</td>
<td>20 yrs</td>
<td>18.0</td>
<td>-</td>
<td>-</td>
<td>Not Home</td>
</tr>
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</table>

Golder Associates
Table A5.3:
Town of Clyde Private Well Inventory

<table>
<thead>
<tr>
<th>OBJ_NUM</th>
<th>Goldid</th>
<th>Easting</th>
<th>Northing</th>
<th>Name</th>
<th>Address</th>
<th>Location</th>
<th>Date Constructed</th>
<th>Well Depth (m)</th>
<th>Well type</th>
<th>Accessible</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>6505765</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>FRANCIS MCCOMB</td>
<td>7 CLYDEBANK DR</td>
<td>front flower bed</td>
<td>23 yrs</td>
<td>18.3</td>
<td>drilled</td>
<td>difficult</td>
<td>Not home, notice delivered, well not located</td>
</tr>
<tr>
<td>6505965</td>
<td>562781</td>
<td>4804052</td>
<td>-</td>
<td>PETER OSTOPOVIC</td>
<td>9 CLYDEBANK DR</td>
<td>backyard</td>
<td>22 yrs</td>
<td>16.2</td>
<td>drilled</td>
<td>difficult</td>
<td>Not home, notice delivered, well not located</td>
</tr>
<tr>
<td>6505966</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>DEBORAH GRAHAM</td>
<td>11 CLYDEBANK DR</td>
<td>-</td>
<td>22 yrs</td>
<td>15.9</td>
<td>-</td>
<td>-</td>
<td>Not Home. Well not located</td>
</tr>
<tr>
<td>6505725</td>
<td>562683</td>
<td>4803990</td>
<td>-</td>
<td>ENZO TERESI</td>
<td>15 CLYDEBANK DR</td>
<td>behind rocks, corner of lot</td>
<td>23 yrs</td>
<td>16.6</td>
<td>drilled</td>
<td>ok</td>
<td>Not Home</td>
</tr>
<tr>
<td>6505761</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>MARY TAYLOR</td>
<td>16 CLYDEBANK DR</td>
<td>-</td>
<td>22 yrs</td>
<td>20.4</td>
<td>drilled</td>
<td>-</td>
<td>Not Home, Well not located</td>
</tr>
<tr>
<td>920853</td>
<td>562647</td>
<td>4803989</td>
<td>-</td>
<td>ALBERTO PEREIRA</td>
<td>17 CLYDEBANK DR</td>
<td>front lawn</td>
<td>9 yrs</td>
<td>14.6</td>
<td>drilled</td>
<td>good</td>
<td>-</td>
</tr>
<tr>
<td>6505973</td>
<td>562620</td>
<td>4803910</td>
<td>-</td>
<td>KEITH PASCOE</td>
<td>18 CLYDEBANK DR</td>
<td>front patio</td>
<td>22 yrs</td>
<td>12.5</td>
<td>-</td>
<td>good</td>
<td>Not Home</td>
</tr>
<tr>
<td>6505768</td>
<td>562577</td>
<td>4803997</td>
<td>-</td>
<td>EDWARD STUEHLER</td>
<td>19 CLYDEBANK DR</td>
<td>front lawn behind wagon wheel</td>
<td>23 yrs</td>
<td>16.8</td>
<td>drilled</td>
<td>good</td>
<td>Not Home</td>
</tr>
<tr>
<td>6505968</td>
<td>562553</td>
<td>4803912</td>
<td>-</td>
<td>JAMAL MEHYO</td>
<td>20 CLYDEBANK DR</td>
<td>front lawn behind rocks</td>
<td>22 yrs</td>
<td>16.5</td>
<td>probably dug</td>
<td>good</td>
<td>Not Home</td>
</tr>
<tr>
<td>6505258</td>
<td>4804030</td>
<td>-</td>
<td>-</td>
<td>ERIC STANGL</td>
<td>21 CLYDEBANK DR</td>
<td>back corner of house</td>
<td>-</td>
<td>-</td>
<td>good</td>
<td>Not Home</td>
<td></td>
</tr>
<tr>
<td>6505969</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>DEREK FRANK</td>
<td>22 CLYDEBANK DR</td>
<td>backyard by deck</td>
<td>&gt;20 yrs</td>
<td>25.0</td>
<td>drilled</td>
<td>good</td>
<td>water</td>
</tr>
<tr>
<td>562498</td>
<td>4804037</td>
<td>1134</td>
<td>VILLAGE RD</td>
<td>STEPHEN GEORGE</td>
<td>23 CLYDEBANK DR</td>
<td>backyard by deck</td>
<td>&gt;20 yrs</td>
<td>25.0</td>
<td>drilled</td>
<td>good</td>
<td>-</td>
</tr>
<tr>
<td>6503882</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>DONALD AUSTIN</td>
<td>1134 VILLAGE RD</td>
<td>-</td>
<td>39 yrs</td>
<td>35.7</td>
<td>-</td>
<td>-</td>
<td>Notice delivered - left on truck window</td>
</tr>
<tr>
<td>6503921</td>
<td>562557</td>
<td>4803638</td>
<td>-</td>
<td>DAVID HALLMAN</td>
<td>1154 VILLAGE RD</td>
<td>front lawn</td>
<td>35 yrs</td>
<td>32.0</td>
<td>-</td>
<td>good</td>
<td>Not Home</td>
</tr>
<tr>
<td>6503908</td>
<td>562522</td>
<td>4803773</td>
<td>-</td>
<td>GORDON GRAHAM</td>
<td>1169 VILLAGE RD</td>
<td>backyard</td>
<td>39 yrs</td>
<td>31.7</td>
<td>-</td>
<td>poor</td>
<td>well under cover, cover has a black metal pump on top</td>
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<tr>
<td>562475</td>
<td>4803781</td>
<td>-</td>
<td>-</td>
<td>SARAH BRUDER</td>
<td>1174 VILLAGE RD</td>
<td>side of house on hill</td>
<td>-</td>
<td>-</td>
<td>good</td>
<td>Not Home, notice delivered</td>
<td></td>
</tr>
<tr>
<td>562525</td>
<td>4803791</td>
<td>-</td>
<td>-</td>
<td>JOHN JASIK</td>
<td>1177 VILLAGE RD</td>
<td>backyard, right side of house</td>
<td>-</td>
<td>10.7</td>
<td>dug or drilled</td>
<td>ok</td>
<td>good water</td>
</tr>
<tr>
<td>6503899</td>
<td>562434</td>
<td>4803805</td>
<td>-</td>
<td>DEANNA MARCY</td>
<td>1180 VILLAGE RD</td>
<td>backyard</td>
<td>46 yrs</td>
<td>38.4</td>
<td>-</td>
<td>ok</td>
<td>-</td>
</tr>
<tr>
<td>6503907</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>SCOTT LAHEY</td>
<td>1185 VILLAGE RD</td>
<td>-</td>
<td>39 yrs</td>
<td>14.6</td>
<td>-</td>
<td>-</td>
<td>Not Home, notice delivered, well not located</td>
</tr>
<tr>
<td>6503906</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>ROBERT LAURENCE</td>
<td>1191 VILLAGE RD</td>
<td>-</td>
<td>41 yrs</td>
<td>13.1</td>
<td>-</td>
<td>-</td>
<td>Not home, notice delivered</td>
</tr>
<tr>
<td>6503903</td>
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<td>-</td>
<td>-</td>
<td>PAUL DECKERT</td>
<td>1198 VILLAGE RD</td>
<td>-</td>
<td>40 yrs</td>
<td>15.2</td>
<td>-</td>
<td>-</td>
<td>Not home, notice delivered</td>
</tr>
<tr>
<td>6808338</td>
<td>-</td>
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<td>THOMAS BUTLER</td>
<td>1199 VILLAGE RD</td>
<td>-</td>
<td>24 yrs</td>
<td>10.6</td>
<td>-</td>
<td>-</td>
<td>Not home, notice delivered</td>
</tr>
<tr>
<td>6503902</td>
<td>562429</td>
<td>4803919</td>
<td>-</td>
<td>GERALD LOCKIE</td>
<td>1206 VILLAGE RD</td>
<td>front lawn</td>
<td>43 yrs</td>
<td>44.5</td>
<td>-</td>
<td>ok</td>
<td>well under pile of leaves and dirt at left corner of house</td>
</tr>
<tr>
<td>RW3</td>
<td>562557</td>
<td>4804316</td>
<td>-</td>
<td>CARL REYNOLDS</td>
<td>1275 VILLAGE RD</td>
<td>backyard</td>
<td>now well</td>
<td>drilled</td>
<td>good</td>
<td>Gone for 4 weeks (OLD ID: 6507869, 6810757)</td>
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</tr>
<tr>
<td>RW4</td>
<td>562155</td>
<td>4804340</td>
<td>-</td>
<td>ROBERT J NICKEL</td>
<td>1310 VILLAGE RD</td>
<td>right side of house in garden</td>
<td>6 yrs</td>
<td>drilled</td>
<td>good</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Golder Associates
ATTACHMENT A6

Constant Rate Testing

- Hydrographs
- Drawdown Versus Elapsed Time Plots
- Municipal Well Interference
- t/r² Composite Plots
- Surface Water Analyses
- Fish Inventory Notes
- MTE Report on Discharge
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PBPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PBPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GROA Shades Mill Site at the Cambridge Head Office.

Phase I
28-Day
Cambridge East
Pumping Test

CMPW2-06 and CMTW2-05

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.2
Groundwater Level (m below ground surface)
Precipitation (mm)
Combined Pumping Rate (m$^3$/day)

Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 5, PBPW1-06 started at 3,378 m$^3$/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.
**Notes:**
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PEPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GROA Shades Mill Site at the Cambridge Head Office.

**Phase I 28-Day Cambridge East Pumping Test**

**Cedarbrook Wellfield Monitors**

- **DRAWN:** JLH
- **APPROVED:** JAP
- **DATE:** APRIL 2016
- **PROJECT:** 05-1112-010 (1500)
- **FIGURE:** A6.4
**Notes:**

1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PEPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.

2) Precipitation data is from the GROCA Shades Mill Site at the Cambridge Head Office.

**Phase I**

28-Day Cambridge East Pumping Test

**Cedarbrook Wellfield Monitors**

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.5
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMF-202-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 6, PBPW1-06 started at 3,378 m$^3$/day (39.1 L/s) on Sept 13 and CMF-100-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.

Phase I
28-Day
Cambridge East Pumping Test

Cedarbrook Creek Piezometers

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.6
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, CMPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the CRCA Shades Mill Site at the Cambridge Head Office.

Phase I
28-Day
Cambridge East Pumping Test

Hilborn Pond Level and Shallow Wells

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.7
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PEPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the CRCA Shades Mill Site at the Cambridge Head Office.
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMP/W2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PB/PW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMP/W1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the CRCA Shades Mill Site at the Cambridge Head Office.

Phase I
28-Day
Cambridge East
Pumping Test

Concession 1
Private Wells

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.9
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMP/W2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PEP/W1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMP/W1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GPCA Shades Mill Site at the Cambridge Head Office.

Phase I
28-Day
Cambridge East Pumping Test

Puslinch Lake Area Staff Gauges and Wells

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.10
Phase I
28-Day
Cambridge East Pumping Test

Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 5, PEPW1-06 started at 3,378 m$^3$/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m$^3$/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GPCA Shades Mill Site at the Cambridge Head Office.

Puslinch Lake Area Wells

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.11
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PEP/W1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GPCA Shades Mill Site at the Cambridge Head Office.
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CM/PW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PEPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CM/PW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMW/2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PE/1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMW/1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.

Phase I
28-Day
Cambridge East
Pumping Test

Shades Mills
Wellfield Monitors

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.14
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPW2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PEPW1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPW1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.

Phase I
28-Day
Cambridge East
Pumping Test

Avenue Road and
Gore Road Private Wells

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.15
Notes:
1) The 3-day constant rate test at SMTW4-08 took place between March 3-6, 2008 at a rate of 1,964 m$^3$/day (22.8 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Phase II
SMTW4-08
Pumping Test

SMTW4-08 and SMTW1-05

DRAWN: JLH   APPROVED: JAP   DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)   FIGURE: A6.16
Notes:
1) The 3-day constant rate test at SMTW4-08 took place between March 3-6, 2008 at a rate of 1,964 m$^3$/day (22.8 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Phase II
SMTW4-08
Pumping Test

Shades Mill Wellfield Monitors

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.17
Notes:
1) The 3-day constant rate test at SMTW4-08 took place between March 3-6, 2008 at a rate of 1,964 m³/day (22.8 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID #: 6149388).

Phase II
SMTW4-08
Pumping Test

Shades Mill Wellfield
Monitors

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.18
Notes:
1) The 3-day constant rate test at SMTW4-08 took place between March 3-6, 2008 at a rate of 1,964 m$^3$/day (22.8 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Phase II
SMTW4-08
Pumping Test
Notes:
1) The 3-day constant rate test at SMTW4-08 took place between March 3-6, 2008 at a rate of 1,964 m$^3$/day (22.8 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Phase II
SMTW4-08
Pumping Test

Pinebush Wellfield Monitors

DRAWN: JLH | APPROVED: JAP | DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) | FIGURE: A6.20
Phase II
SMTW4-08
Pumping Test

Private Wells

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.21

Notes:
1) The 3-day constant rate test at SMTW4-08 took place between March 3-6, 2008 at a rate of 1,964 m³/day (22.8 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).
30-Apr-08 02-May-08 04-May-08 06-May-08 08-May-08 10-May-08 12-May-08

Date

Groundwater Elevation (m asl)

0 5 10 15 20 25 30 35

Precipitation (mm)

0 2000 4000 6000 8000

Pumping Rate (m³/day)

PBPW2-08 and Nearby Test Wells

Phase II
PBPW2-08
Pumping Test

Notes:
1) The 3-day constant rate test at PBTW2-08 took place between May 5-8, 2008 at a rate of 3,273 m³/day (37.9 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

DRAWN: JLH PROJEST: 05-1112-010 (1500) FIGURE: A6.22
APPROVED: JAP DATE: APRIL 2016
Notes:
1) The 3-day constant rate test at PBW2-08 took place between May 5-8, 2008 at a rate of 3.273 m³/day (37.9 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149338).

Phase II
PBPW2-08
Pumping Test

Pinebush Wellfield Monitors

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.23
Notes:
1) The 3-day constant rate test at PBTV2-08 took place between May 5-8, 2008 at a rate of 3,273 m³/day (37.9 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Phase II
PBFW2-08
Pumping Test

Clemens Mill Wellfield
Monitors

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.24
Notes:
1) The 3-day constant rate test at PBTVW2-08 took place between May 5-8, 2008 at a rate of 3,273 m³/day (37.9 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Phase II
PBPW2-08
Pumping Test
**Phase II**

**PBPW2-08**

**Pumping Test**

**Shades Mill Wellfield Monitors**

**Notes:**
1) The 3-day constant rate test at PBPW2-08 took place between May 5-8, 2008 at a rate of 3,273 m³/day (37.9 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

**DRAWN: J LH | APPROVED: JAP | DATE: APRIL 2016**

**PROJECT: 05-1112-010 (1500) | FIGURE: A6.26**
Notes:
1) The 3-day constant rate test at PBTVW2-08 took place between May 5-8, 2008 at a rate of 3,273 m³/day (37.9 L/s).
2) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Phase II
PBWP2-08
Pumping Test

Private Wells

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.27
Phase III
NDPW1-08 and NDTW2-08
Pumping Test
January 2009

Notes:
1) The 2-day constant rate test at NDPW1-08 took place between Jan 13-15, 2009 immediately following step testing at a rate of 6,396 m³/day (74.0 L/s).
2) Testing took place on the open borehole.
3) Testing ended early due to generator failure and ice jams restricting flow of water through culvert.
4) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149398).
Notes:
1) The 2-day constant rate test at NDPW1-08 took place between Jan 13-15, 2009 immediately following step testing at a rate of 6,396 m³/day (74.0 L/s).
2) Testing took place on the open borehole.
3) Testing ended early due to generator failure and ice jams restricting flow of water through culverts.
4) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6146038).

Phase III
NDPW1-08 Pumping Test
January 2009

Monitors Near the Town of Clyde

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.29
Phase III
NDPW1-08
Pumping Test
January 2009

Shallow Monitors Near the Town of Clyde

Notes:
1) The 2-day constant rate test at NDPW1-08 took place between Jan 13-15, 2009 immediately following step testing at a rate of 6,396 m³/day (74.0 L/s).
2) Testing took place on the open borehole.
3) Testing ended early due to generator failure and ice jams restricting flow of water through culverts.
4) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID #: 614038).

DRAWN: J LH | APPROVED: JAP | DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) | FIGURE: A6.30
Notes:
1) The 2-day constant rate test at NDPW1-08 took place between Jan 13-15, 2009 immediately following step testing at a rate of 6,396 m³/day (74.0 L/s).
2) Testing took place on the open borehole.
3) Testing ended early due to generator failure and ice jams restricting flow of water through culverts.
4) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 614638).

Phase III
NDPW1-08
Pumping Test
January 2009

Private Wells
Town of Clyde

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.31
Phase III
NDPW1-08
Pumping Test
January 2009

Clemens Mill Wellfield
Monitors

Notes:
1) The 2-day constant rate test at NDPW1-08 took place between Jan 13-15, 2009 immediately following step testing at a rate of 6,396 m³/day (74.0 L/s).
2) Testing took place on the open borehole.
3) Testing ended early due to generator failure and ice jams restricting flow of water through culverts.
4) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6146388).
Notes:
1) The 2-day constant rate test at NDPW1-08 took place between Jan 13-15, 2009 immediately following step testing at a rate of 6,396 m$^3$/day (74.0 L/s).
2) Testing took place on the open borehole.
3) Testing ended early due to generator failure and ice jams restricting flow of water through culverts.
4) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6146988).

Phase III
NDPW1-08
Pumping Test
January 2009

Pinebush Wellfield Monitors

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.33
Notes:
1) The 6-day constant rate test at NDPW1-08 took place between Sept 24-30, 2009, at a rate of 4,321 m³/day (50.0 L/s).
2) A packer was installed in NDPW1-08 and NDTW2-08 on Sept 15, 2009, to isolate the Gasport Formation from the Guelph Formation. During the test, NDPW1-08 was pumped below the packer.
3) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID #614338).
Notes:
1) The 6-day constant rate test at NDPW1-08 took place between Sept 24-30, 2009 at a rate of 4,321 m³/day (50.0 L/s).
2) A packer was installed in NDPW1-08 and NDTW2-08 on Sept 15, 2009, to isolate the Gasport Fm from the Quakrich Fm. During the test, NDPW1-08 was pumped below the packer.
3) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Phase III
NDPW1-08
Pumping Test
September 2009

Monitors Near the Town of Clyde

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.35
Notes:
1) The 6-day constant rate test at NDPW1-08 took place between Sept 24-30, 2009 at a rate of 4,321 m³/day (50.0 L/s).
2) A packer was installed in NDPW1-08 and NDPW2-08 on Sept 15, 2009, to isolate the Gasport Fm from the Qu'aplih Fm. During the test, NDPW1-08 was pumped below the packer.
3) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Phase III
NDPW1-08
Pumping Test
September 2009

Monitors Near the Town of Clyde

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.35
Notes:
1) The 6-day constant rate test at NDPW1-08 took place between Sept 24-30, 2009 at a rate of 4,321 m³/day (90.0 L/s).
2) A packer was installed in NDPW1-08 and NDPW2-08 on Sept 15, 2009, to isolate the Gasport Fm from the Quolph Fm. During the test, NDPW1-08 was pumped below the packer.
3) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID #6149388).

Phase III
NDPW1-08
Pumping Test
September 2009

Private Wells
Town of Clyde

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.37
Notes:
1) The 6-day constant rate test at NDPW1-08 took place between Sept 24-30, 2009 at a rate of 4,321 m³/day (50.0 L/s).
2) A packer was installed in NDPW1-08 and NDTW2-08 on Sept 15, 2009, to isolate the Gasport Fm from the Qualph Fm. During the test, NDPW1-08 was pumped below the packer.
3) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Phase III
NDPW1-08
Pumping Test
September 2009

Clemens Mill Wellfield
Monitors

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.38
Notes:
1) The 6-day constant rate test at NDPW1-08 took place between Sept 24-30, 2009 at a rate of 4,321 m$^3$/day (50.0 L/s).
2) A packer was installed in NDPW1-08 and NDPW2-08 on Sept 15, 2009, to isolate the Gasport Fm from the Quolihp Fm. During the test, NDPW1-08 was pumped below the packer.
3) Precipitation data is from the Environment Canada Region of Waterloo Climate Station (ID # 6149388).

Phase III
NDPW1-08
Pumping Test
September 2009

Pinebush Wellfield Monitors

DRAWN: JLH  APPROVED: JAP  DATE: APRIL 2016
PROJECT: 05-1112-010 (1500)  FIGURE: A6.39
28-Day Cambridge East Pumping Test

Drawdown Versus Log Time

CMPW1-06 (3,240 m³/day)

CMPW2-06 (3,240 m³/day)

PBPW2-06 (3,378 m³/day)

Elapsed Time Since Start of Pumping (min)

Observed Drawdown (m)

Drawn: JLH
Approved: JAP
Date: April 2016
Project: 05-1112-010 (1500) Figure: A6.41
Phase II Cambridge East Pumping Tests

Drawdown Versus Log Time

Cambridge East Water Supply
Class EA

Figure: A6.42
Phase III Cambridge East Pumping Tests
Drawdown Versus Log Time

Cambridge East Water Supply
Class EA

NDPW1-08 (open hole) 3-Day Pumping Test (6,527 m³/day)

NDPW1-08 (packered) 6-Day Pumping Test (4,321 m³/day)

Expires April 2016

DRAWN: JLH | APPROVED: JAP | DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) | FIGURE: A6.43
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. CMPV2-06 started at 3,240 m³/day (37.5 L/s) on Sept 5, PEBV1-06 started at 3,378 m³/day (39.1 L/s) on Sept 13 and CMPV1-06 started at 3,240 m³/day (37.5 L/s) on Sept 19.
2) Precipitation data is from the GPCA Shades Mill Site at the Cambridge Head Office.

Phase I
28-Day
Cambridge East
Pumping Test

Municipal Production Well
(G16, G17 and G18)
Pumping Rates

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.44
\[ T = 2.303 \times \left( \frac{Q}{4\pi} \right) \times (\text{Slope})^{-1} \]
\[ = \frac{2.303 \times 3204.5}{4\pi(1.1)} \]
\[ = 534 \text{ m}^2/\text{day} \]
\[ = 0.371 \text{ m}^2/\text{min} \]

\[ S = 2.2459 \times T \times (t/r^2) \]
\[ = 2.2459 \times 0.371 \times 0.00001 \]
\[ = 8.3 \times 10^{-6} \]

\[ \text{Slope} = \frac{s}{\log \text{ cycle}(t/r^2)} \]
\[ = \frac{4.4 - 3.3}{1.1} \]
\[ = 1.1 \]
T = \frac{2.303 \times (Q/4\pi) \times (\text{Slope})^{-1}}{\log \text{cycle}(t/r^2)}
= \frac{2.303(3204.5)}{4\pi(0.9)}
= 653 \text{ m}^2/\text{day}
= 0.453 \text{ m}^2/\text{min}

S = 2.2459 \times T \times (t/r^2)_0
= 2.2459 \times (0.453) \times (0.00002)
= 2.0 \times 10^{-6}

\text{Slope} = \frac{s}{\log \text{cycle}(t/r^2)}
= \frac{4.35-3.45}{0.9}
= 0.9

(t/r^2)_0 = 0.00002

Cambridge East Water Supply
Class EA

CMPW2-06 Pumping Test
Drawdown Versus $t/r^2$ Composite
September 2006

DRAWN: JLH | APPROVED: JAP | DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) | FIGURE: A6.46
\[ T = 2.303 \times \left( \frac{Q}{4 \pi L} \right) \times (\text{Slope})^{-1} \]
\[ = \frac{[2.303(3378)]}{4 \pi L(0.9)} \]
\[ = 688 \text{ m}^2/\text{day} \]
\[ = 0.478 \text{ m}^2/\text{min} \]

\[ S = 2.2459 \times T \times (t/r^2)_0 \]
\[ = 2.2459 \times (0.478) \times (0.000015) \]
\[ = 1.6 \times 10^{-5} \]

Slope = \( s/ \log \text{cycle} (t/r^2) \)
\[ = (3.5 - 2.6) \]
\[ = 0.9 \]

\( (t/r^2)_0 = 0.000015 \)
T = 2.303 * (Q/\pi) * (Slope)^{-1}
= [2.303(3273.2)]/[\pi(1.8)]
= 333 m^2/day
= 0.231 m^2/min

S = 2.2459 T (t/r^2)_0
= 2.2459 (0.231) (0.02)
= 1.0 \times 10^{-2}

Slope = \triangle s/ \log cycle (t/r^2)
= (2.9-1.1)
= 1.8

(t/r^2)_0 = 0.02

Cambridge East Water Supply
Class EA

PBPW2-08 Pumping Test
Drawdown Versus t/r^2 Composite
March 2008

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.48
Observed Drawdown (m)

\[ T = 2.303 \times \left( \frac{Q}{4\pi} \right) \times \text{Slope}^{-1} \]

\[ = \frac{2.303(1963.9)}{4\pi(1.3)} \]

\[ = 277 \text{ m}^2/\text{day} \]

\[ = 0.192 \text{ m}^2/\text{min} \]

\[ S = 2.2459 \times T \times (t/r^2)_0 \]

\[ = 2.2459 \times (0.192) \times (0.00015) \]

\[ = 6.5 \times 10^{-5} \]

\[ \text{Slope}_a = \frac{\Delta s}{\text{log cycle}(t/r^2)} \]

\[ = (2.0-0.7) \]

\[ = 1.3 \]

\[ (t/r^2)_0 = 0.00015 \]
\[ T = \frac{2.303 \times Q}{4\pi^2(Slope)} = \frac{2.303(6155)}{4\pi(2.6)} = 434 \text{ m}^2/\text{day} = 0.301 \text{ m}^2/\text{min} \]

\[ S = 2.2459 \times T \times (t/r^2)_0 = 2.2459(0.301)(0.00065) = 4.4 \times 10^{-4} \]

\[ \text{Slope} = \frac{s}{\log \text{cycle}(t/r^2)} = (10.7-8.1) = 2.6 \]

\[(t/r^2)_0 = 0.00065 \]
\[ T = 2.303 \times \left( \frac{Q}{4\pi} \right) \times (\text{Slope})^{-1} \]
\[ = \frac{2.303(4320.6)}{4\pi(2.6)} \]
\[ = 305 \text{ m}^2/\text{day} \]
\[ = 0.211 \text{ m}^2/\text{min} \]

\[ S = 2.2459 \times T \times (t/r^2)_0 \]
\[ = 2.2459 \times (0.211) \times (0.00006) \]
\[ = 2.8 \times 10^{-5} \]

\[ \text{Slope} = \triangle s/ \log \text{cycle}(t/r^2) \]
\[ = (8.2-5.6) \]
\[ = 2.6 \]

\[ (t/r^2)_0 = 0.00006 \]
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<tr>
<td>10/02/2006 11:15</td>
<td>1</td>
<td>10/02/2006 11:45</td>
</tr>
</tbody>
</table>
Total Suspended Solids (TSS) (mg/L)

Precipitation (mm)

Flow Rate (L/s)

28-Day East Cambridge Pumping Test
TSS and Cedarbrook Flow

Cambridge East Water Supply
Class EA

DRAWN: JLH APPROVED: JAP DATE: APRIL 2016
PROJECT: 05-1112-010 (1500) FIGURE: A6.52
This technical memo describes the fish inventory of Cedarbrook Creek done on Friday September 1st 2006 by Taco den Haas and Derek Morningstar. The purpose of the survey was to make an inventory of fish species in Cedarbrook creek. The inventory is required to determine the impact of pumping water into the creek by the pumping test starting on September 5th, 2006.

Cedarbrook Creek was surveyed at three stations between Hillborn pond at the upstream end and the confluence with Mill Creek at the Downstream end. Station one was at the confluence of Mill Creek and Cedarbrook Creek. Station three was at the outflow of Hillborn Pond. Station two was between these two locations. The three stations represented a range of different habitat. All surveys were done by two persons, one operating the backpack electro-fisher and another a dipnet. In total the backpack electrofisher was used during 2626 seconds and a stretch of 135 metres of the creek was surveyed.

Weather conditions in the 24 hours prior to the survey were mainly sunny with some overcast, no precipitation. Air temperature at the time of the survey was 20°C. During the survey Cedarbrook Creek was at moderate stream stage. The water was clear at all three stations. Seeps were observed close to the banks of the creek indicating that groundwater contributes to the flow. Also water temperature in the creek decreases 5°C between Hillborn pond and the confluence with Mill Creek.

In total 108 fish were caught consisting 16 species. One adult brook trout was found at Station 2. Presence of groundwater contributing to the creek and the presence of an adult brook trout makes this site a likely spawning area for this species. Substrate at this site is gravel, suitable for brook trout spawning. Two brown trout were caught at the confluence of Mill Creek and Cedarbrook Creek. The substrate and characteristics of the creek are not ideal for brown trout spawning in this stretch.

Taco den Haas
Table 1 Characteristics of the three stations in Cedarbrook Creek.

<table>
<thead>
<tr>
<th></th>
<th>Station 1</th>
<th>Station 2</th>
<th>Station 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjacent Land Use</td>
<td>Roads &amp; Conservation Land</td>
<td>Residential</td>
<td>Residential</td>
</tr>
<tr>
<td>Vegetation &lt;5m</td>
<td>Swamp thicket &amp; mixed herbs</td>
<td>Cedar Swamp</td>
<td>Dogwood thicket, Cedar swamp</td>
</tr>
<tr>
<td>Substrate</td>
<td>Cobble, Gravel, Sand &amp; Silt</td>
<td>Gravel &amp; Silt</td>
<td>Organic matter, silt, some cobble</td>
</tr>
<tr>
<td>Morphology</td>
<td>Riffles and a deep pool</td>
<td>Run</td>
<td>Run</td>
</tr>
<tr>
<td>Water Temperature (°C)</td>
<td>13.5</td>
<td>15.0</td>
<td>18.0</td>
</tr>
<tr>
<td>Length of station (m)</td>
<td>35</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Electrofishing seconds</td>
<td>1127</td>
<td>740</td>
<td>757</td>
</tr>
<tr>
<td>Number of fish species</td>
<td>12</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Number of fish</td>
<td>55</td>
<td>37</td>
<td>16</td>
</tr>
</tbody>
</table>
Table 2 List of species found at the three Stations in Cedar Creek.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
<th>Station 1</th>
<th>Station 2</th>
<th>Station 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>brown trout</td>
<td><em>Salmo trutta</em></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>brook trout</td>
<td><em>Savelnias fontinalis</em></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>bluntnose minnow</td>
<td><em>Pimephalus notatus</em></td>
<td>9</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>creek chub</td>
<td><em>Semotilus atromaculatus</em></td>
<td>9</td>
<td>27</td>
<td>9</td>
</tr>
<tr>
<td>blacknose dace</td>
<td><em>Rhinichtys</em></td>
<td></td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>fathead minnow</td>
<td><em>Pimephalus promelas</em></td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>northern redbelly dace</td>
<td><em>Phoxinus eos</em></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>smallmouth bass</td>
<td><em>Micropterus</em></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>largemouth bass</td>
<td><em>Micropterus</em></td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>common carp</td>
<td><em>Cyprinus carpio</em></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pumpkinseed</td>
<td><em>Lepomis gibbosus</em></td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>whitesucker</td>
<td><em>Catostomus commersoni</em></td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>rock bass</td>
<td><em>Amplptes rupestris</em></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>brown bullhead</td>
<td><em>Ameiurus nebulosus</em></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>johnny darter</td>
<td><em>Etheostoma nigrum</em></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Rainbow darter</td>
<td><em>Etheostoma caeruleum</em></td>
<td></td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
August 24, 2006
File: C1804 800

Mr. John Petrie, M.Sc., P.Geo
Principal
Golder Associates
2390 Argentia Road
Mississauga, ON L5N 5Z7

Dear Mr. Petrie:

Re: Request for Technical Assistance
Discharge of Well Water from Pumping Test
Upper Country Club Subdivision and Burnett Avenue Pump Station
City of Cambridge

Further to your e-mail of August 17, 2006, we report as follows:

1.0 Storm Sewers

We have reviewed the theoretical capacity of the storm sewers, from the park on Arthur Fach Drive in Upper Country Club subdivision to the SWM pond west of Dellgrove Circle. A spreadsheet of the City of Cambridge Storm Sewer Design Sheet for the 5 year storm is attached. A flow of 39 l/sec was added at the park for the pump test. This analysis indicates that all the storm sewers have capacity for the additional flows. Therefore, we conclude that the storm sewers can accommodate the additional flows from the proposed pump test.

2.0 Stormwater Management Facility

We routed the flow from the proposed pump test, 39 l/sec, through the SWM pond in Upper Country Club Subdivision, using the MIDUSS computer model. The constant flow through the pond will raise the level in the pond by approximately 0.4 m for the duration of the test, and will reduce the active storage in the pond by approximately 2484 m³.

The pond was designed to control peak flows for up to the 5 year storm to pre-development levels. Therefore, for the duration of the pump test, peak flow control for the 5 year storm would not be provided. The main purpose of peak flow control is to minimize potential erosion downstream of the SWM pond. Therefore, the reduction in peak flow control would increase the risk of erosion at the outlet for the duration of the test. However, based on the limited duration of the pump test, the impact of this is likely to be minimal.
The pond was designed to provide 1,714 m$^3$ of extended detention for quality control with 24 hours of detention (ie. 40 m$^3$/ha as per MOE Guidelines, 2003). When this volume of storage is provided for storm water in addition to the pump test flows, the extended detention time is reduced to 10 hours due to the increased head on the outflow control orifice. When the 25mm storm (4 hour duration) is routed through the pond in addition to the pump test flows, extended detention of 2,491 m$^3$ for 14 hours is achieved compared to values of 4,400 m$^3$ and 36 hours, that would normally be achieved for the 25mm storm. Therefore, there will be a reduction in quality control provided for rainfall events that occur during the pump test. Again, based on the limited duration of the pump test, the impact is likely to be minimal.

Discharging the pump test to the storm sewers and through the SWM facility will result in the total volume of water from the pump test being discharged to the Portuguese Swamp. Based on our previous analysis of cumulative discharges to the Portuguese Swamp, this is unlikely to cause any flooding issues. However, we have not assessed any impacts this may have on infiltration, vegetation, wildlife or insects. A copy of our previous report, Modelling of Flood Impacts Related to ESPA 72 (Portuguese Swamp), November 8, 2006, is attached for your reference.

3.0 Sanitary Sewers

We have reviewed the theoretical capacity of the sanitary sewers from the Park on Arthur Fach Drive in Upper Country Club subdivision to Burnett Avenue Pumping Station. Our analysis was based on the actual number of housing units in the drainage area and 3.5 persons per unit. A flow of 39 l/sec was added at the park for the pump test. A spreadsheet of the City of Cambridge Sanitary Sewer Design Chart is attached. Four sections of sewer are slightly under capacity (i.e. estimated flows are 4% to 15% over the pipe capacity). This analysis assumed the entire area was built-out. If the serviced population is reduced by approximately 325 to allow for unbuilt units in Upper Country Club Phase 4, only 2 sections of sewer are approximately 5% over capacity. In addition, the sewers in question are deep (approx. 5m), and could easily accommodate minor surcharging (approx. 0.2m surcharge required to pass excess flow). Therefore, we conclude that the sanitary sewers could accommodate the additional flows from the proposed pump test.
4.0 Burnett Avenue Pumping Station

The Burnett Avenue Pumping Station has been designed and constructed using a phased approach. The initial phase consists of a two pump system with a design capacity of 70 Lps. One of the two pumps is a redundant standby. Ultimately, the pumping station will have a four pump configuration with a total capacity of 180 Lps. The station is currently configured with two pumps per the first phase of the design.

As indicated on the attached sanitary design sheets, given the current buildout within the station's drainage area, the current theoretical peak flow to the pumping station is approximately 110 Lps. This is about 50% higher than the station's current design capacity. This analysis indicates that consideration should be given to upgrading the pumping station to increase its capacity. This type of upgrade is a long term issue and will not meet the immediate requirements of the proposed groundwater pumping program.

To confirm the accuracy of the theoretical flows, a brief review of the station's actual operating records was completed. The operating records indicate that the station is meeting the current flows however the pumps are operating frequently. There is little excess capacity in the station without possibly cutting into the redundant standby capability (i.e. using the both pumps at the same time).

The proposed groundwater flow of 39 Lps represents a significant contribution (56% of design capacity) to the flow. Given that both the theoretical analysis and the actual flows to the station indicate that the station is at its initial phase design capacity, it is not recommended that the groundwater be pumped to the sanitary sewer without any upgrade to the station's pumping capacity.

However, the station's capacity can be upgraded with a temporary standby pump. The pump would have to have to be able to pump at least 39 Lps. It would be powered from the station's existing electrical supply (i.e. not powered by a portable generator). It would operate in emergency standby mode incase the capacity of the two permanent sewage pumps was exceeded. The temporary pump would be operated on the basis of temporary high level float switches completely independant of the station's permanent control system which would not be revised in any way to accommodate the temporary pump. The discharge from the temporary pump would be connected to one of the two existing forcemains via the existing valved bypass connection. Pending City of Cambridge approval of the use of a temporary pump to increase the capacity of the Burnett Avenue Pumping Station, detailed pump sizing and connection logistics will be provided to City staff.
The above information and opinions are provided for your consideration in determining where to discharge wellwater from your proposed pump test. We are not recommending or approving the use of any of these sewer systems. It will be up to the City of Cambridge and the Region of Waterloo as owners and operators of these systems to provide approval for you to use these systems.

Please call if you have any questions or require additional information.

Yours truly,
MTE Consultants Inc.

Ward Wilson, P.Eng
Director, Land Development

cc.  Dave Law, City of Cambridge
     Carlo Radicini, City of Cambridge
     Brad Trussler, Mattamy
     John Piersol, Golder
     Amy Domaratzki, RMOW
ATTACHMENT A7
Public Communication

- Public Notices
- Agreements with Property Owners
- Sample Results Letter
- Public Meeting Participation Lists
REGION OF WATERLOO
NOTICE OF WELL CONSTRUCTION AND TESTING
CITY OF CAMBRIDGE

Dear Resident,

The Regional Municipality of Waterloo has awarded a contract for the drilling and testing of several water supply test wells in the City of Cambridge. The test wells are being installed as part of a program to evaluate whether additional groundwater supplies can be developed in the eastern part of the City.

Test wells have recently been constructed at the following sites shown in the figures on the reverse side of this letter:

1. Behind 808 Burnett Avenue, Cambridge
2. Road allowance behind 60 Cedarbrook Court, Cambridge

From November 18th to December 2nd, 2005, each well will undergo a pumping test of approximately 12 hours duration. Groundwater will be pumped from the test well at rates of up to 1000 l/min (220 gpm) and discharged to the storm water management basins or to adjacent wetland areas shown in the figures.

While no impacts to private wells are anticipated from these short-term tests, staff from Golder Associates Ltd. may carry out a survey of nearby private water wells prior to testing. If you have a water well, Golder personnel may ask questions regarding your well construction, and any past or present problems you may have experienced with water quantity or quality. They may also ask permission to install temporary water level monitoring equipment in your well.

Private well owners within 500 m of each site will be notified at least 24 hours prior to the commencement of testing at that site. Testing at Clemens Mill Location C will begin on Friday November 18, 2005.

No disruption of traffic is anticipated as a result of the well testing.

We thank you for your patience and cooperation during this program. If you have any questions about the project in general or the work being done near you in particular please contact Jim Robinson, the Region’s project manager or John Petrie the consultant’s project manager. Contact information is provided below.

Jim Robinson
Regional Municipality of Waterloo
Water Services Division
150 Frederick Street, 7th Floor
Kitchener, Ontario
N2G 4J3
Phone: 519-575-4424
Fax: 519-575-4452
E-mail: rjim@region.waterloo.on.ca

John Petrie
Golder Associates Ltd.
2390 Argentia Road
Mississauga, Ontario
L5N 5Z7
Phone: 905-567-4444
Fax: 905-567-6561
E-mail: jpetrie@golder.com
Dear Resident,

The Regional Municipality of Waterloo has awarded a contract for the drilling and testing of three test production wells in the City of Cambridge and the installation of five monitoring wells nearby, in both Cambridge and the Township of Puslinch. The test wells and associated monitoring wells are being installed as part of a program to evaluate whether additional groundwater supplies can be developed in the eastern part of the City.

The construction of the three test production wells is currently planned at the following locations, three of which are adjacent to test wells constructed in 2005.

1. 100 Arthur Fach Drive (Witmer Park) in Cambridge OR if not favourable then on the road allowance in front of 2310 Townline Road, Cambridge
2. 870 Townline Road, Cambridge (Portuguese Club)
3. Road allowance behind 60 Cedarbrook Court, Cambridge

Construction locations for the three test production wells and five monitoring wells are shown on the reverse side of this letter:

It is expected that drilling of the first of these wells will commence on May 8th. It is anticipated that the drilling and installation of each well will take about 5 working days to complete, with work being conducted between the hours of 7:30 AM and 6:00 PM. The installation of these wells is expected to be completed by July.

A test pumping program is planned for sometime in August when the three test wells will be pumped during a month long testing program.

Prior to this test pumping program, staff from Golder Associates Ltd. will conduct a survey of nearby private water wells. If you have a water well, Golder personnel may ask questions regarding your well construction and any past or present problems you may have experienced with water quantity or quality. They may also ask permission to install temporary water level monitoring equipment in your well to obtain water level measurements prior to, during and immediately following the test pumping program. Details of the test pumping program will be provided in a second notice to be handed out during the summer.

No disruption of traffic is anticipated as a result of the well drilling or testing.

We thank you for your patience and cooperation during this program. If you have any questions about the project or the work being done in your area, please contact Jim Robinson, the Region’s project manager, or John Petrie the consultant’s project manager. Contact information is provided below.

Jim Robinson
Regional Municipality of Waterloo
Water Services Division
150 Frederick Street, 7th Floor
Kitchener, Ontario
N2G 4J3
Phone: 519-575-4424
Fax: 519-575-4452
E-mail: rjim@region.waterloo.on.ca

John Petrie
Golder Associates Ltd.
2390 Argentia Road
Mississauga, Ontario
L5N 5Z7
Phone: 905-567-4444
Fax: 905-567-6561
E-mail: jpetrie@golder.com
Figure 1 – Test Wells and Monitoring Well Nests
Cambridge East and Puslinch Township
Contracts 2006-014 and 2006-015
Dear Resident,

The Regional Municipality of Waterloo has completed the drilling of three large diameter test production wells in the City of Cambridge and completed the installation of monitoring wells nearby, in both Cambridge and the Township of Puslinch. The test wells and associated monitoring wells are being installed as part of a program to evaluate whether additional municipal groundwater supplies can be developed in the eastern part of the City, as described in a previous letter. A long-term test pumping program for these three wells will begin the week of August 28th and last for four weeks. The details of the pumping test are described below.

The three test production wells that will be pumped in the test have been drilled at the following locations.

1. 100 Arthur Fach Drive (Witmar Park) in Cambridge
2. 870 Townline Road, Cambridge (Portuguese Club)
3. Road allowance behind 60 Cedarbrook Court, Cambridge

The locations of the three test production wells are shown on the reverse side of this letter:

The test pumping program will begin on or about August 28th and last for four weeks. The start of pumping will be staggered with pumping to begin at the Cedarbrook well followed by the Witmar Park well and then finally commencing at the Portuguese Club well. At each well the pumped water will be conveyed in piping and discharged into the sewer system. No disruption of traffic is anticipated at the Portuguese Club location as a result of the testing and discharge piping. At the Witmar Park and Cedarbrook Crt. Locations, the discharge piping may be connected to the sewer system inlets on the road and up to a full lane of the road may be blocked off for the duration of the testing with appropriate signs and barricades put in place.

The pumps for the test will be powered by generators that will run 24 hours a day during the testing. Low noise generators will be used for the testing to minimize noise disturbance during the testing.

We thank you for your patience and cooperation during this program. If you have any questions about the project or the work being done in your area, please contact Jim Robinson, the Region’s project manager, or John Petrie the consultant’s project manager. Contact information is provided below.

Jim Robinson
Regional Municipality of Waterloo
Water Services Division
150 Frederick Street, 7th Floor
Kitchener, Ontario
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Phone: 519-575-4424
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John Petrie
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2390 Argentia Road
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L5N 5Z7
Phone: 905-567-4444
Fax: 905-567-6561
E-mail: jpetrie@golder.com
RE: CONTINGENCY PLAN FOR DOMESTIC WATER WELLS
PUMPING TEST PROGRAM, CAMBRIDGE EAST

Dear Occupant,

As you are likely aware, the Region of Waterloo plans to conduct a pumping test of three test production water wells located in Cambridge east generally in the vicinity of Townline Road. Pumping will begin on or about August 28th and continue into early October.

Our consultant, Golder Associates, has conducted a survey of private water wells and delineated an area where groundwater levels in the bedrock aquifer will likely decline in response to this pumping test. An outline of this area is provided with the attached Question and Answer sheet that was prepared in response to questions from the Residents Meeting held in Puslinch on July 6th. While some change in water levels in the bedrock aquifer in this area will likely be experienced during the testing program, such changes are not expected to interfere with the operation of a bedrock water supply well. Water levels are expected to recover soon after test pumping is terminated and no long term effects will result from this testing program.

However, the possibility exists that shallow (less than 10 m deep) water wells in this area may also experience some water level declines. While the water level decline in shallow wells will be less than in nearby bedrock wells, such a decline could interfere with the operation of a water well where the amount of water above the pump is limited. Because of this concern, the Region has developed the following contingency plan.

The purpose of this letter is to advise you that your well is located in the area where changes in water levels in the bedrock aquifer are anticipated and to advise you of the procedures to follow in the event of a disruption to your well water supply.

The Region of Waterloo maintains a 24/7 emergency number at the Mannheim Treatment Plant. Your address and name has been provided to the operations staff at this location. In the event that you experience a problem with your well water supply during this program, please:

DIAL: (519) 571-6208
STATE YOUR ADDRESS, NAME AND NATURE OF CONCERN
The operator will immediately call Weitzel Pumps and Water Treatment. Weitzel are on contract to the Region to supply water to any householder in the delineated area who experiences a problem with well water supplies during this testing program. Upon receipt of such notification from the Region’s 24/7 staff, Weitzel will immediately dispatch a truck complete with water tank and trained staff to install and connect this tank and ensure provision of water to your household. Water will continue to be delivered until your well water level recovers following completion of the testing program. All costs associated with the provision of emergency water supplies will be paid directly by the Region.

During the testing program, our consultants, Golder Associates will make daily measurements of water levels in numerous wells in the area to monitor the effects of pumping. Golder Associates will also conduct an inspection of your well in the event that you report a problem with your supply. If you would like a second opinion, Puslinch Township’s consultant can be contacted to conduct another inspection. Should problems with the operation of your well be attributable to the testing program, any costs associated with these inspections and the restoration of your well to an operating condition will also be paid directly by the Region.

Should you have any questions, please contact Jim Robinson on (519) 575-4424.

Yours sincerely,

REGION OF WATERLOO

Attachment: Question and Answer

JP/wlm
IMPORTANT

In the event of a disruption to your water supply during Region’s testing program

DIAL: (519) 571-6208

STATE YOUR ADDRESS, NAME AND NATURE OF CONCERN

Note: testing program from August 28th to early October, 2006
INFORMATION UPDATE- SEPTEMBER 29, 2006
LONG TERM PUMPING TEST – CAMBRIDGE

This fourth information update provides depth to water level information obtained at representative monitoring wells and the operational status of the three test production wells recently installed to the west of Townline Road as shown on Figure 1. The Region is monitoring a total of 65 monitoring locations, including 15 private water wells, using dataloggers to obtain a continuous record of water level fluctuations over the testing period. These dataloggers will be downloaded at the end of the test. Manual measurements are also obtained daily at most of these same monitoring locations. These manual measurements have been used to prepare the graphs presented below.

At many monitoring locations, individual wells (piezometers) are screened at different depths within the overburden to depths of about 30 m below ground and within the bedrock to depths of about 120 m below ground. This information update graphically presents depth to water measurements from shallow overburden monitoring wells, generally completed at depths of about 10 m below ground and shallow (upper) bedrock monitoring wells, generally completed at depths of about 40 m below ground.

Groundwater levels normally decline through the summer and early fall and recover in the late fall with the fall rains and spring snow melt. The record of water level fluctuations from the fall of 2005 in one of the Region’s long term monitoring wells (OW5-94) is provided to illustrate the typical decline in water levels observed during the months of September and October.

The three test production wells are completed in the bedrock aquifer to depths of about 120 m below ground. Each of these wells has been constructed with a steel casing extending from ground surface into the top of the bedrock at depths that vary from about 30 to 40 m below ground. Pumping from these wells draws in water from the bedrock aquifer.

The operational status of the three test wells is as follows:

Cedarbrook Crt. Test Well (CMPW02-06) -pumping rate 595 US gpm beginning 12 noon September 5th
Witmar Park Test Well (PBPW01-06) -pumping rate 620 US gpm beginning 1:30 pm September 13th
Portuguese Club Test Well (CMPW01-06) -pumping rate 595 US gpm beginning 12:45 pm September 19th
Figure 1

Legend:
- Test Supply Wells
- Monitoring Wells

WITMAR PARK TEST WELL
PORTUGUESE CLUB TEST WELL
CEDAR BROOK TEST WELL

Base Data: MNR NRVIS, obtained 2004, CANMAP v7.3 2003, Region of Waterloo, obtained in 2005
Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2006
Datum: NAD 83 Projection: UTM Zone 17N
Manual Depth to Water Measurements (meters below measuring point)
Depth to Water Measurements (meters below measuring point)
Dear Resident,

The Regional Municipality of Waterloo has awarded a contract for the drilling and testing of one test well and a shallow monitoring well in the Shades Mill area of the City of Cambridge. The test well is being installed as part of a testing program to evaluate whether suitable groundwater supplies are available in the eastern part of the City. The work is being done as part of the Cambridge East project, the object of which is to enable the Region of Waterloo to pump water from the existing well fields in Cambridge East at their currently permitted rates. The contract work will be supervised by Golder Associates Ltd. on behalf of the Region. Golder staff will be on site for all of the work being done. The drilling locations for the test well and shallow monitoring well, located on Shades Mill Area Grand River Conservation Authority (GRCA) land, are shown on the reverse side of this letter.

The drilling of these wells will commence in early February, 2008. Each well should be completed in approximately 5-8 working days. The work will be conducted between the hours of 7:30 AM and 6:00 PM, from Monday to Friday. The installation of these wells is expected to be completed by mid-February. Following the completion of drilling, an 8-hour duration well performance test and 72-hour long test pumping program will be conducted at the test well site. During this time, a contractor representative will be at the well sites, under the supervision of Golder Associates. Details of the test pumping program will be provided in a second notice to be handed out in mid-February, 2008.

No disruption of traffic is anticipated as a result of the well drilling or testing.

We thank you for your patience and cooperation during this program. If you have any questions about the project or the work being done in your area, please contact Jim Robinson, the Region’s project manager, or John Piersol the consultant’s project manager. Contact information is provided below.

Jim Robinson
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John Piersol
Golder Associates Ltd.
2390 Argentia Road
Mississauga, Ontario
L5N 5Z7
Phone: 905-567-4444
Fax: 905-567-6561
E-mail: jpiersol@golder.com
Shades Mill Drilling Locations on GRCA Land
REGION OF WATERLOO  
NOTICE OF WELL TESTING  
CITY OF CAMBRIDGE

Dear Resident,

This letter serves as a follow-up to the Notice of Well Construction, which was distributed on January 29, 2008. The drilling of these wells was completed on February 19, 2008. The location of the test well and shallow monitoring well, on Shades Mill Area Grand River Conservation Authority (GRCA) land, are shown on the reverse side of this letter.

Please be advised that an 8-hour duration well performance test and 72-hour long test pumping program will be conducted at the test well site. These tests will take place during the weeks of February 25 and March 3, 2008. During this time, a contractor representative will be at the well sites, under the supervision of Golder Associates.

No disruption of traffic is anticipated as a result of the well testing.

We thank you for your patience and cooperation during this program. If you have any questions about the project or the work being done in your area, please contact Jim Robinson, the Region’s project manager, or John Piersol the consultant’s project manager. Contact information is provided below.

Jim Robinson
Regional Municipality of Waterloo  
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Fax: 905-567-6561  
E-mail: jpiersol@golder.com
Shades Mill Drilling Locations on GRCA Land

Monitoring Well Location

Test Well Location
Dear Resident,

The Regional Municipality of Waterloo has completed the drilling of a test production well in the City of Cambridge. The location of the test production well is shown on the reverse side of this letter. The test well is being installed as part of a program to evaluate options to restore municipal groundwater supplies in the eastern part of the City.

A long-term test pumping program for the well will begin during the week of May 5th and should last for three days. The pumped water will be conveyed in piping and discharged into a storm water management pond. There should be no disruption to traffic as a result of the testing and discharge piping.

The pump for the test will be powered by a generator throughout the testing. Low noise generators will be used for the testing in order to minimize noise disturbance during the testing.

The contract work will be supervised by Golder Associates Ltd. on behalf of the Region.

We thank you for your patience and cooperation during this program. If you have any questions about the project or the work being done in your area, please contact Jim Robinson, the Region’s project manager, or John Piersol the consultant’s project manager. Contact information is provided below.

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Test Production Well Location, East Cambridge
Dear Resident,

As you were notified last fall, the Regional Municipality of Waterloo is conducting a drilling and pumping test program at Clyde Park, Township of North Dumfries. This third notice follows two previous notices delivered to residents in September and October, 2008, which provided notification of the construction and testing of two six-inch diameter test wells and a large diameter test production well located in Clyde Park. The large diameter test production well has been drilled and has been left temporarily flowing until the pumping test is completed at which time the well will be fully sealed. Final restoration of the drill site will be completed later in the spring.

The purpose of this third notice is to inform residents of the schedule for the 7-day pumping test, which is planned to take place during the week of January 12th, 2009. A comprehensive monitoring program has been established in advance of this 7-day testing program and includes monitoring of water levels in some private water wells/ponds. The pumping test will be supervised by Golder Associates Ltd. on behalf of the Region.

In the unlikely event that water supplies during testing are disrupted at any private well, the Region will immediately provide an alternative temporary water supply. If you experience water supply problems in your well during the testing, you can call the following Region Number: 519-571-6208, which is manned 24 hours per day, 7 days per week. Following report of a problem, a contractor who provides plumbing and water supply services for the Region will be immediately contacted. This contractor will be available 24 hours a day for the duration of the test and will undertake any action immediately. Following the provision of water, the well will be inspected by a licensed water well contractor to determine if the cause of the problem was water level decline due to the testing program. The provision of a temporary water source and inspection will be done at no cost to the well owner.

The results of the 7-day pumping test will be provided in future correspondence. The water level record obtained from private wells/ponds will be provided to the owner.

We thank you for your patience and cooperation during this program. If you have any questions about the project or the work being done in your area that have not been addressed, please contact Amy Domaratzki, the Region’s project manager, or John Piersol the consultant’s project manager. Contact information is provided below.

Amy Domaratzki
Regional Municipality of Waterloo
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E-mail: jpiersol@golder.com
Dear Resident,

The Regional Municipality of Waterloo is conducting a pumping test program at a test well site in Clyde Park, Township of North Dumfries. The test well program is part of the Integrated Urban System Groundwater Supply Optimization and Expansion Project that the Region is conducting to improve the efficiency of the current water supply system and look for additional water supply well sites to meet future demand in Waterloo Region. As you were notified last spring, a Public Information Centre was held on May 5, 2009 to inform and get input from residents on the Cambridge East Water Supply Class Environmental Assessment and the Clyde Park testing program.

The purpose of this notice is to inform residents of the schedule for a 7-day pumping test, which is planned to take place during the week of August 17th, 2009 at the existing test production well at Clyde Park. This is part of the ongoing work which began in the fall of 2008 with the construction and testing of two six-inch diameter test wells and a large diameter test production well located in Clyde Park. The testing contract work will be supervised by Golder Associates Ltd. on behalf of the Region.

A comprehensive monitoring program is currently being established and will include monitoring of water levels in private water wells, ponds, and wetlands. The results of the 7-day pumping test will be provided in future correspondence. The water level record obtained from private wells/ponds will be provided to the owner.

In the unlikely event that water supplies during testing are disrupted at any private well, the Region will immediately provide an alternative temporary water supply. If you experience water supply problems in your well during the testing, you can call the following Region Number: 519-571-6208, which is manned 24 hours per day, 7 days per week. Following report of a problem, a contractor who provides plumbing and water supply services for the Region will be immediately contacted. This contractor will be available 24 hours a day for the duration of the test and will undertake any action immediately. Following the provision of water, the well will be inspected by a licensed water well contractor to determine if the cause of the problem was water level decline due to the testing program. The provision of a temporary water source and inspection will be done at no cost to the well owner.

We thank you for your patience and cooperation during this program. If you have any questions about the project or the work being done in your area that have not been addressed, please contact Amy Domaratzki, the Region’s project manager, or John Piersol the consultant’s project manager. Contact information is provided below.

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REGION OF WATERLOO
NOTICE OF WELL CONSTRUCTION AND TESTING
VILLAGE OF CLYDE

Dear Resident,

The Regional Municipality of Waterloo has awarded a contract for a drilling and pumping test program at two test well sites in Clyde Park, Township of North Dumfries (locations shown on attached map). A public meeting was held on September 11, 2008 to inform residents about this test well program that is part of the Integrated Urban System Groundwater Supply Optimization and Expansion Project that the Region is conducting to improve the efficiency of the current water supply system and look for additional water supply wells to meet future demand in Waterloo Region. This notice follows the initial letter delivered to residents in early September, which provided further background information on the project.

The purpose of this notice is to inform residents of the schedule for the drilling program and 8-hour duration well performance testing. Also attached are responses to key questions asked by residents at the public meeting.

Well construction is scheduled to begin during the week of September 29th, 2008. Following the drilling process, well performance tests (8-hour duration) will be conducted at the two test well sites. We anticipate that both 8-hour duration tests will take place on separate days during the week of October 6th, 2008. The drilling and testing contract work will be supervised by Golder Associates Ltd. on behalf of the Region. The work will be conducted during the hours of 7 am to 6 pm, Monday to Friday.

Because of the short term duration of the well performance testing, no adverse impacts to nearby private wells or environmental features are anticipated. Should this initial testing provide satisfactory results, a large diameter test production well will then be drilled adjacent to the test well with the greatest capacity and it will be subjected to a 7-day pumping test. A comprehensive monitoring program will be established in advance of this 7-day testing program that will include monitoring of private wells, ponds, wetlands. As part of this program, three new bedrock/overburden monitoring well nests and up to six shallow overburden monitoring well nests will be installed within the area. A second notice will be delivered to local residents advising of the drilling and testing of this large diameter production well should it be drilled.

Additional information on the results of the testing and any potential long-term impacts of the pumping will be provided in future correspondence.

We thank you for your patience and cooperation during this program. If you have any questions about the project or the work being done in your area that have not been addressed, please contact Jim Robinson, the Region’s project manager, or John Piersol the consultant’s assistant project manager. Contact information is provided below.

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Key questions asked by residents at the public meeting held on September 11, 2008 and our responses are provided below.

Will my water well be affected during the testing program?

The 8 hour testing program should not interfere with the operation of any private wells. Because of the short duration of these tests, water level declines will be minor and local during pumping and will return to pre-testing levels within a few hours following the completion of the test.

It is also anticipated that the 7 day testing program will not cause interference with private well operation. A comprehensive monitoring program will be developed and implemented prior to the 7-day pumping test on the larger diameter test production well. While water level declines will be localized and recover to pre-test levels within a few days following this testing, it is important that the changes to groundwater levels during the longer duration test are well understood. The monitoring program will include the measurement of water levels in representative private water wells in the immediate vicinity of the test well and elsewhere in the village to clearly address this concern (and to meet the requirements of the Ministry of the Environment for such testing).

If there is any interruption to my water supply caused by the testing program, how will the Region of Waterloo respond?

In the unlikely event that water supplies during testing are disrupted at any private well, such as a shallow well with low depth of pump submergence or low well capacity, the Region will immediately provide an alternative temporary water supply. If you experience water supply problems in your well during the testing, you can call the following Region Number: 519-571-6208, which is manned 24 hours per day, 7 days per week. This number, details of this response program and the schedule of the long term testing, will be provided in another notice to be delivered in advance of the 7-day test, should the test proceed. Following report of a problem, a contractor who provides plumbing and water supply services for the Region will be immediately contacted. This contactor will be available 24 hours a day for the duration of the test and will undertake any action immediately. Following the provision of water, the well will be inspected by a licensed water well contractor to determine if the cause of the problem was water level decline due to the testing program. The provision of a temporary water source and inspection will be done at no cost to the well owner.

How will the potential for interference with private wells be assessed in the testing program?

During the 7-day pumping test on the large diameter test production well, water levels will be monitored at over 35 wells throughout the area including specially constructed overburden and bedrock monitoring wells and in representative private wells (about 10) where agreed to by the well owner. This monitoring information will be analyzed to determine the extent and degree of water level decline caused by the pumping. This information on the water level decline caused by pumping can then be used to assess the potential for interference with private wells.
What are the next steps after the testing program?

The Clyde Park field testing program will be completed by the end of 2008. The results of the field testing will be analyzed and incorporated into the overall Environmental Assessment of options to optimize groundwater taking from the three Cambridge East well fields, which will be presented to the public in late 2009. Following completion and approval of the environmental assessment, the Region would apply for a Permit To Take Water for any new wells to the Ministry of the Environment prior to construction of any infrastructure (pipeline, well house etc.) associated with a new municipal well.

If the Region is to proceed with a municipal well at this location, would this mean the Village of Clyde would be supplied with municipal water?

There is no plan to supply the village of Clyde with municipal water. A municipal well, should it be constructed here at Clyde Park, would deliver water to the Shades Mills Treatment plant in Cambridge.

What guarantee is there that my well will not be affected in the long-term if Clyde Park eventually becomes the site of a municipal well?

If the results of the Environmental Assessment process show that expected impacts are acceptable, the Region will develop and implement a comprehensive program to monitor water levels on an ongoing basis, as part of the process of construction and operation of a new municipal well at this site. Such monitoring would be a requirement of the Permit To Take Water issued to the Region by the Ministry of the Environment for any new municipal well at this site. The Region of Waterloo also has a well interference policy that guarantees that the Region will restore water supplies if any municipal taking has caused a water level decline that interferes with the use of a private well. Additional details on the Region's well interference policy will be provided in future correspondence.

If you have any additional questions that have not been addressed in this notice, please contact Jim Robinson at 519-575-4424.
REGION OF WATERLOO
SECOND NOTICE OF WELL CONSTRUCTION AND TESTING
VILLAGE OF CLYDE

Dear Resident,

The Regional Municipality of Waterloo is conducting a drilling and pumping test program at two test well sites in Clyde Park, Township of North Dumfries (locations shown on attached map). A public meeting was held on September 11, 2008 to inform residents about this test well program. The test well program is part of the Integrated Urban System Groundwater Supply Optimization and Expansion Project that the Region is conducting to improve the efficiency of the current water supply system and look for additional water supply wells to meet future demand in Waterloo Region. This second notice follows the initial notice of well construction and testing delivered to residents in late September, which provided schedule information on the construction and testing of two six-inch diameter test wells located in Clyde Park. The results of the testing of these two test wells were favourable and the program will continue with the drilling and testing of a large diameter test production well in the park and associated monitoring wells.

The purpose of this second notice is to inform residents of the schedule for the drilling of the test production well and two monitoring well nests. The monitoring well locations are shown on the attached map. The test production well will be drilled adjacent to one of the existing test wells at Clyde Park. A third monitoring well nest will also be installed in one of the existing test wells at Clyde Park.

It is expected that the drilling of the monitoring well nests will take place in late October and the drilling of the test production well will take place during the first two weeks of November, 2008. We anticipate that the construction of all three wells will be completed before the end of the month of November, 2008. The drilling contract work will be supervised by Golder Associates Ltd. on behalf of the Region. The work will be conducted between the hours of 7 am to 6 pm, Monday to Friday.

A 7-day pumping test will be carried out following the construction of the test production well. A comprehensive monitoring program will be established in advance of this 7-day testing program that will include monitoring of private wells, ponds, wetlands. As part of this program, shallow overburden monitoring well nests will be installed within the area. A third notice will be delivered to local residents advising of the schedule for the 7-day pumping test.

The results of the 7-day pumping test will be provided in future correspondence. The water level record obtained from private wells/ponds will be provided to the owner.

We thank you for your patience and cooperation during this program. If you have any questions about the project or the work being done in your area that have not been addressed, please contact Amy Domaratzki, the Region’s project manager, or John Piersol the consultant’s project manager. Contact information is provided below.

Amy Domaratzki
Regional Municipality of Waterloo
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John Piersol
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2390 Argentia Rd.
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E-mail: jpiersol@golder.com
Dear Resident,

The Regional Municipality of Waterloo (Region) needs to expand their monitoring well network to collect groundwater level measurements as part of a baseline monitoring program to support the installation and testing of new production water wells in Cambridge. On behalf of the Region, Golder Associates Ltd. may be contacting you to inquire about the possibilities of installing a monitoring well on your property. To clarify, the monitoring well will be used for monitoring purposes only, and not as a water supply well. The well will be incorporated into the Region’s existing long-term monitoring well network in the area. Personnel from the Region, or their consultants, will need to access the monitoring well periodically and the location of the well could be chosen in a manner most convenient for you. Although this is completely voluntary on your part, we request your cooperation in this important component of the Region’s water supply project.

If you have any questions about the project in general or the work being done in your area in particular, please contact Jim Robinson, the Region’s project manager, or John Petrie the consultant’s project manager. Contact information is provided below.

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John Petrie
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2390 Argentia Road
Mississauga, Ontario L5N 5Z7
Phone: 905-567-4444
Fax: 905-567-6561
E-mail: jpetrie@golder.com
RE: MONITORING OF GROUNDWATER LEVELS
RESIDENTIAL WELLS IN CAMBRIDGE EAST AND PUSLINCH TOWNSHIP
IUS GROUNDWATER SUPPLY OPTIMIZATION AND EXPANSION PROJECT

Dear Homeowner:

In 2005, the Regional Municipality of Waterloo (Region) initiated the Integrated Urban System Groundwater Supply Optimization and Expansion Project (IUS Project) to increase the municipal water supply for the Tri Cities area. This project is being carried out by the consulting team of Golder Associates, Triton Engineering and Blackport Hydrogeology.

As part of the IUS study, the construction of three large diameter bedrock test supply wells in East Cambridge is currently underway at locations on the following sites (Figure 1).

1. 100 Arthur Fach Drive (Witmer Park) in Cambridge
2. 870 Townline Road, Cambridge (Portuguese Club)
3. Road allowance behind 60 Cedarbrook Court, Cambridge

In addition, the construction of at least five additional monitoring well nests is planned for this spring in East Cambridge and Puslinch Township. The locations of these planned monitoring wells are also shown on Figure 1.

A test pumping program will be conducted in August and September 2006 for the three test supply wells mentioned above. An important aspect of the testing program will be to monitor any influence that test well pumping might have on the performance of private residential wells in the area. In this regard, the Region and the consulting team would like to monitor groundwater levels in a number of private residential wells before, during and after the test pumping program.
The purpose of this letter is to seek your permission to install a temporary access pipe in your well so that groundwater levels can be monitored during the testing program. The monitoring equipment will consist of a small self-contained automatic data logger. The access pipe would be installed after receiving your approval and removed in late September 2006 after completion of the testing program. There would be little, if any, disruption to your water supply during the brief time while the access pipe is installed and later removed. This monitoring process would not affect the water quality in your well or its performance. You will be contacted in advance to arrange a convenient time to complete the installation and removal of the access pipe. Your well will be left in its current condition when the monitoring equipment is removed.

All work associated with the installation and removal of this monitoring equipment would be conducted by a licensed well contractor retained by the Region. Golder Associates would be responsible for collecting water level data at some times during the monitoring period. You will be contacted in advance to arrange a suitable time for such monitoring visits. At the completion of the test pumping program, a copy of the water level data obtained from your well will be provided to you.

We hope you will consider this request and grant us permission to install an access pipe and temporarily monitor groundwater levels in your well during the testing program. Your cooperation in this matter will allow the Region to obtain the data necessary for a comprehensive evaluation of groundwater resources in the area. As has previously been discussed with representatives of the Township of Puslinch, water level data developed during this program will be shared with the Township.

If you have any questions, please contact Mr. John Petrie at Golder Associates (905) 567-4444, or Mr. Jim Robinson at the Region of Waterloo (519) 575-4424.

Yours truly,

GOLDER ASSOCIATES LTD.

John Petrie, P.Geo.
Project Manager – Associate

Attachments: Approval for Access Pipe Installation in Residential Well
Figure 1
Approval for Access Pipe Installation in Residential Well

IUS Project

Owner:  

Telephone:  

Address:  

I hereby authorize the Region of Waterloo, its consultant and its contractor, to install an access pipe and data logger in my water supply well for the purpose of monitoring groundwater levels during August and September 2006 for the pumping tests at three new test wells.

Signature:  

Name (please print):  

Date:  
Figure 1- Cambridge East Test and Monitoring Wells

- **Existing Monitoring Well**
- **Planned Monitoring Well**
- **Test Well**
Mr. and Mrs. Homeowner  
Address  
Cambridge, Ontario  
NIT 2J3  

RE: RESULTS OF WATER LEVEL MONITORING AT 111 TOWNLINE RD.  
REGION OF WATERLOO- CAMBRIDGE EAST LONG TERM PUMPING TEST  

Dear Mr. and Mrs. Homeowner:  

As you are aware, the Region of Waterloo is conducting an assessment of the groundwater potential in the area of East Cambridge. As part of this assessment, a long term pumping test of three test production wells was conducted from September 5 to October 2, 2006. We appreciate your cooperation in allowing the Region to monitor water levels in your domestic well during the testing program. This letter provides the results of the water level measurements obtained at your well during this period.  

The three test production wells pumped in the test are completed in the bedrock aquifer to depths of about 120 m below ground surface. The locations of these test production wells are shown in the attached Figure 1. Each of these wells has been constructed with a steel casing extending from ground surface into the top of the bedrock at depths that vary from about 30 to 40 m below ground. Pumping from these wells draws water from the bedrock aquifer.  

The pumping schedule for the test was as follows:  

- **Cedarbrook Crt. Test Well (CMPW02-06)** -pumping rate 595 US gpm beginning 12 noon September 5th;  
- **Witmer Park Test Well (PBPW01-06)** -pumping rate 620 US gpm beginning 1:30 pm September 13th;  
- **Portuguese Club Test Well (CMPW01-06)** -pumping rate 595 US gpm beginning 12:45 pm September 19th; and  
- All three test wells were shut down on October 2nd at 12:30 pm.
During the testing period the Region observed changes in water levels for a total of 65 monitoring locations, including 15 private wells. Water level measurements were obtained both manually and using dataloggers (electronic water level monitoring devices).

The depth to water measurements in your wells showed a small increase of about 0.2 m during the testing period. During the test, water level fluctuations of approximately 0.15 m were evident due to the operation of your pump. We understand that your well remained viable during the testing period.

Thank you again for allowing us to monitor your well during the Region of Waterloo’s long term pumping test. If you have any questions, please contact Mr. John Petrie at Golder Associates (905) 567-4444, or Mr. Jim Robinson at the Region of Waterloo (519) 575-4424.

Yours very truly,

GOLDER ASSOCIATES LTD.

Hydrogeologist       Project Manager, Principal

cc: Jim Robinson, Region of Waterloo

JLH/wlm

Attachments: Figure 1: Well Location Map
Figure 2: Water Levels in Private Well (Graph)
Notes:
1) Pumping rate shown is a combined pumping rate for the three test wells. Cedarbrook started at 595 gpm on Sept 5, Witmer Park started at 620 gpm on Sept 13 and Portuguese Club started at 595 gpm on Sept 19.
2) Precipitation data is from the GRCA Shades Mill Site at the Cambridge Head Office.
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<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>Phone Number</th>
<th>e-Mail</th>
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<tbody>
<tr>
<td>Tom Smith</td>
<td>Louis Rd</td>
<td>249-0495</td>
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<tr>
<td>R. Gordon</td>
<td>Puslinch</td>
<td>654-9849</td>
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<tr>
<td>Doug Dawson</td>
<td>RR#2 Puslinch</td>
<td>658-8292</td>
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<tr>
<td>Helen Purdy</td>
<td>Waterloo Ave, Guelph</td>
<td>519</td>
<td>822-0376</td>
</tr>
<tr>
<td>George Wenzel</td>
<td>RR #22 Cambridge</td>
<td>822-4845</td>
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<tr>
<td>Lynda Walter</td>
<td>Mill creek, L.T.</td>
<td>822-0712</td>
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<tr>
<td>Ken Ross</td>
<td>Rhodea</td>
<td>658-1046</td>
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<tr>
<td>Adrian O'Driscoll</td>
<td>Rhodea Road</td>
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<tr>
<td>Christine Furlong</td>
<td>Queens St West</td>
<td>519-843-3920</td>
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<tr>
<td>Douglas Smith</td>
<td>Arkell Rd. Arkell</td>
<td>519-824-0217</td>
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<tr>
<td>Graham Bowes</td>
<td>Swastika Trail</td>
<td>519 249 1823</td>
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<td>658-2292</td>
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<td>Brian Holt</td>
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# Cambridge East Environmental Assessment

## Participants of July 6 Public Meeting

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<td>U. Pressabah</td>
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<td>Kathy Philips</td>
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<td>Dr. Barry White</td>
<td>Wellington Road 35, RR 6 Guelph,</td>
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Testing for New Municipal Water Supply Wells in East Cambridge

Questions & Answers for Puslinch Residents

A public meeting was held on July 6, 2006 to inform Puslinch residents about the Region of Waterloo’s drilling and testing of new municipal water supply wells in east Cambridge. This work is part of the Integrated Urban System Groundwater Supply Optimization and Expansion Project that the Region is doing to improve the efficiency of the current water supply system and look for additional water supply wells to meet future demand in Waterloo Region.

This package includes background information on the upcoming testing of potential supply wells in this area and answers to questions that were asked at the public meeting or submitted later to Regional staff. Additional information on the results of the testing and any potential long-term impacts of the pumping will be provided in future correspondence.

If you have any questions on this topic that have not been addressed, please contact Jim Robinson at 519-575-4424.

Background Information

In Waterloo Region, we get our drinking water from two sources – groundwater (wells) and the Grand River. The Region is working hard to ensure that our residents continue to have a clean and safe water supply.

To guide the management of our water resources, a Long Term Water Strategy was developed and approved by Regional Council in May 2000. The strategy includes the Integrated Urban System (IUS) Groundwater Supply Optimization and Expansion Project which will assess or expand the capacity of our municipal water supplies in several different areas of the Region.

The wells in the Cambridge East area are no longer able to pump water at their design rate of pumping despite maintenance and remediation efforts; therefore new wells are necessary. For this reason, in early 2005, the Region started evaluating potential new well locations. An engineering consulting firm (Golder Associates) was hired to help with identifying potential sites, drilling, and testing three new test production wells. These wells will be pumped and the surrounding area will be studied to determine what, if any, impacts are observed for municipal and private wells, wetlands, and other water bodies in the area.
Why is the Region drilling to find water in Cambridge East?
The wells in Cambridge East were constructed in the early 1990s. Since their construction, the ability of the wells to pump water has declined despite extensive well maintenance and remediation efforts and consistent underground water levels. (The rock fractures from which the wells draw water have become partially plugged through natural processes) Three additional wells are now needed to restore the well fields to their permitted capacity, which is determined by the Ministry of the Environment.

How were the locations of the potential supply wells identified?
Potential supply well locations were selected to minimize impacts on private wells and surface water. Locations were also chosen based on groundwater flow models and their distance from existing supply wells. Finally, the majority of potential supply wells were located on public or Grand River Conservation Area land to improve access.

What is a pumping test?
A pumping test consists of continuously pumping groundwater from a supply well at a constant rate for an extended period of time and measuring water levels in several nearby wells, surface water bodies and other water resources that could be affected. These measurements provide a way to determine the capacity of the aquifer in which the well is constructed. (An aquifer is an underground layer of gravel or rock fractures that holds water.) The pumping test determines if there are connections between the aquifer and the surface water features in the area. It also provides a way of predicting the effects of long-term municipal pumping.

When are the tests and at what rates will the wells be pumped?
The test is scheduled to begin in late August and continue for about four weeks. Three test production wells will each be pumped during the test at approximately 500 gallons per minute (39 L/sec), for a combined total of approximately 1,500 gallons per minute (114 L/sec). The locations of the three test production wells are shown in Figure 1. Previous short-term pumping of the wells indicated that each of them was capable of being pumped at these rates.

Where is the water from the pumping test to be discharged?
Pumped water will be discharged into the sewer system in Cambridge. No pumped water will be discharged to ground surface in Puslinch Township.

Will the testing impact private deep wells in the area?
The test production wells are constructed in the same deep, fractured limestone aquifer that the Region uses to provide water to all of Cambridge. This is a very high-yield aquifer that is capable of providing abundant water supply for area residents. Water levels in this deep aquifer are not expected to decline significantly during testing, based on the results of a similar long-term pumping test conducted in 1994 in Cambridge and based on ongoing monitoring of water levels over the last decade. Private, deep wells, therefore are not expected to be impacted significantly

Will water levels decline in ponds and shallow private wells during testing?
In this area, the deep aquifer that is being pumped extends to depths of greater than 140 m (400 ft) and is topped by clay and silt till materials that limit connection to shallow aquifers and
Based on the results of the 1994 pumping test, impacts to private ponds and wells will be minimal or non-existent. It is possible that within 1 km of the test wells, shallow wells may be slightly more sensitive to subtle and temporary water level declines because of low depths of pump submergence or low well capacity. This area of concern for private wells is outlined in Figure 1. Deeper wells are not expected to be affected within this area. It is highly unlikely that well testing will influence water levels in private ponds or Puslinch Lake.

The Region will be measuring water levels in various observation wells, private wells, and ponds during testing to confirm that any changes are within acceptable limits. Following completion of the test, water levels will return to their pre-testing levels.

**Where will water levels be measured?**

Water levels will be measured at over 100 stations in the area. These stations include specially constructed overburden and bedrock observation wells, mini-piezometers (small wells adjacent to surface water features), private wells and surface water level stations in wetlands, ponds, creeks and in Puslinch Lake and Little Lake. The monitoring includes 25 observation wells located east of Townline Road in the Township of Puslinch. Water level measurements will be obtained using both electronic and manual measuring instruments prior to, during, and following the pumping test period to provide a three-dimensional picture of any changes.

**How were private wells and ponds selected for monitoring?**

Potential sites for monitoring were identified based on: the results of a door-to-door inventory of private wells conducted within the 1 km radius of the wells; requests from residents who expressed concern about their water wells or ponds; and through the technical analysis undertaken in preparation for the pumping test. The water level monitoring will help ensure that there is not a disruption to private water supplies during testing. Over 15 private wells will be monitored.

**Who do I contact if I have a problem with my well or notice a decline in my pond?**

The Region anticipates that those residents closest to the supply wells are the most likely to experience lower water levels in their private wells during testing. To address the concerns of these residents, a special arrangement has been made to ensure there is no impact on the availability of water to these residents.

Residents within a one kilometre radius of the test wells as shown in Figure 1. If you experience water supply problems in your well, please call the following Region Number which is manned 24 hours per day, 7 days per week:

- Region Number: 519 571-6208.

A contractor, Weitzel Pumps & Water Treatment who provides plumbing and water supply services for the Region will be immediately contacted. This contactor will be available 24 hours a day for the duration of the test and will undertake any action to immediately restore the affected water supplies. Following the provision of water, the well will be inspected to determine if the cause of the problem was water level decline.
If you are in this area and your pond level declines such that fish or aquatic plants are at risk, call the same number and non-potable water will be supplied to the pond.

Provision of water, well inspections, and any repairs related to the well testing will be provided by the Region at no cost to the resident.

Residents within the one kilometre area will have received a notification letter from the Region.

Residents of Puslinch outside the one kilometre area as shown in Figure 1. If you experience a water shortage or significant pond level decline, please contact one of the following people:

- Jim Robinson, Region of Waterloo, 519-575-4424
- John Petrie, Golder Associates, 519-567-4444

Normal business hours are Monday to Friday, 8:30 a.m. to 4:30 p.m. Staff will respond to your concerns as soon as possible following notification. If you experience a water supply problem on the weekend, please leave a message and we will return your call within 24 hours.

Although it is highly unlikely that wells outside of this area will be affected, water will be supplied at no cost to the resident if the pumping test does prevent with normal well use.

**How will the Region advise residents of water level changes during the pumping test?**
A summary of water level trends will be prepared and e-mailed to the Puslinch Township office at the end of each week during the test. The summary will present water levels from the previous week and compare them to pre-pumping levels. The Township of Puslinch has agreed to make this information available to residents.

**When will Puslinch residents be informed of the results of the testing?**
It is anticipated that the pumping test will be completed close to the end of September. Intensive monitoring will continue as long as one month afterwards to measure water level recovery. After that, all data will be compiled and water level graphs will be prepared. This information will be provided to residents at a follow-up public information centre to be held late in 2006 or early 2007.

**What assurance do I have that my well or pond will be safeguarded in the long term?**
Following the conclusion of the pumping test and provision of the data at the public meeting, the Region and our consultant will carefully evaluate the results. The data will be input into a three-dimensional groundwater flow model that will be used to predict the impact of long term pumping. The results of this analysis will be provided to Puslinch Township for review and comment. Further details on this process will be provided in future correspondence.
### Regional Municipality of Waterloo
### Cambridge East Environmental Assessment
### Sign in Sheet

#### North Dumfries Groundwater Investigation
Clyde Park Public Information Session
September 11, 2008

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>Phone #</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robertson</td>
<td>RR6</td>
<td>519-776-6430</td>
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<tr>
<td>ENZO TERESI</td>
<td>RR # 6</td>
<td>621-776-6430</td>
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<tr>
<td>Ray Panare</td>
<td>RR # 6</td>
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<tr>
<td>PATRICIA HEWITT</td>
<td>LANGFORD DR.</td>
<td>620-913-4646</td>
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<tr>
<td>Heather Klemmender</td>
<td>RR # 6</td>
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<tr>
<td>Peter Lucas</td>
<td>CLYDE RD</td>
<td>519-623-4961</td>
<td></td>
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<tr>
<td>Lorrie Richardson</td>
<td>CLYDE RD</td>
<td>519-621-6945</td>
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<tr>
<td>Ina M. L. Hill</td>
<td>LANGFORD DR.</td>
<td>519-621-9329</td>
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<tr>
<td>Norma Sue Ferniege</td>
<td>CLYDE RD</td>
<td>519-621-6105</td>
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<tr>
<td>Heather Schweitz</td>
<td>LANGFORD DR.</td>
<td>519-622-7265</td>
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<tr>
<td>Wm. M. Miller</td>
<td>CLYDE RD</td>
<td>519-624-5847</td>
<td></td>
</tr>
<tr>
<td>Bob Laurence</td>
<td>VILLAGE RD</td>
<td>519-623-2250</td>
<td><a href="mailto:hyflyn@hsfx.ca">hyflyn@hsfx.ca</a></td>
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<tr>
<td>Beverly Hill</td>
<td>CLYDE RD</td>
<td>519-631-6719</td>
<td></td>
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<tr>
<td>Morley Hill</td>
<td>CLYDE RD</td>
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<td></td>
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<tr>
<td>H. Van Oostrum</td>
<td>CLYDE RD</td>
<td>519-624-4880</td>
<td>ema@new. Bell</td>
</tr>
<tr>
<td>C. Furlong</td>
<td>QUEEN ST. Fergus</td>
<td>519-843-3720</td>
<td></td>
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<tr>
<td>Susan Ries</td>
<td>CHAM PL.</td>
<td>519-677-4497</td>
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<tr>
<td>Deborah Graham</td>
<td>CLYDE BANK DR. RR6</td>
<td>519-623-0656</td>
<td><a href="mailto:graham_clyde@sympatico.ca">graham_clyde@sympatico.ca</a></td>
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<tr>
<td>Elizabeth Locke</td>
<td>VILLAGE RD RR6</td>
<td>519-621-4670</td>
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<tr>
<td>Hillswelling</td>
<td>CLYDE RD RR6</td>
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<tr>
<td>Kathy Selleck</td>
<td>LANGFORD DR RR6</td>
<td>519-620-2249</td>
<td><a href="mailto:kSelleck@hsfx.ca">kSelleck@hsfx.ca</a></td>
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<tr>
<td>Beatrice Hallinan</td>
<td>VILLAGE RD RR6</td>
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<tr>
<td>BILL HEWITT</td>
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<tr>
<td>PAUL RICHARDS</td>
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<tr>
<td>Joe Murray</td>
<td>Clydebank</td>
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<td>Lorne</td>
<td>Lushford</td>
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<td>Tim Butler</td>
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<td>Janice Frank</td>
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<td>Susan Fielding</td>
<td>Puslinch Twp. Cntl</td>
<td>519-763-2260</td>
<td></td>
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<tr>
<td>Dick Visser</td>
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<tr>
<td>Howard Hill</td>
<td>Longford Dr. PM#6</td>
<td>519-624-9249</td>
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<tr>
<td>Steve Pachtel</td>
<td>Clyde Rd.</td>
<td>519-624-9498</td>
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<tr>
<td>Darren Towse</td>
<td>Longford Dr.</td>
<td>519-740-3650</td>
<td><a href="mailto:terveb@hfx.ca">terveb@hfx.ca</a></td>
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</tbody>
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North Dumfries Groundwater Investigation
Clyde Park Public Information Session
September 11, 2008
Regional Municipality of Waterloo  
Cambridge East Environmental Assessment  
Questions or Comments Sheet  
North Dumfries Groundwater Investigation  
Clyde Park Public Information Session  
September 11, 2008

<table>
<thead>
<tr>
<th>Name</th>
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<td>What guarantees do we have?</td>
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<td>Historic centre of village needs consideration</td>
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<td>Disruption of small country life</td>
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Please record questions or comments on this sheet and leave it with Regional Staff
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<td>W.A. Miller</td>
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<td>Old spring on property of John Welch.</td>
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<td>Bob Laurence</td>
<td>Request my well monitored.</td>
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Please record questions or comments on this sheet and leave it with Regional Staff.
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<td>Deborah</td>
<td>- please send time line for process</td>
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<td>Graham</td>
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<td>- guaranteed that water supply is wet or not</td>
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<td></td>
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<td>- Concerns about my septic bed being close to well!</td>
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<td>- Pumping house location back on our property</td>
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<tr>
<td>Elizabeth Lockie</td>
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<td>- Request well be monitored during testing</td>
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<tr>
<th>Name</th>
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<td>guarantee my well water is not affected</td>
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<td>monitor my well</td>
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<td>Leanne More</td>
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<td>Concerned about water table and the effects of low water levels</td>
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Please record questions or comments on this sheet and leave it with Regional Staff.
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<tr>
<th>Name</th>
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<td>Check well</td>
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Please record questions or comments on this sheet and leave it with Regional Staff.
ATTACHMENT A8
Water Quality Results
Table A8.1
Inorganic Water Quality - Test Wells

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<th>Sampling Location</th>
<th>ODWS</th>
<th>CMTW1-05</th>
<th>CMTW2-05</th>
<th>CMTW3-05</th>
<th>PBTW1-05</th>
<th>SMTW1-05</th>
<th>PBTW3-07</th>
<th>SMTW2-07</th>
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<tr>
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<td>13-Sep-05</td>
<td>18-Nov-05</td>
<td>23-Nov-05</td>
<td>15-Sep-05</td>
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<td>20-Oct-08</td>
<td>16-Oct-08</td>
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</tbody>
</table>

Inorganic parameters

| Parameter                  | Unit | 85418 | 92886 | 93398 | 85658 | 85945 | 175898 | 160452 | 160828 | 178310 | 178516 | 178887 | 209551 | 209274 |
|----------------------------|------|-------|-------|-------|-------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Alkalinity as CaCO₃ (mg/L) |      | 30-500| 219   | 225   | 265   | 254   | 226    | 235    | 206    | 206    | 215    | 220    | 215    | 228    | 225    |
| Aluminium (mg/L)           |      | 0.1   | <0.005| <0.005| 0.006 | 0.005 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Calcium (mg/L)             |      | 88.5  | 155   | 80.9  | 83.9  | 235   | 85.1   | 598    | 504    | 256    | 259    | 263    | 149    |        |
| Chloride (mg/L)            |      | 250   | 8.38  | 11.5  | 4.49  | 12.2  | 11.8   | 2.01   | 31.1   | 18.6   | 17.5   | 19.3   | 28.8   | 23.6   |
| Dissolved Organic Carbon (mg/L) |      | 5     | 0.8   | <0.5  | 1.1   | 1.7   | 0.9    | 0.6    | 1.1    | <0.5   | 0.5    | 0.6    | 0.8    | 0.6    |
| Hardness (mg/L)            |      | 80-100| 343   | 602   | 318   | 310   | 791    | 323    | 1900   | 1630   | 961    | 974    | 980    | 755    | 574    |
| Iron (mg/L)                |      | 0.3   | 0.044 | 0.049 | 0.089 | 0.552 | 0.227  | 0.034  | 0.132  | 0.12   | 0.114  | 0.087  | 0.084  | 0.129  | 0.097  |
| Magnesium (mg/L)           |      | 29.7  | 52.3  | 28.1  | 24.5  | 49.5  | 28.4   | 97.7   | 89.4   | 78.2   | 79.5   | 78.4   | 60.3   | 49.1   |
| Manganese (mg/L)           |      | 0.1** | 0.02**| 0.002 | 0.005 | 0.048 | 0.038  | 0.015  | 0.003  | 0.015  | 0.012  | 0.005  | 0.005  | 0.008  | 0.004  |
| Nitrate-N (mg/L)           |      | 10    | <0.10 | <0.10 | <0.10 | <0.10 | <0.10  | <0.10  | <0.10  | <0.10  | <0.10  | <0.10  | <0.10  | <0.10  |
| Nitrite-N (mg/L)           |      | 1     | <0.010| <0.010| <0.010| <0.010| <0.015 | <0.015 | <0.015| <0.015| <0.015| <0.015| <0.015| <0.015| <0.015|
| pH (pH Units)              |      | 6.5-6.5| 7.57* | 7.03* | 8.15* | 7.45* | 7.43*  | 7.24*  | 7.35*  | 7.29*  | 7.30*  | 7.30*  | 7.26*  | 6.99*  | 7.16*  |
| Potassium (mg/L)           |      | 1.11  | 1.48  | 0.85  | 0.88  | 1.02  | 0.88   | 2.05   | 1.75   | 1.6    | 1.6    | 1.63   | 1.82   | 1.62   |
| Sodium (mg/L)              |      | 200   | 7.39  | 9.34  | 3.53  | 5.23  | 11.4   | 4.6    | 26.5   | 20.3   | 15.9   | 16.1   | 16.5   | 18.8   | 14.8   |
| Sulphate (mg/L)            |      | 500   | 80.9  | 358   | 28.1  | 23.7  | 492    | 72.8   | 1530   | 1300   | 603    | 684    | 734    | 465    | 281    |

NOTES:
- ODWS - Ontario Drinking Water Quality Standards, Objectives and Guidelines dated June 2006
- MAC - Maximum Acceptable Concentration
- AO/OG - Aesthetic Objective and/or Operational Guideline
- ** - indicates parameter exceeds MAC
- ** - indicates parameter exceeds AO/OG
- * pH estimated due to exceeded holding time.
- ** MAC and AO for manganese based on draft Canadian Drinking Water Guidelines (CDWG) likely to be adopted by Ontario under the Safe Drinking Water Act.
- 1TU = 0.11919 Bq/l per IAEA, 2000 Report

Golder Associates
### Table A8.2

#### Inorganic Water Quality

**28-Day Pumping Test (CMPW1-06, CMPW2-06 and PBPW1-06)**

| Record # | ODWS | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 | CMPW1-06 | CMPW2-06 |
| Sampling Date | 20-Sep-06 | 22-Sep-06 | 22-Sep-06 | 25-Sep-06 | 28-Sep-06 | 28-Sep-06 | 15-Sep-06 | 18-Sep-06 | 20-Sep-06 | 22-Sep-06 | 25-Sep-06 | 28-Sep-06 | 29-Sep-06 | 29-Sep-06 |

#### Inorganic parameters

- **Alkalinity as CaCO₃ (mg/L)**: 30-500 246 228 230 228 232 240 244 236 248 250 240 250
- **Aluminium (mg/L)**: 0.1 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010
- **Calcium (mg/L)**: 83.4 86.3 85.8 89.2 87 105 102 101 99.7 96.6 95.8 94.1
- **Chloride (mg/L)**: 250 18.7 13.2 13.4 13.7 13.5 17.6 17.9 12.1 16 16.6 15.9 94.1
- **Dissolved Organic Carbon (mg/L)**: 5 0.9 0.6 <0.5 0.7 0.7 0.6 0.7 0.8 0.8 0.6 0.8 0.9
- **Hardness (mg/L)**: 80-100 332 343 341 356 351 404 389 385 323 37 31 31.3
- **Iron (mg/L)**: 0.3 0.1 31 20.3 34.5 32.5 32.3 31.7 30.8 31 31 31.3
- **Manganese (mg/L)**: 0.1** 0.02** 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02
- **Nitrate-N (mg/L)**: 10 <0.10 <0.10 <0.10 <0.10 <0.10 <0.10 <0.10 <0.10 <0.10 <0.10 <0.10 <0.10
- **Nitrite-N (mg/L)**: 1 <0.015 <0.015 <0.015 <0.015 <0.015 <0.015 <0.015 <0.015 <0.015 <0.015 <0.015 <0.015 <0.015
- **pH (pH Units)**: 6.5-8.5 7.52* 7.54* 7.52* 7.26* 7.29* 7.20* 7.63* 7.51* 7.46* 7.13* 7.22*
- **Potassium (mg/L)**: 1.09 1.15 1.15 1.2 1.27 1.19 1.15 1.15 1.14 1.16 1.16
- **Sodium (mg/L)**: 200 8.9 9.5 9.6 9.8 11.7 10.7 10.5 9.8 9.7 9.5
- **Sulphate (mg/L)**: 500 120 86.6 88.4 92.4 90.1 139 122 76.5 101 93.3 91.5 89.4

#### Field Parameters

- **pH**: 6.5-8.5 7.19 7.15 7.24 7.19 7.43 7.32 7.19 7.15 7.29 7.22 7.38 7.34
- **Electrical Conductivity (mS/cm)**: 0.63 0.66 0.66 0.66 0.65 0.76 0.74 0.73 0.74 0.71 0.68 0.68
- **Temperature (°C)**: 15 9.8 9.8 9.3 9.8 10 12.7 9.7 10.3 9.8 9.7 9.9

#### NOTES:

- ODWS - Ontario Drinking Water Quality Standards, Objectives and Guidelines dated June 2003
- MAC - Maximum Acceptable Concentration
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- bold - indicates parameter exceeds MAC
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- 1TU = 0.11919 Bq/l per IAEA, 2000 Report

Golder Associates
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Golder Associates
### Inorganic Water Quality
#### Shades Mills Bedrock Wells

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<tr>
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**NOTES:**
- ODWS - Ontario Drinking Water Quality Standards, Objectives and Guidelines dated June 2003
- MAC - Maximum Acceptable Concentration
- AO/OG - Aesthetic Objective and/or Operational Guideline
- **bold** - indicates parameter exceeds MAC
- **-** - indicates parameter exceeds ODWS
- **bold** - indicates parameter exceeds AO/OG
- **** - MAC and AO for manganese based on draft Canadian Drinking Water Guidelines (CDWG) likely to be adopted by Ontario under the Safe Drinking Water Act.
- *pH estimated due to exceeded holding time.*
Table A8.5
Organic Water Quality

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<tr>
<th>Sampling Location</th>
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<th>CMPW1-06</th>
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**Table A8.5**

Organic Water Quality

April 2017

Golder Associates
### Table A8.6
Isotopes and Radionuclides

<table>
<thead>
<tr>
<th>Sampling Location</th>
<th>CMPW1-06</th>
<th>CMPW2-06</th>
<th>PBPW1-06</th>
<th>6699 CONCESSION 1</th>
<th>TW10-78</th>
<th>NDPW1-08</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sampling Date</strong></td>
<td>28-Sep-06</td>
<td>28-Sep-06</td>
<td>28-Sep-06</td>
<td>28-Sep-06</td>
<td>28-Sep-06</td>
<td>19-Jan-09</td>
</tr>
<tr>
<td><strong>Isotope analysis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Oxygen-18</td>
<td>-9.87</td>
<td>-10.03</td>
<td>-10.2</td>
<td>-10.13</td>
<td>-9.34</td>
<td></td>
</tr>
<tr>
<td>Deuterium</td>
<td>-69.34</td>
<td>-69.3</td>
<td>-68.72</td>
<td>-68.21</td>
<td>-66.76</td>
<td></td>
</tr>
<tr>
<td>Tritium (TU)</td>
<td>1.3 +/- 0.4</td>
<td>&lt;0.8 +/- 0.4</td>
<td>5.7 +/- 0.6</td>
<td>13.1 +/- 1.0</td>
<td>14.5 +/- 1.1</td>
<td></td>
</tr>
<tr>
<td><strong>Radionuclides</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Alpha (Bq/l)</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Gross Beta (Bq/l)</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>0.1</td>
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<tr>
<td>Tritium (Bq/l)</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
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</table>