



**Jacques
Whitford**

**Environmental
Engineering
Scientific
Management
Consultants**

Suite 200
2781 Lancaster Road
Ottawa ON
Canada K1B 1A7

Bus 613 738 0708
Fax 613 738 0721

www.jacqueswhitford.com



**Jacques
Whitford**

**An Environment
of Exceptional
Solutions**

FINAL REPORT

Hydrogeological Investigation
and Design Report
Almaguin Highlands Information
Centre
Huntsville Area
Fern Glen Road, Highway 11
G.W.P. 5380-02-00

AINLEY & ASSOCIATES LIMITED

PROJECT NO. 1037297
GEOCRES #31E-291

PROJECT NO. 1037297

REPORT TO **Ainley & Associates Limited**
 280 Pretty River Parkway
 Collingwood, Ontario
 L9Y4J5

FOR **Final Hydrogeological Investigation and**
 Design Report

ON **New Almaguin Highlands Information**
 Centre
 Fern Glen Road, Highway 11
 Huntsville Area
 G.W.P. 5380-02-00
 Geocres #31E-291

May 11, 2009

Jacques Whitford Limited
2781 Lancaster Road
Ottawa, Ontario,
K1B 1A7

Phone: 613-738-0708
Fax: 613-738-0721

www.jacqueswhitford.com



Table of Contents

1.0 INTRODUCTION.....	1
2.0 METHODOLOGY.....	1
2.1 Drilling Investigation	2
2.1.1 Monitoring Well Installation	2
2.1.2 Test Water Well Installation and Disinfection	3
2.2 <i>In-Situ</i> Hydraulic Conductivity Tests.....	3
2.3 Aquifer Testing –Test Well	4
2.4 Groundwater Sampling	4
2.5 Test Hole Survey.....	5
2.6 Review of Background Information	5
2.6.1 Limitations of Data (MOE Water Well Records)	5
3.0 PHYSICAL SETTING.....	6
3.1 Site Description	6
3.2 Physiography and Surface Drainage	6
3.3 Geology and Subsurface Conditions.....	6
3.3.1 Surficial Materials	7
3.3.1.1 Fill.....	7
3.3.2 Sand with Silt to Silt.....	7
3.3.3 Bedrock	8
3.4 Hydrogeology	8
3.4.1 Regional Aquifer.....	8
3.4.2 Site Specific Aquifer	9
3.4.2.1 Site Specific Aquifer Properties.....	9
4.0 LABORATORY ANALYTICAL RESULTS	12
4.1 Soil and Groundwater Standards	12
4.1.1 Soils.....	12
4.1.2 Groundwater.....	13
4.2 Soil Results	13
4.3 Groundwater Results	13
4.3.1 Inorganic and General Chemistry Parameters	14
4.3.2 Microbiological Parameters	16
4.3.3 Volatile Organics, Semi-Volatile Organics, Pesticides, Herbicides, Phenols, and Polychlorinated Biphenyls	16
5.0 CLOSURE.....	17
HYDROGEOLOGICAL DESIGN REPORT	18
6.0 DISCUSSION.....	18
6.1 General	18
6.2 Proposed Development.....	18
6.3 Hydrogeological Conditions	19
6.4 Hydrogeological Assessment for Private Septic Systems.....	20

6.5	Site Specific Aquifer and Groundwater Supply Options	20
7.0	RECOMMENDATIONS.....	23
8.0	CLOSURE.....	23

List of Appendices

APPENDIX A	Drawings
APPENDIX B	Terms and Symbols used On the Record of Borehole Sheets Record of Monitoring Well and Test Water Well Sheets
APPENDIX C	Grain Size Analysis
APPENDIX D	Laboratory Analytical Results and Certificates of Analysis – Fraction Organic Carbon -Soils
APPENDIX E	MOE Water Well Record for the Test Well PW08-1
APPENDIX F	Hydraulic Conductivity Test Results – Monitoring Wells
APPENDIX G	Constant Rate Pumping Test Data and Figures – Test Well PW08-1
APPENDIX H	Laboratory Certificates of Analysis -Groundwater – Test Well PW08-1
APPENDIX I	MOE Water Well Records for the Project Area

1.0 INTRODUCTION

Jacques Whitford Limited (Jacques Whitford) was retained by Ainley & Associates Limited to complete a hydrogeological investigation for the new Almaguin Highlands Information Centre to be located at Fern Glen Road on Highway 11, approximately 25 km north of Huntsville, Ontario, (GWP No. 5380-02-00).

The work was carried out under Agreement No. 5006-E-0050. Authorization to proceed with the investigation was provided by Mr. Mike Neumann, P.Eng., of Ainley & Associates Limited., the prime consultant on this TPM-design assignment.

This hydrogeological investigation report has been prepared specifically to provide background information for the design of a septic system and a water well supply for the project described herein. It contains the factual results of the hydrogeological investigation and the laboratory testing.

This report is organized in 8 sections. Section 1 presents the objectives of the investigation and outlines the scope of the work. Section 2 describes the methodology employed in completing the hydrogeological investigation. Section 3 discusses the physical setting of site and presents the results of the hydrogeological investigation. Section 4 presents the laboratory analytical results of groundwater and soil samples. Section 5 presents limitations of the hydrogeological investigation component of this report. Section 6 discusses the results of the investigation. Section 7 provides recommendations. Section 8 presents limitations of the hydrogeological design component of this report. Supporting information is provided in the appendices at the end of this report.

The scope of work for this project is outlined as follows:

- Review existing information including published geological maps and reports.
- Undertake field investigations to obtain aquifer properties for the design of a septic system and a water well supply.
- Prepare a hydrogeological investigation and a hydrogeological design report.

2.0 METHODOLOGY

This section describes the methodologies employed for reviewing the existing information, the subsurface drilling and well installation, and other field activities.

2.1 Drilling Investigation

2.1.1 Monitoring Well Installation

The drilling program was conducted between November 4 and November 5, 2008, by George Downing Estate Drilling Limited, under the supervision of Jacques Whitford field staff. A track mounted drilling rig equipped with 250 millimetre (mm) outside diameter hollow-stem augers, was employed to drill three boreholes in the overburden.

The subsurface investigation included the drilling of three boreholes, to depths ranging from 5.8 metres (m) below ground surface (bgs) to 17.4 m bgs. Soil samples were recovered from the boreholes at regular intervals using a 50 mm Outside Diameter split-tube sampler by conducting Standard Penetration Tests (SPTs) in general accordance with the procedures outlined in ASTM specification D1586-08a.

Monitoring wells were installed in all three (3) boreholes to permit the measurement of the groundwater elevation and conduct hydraulic conductivity tests. All monitoring wells were installed with the screen in the overburden. All monitoring wells were constructed to the following general specifications:

- A minimum of 3 m of 50 mm inside diameter, #10 slot PVC screen;
- 50 mm inside diameter PVC riser pipe to the surface;
- silica sand filter pack to 0.3 m above the well screen;
- 0.4 m thick bentonite seal above the filter pack;
- backfill to the ground surface, using soil cuttings generated during drilling;
- bentonite sealant was placed around the top of the well to prevent vertical migration of water or contaminants from the surface, or between layers in the subsurface; and
- caps and above grade well casings with covers to protect them from accidental damage and accidental or intentional contamination.

Monitoring well locations are shown on Drawing No. 1 in **Appendix A**. Subsurface conditions at each borehole location were logged in the field by examination of the contents of each split-spoon. The soil stratigraphy is presented on the Borehole and Monitoring Well Records in **Appendix B**.

All recovered soil samples were stored in moisture-proof bags and were returned to our laboratory for detailed classification and testing by a geotechnical engineer. Selected soil samples were tested for grain size distribution and organic carbon content. The results of grain-size analysis of soil samples collected during the subsurface investigation are presented in **Appendix C**.

The results of organic carbon content analysis of soil samples collected during the subsurface investigation are presented in **Appendix D**. The

following table summarizes the key information relating to monitoring well construction.

Well	Total Depth of Borehole (m bgs ¹)	Elevation		Screen		Screened Hydro-Stratigraphic Unit
		Top of Casing (m ASL)	Ground Surface (m ASL)	From (m bgs)	To (m bgs)	
MW08-1	5.80	334.20	333.4	2.75	5.80	Sand with silt (Fill)
MW08-2	11.3	333.65	332.7	8.25	11.25	Sand with silt (SP-SM) to Silt (ML)
MW08-3	17.4	333.79	332.9	14.25	17.35	Silty Sand (SM)

Notes:

¹ metres below ground surface (m bgs).

2.1.2 Test Water Well Installation and Disinfection

The drilling program was conducted between December 3 and December 4, 2008, by F.C Hammond Drilling Limited of Huntsville, Ontario. The test well PW08-1 was drilled to a total depth of 30.49 m bgs.

A truck mounted air rotary drilling rig was used to install the test well and the test well location is shown on Drawing No. 1 in **Appendix A**.

The height of the well casing was extended to 60 centimetres above the ground surface. The top of the casing of the drilled well was also provided with a vermin proof steel cover.

The overburden thickness of 28.78 m was completely cased with a steel casing (150 mm I.D.) and pressure grouted to seal the annulus. The test well was screened in the overburden using a 150 mm (I.D.) stainless steel #10 slot screen, from 28.78 m to 30 m bgs.

The test well was developed by air-lift method (injecting air to lift water to the surface) for one hour. After the completion of well development, test well disinfection was performed by Jacques Whitford in accordance with Ontario Regulation 128/03. The procedures consisted of placing chlorine bleach into the well for a period of at least 24 hours.

Test well record completed by the driller for submission to the Ontario Ministry of the Environment (MOE) is included in **Appendix E**.

2.2 *In-Situ* Hydraulic Conductivity Tests

Rising-head hydraulic conductivity tests were performed in all three (3) monitoring wells. A submersible pump (Grundfos 3) was used to remove water instantly from each of the wells and the rise in the water level was recorded over time using an electronic water level logger.

The data logger recorded the recovery of the well by recording the head of water, as measured by the transducer, at preset increments of time until

the water level in the well recovered to or near its static level. Short time increments were used at the beginning of the test when recovery is quick, and longer time increments of time were used toward the end of the test when recovery is slower. The information obtained was used to estimate the hydraulic conductivity of the permeable overburden materials at the site. The hydraulic conductivity calculation data and figures provided in **Appendix F**.

2.3 Aquifer Testing –Test Well

To assess the quantity of groundwater available for water supply, the test well PW08-1 was subjected to pumping test. Based on the data obtained during the well development activities and the field well yield estimated by the driller, the pumping rate for the constant rate discharge test was selected.

The constant discharge rate pumping test was conducted for a period of eight (8) hours on December 16, 2008. During the pumping test, water level measurements were made on a regular basis to monitor the drawdown of the water level in the test and monitoring wells (PW08-1, MW08-1, MW08-2, and MW08-3) in response to pumping. Water was discharged at an appropriate distance from the test well to ensure that artificial recharge did not occur. Immediately following the pumping test, water level recovery was monitored in the test and monitoring wells until 95% recovery occurred or for 24 hours, whichever occurred first. The pumping test data and figures are provided in **Appendix G**.

2.4 Groundwater Sampling

To assess the quality of groundwater available for water supply, one (1) groundwater sample was collected from the test well on December 15, 2008. Groundwater sampling was conducted with a properly decontaminated submersible pump and a new disposable hose. Prior to groundwater sampling, the test well was pumped at a constant rate until the physical parameters such as temperature, conductivity, pH, and turbidity stabilized within the range of plus or minus 10% over three consecutive measurements.

The groundwater sample was submitted to Paracel Laboratories Limited (Paracel) in Ottawa, Ontario, for analysis of selected inorganic, volatile organic, metal, pesticide/herbicide, general chemical, and microbiological parameters by approved methodologies. Paracel is accredited by the Standards Council of Canada according to protocols provided by the Canadian Association of Environmental Analytical Laboratories (CAEAL) and employs in house quality assurance and quality control programs to govern sample analysis including the analysis of method blanks, spiked blanks, and the analysis of duplicates (10%) for each sample batch. The groundwater sampling results are provided in **Appendix H**.

2.5 Test Hole Survey

The horizontal locations of the test holes were established with a GPS unit to sub-metre accuracy. Ground surface elevation at the test hole locations were surveyed with reference to existing geodetic benchmarks within the vicinity of the study area.

2.6 Review of Background Information

Existing background information relating to the site was reviewed. Data sources included in the review and the types of information provided therein were as follows:

- MOE Water Well Records:
 - Geologic and hydrogeologic information,
 - Lithology information along the depth of the well,
 - Well details including depth of water bearing zones,
- Reports and geology maps from the Ontario Geological Survey and Ministry of Natural Resources:
 - Geology maps and reports relating to bedrock lithology and hydrogeology,
 - Physiography inferred from various geology maps.
- Topographic Maps from Natural Resources Canada:
 - Information on roads, town names, county and municipal boundaries, and surface water features and wetlands.

Other data sources used in this report are specifically referenced throughout. The results of the background information review were combined with the results of the field investigation to provide a summary of the physical, geological, and hydrogeological setting of the study area, which is presented in Sections 3 and 4 of this report.

2.6.1 Limitations of Data (MOE Water Well Records)

The MOE water well records were reviewed in this investigation to identify the area water use and to provide information on site hydrogeology. The quality of the data reported in the MOE water well records may be somewhat questionable for the following reasons:

- The overall data reporting quality is generally poor.
- Reported locations and elevations of the wells may not be accurate.
- Consistency of terms used to describe geology is lacking.
- Reported static water levels, which would have been measured after a short-term well-yield pumping test, may not have fully recovered to a static level and would therefore not necessarily be representative of

static conditions. In addition, static water levels would likely vary from year to year and correlation to current conditions is uncertain.

3.0 PHYSICAL SETTING

3.1 Site Description

The site is located south east of the interchange of Highway 11 and Fern Glen Road which is approximately 25 km north of Huntsville, Ontario.

Highway 11 is generally oriented in a north south direction with two northbound lanes and two southbound lanes. Highway 11 at Fern Glen Road is built on embankments to a rural highway section with wide gravel shoulders and is generally higher than the surrounding lands.

The subject property which is currently undeveloped is approximately 330 m long and varies in width from approximately 100 m in the north half to approximately 160 m in the south half.

3.2 Physiography and Surface Drainage

The site is located within the Algonquin Highland physiographic region. The Algonquin Highland is defined as bedrock controlled, Pre-Cambrian upland (elevation range of 330 to 455 m geodetic) with moderate to high topographic relief (over 100 m) and locally regionally extensive drift cover. The Algonquin Highland region is characterized by undulating terrain with rock knobs and narrow deep valleys. The report area is located within the Great Lakes watershed and contains a well integrated drainage network. The main stream flow within the Algonquin Highland is directed towards the south and west into Georgian Bay.

The observed geodetic elevations at the site during the hydrogeological investigation ranged from 328 to 338 m. The northern two thirds of the site is currently covered with approximately 5 m of fill material. It is understood that the site was stripped of organic materials and backfilled with compacted earth fill and select subgrade material (SSM) in accordance with MTO Specifications 501.07.03 Compacting and 501.08 Quality Assurance. The top of the fill material has a 1.4% slope toward the east. The edge of the fill slopes down to the natural grades to the south, east and north at approximately 3H:1V. Drainage for the site is provided by the slopes surrounding the base of the fill pile which slopes away from the pile at a 1.5 to 2.0% slope.

3.3 Geology and Subsurface Conditions

Continental scale glaciers repeatedly advanced and retreated over the Algonquin Highland Region throughout the last two million years, leaving behind a variety of glacial, glaciofluvial, and glaciolacustrine sediments.

Overburden cover within the project site and surrounding area is characterized by glaciolacustrine sediments consisting primarily of grey to greyish brown sand with silt. Thicker overburden sequences reportedly occur along the Highway 11 corridor. The overburden cover reportedly becomes more extensive within the Algonquin Highland Region where the project site is located. Overburden thickness in excess of 100 m has been encountered in water wells along the valleys of Big East River located 20 km southeast of the site. Overburden in the project area is reportedly underlain by Pre-Cambrian migmatitic rocks and gneisses.

3.3.1 Surficial Materials

The subsurface conditions observed in the boreholes are presented in detail on the monitoring well and pumping well records provided in **Appendix B**. An explanation of the symbols and terms used to describe the monitoring well and pumping well records is also provided. The subsurface investigation included the drilling a total of three monitoring wells and one test well on site, to depths ranging from 5.8 m bgs to 30 m bgs. A borehole/monitoring well location plan is shown on Drawing No. 1 (**Appendix A**).

3.3.1.1 Fill

Sand fill was encountered in all three monitoring wells. The thickness of the sand fill was approximately 5.1 m to 6.1 m, extending to Geodetic elevations of about 326.6 m to 327.8 m. Based on the observed SPT results, the sand fill is very loose to compact.

The sand contained some silt, trace gravel and occasional cobbles. Gravel content is higher near the surface of the hole and decreases with depth. Gradation testing on these samples of the fill indicated 6 % to 17 % gravel, 76 % to 82% sand and 7% to 14% fines. These results are presented in **Appendix C**.

A 0.7 m thick layer of boulders or rock fill was observed beneath the sand fill in MW 08-3. This material extended to elevation 327.2 m.

3.3.2 Sand with Silt to Silt

Sand with silt to Silt was encountered below the fill in monitoring wells MW08-2 and MW08-3. The sand was encountered at a depth of approximately 5.8 m and 6.1 m bgs, Geodetic elevations of about 326.6 m and 327.2 m.

The density of this material varied from very loose to compact based on the observed SPT results. Gradation testing on two samples was carried out and yielded 0% gravel, 8% and 53% sand, and 47% and 92% fines.

3.3.3 Bedrock

Overburden in the project area is reportedly underlain by Pre-Cambrian migmatitic rocks and gneisses. Bedrock was not encountered in monitoring or test wells which were extended to a maximum depth of 30 m at the site.

3.4 Hydrogeology

The hydrogeology in the project site and surrounding area has been inferred primarily based on site reconnaissance, MOE water well records, lithologic/hydrogeologic information from monitoring wells, and relevant geologic/ hydrogeologic information from the surrounding area.

3.4.1 Regional Aquifer

Regional aquifers in the overburden are reportedly difficult to characterize as the majority of the overburden aquifers in the Algonquin Highland Region are associated with glacial or peri-glacial landforms. The overburden aquifers are discontinuous and highly variable, often interrupted by uneven bedrock topography of the Algonquin Highland Region. Greater well yields reportedly correspond to areas with well sorted and coarse textured overburden.

Within the Algonquin Highland Region, coarse textured glaciofluvial deposits serve as the most productive aquifers and reportedly confined to bedrock valleys or depressions and directly overlie either bedrock or till. The Village of Burk's Falls is located approximately 13 kilometres (kms) north of the project site, near the junction of Highway 11 and Hwy. 520. The Village of Burk's Falls obtains its drinking water from a productive sand and gravel aquifer.

The typical overburden aquifer from the surface in the project area appears to consist of permeable glaciolacustrine fine sands and silts with relatively poor yield.

Pre-Cambrian bedrock aquifers may exist within the project area at depths immediately below the overburden aquifer in fractured bedrock and overburden contact zones depending on fracturing and connectivity of bedrock fractures. Portions of the Pre-Cambrian bedrock aquifer can be either confined or unconfined depending on the presence or absence of low-permeability to impermeable layers, respectively.

Singer and Cheng of MOE examined the records of 10,022 wells in the Pre-Cambrian bedrock of Northern Ontario. Of these, a total of 717 wells were reported dry. The authors showed that the majority of the wells had specific capacity values less than 5 Litres per minute/per metre (L/min/m). The records also indicated that the majority of wells yield fresh water and generally hard. Water is reportedly obtained from a variety of depths in

bedrock but most wells seem to obtain suitable supplies from the upper 10 to 15 m of bedrock.

A MOE water well record search performed for the area within the 500 m of the project site produced two (2) water well records (**Appendix I**). Groundwater use in the immediate vicinity of the project area appears to be limited since rural settlement is sparse.

3.4.2 Site Specific Aquifer

The glaciolacustrine sand and silt aquifer at the project site does not appear to be a significant source of water supply. The thickness and extent of the poorly sorted glaciolacustrine sand and silt aquifer at the site is not known.

3.4.2.1 Site Specific Aquifer Properties

The site specific aquifer properties acquired for the purposes of assessing septic system and groundwater supply potential include groundwater elevations, hydraulic conductivity, transmissivity, and yield. Each of these parameters is discussed in this section.

Groundwater Elevations

Water level measurements were obtained on December 17, 2008, and the water depth ranged from 3.7 m to 4.6 m bgs. Groundwater elevations ranged from 328.7 m to 329 m Geodetic, indicating a relatively flat groundwater gradient, possibly influenced by the site and regional topography. The observed groundwater elevations within the site are presented in the following table. The observed groundwater elevations are shown in Drawing No. 2 (**Appendix A**).

**Summary of Static Water Elevations
[December 17, 2008]**

Well	Ground Surface Elevation (mASL)	Static Water Level (m) from below Ground Surface Dec. 17, 2008	Static Water Level Elevation (mASL) Dec. 17, 2008
MW08-1	333.4	4.4	329.0
MW08-2	332.7	3.7	329.0
MW08-3	332.9	4.1	328.8
PW08-1	333.3	4.6	328.7

Notes: mASL = metres above mean sea level.

Hydraulic Conductivity

Hydraulic conductivities were estimated for the three monitoring wells and provided in the following table. Based on the results, the hydraulic conductivity of the overburden aquifer varied from 2.1E-04 to 3.4E-04

cm/sec. This range is typical of sand and silt¹. The results of the hydraulic conductivity tests are included in **Appendix F**.

Well	Horizontal Hydraulic Conductivity (cm/sec.)	Solution Method	Representative Stratigraphic Layer (adjacent to well screen)
MW08-1	2.1E-04	Hvorslev	Sand with silt (Fill)
MW08-2	1.9E-04	Hvorslev	Sand with silt (SP-SM) to Silt (ML)
MW08-3	3.4E-04	Hvorslev	Silty Sand (SM)
Average: 3.10E-4 (cm/sec.)			

Aquifer Test Analysis

On December 16, 2008, an 8-hour pumping test was performed on the test well PW08-1. The objectives of the pumping test were to assess the availability of an adequate supply of groundwater, and to allow for the prediction of long-term response to groundwater pumping.

The data for the 8-hour pumping and 24-hour recovery tests performed on test well PW08-1 is included in **Appendix G**. The drawdown-recovery and distance-drawdown plots are also provided in **Appendix G**.

The pumping test was at a constant pumping rate of 32.4 m³/day. The water level was drawn down by 22.1 m during the pumping test, and recovered 87 % in 40 minutes after the pump was shut-off (**Appendix G**).

The analysis of pumping test data was based on the following assumptions:

- The aquifer has an infinite areal extent.
- The aquifer is of uniform thickness over the area influenced by the pumping test.
- Prior to pump testing, piezometric surface is horizontal (or nearly so) over the area that will be influenced by the testing.
- The well receives water by horizontal flow.
- The diameter of the well is small (i.e., the storage in the well can be neglected).

These are for an ideal aquifer consisting of a porous medium. Non-ideal aquifer systems include the fractured bedrock aquifers.

Estimates of transmissivity of the overburden aquifer at the site was calculated from the drawdown vs. time data using the method of Cooper and Jacob (1946). The method was applied to the plot of drawdown vs. log

¹Freeze, R. A., and J. A. Cherry, 1979. *Groundwater*, Prentice-Hall, Englewood Cliffs, N.J.

time included in **Appendix G**. Transmissivity was calculated using the following relationship:

$$T = 0.183 Q / \Delta s$$

Where:

Δs = drawdown over one log cycle (m)

Q = pumping rate (m³/day)

T = transmissivity

Results of the aquifer test analysis is summarized in following table.

Summary of Pump Testing Results

Pumping Well	Total Depth of Well (m)	Groundwater Level (m bgs) Dec. 17, 2008	Analysis	Drawdown Over One Log Cycle Δ s (m)	Calculated Transmissivity (m ² /day)
PW08-1	30.49	4.6	drawdown	7.5	0.85
			recovery	-	-
Transmissivity					0.85

Estimated Well Yield

The well yield for PW08-1 was estimated by the driller at the well installation and development to be around 5 to 6 USgal/min (32.4 m³/day). The 8-hour pumping test was carried out at a discharge rate of 32.4 m³/day (6 USgal/min). The available drawdown in the well prior to the pumping test was 25.422 m and a maximum drawdown of 22.1 m was observed. This corresponds to 87 % of the available drawdown being utilized at a discharge rate of 32.4 m³/day (6 USgal/min).

Based on the data obtained during the pumping test, it is concluded that the test well PW08-1 is capable of sustaining a short-term yield of at least 32.4 m³/day (6 USgal/min).

Estimated Long-Term Safe Yield

The 10-year safe yield for the test well PW08-1 was estimated based on the assumption of continuous well operation.

The long-term yield for the test well PW08-1 was determined to be about 2 USgal/min with 22.1 m of drawdown. According to the Theis², the theoretical 10 year safe yield can be estimated by:

$$Q(\text{max}) = \frac{4\pi T(s_o - s)}{W(u)}$$

Where:

Q = maximum pumping rate (m³/day or USgal/min)

S_o-S = 22.1 (observed drawdown in m)

T = 0.85 m²/day (transmissivity calculated from the 8-hour pumping test for the test well PW08-1)

W(u) = 16.9 (well function³)

In the well function W(u), u is equal to:

$$u = \frac{r^2 S}{4Tt}$$

Where:

r = well radius = 0.076 m

S = 6 x 10⁻² (storativity is dimensionless and calculated from the results of the pumping test)

T = 0.85 m²/day (transmissivity calculated from the 8-hour pumping test for the test well PW08-1)

t = 3650 days time since pumping started

4.0 LABORATORY ANALYTICAL RESULTS

The soil and water laboratory analytical results are presented in **Appendices D and H**, respectively. This section presents laboratory results, field observations, and rationale for the selection of the regulatory standards.

4.1 Soil and Groundwater Standards

4.1.1 Soils

² Walton., W.C. 1985. *Practical Aspects of Groundwater Modeling*. National Water Well Association, Ohio, 21 p.

³ Fetter Jr., C.W. 1980. *Applied Hydrogeology*. Merrill Publishing Company, Ohio, 460 p.

Solid-phase organic carbon contents of soil or geologic deposits, typically expressed as fraction organic carbon (f_{oc}) may provide some indication of the potential for denitrification. Four (4) soil samples collected from various depths from the septic bed area during the installation of monitoring wells were submitted for analysis of f_{oc} , for the purpose of assessing the denitrification potential of the site. The results of f_{oc} analysis will be used to provide recommendations for the septic system design. The results of f_{oc} analysis will be compared with the available literature values to gain an understanding of the denitrification potential of the on-site soils.

4.1.2 Groundwater

Ontario Drinking Water Quality Standards Regulation O. Reg. 169/03 (revised June, 2006) serves as a reference for the design and operation of water treatment plants to produce water that continuously satisfies the standards, objectives and guidelines of drinking water quality. Ontario Drinking Water Standards (ODWS) specified in the O. Reg. 169/03 (revised June, 2006) will be used to compare the laboratory analytical results of the raw groundwater sample collected from the test well PW08-1, since the intended use of the groundwater at the project site is for human consumption and other domestic use.

The ODWS quality objectives and guidelines are divided into four categories: non-health related operational guidelines (OG) and aesthetic objectives (AO), health related maximum acceptable concentrations (MAC), and health related interim maximum acceptable concentrations (IMAC).

4.2 Soil Results

The observed f_{oc} in the soil samples ranged from <0.1 to 0.2 (% by weight). These values are one order of magnitude higher than f_{oc} values typically found in sand aquifers in Southern Ontario. These values are suggestive of relatively higher denitrification potential; however the fine grained silt sediments at the site could limit the bioavailability of f_{oc} .

The laboratory analytical results for f_{oc} testing carried out on soil samples acquired from the site are presented in **Appendix D**.

4.3 Groundwater Results

The water well was installed on December 3 and 4, 2008. The well was disinfected with chlorine bleach on December 4, 2008. A groundwater sample was acquired on December 15, 2008. The laboratory analytical results for testing carried out on the groundwater sample from the test well PW08-1 is presented in **Appendix H**.

4.3.1 Inorganic and General Chemistry Parameters

The groundwater sample was analyzed for a number of commonly occurring inorganic and general chemistry parameters. Parameters detected above the laboratory method detection limits and ODWS are discussed below.

General Inorganics and Anions

Alkalinity (Total): Alkalinity is a measure of the resistance of the water to the effects of acids added to water. The reported concentration of Alkalinity (28 mg/L) is below the operational objective (30 to 500 mg/L).

Ammonia (as Nitrogen): Reported concentration of Ammonia is 0.08 mg/L. Currently, the province of Ontario does not have any guidelines for this parameter.

Chloride: Chloride is a common non-toxic material present in small amounts in drinking water and produces a detectable salty taste at or above 250 mg/L. The reported concentration of Chloride (140 mg/L) in water is below the aesthetic objective (250 mg/L).

Colour: Reported concentration of Colour in water is 161 TCU (True Colour Units), which exceeded the aesthetic objective of 5 TCU.

Hardness: Hardness is caused by dissolved calcium and magnesium in groundwater, and is expressed as the equivalent quantity of calcium carbonate. Hardness levels between 80 and 100 mg/L as calcium carbonate (CaCO₃) are considered to provide an acceptable balance between corrosion and incrustation. Reported concentration of Hardness (129 mg/L) exceeded the operational guideline.

Nitrate (Expressed as N): Nitrate is present in groundwater as a result of natural decay of plant or animal material, the use of agricultural fertilizers, domestic sewage or treated wastewater contamination. Reported concentration of Nitrate (1.6 mg/L) is below the MAC of 10 mg/L.

pH: pH is a parameter that indicates the acidity of a water sample. The ODWS specifies an acceptable range of pH in drinking water between 6.5 and 8.5. The reported level of the pH (6.43) in water is not within this range.

Sulphate: Reported concentration of Sulphate (16 mg/L) is below the aesthetic objective (500 mg/L).

Total Dissolved Solids (TDS): The term "total dissolved solids" refers mainly to the inorganic substances dissolved in water. The principal constituents of TDS are chloride, sulphates, calcium, magnesium and bicarbonates. Excessive hardness, taste, mineral deposition or corrosion is common properties of water with high TDS. The reported concentration of TDS (268 mg/L) in water is below the aesthetic objective (500 mg/L).

The palatability of drinking water with a TDS level less than 500 mg/L is generally considered to be good.

Turbidity: Excess turbidity in water becomes visible to the naked eye and its presence may be objectionable to users. The aesthetic objective specified by the ODWS for turbidity in filtered drinking water (at the point of consumption) is 5.0 Nephelometric Turbidity Units (NTU). The reported turbidity level in raw groundwater (not filtered) is 27.4 NTU. Raw groundwater supply may contain inorganic-based turbidity, which may not seriously hinder disinfection. For such supplies, an operational guideline for turbidity is not established, however, additional treatment may be required prior to the human consumption.

Metals

Aluminum: Reported concentration of Aluminum (0.003 mg/L) is below the operational guideline of 0.1 mg/L.

Barium: Reported concentration of Barium (0.036 mg/L) is below the MAC of 1.0 mg/L.

Calcium: Calcium is usually one of the most important contributors to hardness. Currently, the province of Ontario does not have any guidelines for this parameter. Reported concentration of Calcium in water is 38.2 mg/L.

Chromium: Reported concentration of Chromium (0.003 mg/L) is below the MAC of 0.05 mg/L.

Copper: Reported concentration of Copper (0.0006 mg/L) is below the aesthetic objective of 1 mg/L.

Iron: Iron may be present in groundwater as a result of mineral deposits and chemically reducing underground conditions. Excessive levels of Iron in drinking water supplies may impart a brownish colour to laundered goods, plumbing fixtures and the water itself. The precipitation of Iron can also promote the growth of Iron bacteria in water mains and service pipes. Reported concentration of Iron (0.462 mg/L) exceeded the aesthetic objective of 0.3 mg/L.

Magnesium: Magnesium is usually one of the most important contributors to hardness. The reported concentration of Magnesium is 8.1 mg/L. Currently, the province of Ontario does not have any guidelines for this parameter.

Manganese: Like iron, manganese is objectionable in water supplies because it stains laundry and fixtures black. Reported concentration of Manganese (0.037 mg/L) is below the aesthetic objective of 0.05 mg/L.

Sodium: Reported concentration of Sodium (29.8 mg/L) is below the aesthetic objective of 200 mg/L.

The following summarizes the anion, inorganic, and metal parameters that exceeded the ODWS guidelines, objectives, and health related MACs.

- *Operational Guideline:* Hardness (129 mg/L) and pH (6.43)
- *Non-health related Aesthetic Objective:* Iron (0.462 mg/L)

4.3.2 Microbiological Parameters

The laboratory results for the microbiological parameters are discussed below.

E.Coli: Escherichia coli or E. coli is a single species of bacteria that is a subset of total and fecal coliforms. E. coli is normally found in human and animal intestines, and is the most reliable indicator of fecal contamination in water. Its presence in drinking water represents a health concern because they are usually associated with sewage or animal wastes. The MAC specified in the ODWS for E.Coli in drinking water is 0 Colony Forming Units (CFU)/ 100 mL. E. coli was not detected in water sample collected from this location (i.e., E.Coli < 1).

Fecal Coliforms: The MAC specified in the ODWS for Fecal Coliforms in drinking water is 0 CFU/ 100 mL. Fecal Coliforms were not detected in water sample collected from this location (i.e., Fecal Coliforms < 1).

Heterotrophic Plate Count (HPC): The reported concentration of HPC is 350 CFU/mL. Currently, the province of Ontario does not have any guidelines for this parameter. HPC results give an indication of overall water quality in drinking-water systems. HPC results typically used as a tool for monitoring the overall quality of the water, both immediately post-treatment and in the distribution system.

Total Coliforms: Total Coliforms include both pathogenic and non-pathogenic bacteria. Reported concentration of Total Coliforms (8 CFU/100 mL) in raw untreated groundwater is above the the MAC of 0 CFU/100 mL.

The following summarizes the anion, inorganic, and metal parameters that exceeded the ODWS guidelines, objectives, and health related MACs.

- *Health related Maximum Acceptable Concentration:* Total Coliforms (8 CFU/100 mL)

4.3.3 Volatile Organics, Semi-Volatile Organics, Pesticides, Herbicides, Phenols, and Polychlorinated Biphenyls

The groundwater sample was analyzed for a number of commonly occurring volatile organics, semi-volatile organics, pesticides, herbicides, phenols, and polychlorinated biphenyls. The laboratory analytical results indicated that these parameters were either non-detectable or not detected above the laboratory method detection limits.

5.0 CLOSURE

This report has been prepared for the sole benefit of the Ainley & Associates Limited and the Ontario Ministry of Transportation (MTO). The report may not be used by any other person or entity without the express written consent of Jacques Whitford, Ainley & Associates Limited, and the MTO. Any use that a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. Jacques Whitford accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

The information contained in this report is based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Due to the nature of the investigation and the limited data available, Jacques Whitford cannot warrant against undiscovered environmental or hydrogeological liabilities.

A subsurface investigation is a limited sampling of a site. The subsurface conditions provided herein are based on information gathered at specific borehole locations and can only be extrapolated to an undefined limited area around these locations. The extent of the limited area depends on the soil and groundwater conditions as well as the history of the site reflecting natural, construction and other activities. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information.

This report was prepared by Su-Kim Roy, Eng., P.Eng., and Sonny Sundaram, Ph.D., P.Geo. and reviewed by Jacques Sauriol, M.Sc., P.Geo., and Fred Griffiths, Ph.D., P.Eng.

Respectfully submitted,

JACQUES WHITFORD LIMITED

Su-kim Roy, M.Eng., P.Eng.
Project Engineer

Sonny Sundaram, Ph. D., P. Geo.
Senior Hydrogeologist

Jacques Sauriol, M.Sc., P. Geo.
Project Manager/ Senior Reviewer

Fred J. Griffiths, Ph. D., P. Eng.
Designated Principal
MTO Contact



HYDROGEOLOGICAL DESIGN REPORT

**New Almaguin Highlands Information Centre
Fern Glen Road, Highway 11
Near Huntsville, Ontario
G.W.P. 5380-02-00
Geocres #31E-223**

6.0 DISCUSSION

6.1 General

The site is located south east of the interchange of Highway 11 and Fern Glen Road which is approximately 25 km north of Huntsville, Ontario.

Highway 11 is generally oriented in a north south direction with two northbound lanes and two southbound lanes. Highway 11 at Fern Glen Road is built on embankments to a rural highway section with wide gravel shoulders and is generally higher than the surrounding lands.

The subject property which is currently undeveloped is approximately 330 m long and varies in width from approximately 100 m in the north half to approximately 160 m in the south half.

The northern two thirds of the site is currently covered with approximately 5 m of fill material. It is understood that the site was stripped of organic materials and backfilled with compacted earth fill and select subgrade material (SSM) in accordance with MTO Specifications 501.07.03 Compacting and 501.08 Quality Assurance.

6.2 Proposed Development

The Ministry of Transportation (MTO) is planning to construct the new Almaguin Highlands Information Centre on the subject property. The facilities will include an access road, bus, recreational vehicle and car parking, snowmobile pull-offs, and a one-storey building. The building is proposed to be approximately 23 m by 23 m in area and will have a finished floor elevation of 334.5 m Geodetic. No basement is proposed. Water supply to the building will be provided from an on-site well. Septic services will include a below grade pipe to a septic tank and bed to be located to the southwest of the building. The proposed configuration of the site is indicated on Drawing No. 1 in **Appendix A**.

The proposed grading plan for the site includes placing additional fill at the building of as much as 1 m.

6.3 Hydrogeological Conditions

The hydrogeological and hydrostratigraphic conditions encountered are summarized on the Stratigraphic Profiles of **Drawing No. 2** in **Appendix A** as well as the Record of Monitoring Well sheets in **Appendix B**. The following is a brief description of the hydrogeological conditions encountered.

Septic Bed Area

Three (3) monitoring wells were installed within the septic bed footprint. The average existing grade at the monitoring wells drilled in 2008 is approximately 333 m. The soils within the septic bed footprint were observed to consist of as much as 6.1 m of fill over native sand and silt. No organic layer was encountered during the installation of monitoring wells.

The fill was reported to be placed and compacted to MTO standards in 2003. Stripping of the site is also reported to have occurred and likely included removal of as much as 1.7 m of peat. Laboratory testing on samples acquired of the fill within the septic bed footprint indicates some variability in the material, in particular the fines content ranged from 7% to 14%. The native sand and silt within the septic bed footprint have been determined to contain fines ranging from 47% to 91%.

The observed fraction organic carbon (foc) in the soil samples collected from the septic bed area ranged from <0.1 and 0.2 (% by weight). These values are one order of magnitude higher than foc values typically found in sand aquifers in Southern Ontario. These values are suggestive of relatively higher denitrification potential; however the fine grained silt sediments at the site could limit the bioavailability of foc.

Water level measurements were documented on December 17, 2008, and the water depth ranged from 3.7 m to 4.4 m bgs. Groundwater elevations ranged from 328.8 m to 329.0 m Geodetic, indicating a relatively flat groundwater gradient and possibly influenced by the site and regional topography. The observed groundwater elevations are shown in Drawing No. 2 (**Appendix A**).

The observed groundwater elevations within septic bed area were reasonably consistent with the observed groundwater elevation within the building footprint area and average static groundwater elevation for the site is approximately 328.8 m Geodetic.

Based on observations from the installation of the test water well, it will be assumed that the overburden extends to at least a depth of 30 m below ground surface or Elevation 303 m Geodetic.

6.4 Hydrogeological Assessment for Private Septic Systems

It is our understanding that the design flow rate (Q) will be within the Ontario Building Code (OBC)(O. Reg 350/06; April 7, 2007). It is thus assumed that the Q will be less than 10,000 Litres per day (Lpd). Based on the provided site plan, the land area designated for the septic leaching bed is 42.8 m by 70.6 m, equal to 3,012 m² surface area. It is also our understanding that the leaching bed is to be further raised by two additional metres of soil below the perforated tiles.

Based on the Building Code Supplementary Standard SB-6, the equivalent unified soil classification is SM to SC. The assigned hydraulic conductivities range between 10⁻⁶ to 10⁻³ cm/sec with an equivalent t-time estimate of 20 to 30 minutes per cm. These ranges are consistent with the field *in-situ* hydraulic conductivities estimated during the hydrogeological investigation.

It is assumed that the septic system design will be of a Class 4 Sewage System composed of a septic tank and a leaching bed, as per OBC. Furthermore, the leaching bed will consist of a raised fill based absorption trenches.

The maximum hydraulic loading rate as per Table 8.78.4.1A of the OBC is prescribed at 8 L/m²/day. The required leaching bed area is thus calculated as 10,000 Lpd divided by 8 L/m²/day = 1250 m², or 42 percent of the available 3012 m² area. The balance of the area could be designated as a spare area, as is frequently requested by some local Health Unit Offices in Ontario. Because of the observed depths to water table, excessive hydraulic mounding is not anticipated.

Under the existing OBC, there is no requirement for the computation of mounding and nitrate loading. However, the septic effluent loading will occur in the same hydro-stratigraphic unit (i.e., sand and silt) as the screened portion of the test well (assuming that the test well PW08-1 is maintained for the future use as the water supply well).

The OBC specifies a minimum of 30 m horizontal separation distance between the water supply well and the septic leaching bed. We have assumed a 70 m setback between the well and the septic leaching bed.

We also take note that the screened portion of the test well is at 30 m bgs, which will contribute to additional vertical separation distance with the septic system. The presence of elevated organic carbon in the overburden material will further contribute to denitrification of any effluent migration.

6.5 Site Specific Aquifer and Groundwater Supply Options

Regionally, the glaciolacustrine sand and silt aquifer does not appear to be a significant source of water supply. The thickness and extent of the poorly sorted glaciolacustrine sand and silt aquifer at the site is not known.

The well yield for PW08-1 was estimated by the driller at the well installation and development to be around 5 to 6 USgal/min. The 8-hour pumping test was carried out at a discharge rate of 6 USgal/min. The available drawdown in the well prior to the pumping test was 25.422 m and a maximum drawdown of 22.1 m was observed. This corresponds to 87 % of the available drawdown being utilized at a discharge rate of 6 USgal/min.

It is understood that the proposed development requires a water supply capable of fulfilling following requirements:

- Potable supply: less than 10 m³/day (set by maximum flow rate into the septic field).
- Fire suppression: fire flow demand is currently unknown.

It is concluded that, an alternative method is required to satisfy the fire suppression needs.

In addition, poor water yield from the glacio-lacustrine aquifer may restrict the pump cycles during the operation of the well to 20 min pump-on and 40 min pump-off. A properly sized and designed water reservoir should be used to meet the fire suppression and peak hour potable water demands.

Pump rate greater than 6 USgal/min is not recommended for the wells completed in this aquifer.

The following table provides a comparison of various groundwater supply options.

Water Supply Source Option	Advantages	Disadvantages	Relative Cost	Risks/ Consequences
Drilled well - Glacio-lacustrine aquifer (e.g., PW08-1 is installed within this aquifer)	Lower cost than installing deep bedrock or overburden aquifer well	-Yield will be poor -Will require the use of treatment systems to reduce the turbidity and iron levels -Potential for intercepting the contamination from the surface is high over the long-term -Will require proper design and development of a filter pack around the screen to minimize the ingress of fines	Low	Poor short term and long term yield
Drilled well - overburden aquifer	Potential for obtaining greater yield	-Potential for intercepting the contamination from the surface is high over the long-term	High	The presence of a sand and gravel aquifer within the project site needs to be confirmed with supplemental testing and investigation. There is no guarantee that a greater yielding sand and gravel aquifer will be found during these supplemental investigation
Drilled well - Pre-Cambrian bedrock aquifer	Potential for obtaining greater yield. Potential for intercepting the contamination from the surface is relatively low over the long-term	-Potential for intercepting saline water exists if the terminating depth of the well is deeper -Costs associated with the steel casing	Medium	There is no guarantee that a greater yielding bedrock aquifer will be found.
Shallow large diameter collector well – overburden	Potential to augment the water supply from shallow dug well	-Depth of well is limited to a maximum of 6 to 8 m. -Potential for intercepting the contamination from the surface is higher over the near-term.	High	Well could become dry seasonally.

Based on our review of the options, it is recommended that the water supply from the test well PW08-1 be augmented with the installation of a tank sized to store water for fire suppression and peak hour potable water supply requirements.

7.0 RECOMMENDATIONS

Septic Leaching Bed

- The Ontario Building Code specifies a minimum of 30 m horizontal separation distance between the water supply well and the septic leaching bed. Any potential well should be located up-gradient (topographic) of the septic bed area and separated by a horizontal distance of 30 m.

Groundwater Supply (Test Well PW08-1)

- The pump should be a submersible type located above the well screen. Pump cycles should be 20 min pump on followed by 40 min pump off to allow the well to recover. Pump rate should be no more than 6 USgal/min.
- The performance of the well should be documented by monitoring flow and associated drawdown. Longer term hydraulic test would be advisable.
- Future assessment could include a step pumping test to establish the current performance curve to allow computation of well efficiency and compare with future well performance.
- Water quality issues include Colour, pH, Turbidity, Iron, and elevated concentrations of Total Coliforms. The Ontario Drinking Water Standard (ODWS) for Total Coliforms is non-detectable concentrations; if they are detected, then, the ODWS recommends corrective action (i.e., disinfection) and re-sampling to conform non-detectable concentrations.
- Based on the sampling schedule prescribed by local health unit, monitoring of the bacterial quality (+ nitrate) of the groundwater should be conducted to ensure no detrimental effect of the septic system. The deep grouted casing associated with short well screen should provide some level of safety to the water supply.
- The location of an additional second on-site well could include the exploration of a deeper bedrock aquifer well to augment the water supply.

8.0 CLOSURE

This report has been prepared for the sole benefit of the Ainley & Associates Limited and the Ontario Ministry of Transportation (MTO). The report may not be used by any other person or entity without the express written consent of Jacques Whitford, Ainley & Associates Limited, and the MTO. Any use that a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. Jacques Whitford accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

The information and conclusions contained in this report are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Conclusions and recommendations presented in this report should not be construed as legal advice.

The conclusions and recommendations presented in this report represent the best technical judgment of Jacques Whitford and are based on the information gathered during the site history review, field investigation, and site reconnaissance. Due to the nature of the investigation and the limited data available, Jacques Whitford cannot warrant against undiscovered environmental liabilities.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

This report was prepared by Su-Kim Roy, P.Eng., and Sonny Sundaram, Ph.D., P.Geo. and reviewed by Jacques Sauriol, M.Sc., P.Geo., and Fred Griffiths, Ph.D., P.Eng.

Respectfully submitted,

JACQUES WHITFORD LIMITED

Original signed by:

Su-Kim Roy, M.Eng., P.Eng.
Project Engineer

Original signed by:

Sonny Sundaram, Ph. D., P. Geo.
Senior Hydrogeologist

Original signed by:

Jacques Sauriol, M.Sc., P. Geo.
Project Manager/Senior Reviewer

Original signed by:

Fred J. Griffiths, Ph. D., P. Eng.
Designated Principal
MTO Contact

SS/JS/FG/hc

*P:\2008\1037297 - MTO Almaguin Hydrogeology\Report\Final for MTO\Hydrogeological Investigation
Final_May_11_2009 MTO.doc*



STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Jacques Whitford Limited and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Jacques Whitford's present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Jacques Whitford is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Jacques Whitford at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

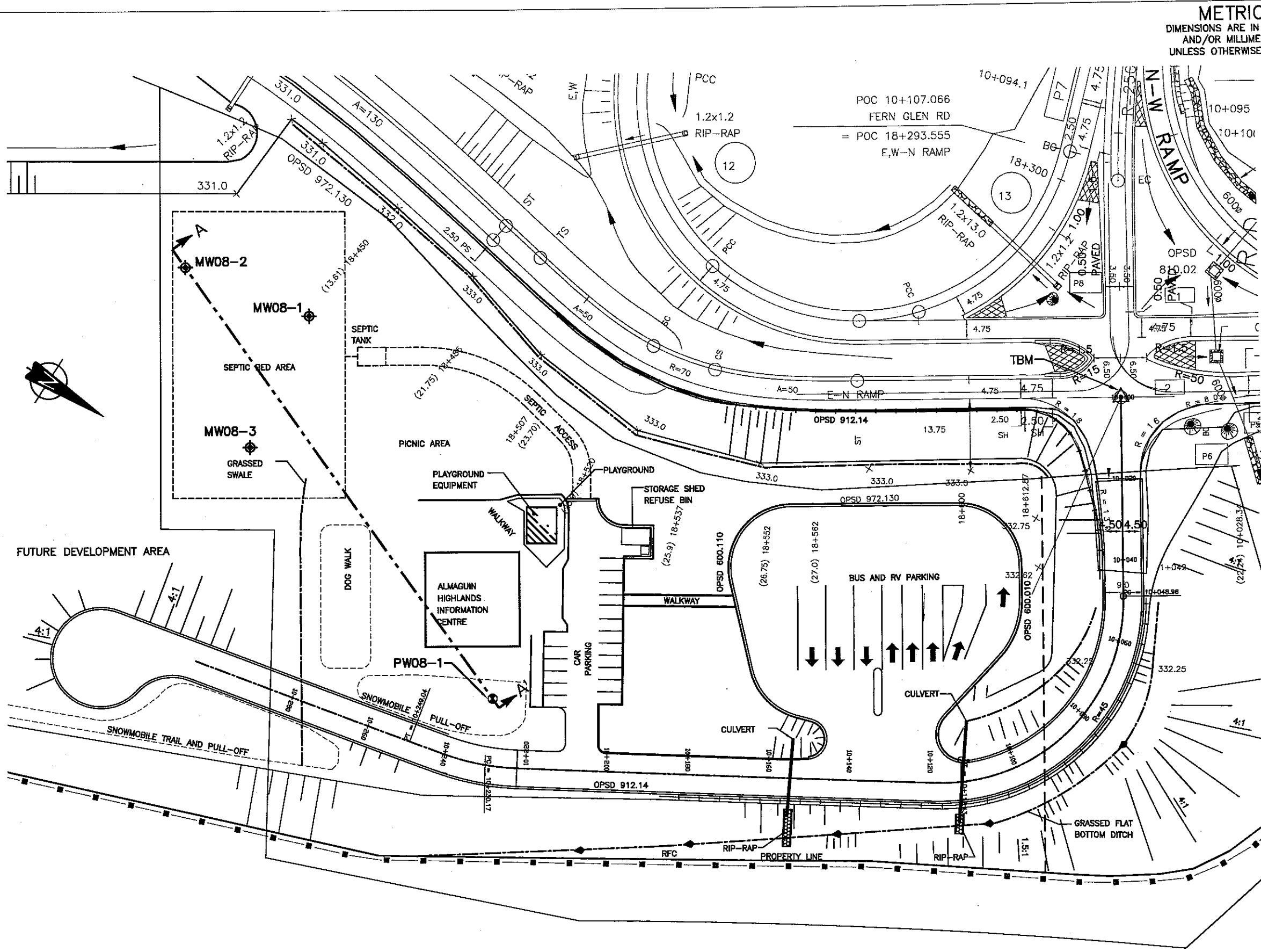
VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Jacques Whitford must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Jacques Whitford will not be responsible to any party for damages incurred as a result of failing to notify Jacques Whitford that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Jacques Whitford, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Jacques Whitford cannot be responsible for site work carried out without being present.



Appendix A

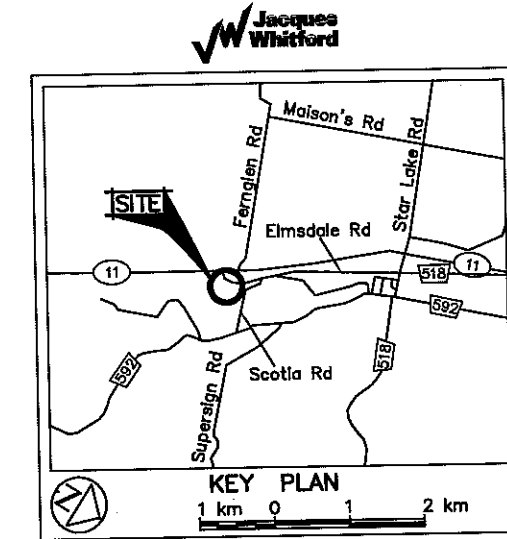
Drawings



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 5380-02-00

HIGHWAY 11 - ALMAGUIN
HIGHLANDS INFORMATION CENTRE
STATION
WELL LOCATIONS



LEGEND				
	Monitoring Well			
	Test Well			
	Temporary Benchmark, 341.877 m			

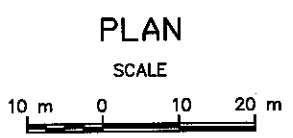
No	ELEV	COORDINATES	
		NORTH	EAST
MW08-1	333.4	5 041 209.1	320 160.1
MW08-2	332.7	5 041 176.8	320 166.6
MW08-3	332.9	5 041 214.1	320 195.3
PW08-1	333.3	5 041 297.9	320 215.3

NOTE: The complete pavement design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REVISIONS		DATE		BY	DESCRIPTION

GEORES No 31E-291

HWY No 11	CHECKED	DATE 2009-05-11	SITE
SUBM'D SS	CHECKED	APPROVED	DWG 1
DRAWN GBB	CHECKED		



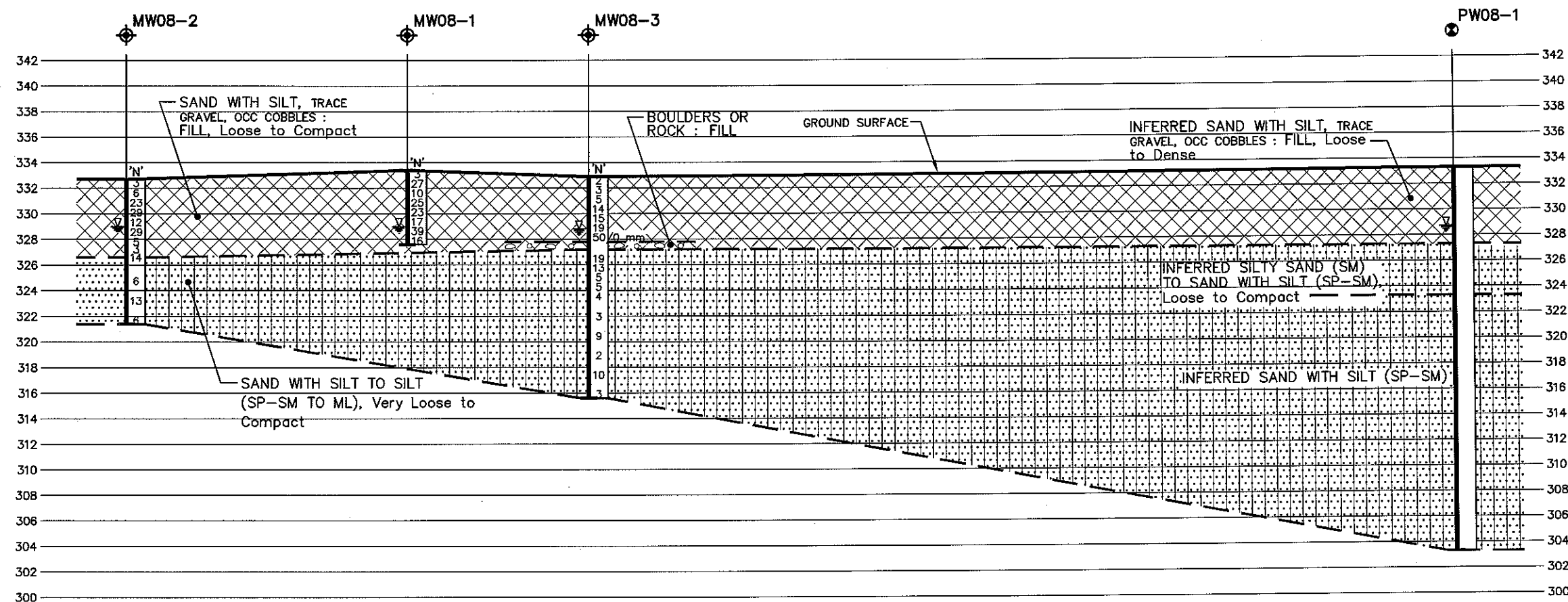
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 5380-02-00

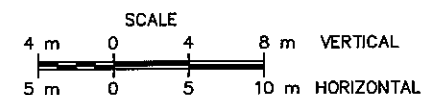
HIGHWAY 11 - ALMAGUIN
HIGHLANDS INFORMATION CENTRE
SOIL STRATA



SHEET
-



CROSS-SECTION A-A'



LEGEND

- Monitoring Well
- Test Well
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation (December 17, 2008)

No	ELEV	COORDINATES	
		NORTH	EAST
MW08-1	333.4	5 041 209.1	320 160.1
MW08-2	332.7	5 041 176.8	320 166.6
MW08-3	332.9	5 041 214.1	320 195.3
PW08-1	333.3	5 041 297.9	320 215.3

NOTE

The boundaries between soil strata have been established only at Well locations. Between wells the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REVISIONS	DATE	BY	DESCRIPTION

GEOCRES No 31E-291			
HWY No 11			DIST
SUBM'D SS	CHECKED	DATE 2009-05-11	SITE
DRAWN GBB	CHECKED	APPROVED	DWG 2

Appendix B
Terms and Symbols Used on the Record of Borehole Sheet
Record of Monitoring Well Sheets

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

<i>Topsoil</i>	- mixture of soil and humus capable of supporting vegetative growth
<i>Peat</i>	- mixture of visible and invisible fragments of decayed organic matter
<i>Till</i>	- unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

<i>Desiccated</i>	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	- having cracks, and hence a blocky structure
<i>Varved</i>	- composed of regular alternating layers of silt and clay
<i>Stratified</i>	- composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	- > 75 mm in thickness
<i>Seam</i>	- 2 mm to 75 mm in thickness
<i>Parting</i>	- < 2 mm in thickness

Terminology describing soil types:

The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488). The classification excludes particles larger than 76 mm (3 inches). The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	> 20%

Terminology describing compactness of cohesionless soils:

The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test N-Value (also known as N-Index). A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
<i>Very Loose</i>	<4
<i>Loose</i>	4-10
<i>Compact</i>	10-30
<i>Dense</i>	30-50
<i>Very Dense</i>	>50

Terminology describing consistency of cohesive soils:

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests.

Consistency	Undrained Shear Strength	
	kips/sq.ft.	kPa
<i>Very Soft</i>	<0.25	<12.5
<i>Soft</i>	0.25 - 0.5	12.5 - 25
<i>Firm</i>	0.5 - 1.0	25 - 50
<i>Stiff</i>	1.0 - 2.0	50 - 100
<i>Very Stiff</i>	2.0 - 4.0	100 - 200
<i>Hard</i>	>4.0	>200

ROCK DESCRIPTION

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	<i>Very Poor</i>
25-50	<i>Poor</i>
50-75	<i>Fair</i>
75-90	<i>Good</i>
90-100	<i>Excellent</i>

Rock quality classification is based on a modified core recovery percentage (RQD) in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on NW core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from *in situ* fractures. The terminology describing rock mass quality based on RQD is subjective and is underlain by the presumption that sound strong rock is of higher engineering value than fractured weak rock.

Terminology describing rock mass:

Spacing (mm)	Joint Classification	Bedding, Laminations, Bands
> 6000	<i>Extremely Wide</i>	-
2000-6000	<i>Very Wide</i>	<i>Very Thick</i>
600-2000	<i>Wide</i>	<i>Thick</i>
200-600	<i>Moderate</i>	<i>Medium</i>
60-200	<i>Close</i>	<i>Thin</i>
20-60	<i>Very Close</i>	<i>Very Thin</i>
<20	<i>Extremely Close</i>	<i>Laminated</i>
<6	-	<i>Thinly Laminated</i>

Terminology describing rock strength:

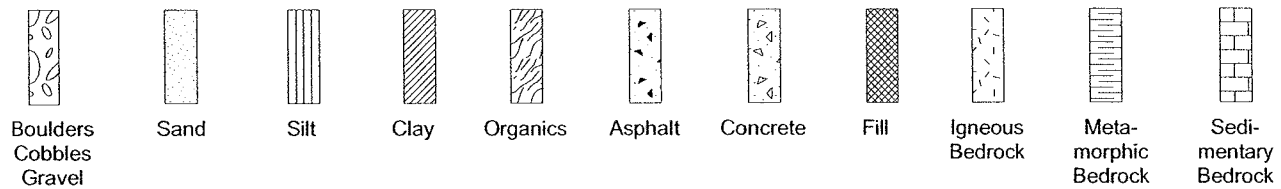
Strength Classification	Unconfined Compressive Strength (MPa)
<i>Extremely Weak</i>	< 1
<i>Very Weak</i>	1 – 5
<i>Weak</i>	5 – 25
<i>Medium Strong</i>	25 – 50
<i>Strong</i>	50 – 100
<i>Very Strong</i>	100 – 250
<i>Extremely Strong</i>	> 250

Terminology describing rock weathering:

Term	Description
<i>Fresh</i>	No visible signs of rock weathering. Slight discolouration along major discontinuities
<i>Slightly Weathered</i>	Discolouration indicates weathering of rock on discontinuity surfaces. All the rock material may be discoloured.
<i>Moderately Weathered</i>	Less than half the rock is decomposed and/or disintegrated into soil.
<i>Highly Weathered</i>	More than half the rock is decomposed and/or disintegrated into soil.
<i>Completely Weathered</i>	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.

STRATA PLOT

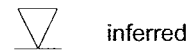
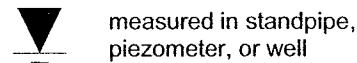
Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT



RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE / RQD





Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and N-values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N value corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log. RQD is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to A size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (305 mm) into the soil. The DCPT is used as a probe to assess soil variability. Soil type may be inferred from adjacent boreholes and test pits.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_{p(50)}$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

RECORD OF BOREHOLE No MW 08-1										1 OF 1		METRIC			
W.P. GWP 5380-02-00		LOCATION Proposed Septic Bed E320160 N5041209				ORIGINATED BY JF									
DIST Huntsville HWY 11		BOREHOLE TYPE HS Augers, Split Spoons				COMPILED BY JF									
DATUM Geodetic		DATE 08.11.05 - 08.11.05				CHECKED BY FG									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
333.4 0.0	Sand Fill Sand with silt, trace gravel, occasional cobbles, loose to dense, brown (FILL) - gravel decreasing with depth		1	SS	3	▽	333								6 80 (14)
			2	SS	27										
			3	SS	10										
			4	SS	25										
			5	SS	23										
			6	SS	17										
			7	SS	39										
			8	SS	16										
327.6 5.8	End of Borehole Monitoring Well Installed Water Level: Date: December 17, 2008 Depth: 4.4 m below ground surface Elevation: 329.0 mASL														

RECORD OF BOREHOLE No MW 08-2										1 OF 2		METRIC				
W.P. <u>GWP 5380-02-00</u>			LOCATION <u>Proposed Septic Bed E320167 N5041177</u>			ORIGINATED BY <u>JF</u>										
DIST <u>Huntsville HWY 11</u>			BOREHOLE TYPE <u>HS Augers, Split Spoons</u>			COMPILED BY <u>JF</u>										
DATUM <u>Geodetic</u>			DATE <u>08.11.05 - 08.11.05</u>			CHECKED BY <u>FG</u>										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE								WATER CONTENT (%) 20 40 60 80 100
332.7	Sand Fill		1	SS	3	▽	332								11 82 (7)	
	Sand with silt, trace gravel, occasional cobbles, loose to compact, brown (FILL)		2	SS	6		331									
			3	SS	23		330									
			4	SS	29		329									
			5	SS	12		328									
			6	SS	29		327									
			7	SS	5											
			8	SS	3											
326.6	SAND with silt (SP-SM) to SILT (ML), loose to compact, grey		9	SS	14		326									0 8 (92)
6.1							325									
			10	SS	6		324									
			11	SS	13	323										

Continued Next Page

RECORD OF BOREHOLE No MW 08-2										2 OF 2		METRIC			
W.P. <u>GWP 5380-02-00</u>			LOCATION <u>Proposed Septic Bed E320167 N5041177</u>					ORIGINATED BY <u>JF</u>							
DIST <u>Huntsville</u> HWY <u>11</u>			BOREHOLE TYPE <u>HS Augers, Split Spoons</u>					COMPILED BY <u>JF</u>							
DATUM <u>Geodetic</u>			DATE <u>08.11.05 - 08.11.05</u>					CHECKED BY <u>FG</u>							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
	SAND with silt (SP-SM) to SILT (ML), loose to compact, grey <i>(continued)</i>														
			12	SS	6		322								
321.4	End of Borehole														
11.3	Monitoring Well Installed Water Level: Date: December 17, 2008 Depth: 3.7 m below ground surface Elevation: 329.0 mASL														

RECORD OF BOREHOLE No MW 08-3										1 OF 2		METRIC								
W.P. <u>GWP 5380-02-00</u>			LOCATION <u>Proposed Septic Bed E320195 N5041214</u>			ORIGINATED BY <u>JF</u>														
DIST <u>Huntsville</u> HWY <u>11</u>			BOREHOLE TYPE <u>HS Augers, Split Spoons</u>			COMPILED BY <u>JF</u>														
DATUM <u>Geodetic</u>			DATE <u>08.11.05 - 08.11.05</u>			CHECKED BY <u>FG</u>														
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80	100	20	40	60
332.9 0.0	Sand Fill Sand with silt, trace gravel, occasional cobbles, very loose to compact, brown (FILL)		1	SS	2	▽														
			2	SS	3		332													
			3	SS	5		331													
	- gravel decreasing with depth		4	SS	14		330													
			5	SS	15															
			6	SS	19		329													
			7	SS	50/ 0mm		328													
327.8 5.1	Boulders or Rock Fill (FILL)																			
327.2 5.8	SAND with silt (SP-SM) to SILTY SAND (SM), very loose to compact, grey		8	SS	19		327													
			9	SS	13		326													
			10	SS	5		325													
			11	SS	5		324													
			12	SS	4															
							323													

ONTARIO MTO 1037243.GPJ ONTARIO MOT.GDT 09/02/04

Continued Next Page

RECORD OF BOREHOLE No MW 08-3										2 OF 2		METRIC			
W.P. <u>GWP 5380-02-00</u>		LOCATION <u>Proposed Septic Bed E320195 N5041214</u>				ORIGINATED BY <u>JF</u>									
DIST <u>Huntsville HWY 11</u>		BOREHOLE TYPE <u>HS Augers, SplitSpoons</u>				COMPILED BY <u>JF</u>									
DATUM <u>Geodetic</u>		DATE <u>08.11.05 - 08.11.05</u>				CHECKED BY <u>FG</u>									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
	SAND with silt (SP-SM) to SILTY SAND (SM), very loose to compact, grey (continued)		13	SS	3		322								
							321								
320.8 12.2	SILTY SAND (SM), very loose to loose, greyish brown		14	SS	9		320								
							319								0 53 (47)
			15	SS	2		318								
			16	SS	10		317								
			17	SS	3		316								
315.6 17.4	End of Borehole Monitoring Well Installed Water Level: Date: December 17, 2008 Depth: 4.1 m below ground surface Elevation: 328.8 mASL														

ONTARIO MTO 1037243.GPJ ONTARIO.MOT.GDT 08/02/04

Appendix C

Grain Size Analysis



**Jacques
Whitford**

2781 Lancaster Rd. Tel: 613 738-0708
Ottawa, Ontario K1B 1A7 Fax: 613 738-0721

Sieve Analysis

Client : **Ainley Group**
Project : **Highway 11 Septic Bed**
Material Type : **Soils/Aggregate :**
Proposed Use : **Fill/Granulars :**
Supplier : **N/A**
Source : **MW08-1 SS1**
Sampled From : **0'-2'**
Sampled By : **Jeff Forrester**
Tested By : **Blaine Miller**

Project No. : **1037297**
Test Method : **LS 602 (ASTM C136)**
Sample No. : **8438**

Date Sampled : **05-Nov-2008**
Date Tested : **27-Nov-2008**

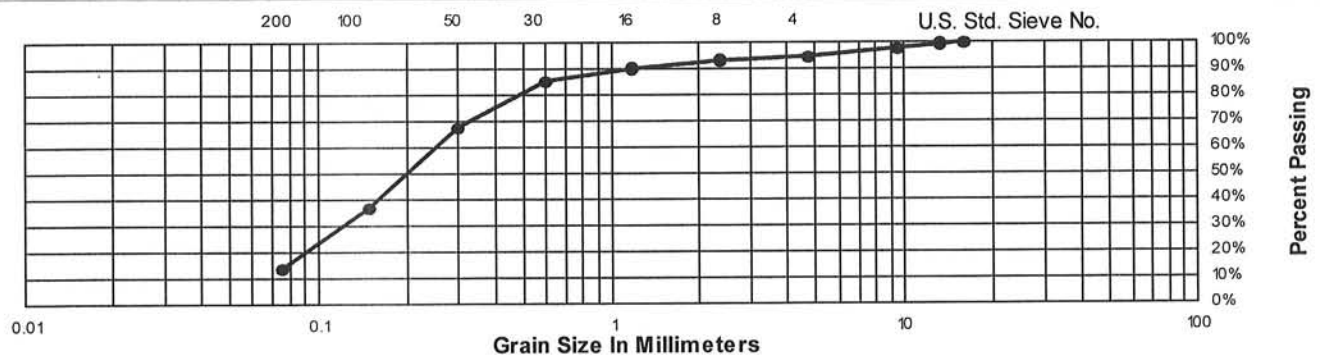
Wash Test Data

Sample Weight Before Sieve :	621.8	Sample Weight Before Wash :	309.8	
Sample Weight After Sieve :	621.3	Sample Weight After Wash :	269.1	
% Loss In Sieve :	0.08	% Passing No.200 :	13.1	Corrected : 12.380

Sieve Analysis

Sieve No.	Size of Opening		Wt. Retained grams	Cum. Wt. Retained grams	% Passing	Specification	
	Inches	mm				Min	Max
	3	76.2					
	2	53					
	1	26.5					
	3/4	19					
	5/8	16	0.0	0.0	100.0		
	1/2	13.2	5.8	5.8	99.1		
	3/8	9.5	8.8	14.6	97.7		
+4	0.187	4.75	19.8	34.4	94.5		
-4			586.9	621.3			
8	0.0937	2.36		5.6	92.8		
16	0.0469	1.18		13.8	90.3		
30	0.0234	0.600		30.0	85.3		
50	0.0117	0.300		87.8	67.7		
100	0.0059	0.150		188.8	36.9		
200	0.0029	0.075		263.7	14.1		
-200				268.7			

Classification of Sample : % Gravel : **5.5** % Sand : **80.4** % Silt & Clay : **14.1**



Remarks :

Laboratory Supervisor : Blaine Miller

Date : November 28, 2008



**Jacques
Whitford**

2781 Lancaster Rd. Tel: 613 738-0708
Ottawa, Ontario K1B 1A7 Fax: 613 738-0721

Sieve Analysis

Client : **Ainley Group**
Project : **Highway 11 Septic Bed**
Material Type : **Soils/Aggregate :**
Proposed Use : **Fill/Granulars :**
Supplier : **N/A**
Source: **MW08-2 SS1**
Sampled From : **0'-2'**
Sampled By : **Jeff Forrester**
Tested By : **Blaine Miller**

Project No. : **1037297**
Test Method : **LS 602 (ASTM C136)**
Sample No.: **8439**

Date Sampled : **05-Nov-2008**
Date Tested : **27-Nov-2008**

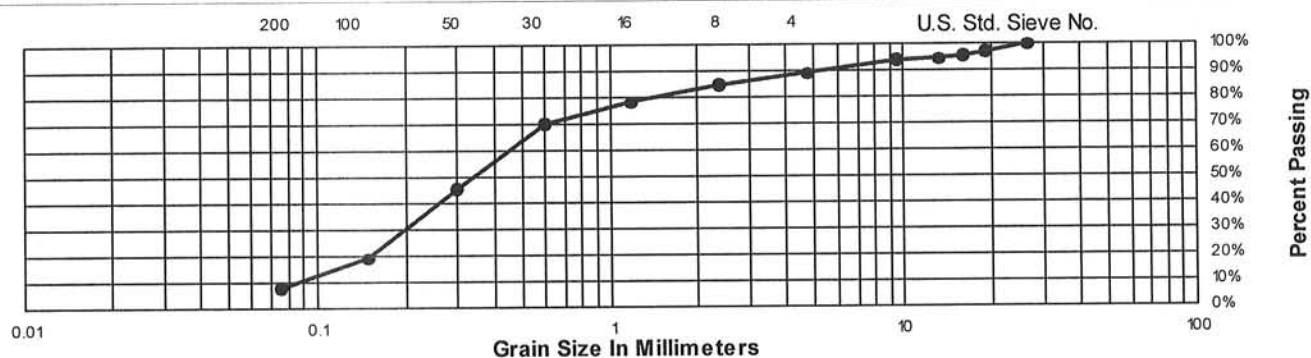
Wash Test Data

Sample Weight Before Sieve :	612.6	Sample Weight Before Wash :	275.1	
Sample Weight After Sieve :	611.9	Sample Weight After Wash :	253.7	
% Loss In Sieve :	0.11	% Passing No.200 :	7.8	Corrected : 6.965

Sieve Analysis

Sieve No.	Size of Opening		Wt. Retained grams	Cum. Wt. Retained grams	% Passing	Specification	
	Inches	mm				Min	Max
	3	76.2					
	2	53					
	1	26.5	0.0	0.0	100.0		
	3/4	19	20.1	20.1	96.7		
	5/8	16	6.0	26.1	95.7		
	1/2	13.2	6.2	32.3	94.7		
	3/8	9.5	7.4	39.7	93.5		
+4	0.187	4.75	25.7	65.4	89.3		
-4			546.5	611.9			
8	0.0937	2.36		15.3	84.3		
16	0.0469	1.18		32.8	78.7		
30	0.0234	0.600		59.5	70.0		
50	0.0117	0.300		136.3	45.1		
100	0.0059	0.150		215.3	19.4		
200	0.0029	0.075		251.6	7.6		
-200				253.5			

Classification of Sample : % Gravel : 10.7 % Sand : 81.7 % Silt & Clay : 7.6



Remarks :

Laboratory Supervisor :

Brian Prewost

Date : *November 28/2008*



**Jacques
Whitford**

2781 Lancaster Rd. Tel: 613 738-0708
Ottawa, Ontario K1B 1A7 Fax: 613 738-0721

Sieve Analysis

Client : **Ainley Group**
Project : **Highway 11 Septic Bed**
Material Type : **Soils/Aggregate :**
Proposed Use : **Fill/Granulars :**
Supplier : **N/A**
Source : **MW08-2 SS10**
Sampled From : **25'-27'**
Sampled By : **Jeff Forrester**
Tested By : **Blaine Miller**

Project No. : **1037297**
Test Method : **LS 602 (ASTM C136)**
Sample No. : **8440**

Date Sampled : **05-Nov-2008**
Date Tested : **27-Nov-2008**

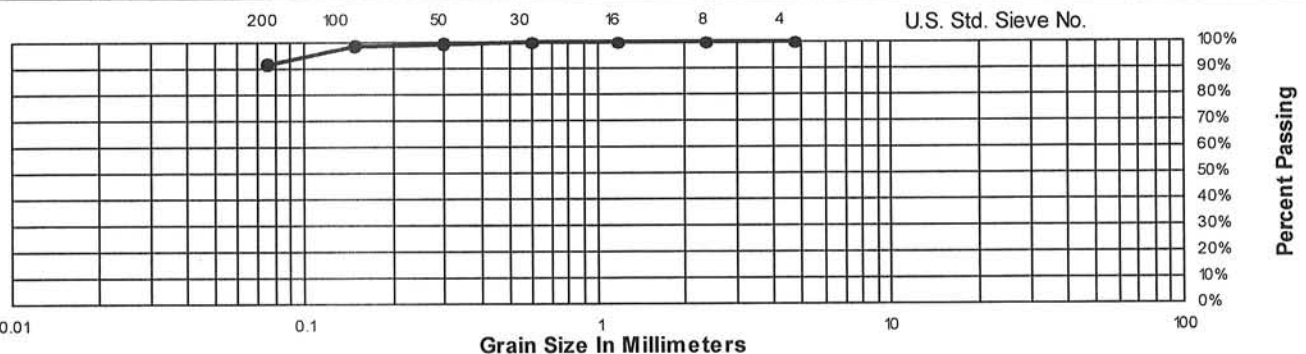
Wash Test Data

Sample Weight Before Sieve :	201.5	Sample Weight Before Wash :	201.4	
Sample Weight After Sieve :	201.4	Sample Weight After Wash :	20.2	
% Loss In Sieve :	0.05	% Passing No.200 :	90	Corrected : 90.000

Sieve Analysis

Sieve No.	Size of Opening		Wt. Retained	Cum. Wt. Retained	% Passing	Specification	
	Inches	mm	grams	grams		Min	Max
	3	76.2					
	2	53					
	1	26.5					
	3/4	19					
	5/8	16					
	1/2	13.2					
	3/8	9.5					
+4	0.187	4.75	0.0	0.0	100.0		
-4			201.4	201.4			
8	0.0937	2.36		0.0	100.0		
16	0.0469	1.18		0.0	100.0		
30	0.0234	0.600		0.2	99.9		
50	0.0117	0.300		0.8	99.6		
100	0.0059	0.150		3.2	98.4		
200	0.0029	0.075		17.0	91.6		
-200				20.2			

Classification of Sample : % Gravel : 0.0 % Sand : 8.4 % Silt & Clay : 91.6



Remarks :

Laboratory Supervisor : Brian Preest

Date : November 28/2008



**Jacques
Whitford**

2781 Lancaster Rd. Tel: 613 738-0708
Ottawa, Ontario K1B 1A7 Fax: 613 738-0721

Sieve Analysis

Client : **Ainley Group**
Project : **Highway 11 Septic Bed**
Material Type : **Soils/Aggregate :**
Proposed Use : **Fill/Granulars :**
Supplier : **N/A**
Source : **MW08-3 SS1**
Sampled From : **0'-2'**
Sampled By : **Jeff Forrester**
Tested By : **Blaine Miller**

Project No. : **1037297**
Test Method : **LS 602 (ASTM C136)**
Sample No.: **8441**

Date Sampled : **05-Nov-2008**
Date Tested : **27-Nov-2008**

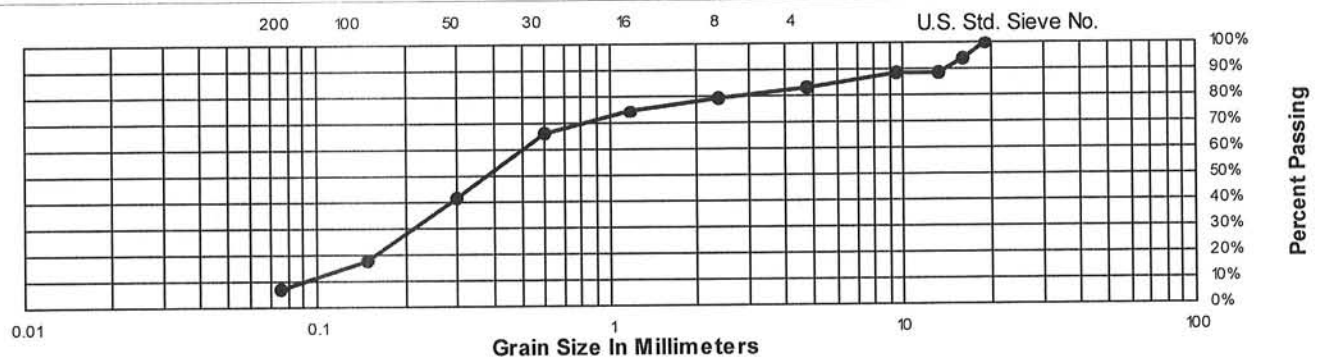
Wash Test Data

Sample Weight Before Sieve :	546.4	Sample Weight Before Wash :	279.7	
Sample Weight After Sieve :	545.8	Sample Weight After Wash :	257.0	
% Loss In Sieve :	0.11	% Passing No.200 :	8.1	Corrected : 6.747

Sieve Analysis

Sieve No.	Size of Opening		Wt. Retained grams	Cum. Wt. Retained grams	% Passing	Specification	
	Inches	mm				Min	Max
	3	76.2					
	2	53					
	1	26.5					
	3/4	19	0.0	0.0	100.0		
	5/8	16	35.3	35.3	93.5		
	1/2	13.2	27.0	62.3	88.6		
	3/8	9.5	1.1	63.4	88.4		
+4	0.187	4.75	27.6	91.0	83.3		
-4			454.8	545.8			
8	0.0937	2.36		13.8	79.2		
16	0.0469	1.18		29.6	74.5		
30	0.0234	0.600		57.9	66.1		
50	0.0117	0.300		139.5	41.8		
100	0.0059	0.150		219.1	18.0		
200	0.0029	0.075		255.1	7.3		
-200				256.5			

Classification of Sample : % Gravel : 16.7 % Sand : 76.0 % Silt & Clay : 7.3



Remarks :

Laboratory Supervisor : Brian Prewost

Date : November 28/2008



**Jacques
Whitford**

2781 Lancaster Rd. Tel: 613 738-0708
Ottawa, Ontario K1B 1A7 Fax: 613 738-0721

Sieve Analysis

Client : **Ainley Group**
Project : **Highway 11 Septic Bed**
Material Type : **Soils/Aggregate :**
Proposed Use : **Fill/Granulars :**
Supplier : **N/A**
Source : **MW08-3 SS15**
Sampled From : **45'-47'**
Sampled By : **Jeff Forrester**
Tested By : **Blaine Miller**

Project No. : **1037297**
Test Method : **LS 602 (ASTM C136)**
Sample No.: **8442**

Date Sampled : **05-Nov-2008**
Date Tested : **27-Nov-2008**

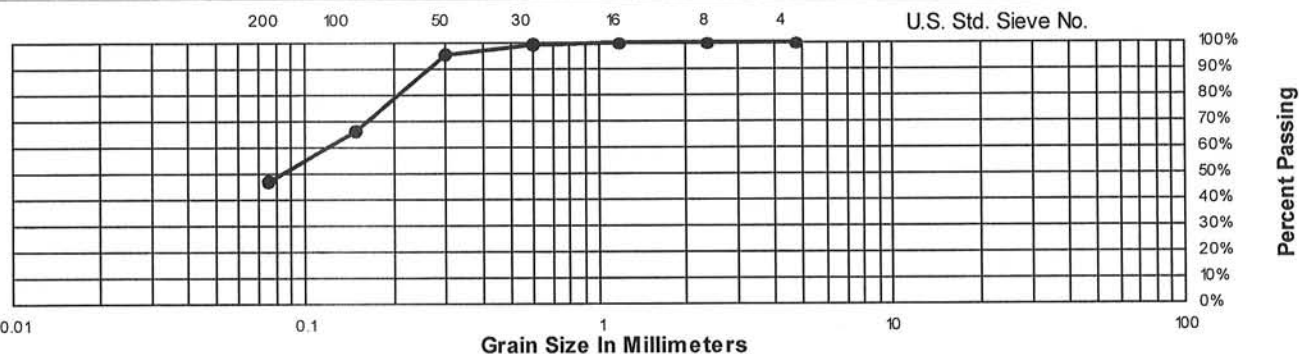
Wash Test Data

Sample Weight Before Sieve :	331.1	Sample Weight Before Wash :	279.3	
Sample Weight After Sieve :	330.9	Sample Weight After Wash :	151.8	
% Loss In Sieve :	0.06	% Passing No.200 :	45.6	Corrected : 45.600

Sieve Analysis

Sieve No.	Size of Opening		Wt. Retained	Cum. Wt. Retained	% Passing	Specification	
	Inches	mm	grams	grams		Min	Max
	3	76.2					
	2	53					
	1	26.5					
	3/4	19					
	5/8	16					
	1/2	13.2					
	3/8	9.5					
+4	0.187	4.75	0.0	0.0	100.0		
-4			330.9	330.9			
8	0.0937	2.36		0.2	99.9		
16	0.0469	1.18		0.3	99.9		
30	0.0234	0.600		1.0	99.6		
50	0.0117	0.300		13.3	95.2		
100	0.0059	0.150		94.0	66.3		
200	0.0029	0.075		147.2	47.3		
-200				151.6			

Classification of Sample : % Gravel : 0.0 % Sand : 52.7 % Silt & Clay : 47.3



Appendix D
Laboratory Analytical Results and Certificates of Analysis –
Fraction Organic Carbon –Soils



TRUSTED.
RESPONSIVE.
RELIABLE.

OTTAWA ✪ NIAGARA FALLS ✪ MISSISSAUGA ✪ SARNIA

Date: Dec. 8, 08

Attn: Sonny Sundaram
Company: Jacques Whitford Ltd.

From: Dale Robertson

re: Subcontracted Analysis, Paracel Order 0848085

The samples for your project, identified below, were subcontracted for the listed parameters. A copy of the subcontractor's report is attached.

Project Reference	1037297
Parameter	Fraction Organic Carbon
Sample Date	November 5, 2008
Chain of Custody #	31548

Originating Office: ☒ - Ottawa ☐ - Niagara Falls ☐ - Mississauga ☐ - Sarnia

1 800 748 1947
PARACEL@PARACELLABS.COM

WWW.PARACELLABS.COM

OTTAWA
Dale Robertson, Lab. Mgr.
Dale@PARACELLABS.COM

MISSISSAUGA
Dale Robertson, Lab. Mgr.
Dale@PARACELLABS.COM

NIAGARA FALLS
Dale Robertson, Lab. Mgr.
Dale@PARACELLABS.COM

SARNIA
Dale Robertson, Lab. Mgr.
Dale@PARACELLABS.COM

C.O.C.: ---

REPORT No. B08-38986

Report To:

Paracel Laboratories Ltd.
2319 St. Laurent Blvd. Unit 300
Ottawa, ON, K1G 4J8

Attention: Dale Robertson

Caduceon Environmental Laboratories

2378 Holly Lane
Ottawa, Ontario, K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 27-Nov-08

JOB/PROJECT NO.: 0848085

DATE REPORTED: 05-Dec-08

P.O. NUMBER:

SAMPLE MATRIX: Soil

WATERWORKS NO.

Parameter:			Fractional Organic Carbon				
Units:			% by wt				
M.D.L.:			0.1				
Reference Method:			EPA 415.1				
Date/Site Analyzed:			05-Dec-08/O				
Client I.D.	Sample I.D.	Date Collected					
MW08-1 SS2	B08-38986-1	05-Nov-08	0.1				
MW08-2 SS2	B08-38986-2	05-Nov-08	0.2				
MW08-2 SS11	B08-38986-3	05-Nov-08	< 0.1				
MW08-3 SS2	B08-38986-4	05-Nov-08	0.2				



Krystyna Pipin, M. Sc.
Lab Supervisor

M.D.L. = Method Detection Limit

Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,P-Peterborough,M-Moncton

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

Appendix E

MOE Water Well Record for the Test Well PW08-1



Ministry of
the Environment

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

A 069277

Well Record

Regulation 903 Ontario Water Resources Act

Measurements recorded in: ☐ Metric ☒ Imperial

Page _____ of _____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	<input type="checkbox"/> Well Constructed by Well Owner
MINISTRY OF TRANSPORTATION OF ONTARIO			
Mailing Address (Street Number/Name)	Province	Postal Code	Telephone No. (inc. area code)
200-2781 KANAWA RD c/o JACQUES WHITFORD LIMITED OTTAWA	ONT.	K1H 1A7	613 738 9708

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Intersection of Hwy 11 & Fern Glen Rd	PERRY	Pt 16	8
County/District/Municipality	City/Town/Village	Province	Postal Code
PERRY SOUND	EMSDALE	Ontario	
UTM Coordinates	Zone	Easting	Northing
NAD 83	10	632589	50141164
Municipal Plan and Sublot Number		Other	

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft)
BROWN	SAND GRAVEL		COARSE	0 100

Annular Space			
Depth Set at (m/ft)	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)	
0 98	Bentonite		

Method of Construction		Well Use	
<input type="checkbox"/> Cable Tool	<input type="checkbox"/> Diamond	<input checked="" type="checkbox"/> Public	<input type="checkbox"/> Commercial
<input checked="" type="checkbox"/> Rotary (Conventional)	<input type="checkbox"/> Jetting	<input checked="" type="checkbox"/> Domestic	<input type="checkbox"/> Municipal
<input type="checkbox"/> Rotary (Reverse)	<input type="checkbox"/> Driving	<input type="checkbox"/> Livestock	<input type="checkbox"/> Test Hole
<input type="checkbox"/> Boring	<input type="checkbox"/> Digging	<input type="checkbox"/> Irrigation	<input type="checkbox"/> Cooling & Air Conditioning
<input checked="" type="checkbox"/> Air percussion		<input type="checkbox"/> Industrial	
<input type="checkbox"/> Other, specify		<input type="checkbox"/> Other, specify	

Construction Record - Casing				Status of Well	
Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		
6 7/8	Steel	188	0 98	<input checked="" type="checkbox"/> Water Supply	
				<input type="checkbox"/> Replacement Well	
				<input type="checkbox"/> Test Hole	
				<input type="checkbox"/> Recharge Well	
				<input type="checkbox"/> Dewatering Well	
				<input checked="" type="checkbox"/> Observation and/or Monitoring Hole	
				<input type="checkbox"/> Alteration (Construction)	
				<input type="checkbox"/> Abandoned, Insufficient Supply	
				<input type="checkbox"/> Abandoned, Poor Water Quality	
				<input type="checkbox"/> Abandoned, other, specify	
				<input type="checkbox"/> Other, specify	

Construction Record - Screen				
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	
6"	Stainless Steel	12	96 100	

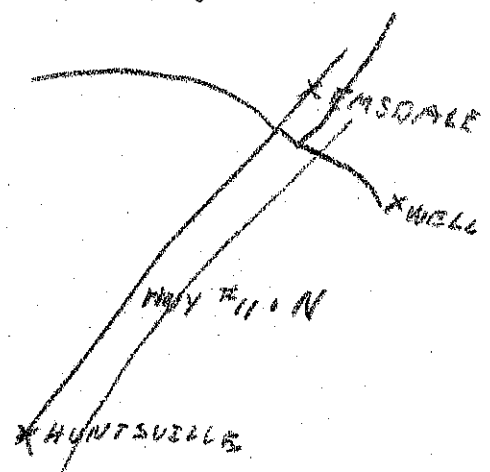
Water Details		Hole Diameter	
Water found at Depth	Kind of Water: <input type="checkbox"/> Fresh <input checked="" type="checkbox"/> Untested	Depth (m/ft)	Diameter (cm/in)
98 (m/ft) <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify		From To	
Water found at Depth	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested	0 100	8 3/4
(m/ft) <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify			6 7/8
Water found at Depth	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested		
(m/ft) <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify			

Business Name of Well Contractor		Well Contractor's Licence No.	
F.C. HAMMOND WELL DRILLING		25510	
Business Address (Street Number/Name)		Municipality	
200 CHAFFET TOWNSHIP RD		Huntsville	
Province	Postal Code	Business E-mail Address	
Ont	P1H1C8	hamwell@vianet.on.ca	
Bus. Telephone No. (inc. area code)		Name of Well Technician (Last Name, First Name)	
705 789 4361		BENNETT BLAYN	
Well Technician's Licence No.		Signature of Technician and/or Contractor	
31247		B. Bennett	
Date Submitted		Y Y Y Y M M D D	

Results of Well Yield Testing			
After test of well yield, water was:		Draw Down	
<input checked="" type="checkbox"/> Clear and sand free		Time (min)	Water Level (m/ft)
<input type="checkbox"/> Other, specify		Static Level	12
If pumping discontinued, give reason:		1	1
Pump intake set at (m/ft)		2	2
95		3	3
Pumping rate (l/min / GPM)		4	4
6		5	5
Duration of pumping		10	10
9 hrs + min		15	15
Final water level end of pumping (m/ft)		20	20
95		25	25
If flowing give rate (l/min / GPM)		30	30
Recommended pump depth (m/ft)		40	40
95		50	50
Recommended pump rate (l/min / GPM)		60	60
6			
Well production (l/min / GPM)			
6			
Disinfected?			
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			

Map of Well Location

Please provide a map below following instructions on the back.



Comments:	Well owner's information package delivered	Date Package Delivered	Ministry Use Only
	<input type="checkbox"/> Yes <input type="checkbox"/> No	Y Y Y Y M M D D	Audit No. 86459
		Date Work Completed	2008/12/03
			Received

Appendix F

Hydraulic Conductivity Test Results – Monitoring Wells

Project Number 1037297
Site: MTO Highway 11, Fren Glen Road
Monitoring Location: MW08-1

Depth of Well: 5.8 m (below grade)
 Static Level: 5.2 m (below TOPC)
 Inner Well Diameter: 50 mm
 Water Column Height: 1.4 m
 From MW Log
 Stick Up: 0.802 m
 Depth to static WT from grade: 4.4 m
 Screen length: 3.049 m
 Depth to top of well screen from grade: 2.751 m
 Depth to well bottom from grade: 5.8 m

Cumul. Seconds	Depth to Water (m)	Cumulative Time (min)	Displacement (m)	
0	5.200	0.00	0.000	
15	5.438	0.25	0.238	
60	5.400	1.00	0.200	
90	5.380	1.50	0.180	
120	5.362	2.00	0.162	
150	5.343	2.50	0.143	
180	5.328	3.00	0.128	
210	5.313	3.50	0.113	
240	5.303	4.00	0.103	
270	5.295	4.50	0.095	
300	5.287	5.00	0.087	
330	5.282	5.50	0.082	
360	5.276	6.00	0.076	
390	5.270	6.50	0.070	
420	5.267	7.00	0.067	
450	5.263	7.50	0.063	(incomplete recovery)
480	5.260	8.00	0.060	

Project Number 1037297
Site: MTO Highway 11, Fren Glen Road
Monitoring Location: MW08-2

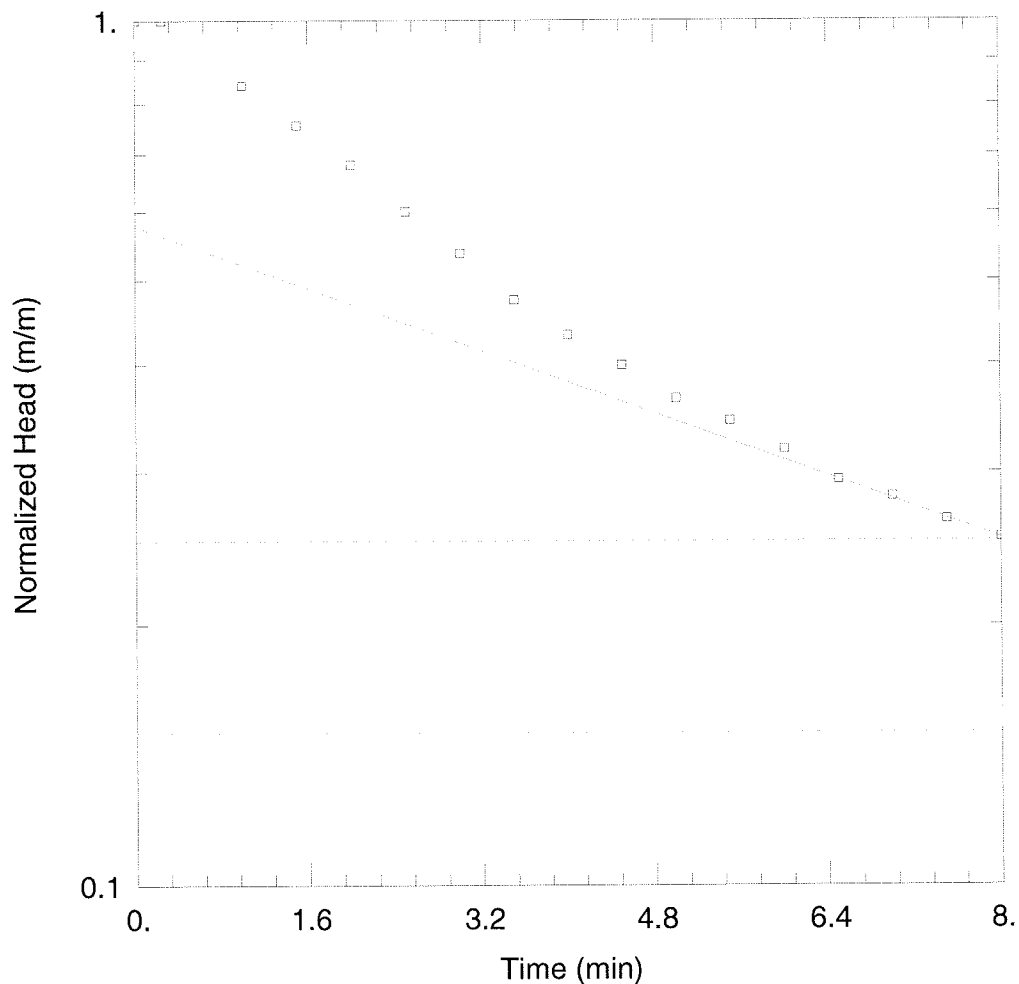
Depth of Well:	11.3 m (below grade)
Static Level:	4.612 m (below TOPC)
Inner Well Diameter:	50 mm
Water Column Height:	7.639 m
From MW Log	
Stick Up:	0.951 m
Depth to static WT from grade:	3.661 m
Screen length:	3.049 m
Depth to top of well screen from grade:	8.251 m
Depth to well bottom from grade:	11.3 m

Cumul. Seconds	Depth to Water (m)	Cumulative Time (min)	Displacement (m)	
0	4.612	0.00	0.000	
15	7.890	0.25	3.278	
30	7.630	0.50	3.018	
45	7.423	0.75	2.811	
60	7.143	1.00	2.531	
90	6.754	1.50	2.142	
120	6.445	2.00	1.833	
150	6.140	2.50	1.528	
180	5.933	3.00	1.321	
210	5.719	3.50	1.107	
240	5.563	4.00	0.951	
270	5.415	4.50	0.803	
300	5.310	5.00	0.698	
330	5.208	5.50	0.596	
360	5.115	6.00	0.503	
390	5.067	6.50	0.455	
420	4.996	7.00	0.384	
450	4.946	7.50	0.334	
480	4.904	8.00	0.292	
540	4.832	9.00	0.220	(incomplete recovery)

Project Number 1037297
Site: MTO Highway 11, Fren Glen Road
Monitoring Location: MW08-3

Depth of Well: 17.4 m (below grade)
 Static Level: 4.97 m (below TOPC)
 Inner Well Diameter: 50 mm
 Water Column Height: 13.322 m
 From MW Log
 Stick Up: 0.892 m
 Depth to static WT from grade: 4.078 m
 Screen length: 3.049 m
 Depth to top of well screen from grade: 14.351 m
 Depth to well bottom from grade: 17.4 m

Cumul. Seconds	Depth to Water (m)	Cumulative Time (min)	Displacement (m)	
0	4.970	0.00	0.000	
15	5.390	0.25	0.420	
30	5.000	0.50	0.030	
60	4.990	1.00	0.020	
90	4.987	1.50	0.017	
120	4.985	2.00	0.015	
150	4.980	2.50	0.010	
180	4.978	3.00	0.008	
210	4.976	3.50	0.006	
240	4.975	4.00	0.005	
270	4.975	4.50	0.005	
300	4.973	5.00	0.003	
330	4.972	5.50	0.002	
360	4.972	6.00	0.002	
390	4.972	6.50	0.002	
420	4.970	7.00	0.000	
450	4.970	7.50	0.000	
480	4.970	8.00	0.000	(complete recovery)



Data Set: P:\...MW08-1 Rising Head, Hvorslev, Unconfined.aqt
 Date: 02/03/09 Time: 16:40:15

PROJECT INFORMATION

Company: Jacques Whitford Ltd.
 Client: MTO
 Project: 1037297
 Location: Hwy. 11 Huntsville
 Test Well: MW08-1
 Test Date: 2008-12-17

AQUIFER DATA

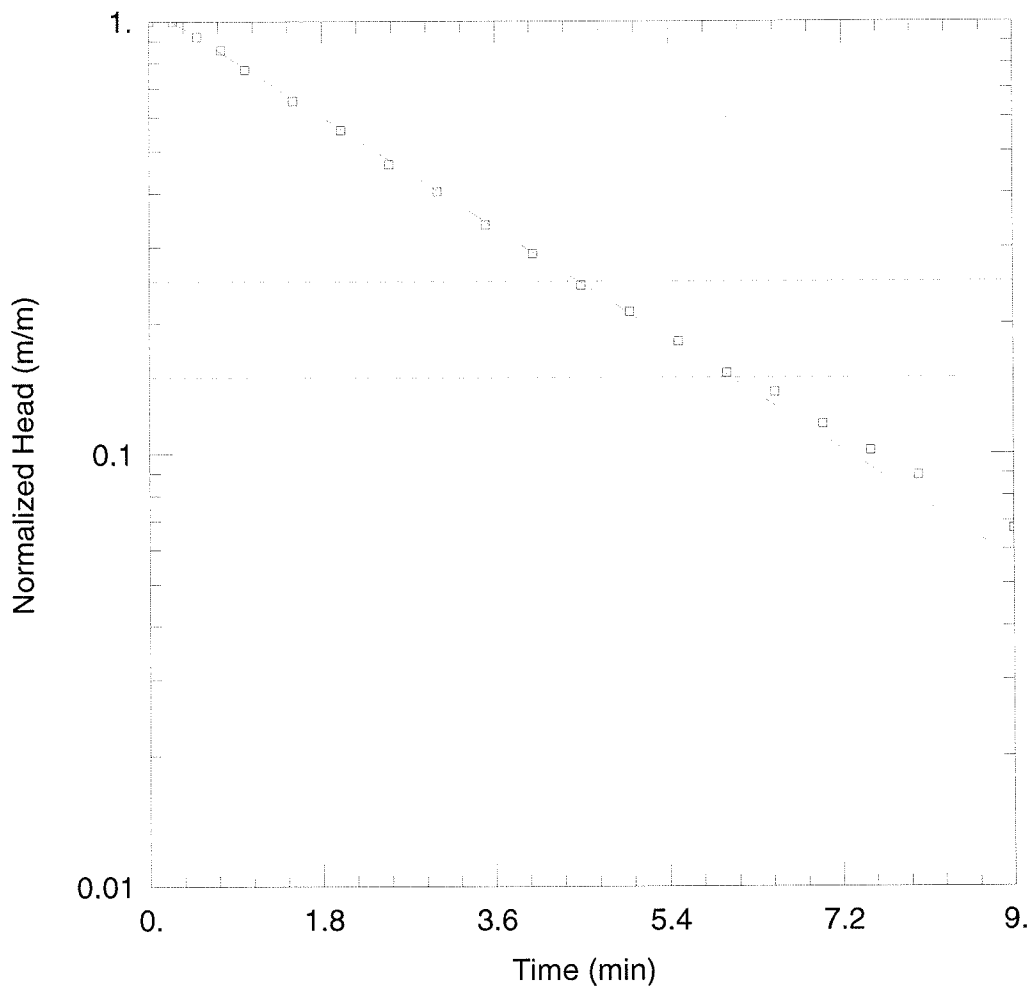
Saturated Thickness: 1.4 m Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (MW08-1)

Initial Displacement: 0.238 m Static Water Column Height: 1.4 m
 Total Well Penetration Depth: 3.049 m Screen Length: 3.049 m
 Casing Radius: 0.0254 m Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
 $K = 0.0002111$ cm/sec $y_0 = 0.1375$ m



Data Set: P:\...MW08-2 Rising Head, Hvorslev, Unconfined.aqt
 Date: 02/03/09 Time: 17:05:35

PROJECT INFORMATION

Company: Jacques Whitford Ltd.
 Client: MTO
 Project: 1037297
 Location: Hwy. 11 Huntsville
 Test Well: MW08-2
 Test Date: 2008-12-17

AQUIFER DATA

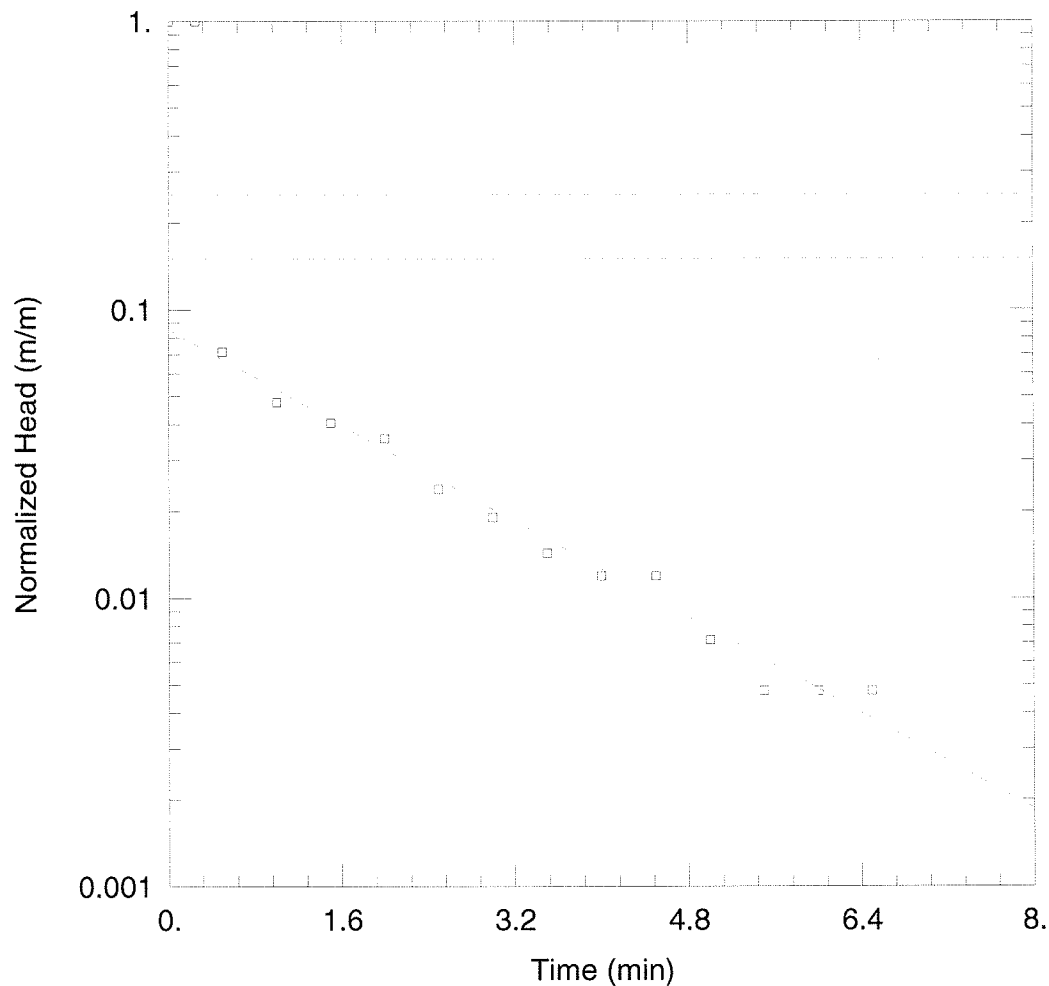
Saturated Thickness: 7.639 m Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (MW08-2)

Initial Displacement: 3.278 m Static Water Column Height: 7.639 m
 Total Well Penetration Depth: 7.639 m Screen Length: 3.049 m
 Casing Radius: 0.0254 m Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
 $K = 0.0001961$ cm/sec $y_0 = 3.542$ m



Data Set: P:\...MW08-3 Rising Head, Hvorslev, Unconfined.aqt

Date: 02/03/09

Time: 16:39:47

PROJECT INFORMATION

Company: Jacques Whitford Ltd.

Client: MTO

Project: 1037297

Location: Hwy. 11 Huntsville

Test Well: MW08-3

Test Date: 2008-12-17

AQUIFER DATA

Saturated Thickness: 13.32 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (MW08-3)

Initial Displacement: 0.42 m

Static Water Column Height: 13.32 m

Total Well Penetration Depth: 13.32 m

Screen Length: 3.049 m

Casing Radius: 0.0254 m

Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.0003454$ cm/sec

$y_0 = 0.03582$ m

Appendix G

Constant Rate Pumping Test Data and Figures – Test Well PW08-1

Pump Test Field Data
Greenbank Rd and Strandford Dr. (MW06-9)
Oct. 30 to Nov. 2, 2006

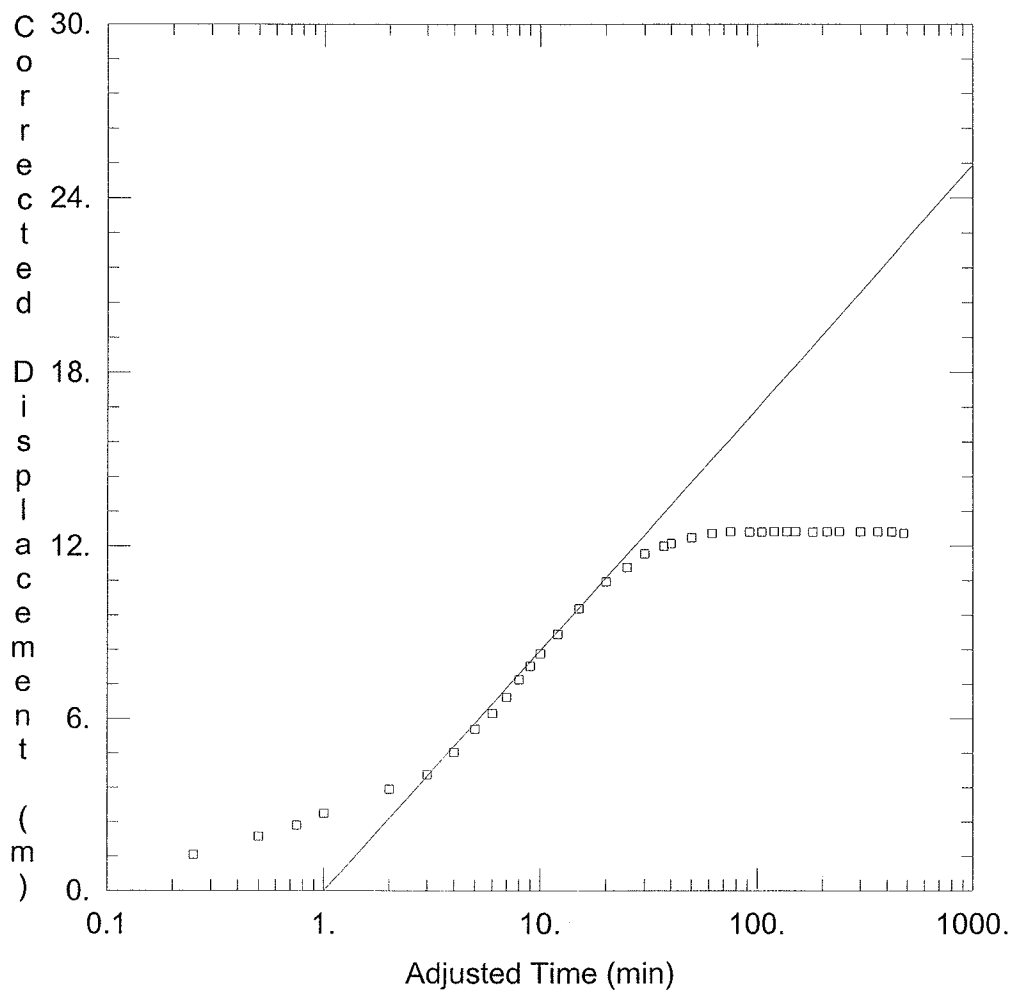
Project #1013971

Project No.: 1037297			Pumping Well: PW08-1			Test Parameters			Observation Well: MW08-1			Observation Well: MW08-2			Observation Well: MW08-3		
Client: MTO			Depth (m): 30.49			Pump Set (m): 28.66			Depth (m): 5.8			Depth (m): 11.3			Depth (m): 17.4		
Location: Highway 11, Almaguin Highlands			Casing (m): 27.44			Pump Size (hp): --			Casing (m): (stick up) 3.553			Casing (m): (stick up) 9.202			Casing (m): (stick up) 15.243		
Date/Time: Dec. 16th to 17th, 2008			Diam (mm): 152.4			Static WL (m): 5.187			Diam (mm): 50			Diam (mm): 50			Diam (mm): 50		
Contractor: --			Q (USgpm): 6			Meas. Point: Top of Casing			Distance (m): 104.56			Distance (m): 130.56			Distance (m): 86.13		
Time (h:m:s)	Time (min)	Cumulative Time	Water Level (WL) below Top of Casing (bTOC)			Field Chemistry			Time (min)	WL bTOC (m)	Drawdown (m)	Time (min)	WL bTOC (m)	Drawdown (m)	Time (min)	WL bTOC (m)	Drawdown (m)
			WL bTOC (m)	Drawdown (m)	Flow (USgpm)	Turbidity (NTU)	Cond.	pH									
10:18:00 AM	0		5.187	0.000	0	--	--	--	--	--	--	--	--	--	--	--	--
10:18:15 AM	0.25	0.25	6.480	1.293	6	--	--	--	--	--	--	--	--	--	--	--	--
10:18:30 AM	0.5	0.5	7.160	1.973	6	--	--	--	--	--	--	--	--	--	--	--	--
10:18:45 AM	0.75	0.75	7.585	2.398	6	--	--	--	--	--	--	--	--	--	--	--	--
10:19:00 AM	1	1	8.055	2.868	6	--	--	--	--	--	--	--	--	--	--	--	--
10:20:00 AM	2	2	9.010	3.823	6	--	--	--	--	--	--	--	--	--	--	--	--
10:21:00 AM	3	3	9.630	4.443	6	--	--	--	--	--	--	--	--	--	--	--	--
10:22:00 AM	4	4	10.590	5.403	6	--	--	--	--	--	--	--	--	--	--	--	--
10:23:00 AM	5	5	11.640	6.453	6	--	--	--	--	--	--	--	--	--	--	--	--
10:24:00 AM	6	6	12.390	7.203	6	61.3	0.774	5.36	--	--	--	--	--	--	--	--	--
10:25:00 AM	7	7	13.200	8.013	6	53.8	0.732	5.71	--	--	--	--	--	--	--	--	--
10:26:00 AM	8	8	14.110	8.923	6	--	--	--	--	--	--	--	--	--	--	--	--
10:27:00 AM	9	9	14.850	9.663	6	--	--	--	--	--	--	--	--	--	--	--	--
10:28:00 AM	10	10	15.570	10.383	6	49.8	0.725	5.12	--	--	--	--	--	--	--	--	--
10:30:00 AM	12	12	16.760	11.573	6	36.1	0.685	6.00	--	--	--	--	--	--	--	--	--
10:33:00 AM	15	15	18.490	13.303	6	29.8	0.659	6.24	--	--	--	--	--	--	--	--	--
10:38:00 AM	20	20	20.640	15.453	6	27.9	0.633	6.23	--	--	--	--	--	--	--	--	--
10:43:00 AM	25	25	21.980	16.793	6	44.7	0.616	6.24	--	--	--	--	--	--	--	--	--
10:48:00 AM	30	30	23.530	18.343	6	21.2	0.582	6.21	--	--	--	--	--	--	--	--	--
10:55:00 AM	37	37	24.580	19.393	6	13	0.59	6.28	--	--	--	--	--	--	--	--	--
10:58:00 AM	40	40	24.950	19.763	6	17.7	0.56	6.26	--	--	--	--	--	--	--	--	--
11:08:00 AM	50	50	25.920	20.733	6	66.2	0.568	6.34	--	--	--	--	--	--	--	--	--
11:20:00 AM	62	62	26.780	21.593	6	0	0.552	6.31	--	--	--	--	--	--	--	--	--
11:33:00 AM	75	75	27.260	22.073	6	250	0.535	6.38	--	--	--	--	--	--	--	--	--
11:50:00 AM	92	92	27.230	22.043	6	0	0.585	6.47	--	--	--	--	--	--	11:50:00 AM	4.980	-0.003
11:52:00 AM	94	94	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11:59:00 AM	101	101	--	--	--	--	--	--	11:59:00 AM	5.242	-0.008	--	--	--	--	--	--
12:03:00 PM	105	105	27.230	22.043	6	0	0.532	6.4	--	--	--	--	--	--	--	--	--
12:18:00 PM	120	120	27.250	22.063	6	0	0.529	6.57	--	--	--	--	--	--	--	--	--
12:31:00 PM	133	133	--	--	--	--	--	--	12:31:00 PM	5.288	0.038	--	--	--	--	--	--
12:35:00 PM	137	137	27.255	22.068	6	0	0.541	6.62	--	--	--	--	--	--	--	--	--
12:36:00 PM	138	138	--	--	--	--	--	--	--	--	--	12:36:00 PM	4.663	0.026	--	--	--
12:40:00 PM	142	142	--	--	--	--	--	--	--	--	--	--	--	--	12:40:00 PM	4.986	0.003
12:48:00 PM	150	150	27.250	22.063	6	0	0.536	6.46	--	--	--	--	--	--	--	--	--
1:18:00 PM	180	180	27.180	21.993	6	0	0.533	6.44	--	--	--	--	--	--	--	--	--
1:20:00 PM	182	182	--	--	--	--	--	--	1:20:00 PM	5.242	-0.008	--	--	--	--	--	--
1:25:00 PM	187	187	--	--	--	--	--	--	--	--	--	1:25:00 PM	4.663	0.026	--	--	--
1:30:00 PM	192	192	--	--	--	--	--	--	--	--	--	--	--	--	1:30:00 PM	4.986	0.003
1:48:00 PM	210	210	27.270	22.083	6	29.1	0.53	6.52	--	--	--	--	--	--	--	--	--
2:18:00 PM	240	240	27.270	22.083	6	100	0.53	6.43	2:18:00 PM	5.242	-0.008	--	--	--	--	--	--
2:25:00 PM	247	247	--	--	--	--	--	--	--	--	--	2:25:00 PM	4.657	0.020	--	--	--
2:30:00 PM	252	252	--	--	--	--	--	--	--	--	--	--	--	--	2:30:00 PM	4.986	0.003
3:18:00 PM	300	300	27.270	22.083	6	102	0.52	6.48	--	--	--	--	--	--	--	--	--
3:20:00 PM	302	302	--	--	--	--	--	--	3:20:00 PM	5.242	-0.008	--	--	--	--	--	--
3:25:00 PM	307	307	--	--	--	--	--	--	--	--	--	3:25:00 PM	4.657	0.020	--	--	--
3:30:00 PM	312	312	--	--	--	--	--	--	--	--	--	--	--	--	3:30:00 PM	4.986	0.003
4:18:00 PM	360	360	27.270	22.083	6	0	0.53	6.63	--	--	--	--	--	--	--	--	--
4:25:00 PM	367	367	--	--	--	--	--	--	--	--	--	4:25:00 PM	4.657	0.020	--	--	--
4:30:00 PM	372	372	--	--	--	--	--	--	--	--	--	--	--	--	4:30:00 PM	4.986	0.003
5:18:00 PM	420	420	27.270	22.083	6	0	0.52	6.56	--	--	--	--	--	--	--	--	--
5:20:00 PM	422	422	--	--	--	--	--	--	5:20:00 PM	5.242	-0.008	--	--	--	--	--	--
5:25:00 PM	427	427	--	--	--	--	--	--	--	--	--	5:25:00 PM	4.651	0.014	--	--	--
5:30:00 PM	432	432	--	--	--	--	--	--	--	--	--	--	--	--	5:30:00 PM	4.983	0.000
6:10:00 PM	480	480	26.920	21.733	6	0	0.52	6.72	--	--	--	--	--	--	--	--	--

Pump Test Field Data
Greenbank Rd and Strandherd Dr. (MW06-9)
Oct. 30 to Nov. 2, 2006

Project #1013971

Project No.: 1037297			Pumping Well: PW08-1			Test Parameters			Observation Well: MW08-1			Observation Well: MW08-2			Observation Well: MW08-3		
Client: MTO			Depth (m): 30.49			Pump Set (m): 28.66			Depth (m): 5.8			Depth (m): 11.3			Depth (m): 17.4		
Location: Highway 11, Almaguin Highlands			Casing (m): 27.44			Pump Size (hp): --			Casing (m): (stick up) 3.553			Casing (m): (stick up) 9.202			Casing (m): (stick up) 15.243		
Date/Time: Dec. 16th to 17th, 2008			Diam (mm): 152.4			Static WL (m): 5.187			Diam (mm): 50			Diam (mm): 50			Diam (mm): 50		
Contractor: --			Q (USgpm): 6			Meas. Point: Top of Casing			Distance (m): 104.56			Distance (m): 130.56			Distance (m): 86.13		
Time (h:m:s)	Time (min)	Cumulative Time	Water Level (WL) below Top of Casing (bTOC)			Field Chemistry			Time (min)	WL bTOC (m)	Drawdown (m)	Time (min)	WL bTOC (m)	Drawdown (m)	Time (min)	WL bTOC (m)	Drawdown (m)
			WL bTOC (m)	Drawdown (m)	Flow (USgpm)	Turbidity (NTU)	Cond.	pH									
6:14:00 PM	484	484	26.640	21.453	--	--	--	Recovery									
6:14:15 PM	484.25	484.25	26.180	20.993	--	--	--										
6:14:30 PM	484.5	484.5	25.830	20.643	--	--	--										
6:14:45 PM	484.75	484.75	25.560	20.373	--	--	--										
6:15:00 PM	485	485	25.340	20.153	--	--	--										
6:15:00 PM	486	486	25.110	19.923	--	--	--										
6:16:00 PM	487	487	24.180	18.993	--	--	--										
6:17:00 PM	488	488	23.240	18.053	--	--	--										
6:18:00 PM	489	489	22.290	17.103	--	--	--										
6:19:00 PM	490	490	21.400	16.213	--	--	--										
6:20:00 PM	491	491	20.535	15.348	--	--	--										
6:21:00 PM	492	492	19.730	14.543	--	--	--										
6:22:00 PM	493	493	18.960	13.773	--	--	--										
6:23:00 PM	494	494	18.260	13.073	--	--	--										
6:24:00 PM	496	496	16.960	11.673	--	--	--										
6:25:00 PM	499	499	15.050	9.863	--	--	--										
6:29:00 PM	504	504	12.400	7.213	--	--	--										
6:34:00 PM	509	509	10.770	5.583	--	--	--										
6:39:00 PM	509	509	10.770	5.583	--	--	--										
6:44:00 PM	514	514	9.360	4.173	--	--	--										



WELL TEST ANALYSIS

Data Set: P:\...\PW08-1unconf C-J (JS).aqt

Date: 01/29/09

Time: 11:06:12

PROJECT INFORMATION

Company: Jacques Whitford Ltd.

Client: MTO

Project: 1037297

Location: Hwy. 11 Huntsville

Test Well: PW08-1

Test Date: 2008-12-16

AQUIFER DATA

Saturated Thickness: 25.42 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PW08-1	0	0

Observation Wells

Well Name	X (m)	Y (m)
□ PW08-1	0	0

SOLUTION

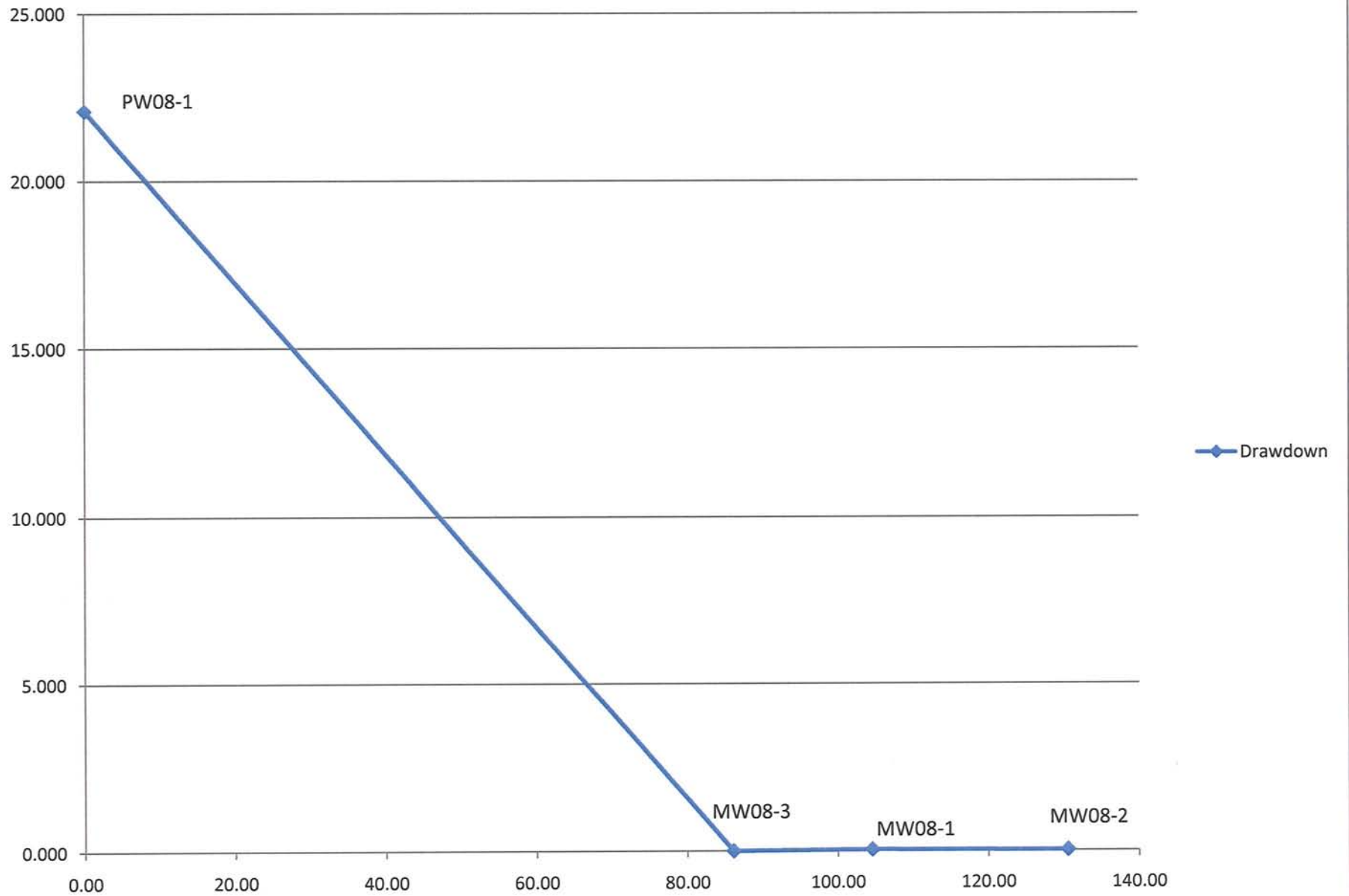
Aquifer Model: Unconfined

Solution Method: Cooper-Jacob

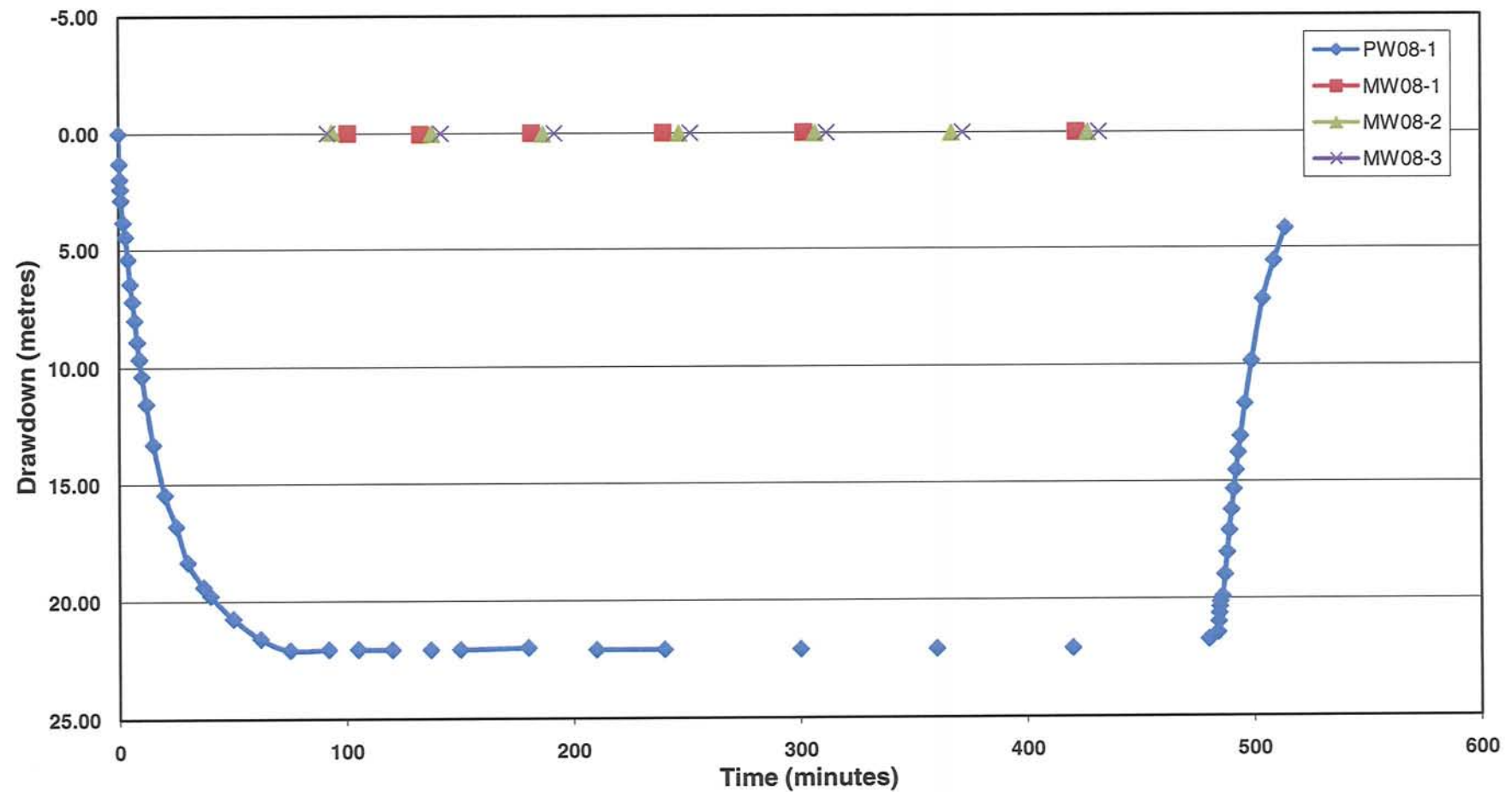
$T = 0.8592 \text{ m}^2/\text{day}$

$S = 0.05766$

Maximum Drawdown with Distance from Pumping Well



Pumping Test at MTO Highway 11, Huntsville December 16-17, 2008



Appendix H
Laboratory Certificates of Analysis -Groundwater – Test Well
PW08-1

Certificate of Analysis

Jacques Whitford Limited (Ottawa)

200-2781 Lancaster Rd.

Ottawa, ON K1B 1A7

Attn: Sonny Sundaram

Phone: (613) 738-0708

Fax: (613) 738-0721

Client PO: 1037297 Phase Z9100

Project: 1037297

Custody: 54475

Report Date: 22-Dec-2008

Order Date: 16-Dec-2008

Order #: 0851048

This Certificate of Analysis contains analytical data applicable to the following samples submitted:

Paracel ID Client ID

0851048-01 PW08-1

Approved By:



Dale Robertson, BSc
Laboratory Director

Any use of these results implies your agreement that our total liability in connection with this work, however arising shall be limited to the amount paid by you for this work, and that our employees or agents shall not under circumstances be liable to you in connection with this work

Certificate of Analysis

Report Date: 22-Dec-2008

Order Date: 16-Dec-2008

Client: **Jacques Whitford Limited (Ottawa)**

Client PO: 1037297 Phase Z9100

Project Description: 1037297

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total	EPA 310.1 - Titration	17-Dec-08	17-Dec-08
Ammonia, as N	EPA 351.2 - Auto Colour	19-Dec-08	19-Dec-08
Anions	EPA 300.1 - IC	16-Dec-08	17-Dec-08
Bacteria, background	MOE E3407	16-Dec-08	16-Dec-08
Colour	SM2120 - Spectrophotometric	16-Dec-08	16-Dec-08
Cyanide, free	MOE E3015 - Auto Colour	17-Dec-08	17-Dec-08
DOC	MOE E3247B - Combustion IR, filtration	16-Dec-08	16-Dec-08
E. coli	MOE E3407	16-Dec-08	16-Dec-08
Fecal Coliform	SM 9222D	16-Dec-08	16-Dec-08
Hardness	Hardness	19-Dec-08	19-Dec-08
Heterotrophic Plate Count	SM 9215C	16-Dec-08	16-Dec-08
Mercury	EPA 245.1 - Cold Vapour AA	18-Dec-08	18-Dec-08
Metals, low level	EPA 200.8 - ICP-MS	18-Dec-08	18-Dec-08
pH	EPA 150.1 - pH probe	17-Dec-08	17-Dec-08
Solids, dissolved	EPA SM 2540C - gravimetric, filtration	19-Dec-08	19-Dec-08
Sulphide	SM 4500SE - Colourimetric	17-Dec-08	17-Dec-08
Total Coliform	MOE E3407	16-Dec-08	16-Dec-08
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	19-Dec-08	19-Dec-08
Turbidity	SM 2130B - Turbidity meter	16-Dec-08	16-Dec-08
VOCs	EPA 624 - P&T GC-MS	19-Dec-08	19-Dec-08

Certificate of Analysis

Report Date: 22-Dec-2008

Order Date: 16-Dec-2008

Client: **Jacques Whitford Limited (Ottawa)**

Client PO: 1037297 Phase Z9100

Project Description: 1037297

Client ID:	PW08-1	-	-	-
Sample Date:	15-Dec-08	-	-	-
Sample ID:	0851048-01	-	-	-
MDL/Units	Water	-	-	-

Microbiological Parameters in Water

Bacteria, background	1 CFU/100 mL	TNTC	-	-	-
E. coli	1 CFU/100 mL	<1 [1]	-	-	-
Heterotrophic Plate Count	10 CFU/ml	350	-	-	-
Total Coliforms	1 CFU/100 mL	8 [1]	-	-	-
Fecal Coliforms	1 CFU/100 mL	<1	-	-	-

General Inorganics

Alkalinity, total	5 mg/L	28	-	-	-
Hardness	1.0 mg/L	129	-	-	-
Ammonia as N	0.01 mg/L	0.08	-	-	-
Colour	2 TCU	161	-	-	-
Cyanide, free	0.002 mg/L	<0.002	-	-	-
pH	0.05 pH Units	6.43	-	-	-
Total Dissolved Solids	10 mg/L	268	-	-	-
Sulphide	0.02 mg/L	<0.02	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.1	-	-	-
Turbidity	0.1 NTU	27.4	-	-	-
Dissolved Organic Carbon	0.5 mg/L	<0.5	-	-	-

Anions

Chloride	1 mg/L	140	-	-	-
Fluoride	0.1 mg/L	<0.1	-	-	-
Nitrate as N	0.1 mg/L	1.6	-	-	-
Nitrite as N	0.05 mg/L	<0.05	-	-	-
Sulphate	1 mg/L	16	-	-	-

Metals

Mercury	0.1 ug/L	<0.1	-	-	-
Aluminum	1 ug/L	3	-	-	-
Antimony	0.5 ug/L	<0.5	-	-	-
Arsenic	1 ug/L	<1	-	-	-
Barium	5 ug/L	36	-	-	-
Boron	10.0 ug/L	<10.0	-	-	-
Cadmium	0.1 ug/L	<0.1	-	-	-

Tel: 1-800-749-1947
 Email: PARACEL@PARACELLABS.COM

WWW.PARACELLABS.COM

OTTAWA
 300-2319 St. Laurent Blvd
 Ottawa, ON K1G 4J8

MISSISSAUGA
 6645 Kipling Rd. Unit #27
 Mississauga, ON L5N 6J3

NIAGARA FALLS
 5415 Morning Glory Cr.
 Niagara Falls, ON L2J 0A3

SARNIA
 123 Christina St. N.
 Sarnia, ON N7T 5T7

Certificate of Analysis

Report Date: 22-Dec-2008

Order Date: 16-Dec-2008

Client: **Jacques Whitford Limited (Ottawa)**

Client PO: 1037297 Phase Z9100

Project Description: 1037297

	Client ID:	PW08-1	-	-	-
	Sample Date:	15-Dec-08	-	-	-
	Sample ID:	0851048-01	-	-	-
	MDL/Units	Water	-	-	-
Calcium	100 ug/L	38200	-	-	-
Chromium	1 ug/L	3	-	-	-
Copper	0.5 ug/L	0.6	-	-	-
Iron	100 ug/L	462	-	-	-
Lead	0.1 ug/L	<0.1	-	-	-
Magnesium	200 ug/L	8100	-	-	-
Manganese	5 ug/L	37	-	-	-
Selenium	1 ug/L	<1	-	-	-
Sodium	200 ug/L	29800	-	-	-
Uranium	0.1 ug/L	<0.1	-	-	-
Zinc	10 ug/L	<10	-	-	-

Volatiles

Benzene	0.5 ug/L	<0.5	-	-	-
Bromodichloromethane	0.4 ug/L	<0.4	-	-	-
Bromoform	0.5 ug/L	<0.5	-	-	-
Bromomethane	0.7 ug/L	<0.7	-	-	-
Carbon Tetrachloride	0.5 ug/L	<0.5	-	-	-
Chlorobenzene	0.4 ug/L	<0.4	-	-	-
Chloroethane	1.0 ug/L	<1.0	-	-	-
Chloroform	0.5 ug/L	<0.5	-	-	-
Chloromethane	3.0 ug/L	<3.0	-	-	-
Dibromochloromethane	0.5 ug/L	<0.5	-	-	-
1,2-Dibromoethane	1.0 ug/L	<1.0	-	-	-
1,2-Dichlorobenzene	0.4 ug/L	<0.4	-	-	-
1,3-Dichlorobenzene	0.4 ug/L	<0.4	-	-	-
1,4-Dichlorobenzene	0.4 ug/L	<0.4	-	-	-
1,1-Dichloroethane	0.5 ug/L	<0.5	-	-	-
1,2-Dichloroethane	0.5 ug/L	<0.5	-	-	-
1,1-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
cis-1,2-Dichloroethylene	0.4 ug/L	<0.4	-	-	-
trans-1,2-Dichloroethylene	1.0 ug/L	<1.0	-	-	-
1,2-Dichloropropane	0.5 ug/L	<0.5	-	-	-

1-800-749-1947
PARACEL@PARACELLABS.COM

WWW.PARACELLABS.COM

OTTAWA
300-2319 St. Laurent Blvd.
Ottawa, ON K1G 4J8

MISSISSAUGA
6645 Kitchener Rd. Unit #27
Mississauga, ON L5N 6J3

NIAGARA FALLS
5415 Morning Glory Cr.
Niagara Falls, ON L2J 0A3

SARNIA
123 Christina St. N.
Sarnia, ON N1T 5T7

Certificate of Analysis

Report Date: 22-Dec-2008

Order Date: 16-Dec-2008

Client: **Jacques Whitford Limited (Ottawa)**

Client PO: 1037297 Phase Z9100

Project Description: 1037297

	Client ID:	PW08-1	-	-	-
	Sample Date:	15-Dec-08	-	-	-
	Sample ID:	0851048-01	-	-	-
	MDL/Units	Water	-	-	-
cis-1,3-Dichloropropylene	0.4 ug/L	<0.4	-	-	-
trans-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	-	-
Ethylbenzene	0.5 ug/L	<0.5	-	-	-
Methylene Chloride	4.0 ug/L	<4.0	-	-	-
Styrene	0.4 ug/L	<0.4	-	-	-
1,1,1,2-Tetrachloroethane	0.5 ug/L	<0.5	-	-	-
1,1,2,2-Tetrachloroethane	0.6 ug/L	<0.6	-	-	-
Tetrachloroethylene	0.5 ug/L	<0.5	-	-	-
Toluene	0.5 ug/L	<0.5	-	-	-
1,1,1-Trichloroethane	0.4 ug/L	<0.4	-	-	-
1,1,2-Trichloroethane	0.6 ug/L	<0.6	-	-	-
Trichloroethylene	0.4 ug/L	<0.4	-	-	-
Trichlorofluoromethane	1.0 ug/L	<1.0	-	-	-
1,3,5-Trimethylbenzene	0.5 ug/L	<0.5	-	-	-
Vinyl chloride	0.4 ug/L	<0.4	-	-	-
m,p-Xylenes	0.5 ug/L	<0.5	-	-	-
o-Xylene	0.5 ug/L	<0.5	-	-	-
4-Bromofluorobenzene	Surrogate	108%	-	-	-
Dibromofluoromethane	Surrogate	93.4%	-	-	-
Toluene-d8	Surrogate	94.3%	-	-	-

Certificate of Analysis

Report Date: 22-Dec-2008

Order Date: 16-Dec-2008

Client: **Jacques Whitford Limited (Ottawa)**

Client PO: 1037297 Phase Z9100

Project Description: 1037297

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Colour	ND	2	TCU						
Cyanide, free	ND	0.002	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Dissolved Organic Carbon	ND	0.5	mg/L						
Metals									
Mercury	ND	0.1	ug/L						
Aluminum	ND	1	ug/L						
Antimony	ND	0.5	ug/L						
Arsenic	ND	1	ug/L						
Barium	ND	5	ug/L						
Boron	ND	10.0	ug/L						
Cadmium	ND	0.1	ug/L						
Calcium	ND	100	ug/L						
Chromium	ND	1	ug/L						
Copper	ND	0.5	ug/L						
Iron	ND	100	ug/L						
Lead	ND	0.1	ug/L						
Magnesium	ND	200	ug/L						
Manganese	ND	5	ug/L						
Selenium	ND	1	ug/L						
Sodium	ND	200	ug/L						
Uranium	ND	0.1	ug/L						
Zinc	ND	10	ug/L						
Microbiological Parameters in Water									
Bacteria, background	ND	1	CFU/100 mL						
E. coli	ND	1	CFU/100 mL						
Heterotrophic Plate Count	ND	10	CFU/ml						
Total Coliforms	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Volatiles									
Benzene	ND	0.5	ug/L						
Bromodichloromethane	ND	0.4	ug/L						
Bromoform	ND	0.5	ug/L						
Bromomethane	ND	0.7	ug/L						
Carbon Tetrachloride	ND	0.5	ug/L						
Chlorobenzene	ND	0.4	ug/L						
Chloroethane	ND	1.0	ug/L						
Chloroform	ND	0.5	ug/L						
Chloromethane	ND	3.0	ug/L						
Dibromochloromethane	ND	0.5	ug/L						
1,2-Dibromoethane	ND	1.0	ug/L						

Certificate of Analysis

Report Date: 22-Dec-2008

Order Date: 16-Dec-2008

Client: **Jacques Whitford Limited (Ottawa)**

Client PO: 1037297 Phase Z9100

Project Description: 1037297

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,2-Dichlorobenzene	ND	0.4	ug/L						
1,3-Dichlorobenzene	ND	0.4	ug/L						
1,4-Dichlorobenzene	ND	0.4	ug/L						
1,1-Dichloroethane	ND	0.5	ug/L						
1,2-Dichloroethane	ND	0.5	ug/L						
1,1-Dichloroethylene	ND	0.5	ug/L						
cis-1,2-Dichloroethylene	ND	0.4	ug/L						
trans-1,2-Dichloroethylene	ND	1.0	ug/L						
1,2-Dichloropropane	ND	0.5	ug/L						
cis-1,3-Dichloropropylene	ND	0.4	ug/L						
trans-1,3-Dichloropropylene	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Methylene Chloride	ND	4.0	ug/L						
Styrene	ND	0.4	ug/L						
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L						
1,1,2,2-Tetrachloroethane	ND	0.6	ug/L						
Tetrachloroethylene	ND	0.5	ug/L						
Toluene	ND	0.5	ug/L						
1,1,1-Trichloroethane	ND	0.4	ug/L						
1,1,2-Trichloroethane	ND	0.6	ug/L						
Trichloroethylene	ND	0.4	ug/L						
Trichlorofluoromethane	ND	1.0	ug/L						
1,3,5-Trimethylbenzene	ND	0.5	ug/L						
Vinyl chloride	ND	0.4	ug/L						
m,p-Xylenes	ND	0.5	ug/L						
o-Xylene	ND	0.5	ug/L						
Surrogate: 4-Bromofluorobenzene	83.5		ug/L		104	83-134			
Surrogate: Dibromofluoromethane	84.2		ug/L		105	78-124			
Surrogate: Toluene-d8	74.5		ug/L		93.1	76-118			

Certificate of Analysis

Report Date: 22-Dec-2008

Order Date: 16-Dec-2008

Client: **Jacques Whitford Limited (Ottawa)**

Client PO: 1037297 Phase Z9100

Project Description: 1037297

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	59.3	1	mg/L	59.1			0.3	10	
Fluoride	0.27	0.1	mg/L	0.26			7.0	10	
Nitrate as N	0.41	0.1	mg/L	0.41			0.4	20	
Nitrite as N	ND	0.05	mg/L	ND				20	
Sulphate	440	10	mg/L	401			9.4	10	
General Inorganics									
Alkalinity, total	178	5	mg/L	178			0.0	2	
Ammonia as N	0.016	0.01	mg/L	0.015			5.6	8	
Colour	163	2	TCU	161			1.2	12	
Cyanide, free	ND	0.002	mg/L	ND				20	
pH	6.45	0.05	pH Units	6.43			0.3	10	
Total Dissolved Solids	270	10	mg/L	268			0.7	10	
Sulphide	ND	0.02	mg/L	ND				10	
Total Kjeldahl Nitrogen	ND	0.1	mg/L	ND				10	
Turbidity	27.5	0.1	NTU	27.4			0.4	10	
Dissolved Organic Carbon	ND	0.5	mg/L	ND				37	
Metals									
Mercury	ND	0.1	ug/L	ND				20	
Aluminum	ND	1	ug/L	ND				27	
Antimony	0.75	0.5	ug/L	0.99			27.2	26	QR-01
Arsenic	ND	1	ug/L	ND				29	
Barium	232	5	ug/L	232			0.1	34	
Boron	17	10.0	ug/L	16			3.2	33	
Cadmium	ND	0.1	ug/L	ND				33	
Calcium	45400	1000	ug/L	45400			0.0	30	
Chromium	3.1	1	ug/L	3.0			5.3	32	
Copper	0.52	0.5	ug/L	0.52			0.1	32	
Iron	647	100	ug/L	636			1.8	32	
Lead	ND	0.1	ug/L	ND				32	
Magnesium	18300	200	ug/L	18100			1.0	30	
Manganese	44.9	5	ug/L	45.1			0.5	29	
Selenium	ND	1	ug/L	ND				28	
Sodium	34600	200	ug/L	35600			2.9	27	
Uranium	ND	0.1	ug/L	ND				27	
Zinc	ND	10	ug/L	ND				27	
Microbiological Parameters in Water									
Bacteria, background	TNTC	1	CFU/100 mL	TNTC				30	
E. coli	ND	1	CFU/100 mL	ND				30	BAC01
Heterotrophic Plate Count	390	10	CFU/ml	350			11.0	30	
Total Coliforms	7	1	CFU/100 mL	8			13.3	30	BAC01
Fecal Coliforms	ND	1	CFU/100 mL	ND				30	
Volatiles									
Benzene	ND	0.5	ug/L	ND				20	
Bromodichloromethane	1.30	0.4	ug/L	1.40			7.4	25	
Bromoform	ND	0.5	ug/L	ND				25	
Bromomethane	ND	0.7	ug/L	ND				25	
Carbon Tetrachloride	ND	0.5	ug/L	ND				25	
Chlorobenzene	ND	0.4	ug/L	ND				25	
Chloroethane	ND	1.0	ug/L	ND				25	
Chloroform	1.83	0.5	ug/L	1.69			8.0	19	
Chloromethane	ND	3.0	ug/L	ND				25	

Certificate of Analysis

Report Date: 22-Dec-2008

Order Date: 16-Dec-2008

Client: **Jacques Whitford Limited (Ottawa)**

Client PO: 1037297 Phase Z9100

Project Description: 1037297

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Dibromochloromethane	0.93	0.5	ug/L	0.97			4.2	25	
1,2-Dibromoethane	ND	1.0	ug/L	ND				25	
1,2-Dichlorobenzene	ND	0.4	ug/L	ND				25	
1,3-Dichlorobenzene	ND	0.4	ug/L	ND				25	
1,4-Dichlorobenzene	ND	0.4	ug/L	ND				25	
1,1-Dichloroethane	ND	0.5	ug/L	ND				21	
1,2-Dichloroethane	ND	0.5	ug/L	ND				25	
1,1-Dichloroethylene	ND	0.5	ug/L	ND				21	
cis-1,2-Dichloroethylene	ND	0.4	ug/L	ND				20	
trans-1,2-Dichloroethylene	ND	1.0	ug/L	ND				25	
1,2-Dichloropropane	ND	0.5	ug/L	ND				25	
cis-1,3-Dichloropropylene	ND	0.4	ug/L	ND				25	
trans-1,3-Dichloropropylene	ND	0.5	ug/L	ND				25	
Ethylbenzene	ND	0.5	ug/L	ND				35	
Methylene Chloride	ND	4.0	ug/L	ND				25	
Styrene	ND	0.4	ug/L	ND				25	
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L	ND				25	
1,1,2,2-Tetrachloroethane	ND	0.6	ug/L	ND				25	
Tetrachloroethylene	ND	0.5	ug/L	ND				31	
Toluene	ND	0.5	ug/L	ND				30	
1,1,1-Trichloroethane	ND	0.4	ug/L	ND				25	
1,1,2-Trichloroethane	ND	0.6	ug/L	ND				25	
Trichloroethylene	ND	0.4	ug/L	ND				30	
Trichlorofluoromethane	ND	1.0	ug/L	ND				25	
1,3,5-Trimethylbenzene	ND	0.5	ug/L	ND				20	
Vinyl chloride	ND	0.4	ug/L	ND				25	
m,p-Xylenes	ND	0.5	ug/L	ND				34	
o-Xylene	ND	0.5	ug/L	ND				32	
Surrogate: 4-Bromofluorobenzene	86.5		ug/L	ND	108	83-134			
Surrogate: Dibromofluoromethane	77.4		ug/L	ND	96.7	78-124			
Surrogate: Toluene-d8	74.5		ug/L	ND	93.1	76-118			

Certificate of Analysis

Report Date: 22-Dec-2008

Order Date: 16-Dec-2008

Client: **Jacques Whitford Limited (Ottawa)**

Client PO: 1037297 Phase Z9100

Project Description: 1037297

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	9.08	1	mg/L	ND	90.8	78-112			
Fluoride	1.04	0.1	mg/L	ND	104	73-113			
Nitrate as N	0.98	0.1	mg/L	ND	97.6	81-112			
Nitrite as N	0.905	0.05	mg/L	ND	90.5	76-107			
Sulphate	9.50	1	mg/L	ND	95.0	75-111			
General Inorganics									
Ammonia as N	0.260	0.01	mg/L	0.015	98.2	81-124			
Cyanide, free	0.03	0.002	mg/L	ND	96.3	50-137			
Total Dissolved Solids	106	10	mg/L	ND		75-125			
Sulphide	0.48	0.02	mg/L	ND	95.0	79-115			
Total Kjeldahl Nitrogen	2.1	0.1	mg/L	ND	105	81-126			
Dissolved Organic Carbon	10.9	0.5	mg/L	ND	109	60-133			
Metals									
Mercury	3.27	0.1	ug/L	ND	109	78-137			
Aluminum	47.2		ug/L	ND	102	74-130			
Antimony	45.0		ug/L	0.99	88.1	78-126			
Arsenic	56.5		ug/L	0.2	113	83-119			
Barium	270		ug/L	232	76.6	83-116			QS-03
Boron	62		ug/L	16	91.6	71-128			
Cadmium	47.5		ug/L	ND	95.3	78-119			
Calcium	1070		ug/L	ND	107	64-127			
Chromium	47.7		ug/L	3.0	89.4	80-124			
Copper	47.2		ug/L	0.52	93.3	75-123			
Iron	1610		ug/L	636	97.6	66-119			
Lead	53.3		ug/L	ND	107	77-126			
Magnesium	1080		ug/L	ND	108	75-131			
Manganese	89.9		ug/L	45.1	89.6	79-123			
Selenium	59.7		ug/L	0.4	119	81-125			
Sodium	1120		ug/L	ND	112	67-132			
Uranium	51.9		ug/L	0.08	104	70-131			
Zinc	54		ug/L	ND	111	78-130			
Volatiles									
Benzene	34.0	0.5	ug/L	ND	85.0	55-141			
Bromodichloromethane	40.0	0.4	ug/L	ND	100	52-139			
Bromoform	38.6	0.5	ug/L	ND	96.4	52-170			
Bromomethane	40.6	0.7	ug/L	ND	102	32-138			
Carbon Tetrachloride	42.9	0.5	ug/L	ND	107	49-149			
Chlorobenzene	34.6	0.4	ug/L	ND	86.4	64-137			
Chloroethane	38.8	1.0	ug/L	ND	97.0	39-152			
Chloroform	39.1	0.5	ug/L	ND	97.7	58-138			
Chloromethane	35.7	3.0	ug/L	ND	89.3	24-163			
Dibromochloromethane	37.8	0.5	ug/L	ND	94.4	61-153			
1,2-Dibromoethane	37.1	1.0	ug/L	ND	92.6	61-145			
1,2-Dichlorobenzene	32.6	0.4	ug/L	ND	81.5	60-150			
1,3-Dichlorobenzene	32.3	0.4	ug/L	ND	80.8	62-149			
1,4-Dichlorobenzene	32.8	0.4	ug/L	ND	81.9	63-132			
1,1-Dichloroethane	38.6	0.5	ug/L	ND	96.6	51-156			
1,2-Dichloroethane	42.2	0.5	ug/L	ND	105	50-140			
1,1-Dichloroethylene	37.0	0.5	ug/L	ND	92.6	43-153			
cis-1,2-Dichloroethylene	38.9	0.4	ug/L	ND	97.2	58-145			
trans-1,2-Dichloroethylene	40.6	1.0	ug/L	ND	102	51-145			
1,2-Dichloropropane	33.4	0.5	ug/L	ND	83.4	56-136			
cis-1,3-Dichloropropylene	35.9	0.4	ug/L	ND	89.8	54-141			

Tel: 1-800-749-1947
Email: PARACEL@PARACELLABS.COM

WWW.PARACELLABS.COM

OTTAWA
300-2319 St. Laurent Blvd
Ottawa, ON K1G 4J8

MISSISSAUGA
6645 Kipling Rd. Unit #27
Mississauga, ON L5N 6J3

NIAGARA FALLS
5415 Morning Glory Cr.
Niagara Falls, ON L2J 0A3

SARNIA
123 Christina St. N.
Sarnia, ON N7T 5T7

Certificate of Analysis

Report Date: 22-Dec-2008

Order Date: 16-Dec-2008

Client: **Jacques Whitford Limited (Ottawa)**

Client PO: 1037297 Phase Z9100

Project Description: 1037297

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
trans-1,3-Dichloropropylene	38.7	0.5	ug/L	ND	96.6	61-140			
Ethylbenzene	35.7	0.5	ug/L	ND	89.2	61-139			
Methylene Chloride	36.9	4.0	ug/L	ND	92.2	58-149			
Styrene	34.6	0.4	ug/L	ND	86.6	63-143			
1,1,1,2-Tetrachloroethane	38.1	0.5	ug/L	ND	95.2	61-148			
1,1,2,2-Tetrachloroethane	39.2	0.6	ug/L	ND	97.9	50-157			
Tetrachloroethylene	36.8	0.5	ug/L	ND	91.9	51-145			
Toluene	34.0	0.5	ug/L	ND	85.1	54-136			
1,1,1-Trichloroethane	40.2	0.4	ug/L	ND	100	55-140			
1,1,2-Trichloroethane	33.4	0.6	ug/L	ND	83.6	63-144			
Trichloroethylene	36.2	0.4	ug/L	ND	90.6	52-135			
Trichlorofluoromethane	43.8	1.0	ug/L	ND	110	37-155			
1,3,5-Trimethylbenzene	33.0	0.5	ug/L	ND	82.4	61-151			
Vinyl chloride	38.5	0.4	ug/L	ND	96.2	31-159			
m,p-Xylenes	69.1	0.5	ug/L	ND	86.3	61-139			
o-Xylene	35.1	0.5	ug/L	ND	87.7	60-142			
Surrogate: 4-Bromofluorobenzene	81.2		ug/L		101	83-134			
Surrogate: Dibromofluoromethane	79.5		ug/L		99.4	78-124			
Surrogate: Toluene-d8	76.7		ug/L		95.9	76-118			

Certificate of Analysis

Report Date: 22-Dec-2008

Order Date: 16-Dec-2008

Client: **Jacques Whitford Limited (Ottawa)**

Client PO: 1037297 Phase Z9100

Project Description: 1037297

Sample and QC Qualifiers Notes

- 1- BAC01 : Greater than 200 CFU of background colonies per filter may interfere with target reactions and the analysts' ability to count E. coli & Total Coliform. The target colonies may be under-represented.
- 2- QR-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.
- 3- QS-03 : Spike recovery not acceptable as the concentration was outside of the calibration range.

Sample Data Revisions

None

Work Order Revisions/Comments:

None

Other Report Notes:

n/a: not applicable

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.



TRUSTED.
RESPONSIVE.
RELIABLE.

OTTAWA NIAGARA FALLS MISSISSAUGA SARNIA

Date: Jan. 5, 09

Attn: Sonny Sundaram
Company: Jacques Whitford Limited

From: Dale Robertson

re: Subcontracted Analysis, Paracel Order 0851048

The samples for your project, identified below, were subcontracted for the listed parameters. A copy of the subcontractor's report is attached.

Project Reference	1037297
Parameter	OCP, PCB, SVOC and Phenols
Sample Date	Dec 15, 2008
Chain of Custody #	54475

Originating Office: ☒ - Ottawa

☐ - Niagara Falls

☐ - Mississauga

☐ - Sarnia

1-800-749-1947
PARACEL@PARACELLABS.COM
WWW.PARACELLABS.COM

OTTAWA
314027's Rd. West #103
Ottawa, ON K1H 1G9
MISSISSAUGA
2000 Burnhamthorpe Rd. West #200
Mississauga, ON L4W 3N2

NIAGARA FALLS
440 Main Street, 2nd Fl.
Niagara Falls, ON L2E 1G5
SARNIA
200 Front Street E.
Sarnia, ON N6A 1T7

Client: Paracel Laboratories Ltd.
300-2319 St. Laurent Blvd.
Ottawa, ON
K1G 4J8
Attention: Mr. Dale Robertson

Report Number: 2831748
Date: 2009-01-02
Date Submitted: 2008-12-18

Project: 0851048

P.O. Number:

Matrix: Water

Chain of Custody Number: 719973

			LAB ID:	682598					GUIDELINE		
			Sample Date:	2008-12-17							
			Sample ID:	PW08-1					ODWSOG		
PARAMETER	UNITS	MRL							TYPE	LIMIT	UNITS
Organochlorine Pesticides (OCPs) & PCBs											
Aldrin	ug/L	0.005	<0.005						MAC	0.7	ug/L
Dieldrin	ug/L	0.006	<0.006								
Aldrin + Dieldrin	ug/L	0.012	<0.012								
a-chlordane	ug/L	0.006	<0.006								
g-chlordane	ug/L	0.006	<0.006								
Oxychlordane	ug/L	0.006	<0.006						MAC	7	ug/L
Chlordane (Total)	ug/L	0.018	<0.018								
op-DDT	ug/L	0.006	<0.006								
pp-DDD	ug/L	0.006	<0.006								
pp-DDE	ug/L	0.006	<0.006								
pp-DDT	ug/L	0.006	<0.006						MAC	30	ug/L
(DDT) + Metabolites	ug/L	0.024	<0.024								
Heptachlor	ug/L	0.005	<0.005								
Heptachlor epoxide	ug/L	0.006	<0.006								
Heptachlor + Heptachlor Epoxide	ug/L	0.012	<0.012								
Lindane	ug/L	0.005	<0.005						MAC	4	ug/L
Methoxychlor	ug/L	0.024	<0.024						MAC	900	ug/L
Polychlorinated Biphenyls (PCBs)	ug/L	0.1	<0.1						IMAC	3	ug/L
CHLOROPHENOLS											
2,3,4,6-tetrachlorophenol	ug/L	0.5	<0.5						MAC	100	ug/L
2,4,6-trichlorophenol	ug/L	0.5	<0.5						MAC	5	ug/L
2,4-dichlorophenol	ug/L	0.5	<0.5						MAC	900	ug/L
Pentachlorophenol	ug/L	0.5	<0.5						MAC	60	ug/L
PHENOXYACID HERBICIDES											
2,4,5-trichlorophenoxyacetic acid (2,4,5-T)	ug/L	1	<1						MAC	280	ug/L
2,4-dichlorophenoxyacetic acid (2,4-D)	ug/L	1	<1						IMAC	100	ug/L
Bromoxynil	ug/L	0.5	<0.5						IMAC	5	ug/L
Dicamba	ug/L	1	<1						MAC	120	ug/L
Dinoseb	ug/L	1	<1						MAC	10	ug/L

MRL = Method Reporting Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Tony Zhao
Organic Lab Coordinator

Client: Paracel Laboratories Ltd.
300-2319 St. Laurent Blvd.
Ottawa, ON
K1G 4J8

Attention: Mr. Dale Robertson

Report Number: 2831748
Date: 2009-01-02
Date Submitted: 2008-12-18

Project: 0851048

P.O. Number:

Matrix: Water

Chain of Custody Number: 719973

			LAB ID:	682598						GUIDELINE		
			Sample Date:	2008-12-17								
			Sample ID:	PW08-1						ODWSOG		
PARAMETER	UNITS	MRL								TYPE	LIMIT	UNITS
Picloram	ug/L	5	<5							IMAC	190	ug/L
CARBAMATES												
Bendiocarb	ug/L	2	<2							MAC	40	ug/L
Carbaryl	ug/L	5	<5							MAC	90	ug/L
Carbofuran	ug/L	5	<5							MAC	90	ug/L
TRIAZINE & RELATED HERBICIDES												
Alachlor	ug/L	0.5	<0.5							IMAC	5	ug/L
Atrazine	ug/L	0.2	<0.2									
De-ethylated atrazine	ug/L	0.5	<0.5									
Atrazine + N-dealkylated metabolites	ug/L	0.2	<0.2							IMAC	5	ug/L
Cyanazine	ug/L	1	<1							IMAC	10	ug/L
Metolachlor	ug/L	0.5	<0.5							IMAC	50	ug/L
Metribuzin	ug/L	5	<5							MAC	80	ug/L
Prometryne	ug/L	0.25	<0.25							IMAC	1	ug/L
Simazine	ug/L	1	<1							IMAC	10	ug/L
ORGANOPHOSPHOROUS PESTICIDES												
Azinphos-methyl	ug/L	2	<2							MAC	20	ug/L
Chlorpyrifos	ug/L	1	<1							MAC	90	ug/L
Diazinon	ug/L	1	<1							MAC	20	ug/L
Diclofop-methyl	ug/L	0.9	<0.9							MAC	9	ug/L
Dimethoate	ug/L	2.5	<2.5							IMAC	20	ug/L
Malathion	ug/L	5	<5							MAC	190	ug/L
Parathion	ug/L	1	<1							MAC	50	ug/L
Phorate	ug/L	0.5	<0.5							IMAC	2	ug/L
Temephos	ug/L	10	<10							IMAC	280	ug/L
Terbufos	ug/L	0.4	<0.4							IMAC	1	ug/L
Triallate	ug/L	1	<1							MAC	230	ug/L
Trifluralin	ug/L	0.4	<0.4							IMAC	45	ug/L
BENZO (a) PYRENE												
Benzo(a)pyrene	ug/L	0.01	<0.01							MAC	0.01	ug/L

MRL = Method Reporting Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Tony Zhao
Organic Lab Coordinator

Appendix I

MOE Water Well Records for the Project Area

Well Computer Print Out Data as of October 27 2008

TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
PERRY TOWNSHIP CON 08 (017)	17 632990 5040993 ^L	1992/06 3665	06 05 06	FR 0121	020 / 007 / 2:0	DO		4806524 (121311) BRWN SAND STNS 0009 GREY GRNT FCRD 0020 GREY GRNT 0125
PERRY TOWNSHIP 08 (016)	17 632569 5041163 ^M	2004/12 6838	02 02 02	FR 0013				4809873 (Z13320) A013255 BRWN SAND GRVL 0021 GREY SAND SILT 0052 BRWN SAND GRVL 0017 GREY SAND SILT 0052 BRWN SAND GRVL 0017 GREY SAND SILT 0027

Well Computer Print Out Data as of October 27 2008

Page: 2 / 2

Notes:

1. UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
2. Date Work Completed
3. Well Contractor Licence Number
4. Casing diameter in inches
5. Unit of Depth in Feet
6. See Table 4 for Meaning of Code
7. STAT LVL: Static Water Level in Feet ; PUMP LVL: Water Level After Pumping in Feet
8. Pump Test Rate in GPM, Pump Test Duration in Hour : Minutes
9. See Table 3 for Meaning of Code
10. Screen Depth and Length in feet
11. See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms									
Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBND	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDY		

2. Core Color	
Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Water Use			
Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial		
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail			
Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		