

# patersongroup

Geotechnical  
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**Consolidated Terrain Analysis and  
Hydrogeological Study Reports**  
Greely Village Centre Subdivision  
Part of Lot 73 and Part of Lot 74,  
Registrar's Compiled Plan 902  
Ottawa (Osgoode), Ontario

Prepared For

Sunset Lakes  
Development Corporation

**Paterson Group Inc.**  
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## 1.0 INTRODUCTION

### 1.1 Terms of Reference

The firm of Paterson Group Inc. was retained by Mr. Dan Anderson, of Sunset Lakes Development Corporation, to prepare a Terrain Analysis and Hydrogeological Study for a parcel of land forming part of the proposed Greely Village Centre, located within Part of Lots 73 & 74, Registrar's Compiled Plan 902, contained within Part of Lot 6, Concession 5, in the former Township of Osgoode, City of Ottawa, Ontario.

### 1.2 Background

The subject property is located at the corner of Regional Highway No. 31 and Parkway road in the southeast part of the Village of Greely, Ontario (refer to the Key Plan illustrated in DWG. PH0145-1 located in Appendix 5). The total area in the subdivision application is 30.35 ha (78.21 acres) and will consist of the following land uses on private services:

- Professional Office Park ;
- and a 75 residential lot subdivision .

The purpose of this study has been to ascertain and assess the specific terrain and hydrogeological conditions that currently exist beneath the subject property as they relate to the suitability of the site for development on private services with minimal impact on groundwater resources.

## **2.0 STUDY METHODOLOGY**

### **2.1 Terrain Analysis**

As part of this study, a series of test pits were put down on the subject property to delineate the subsurface soil conditions beneath the site. The field investigation for the residential subdivision was initiated on June 3, 2005. The test pit locations were selected by Paterson Group Inc. personnel to ensure that adequate representation of the subsurface profile was delineated. All test pit locations were selected to accommodate excavation using a standard backhoe. A total of 13 test pits were put down in conjunction with the terrain investigation. The soil profile and test data sheets for each test pit are provided in Appendix 1.

The test pit locations were recorded and the subsurface conditions, including the soil morphology and depth to the groundwater table, were carefully observed and recorded by Paterson Group Inc. personnel as the test pits were advanced. Representative samples of each major soil type were recovered from the test pits. The samples were carefully sealed and returned to our laboratory for further analysis.

### **2.2 Test Well Installation**

Five (5) test wells, denoted as TW1 to TW5 respectively, were constructed at the site by Gilles Bourgeois Well Drilling of St. Albert, Ontario. The test well locations were carefully chosen based on topography and site access considerations. Actual well construction was carried out between April 27, 2005 and May 5, 2005 under the direct supervision of qualified Paterson Group Inc. personnel. The MOE Water Well Record for each test well is provided in Appendix 2.

The casing hole for each test well was advanced at least 1.2 m into the underlying bedrock formation using rotary air drill rig. The annular space was grouted with a neat cement slurry delivered through pressure grouting equipment. Grout was pumped until return to surface in the annular space was observed and a 24 hour set up time was realized prior to continuing drilling.

A 150 mm diameter button bit was used to advance each well to completion through the rock formation. A cross sectional diagram of TW1 is provided in Figure 1 of Appendix 5 and adequately reflects the typical construction of the test wells at the site.

In addition to the field testing component of this study, published MOE Water Well Records were reviewed to assess the general aquifer characteristics of the area. A detailed analysis of these records is presented in Section 5.0.

Test well construction, as well as other site hydrogeology is discussed in Section 6.0.

### **2.3 Aquifer Analysis**

Each test well was pump for a duration of six hours. The pump tests were conducted using a 1.5HP electric submersible pump powered by a portable gasoline generator. The water discharge line was placed downgradient of the well and at a sufficient length in order to minimize the potential for short-circuiting and recharge of the pumped well.

Recovery data was collected for each pump test to assist with aquifer analysis. Several test wells were observed to recover within the first few minutes after pumping had ended and all wells were observed to reach at least 95% recovery within a reasonable period of time.

Pump testing data was analyzed using Waterloo Hydrogeologic's "Aquifer Test" v. 2.5 aquifer analysis software package. The following analytical methods were applied (data permitting):

- Cooper Jacob's Time Drawdown;
- Theis Recovery;
- and Theis (Curve matching).

The results of the aquifer analysis are presented and discussed in Section 7.0.

### **2.4 Laboratory Testing**

#### **Soil**

Hydrometer analysis was performed in accordance with ASTM testing methods, on a total of four (4) soil samples recovered as part of the test pit investigation. The grain size distribution curves are provided in Appendix 1 and are discussed in Section 4.1.

All soil samples will be stored in our laboratory for a period of three months after issuance of this report. They will then be discarded unless we are directed otherwise.

### **Groundwater**

Two (2) water samples were collected from each of the five (5) test wells during the course of the pump testing at three (3) hours of pumping and at six (6) hours of pumping, respectively, and were preserved for chemical analyses. The samples were submitted to Accutest Laboratories, of Nepean, Ontario for analysis of a standard "Subdivision Supply Requirement" package which includes a comprehensive suite of health and aesthetic based parameters that are typically used to assess water quality for the purposes of human consumption. The analytical results of each water sample are provided in Appendix C, and are discussed in detail under Section 7.2.

### **3.0 SITE DESCRIPTION**

The primary use of the site has historically been for agricultural use. Specifically, the subject parcel of land has been farmed for various cash crops from a series of fields. Aside from a few trees delineating the field boundaries, the site is generally clear of treed areas.

#### **3.1 Topography and Drainage**

The topographical relief of the site is generally flat with near level conditions throughout. Overall relief is towards the north-northeast at a slope of between 0.5 % to 1 %.

The surficial drainage of the site is achieved through a series of drainage ditches located parallel to Parkway Road. The drainage ditches direct surface runoff towards the roadside ditch along Sale barn Road; the eastern boundary of the site.

#### **3.2 Surrounding Land Uses Within 500 m**

The lands directly surrounding the site to the north of Highway No. 31 are predominantly active agricultural lands. Existing privately serviced residential dwellings contained in existing plans of subdivision occupy the south side of Highway No. 31 across from the site.

## **4.0 GEOLOGY**

The following sections describe the regional and site specific geology of the study area.

### **4.1 Surficial Geology**

A review of available surficial soils mapping surrounding the subject property contained in Soil Survey Report No. 58 indicates the site is generally located on deposits of low permeable soils of the Manotick association, specifically the Allendale series. The Allendale series is categorized as a poorly drained marine soil having a grayish brown to olive gray colour with reddish brown to dark yellowish brown mottling throughout.

A narrow band of the well draining Grenville soil association encroaches from the south east of the property, however this soil occupies a relatively small area of the subject site.

Based on the results of the test-pit excavation program, overburden thickness across the site and beneath the proposed subdivision, is more than 3 m in all areas encountered in the subject property. Using well recognized techniques for field identification of soils, four (4) specific stratigraphic units were identified in the areas investigated. The soils were classified using the Unified Soil Classification System (USCS) and hydraulic conductivities were estimated based on published data correlating soil types to permeability. The stratigraphic units are summarized below in Table 1:



<b>TABLE 1 SUMMARY OF UNIQUE STRATIGRAPHIC UNITS ENCOUNTERED ON SUBJECT PROPERTY</b>				
<b>Stratigraphic Unit</b>	<b>General Description (USCS Classification)</b>	<b>Composition<sup>1</sup> (%sand, silt, clay)</b>	<b>Thickness (m)</b>	<b>Estimated Hydraulic Conductivity<sup>2</sup> (cm/s)</b>
1	SM - Silty sand - inorganic silt with fine sand composite	Not Available	0.3 to more than 1.2	$10^{-3}$ to $10^{-5}$
2	GM- gravel, sand silt mixture (glacial till)	Not Available	1.2 to more than 1.5	$10^{-2}$ to $10^{-4}$
3	ML-MH- inorganic silts and silty or clayey silts with slight plasticity	0.3-3.7% sand 41.7-51.3 silt 45-58% clay	2.1 to more than 6	$10^{-5}$ to less than $10^{-7}$
4	CH-CL- inorganic clay of high plasticity to silty clay	5.5-10% sand 20.5 - 29.7% silt 60 - 74% clay	2.7 to more than 6	$10^{-7}$ to less than $10^{-9}$

1. Composition for CH, CL, ML and MH determined from grain size and hydrometer analysis.

2. Hydraulic conductivity estimated based on MOE Manual of Guidelines and Policies (1987)

These stratigraphic units are generally consistent with the surficial soil map in the close proximity to the site.

Laboratory hydrometer testing was performed on representative samples of the CH, CL, MH and ML soil units to validate in situ field identification and hydraulic conductivity estimates. The percent composition was easily determined (refer to Table 1) and hydraulic conductivity was validated. The grain size distribution curves are provided in Appendix 1.

Test pit locations and corresponding stratigraphy of the main soil types are summarized on the Test Hole Locations Plan (DWG. PH0145-1 in Appendix 5). The test pit logs are found in Appendix 1.

#### **4.2 Bedrock Geology**

Published mapping indicates that the study area is underlain by Paleozoic bedrock of the Oxford Formation. The MOE Water Well Records confirm the presence of limestone bedrock under the site at depths varying from 6.7 m to 7.9 m. Site specific observations indicated that bedrock was not encountered in any of the test pits put down in the subject area.

The primary water supply aquifer is anticipated to consist of fractured zones in the Paleozoic bedrock.

## **5.0 REGIONAL HYDROGEOLOGY**

A total of 76 published MOE Water Well Records for the area immediately surrounding the site were reviewed. The respective water well records for each grouping of surrounding wells are summarized in Appendix 2. Graphical representation of the statistical analysis performed on the Water Well Records is also presented in Appendix 2.

### **5.1 Overburden Analysis**

The statistical analysis of the published records indicates that none of the wells had overburden thicknesses of less than 3 m. Moreover, only 10% of the wells in the published MOE records were reported to have less than 6.1 m of overburden.

The above data confirms that the thickness of overburden observed in the test pits put down for the terrain analysis is, indeed, representative of overburden conditions over the entire site.

### **5.2 Well Depth**

With respect to well depth, the analysis of the published records reveals that all wells were completed in Paleozoic bedrock formations and well depths vary little in the immediate surroundings. 84% of the wells in the published MOE records were completed at depths between 12 m and 43 m; no wells were completed at depths greater than 43 m. This grouping of well depths suggests the presence of several fractured regions within the Paleozoic strata.

### **5.3 Aquifer Depth**

All of the surrounding wells were reported to have encountered water at depths between 6 m and 43 m. Approximately 54% of the surrounding wells encountered water bearing formations at depths of between 12 m and 18 m. Comparative analysis against overburden thickness and well depths suggests the broad presence of water bearing formations at 12 m to 24 m within the Paleozoic bedrock.

#### **5.4 Well Yield**

Published well records indicate that 100% of the surrounding wells have well yields of more than 3 IGPM and 5% of these wells are reported to have well yields of more than 50 IGPM.

Comparative analysis of the reported well yields against aquifer depths suggests that the water bearing formations between 12 m and 24 m are capable of providing well yields of between 5 IGPM and 30 IGPM: this is considered to be a water bearing formation with above average yield potential.

#### **5.5 Free Flowing Artesian Wells**

Of the surrounding wells reviewed, only one (1) well were reported to be free flowing artesian wells.

## 6.0 SITE HYDROGEOLOGY

As stated previously, a total of five (5) test wells were constructed throughout the site (refer to Dwg. No. PH0145-1 in Appendix 5). Construction details for each test well, based on MOE Water Well Records and site notes, are summarized below in Table 2. The geodetic elevations of the top of casing for the test wells were provided from a separate survey conducted in conjunction with other related work.

TABLE 2 SUMMARY OF GEOLOGIC CONDITIONS OBSERVED DURING TEST WELL CONSTRUCTION					
Test Well No.	GEODETTIC ELEVATIONS (metres above Mean Sea Level)				Geologic Description of Rock Formation
	Top of Casing	Existing Grade	Top of Rock	Bottom of Well	
1	92.05	91.5	83.88	61	grey limestone, layered
2	90.9	90.2	82.28	35	grey limestone, white sandstone
3	89.9	89.2	82.19	40	grey limestone, layered
4	86.65	85.9	79.2	49	grey limestone
5	86.3	85.7	77.78	55	grey limestone

A review of Table 2 shows that the hydrogeology of the test wells is generally consistent with the data presented in Section 5. Furthermore, overall well depths were generally consistent, having been completed at approximate depths of between 25 m and 50 m. Reported well yields were consistent with the wells in the surrounding area.

Using the geodetic elevations of the well casings, test well construction data and static water levels were used to analyze groundwater flow through the site.

The supply aquifers were intercepted between 28 m and 53 m below the surface of the ground. The static water levels reported in the test wells indicate piezometric head pressures on the aquifer of between 25.8 m and 51.3 m (i.e. 35 psi and 69.8 psi). The presence of these significant pressures suggests that the aquifer is being acted on by two aquitards, thus creating a confined aquifer. By definition, **"a confined aquifer is an aquifer that is confined between two aquitards."** (Freeze & Cherry, 1979) The combination of the low permeable overburden

material and the bedrock above the supply aquifer can, therefore, be considered an aquitard.

Piezometric head analysis was conducted using the Surfer (v.8) software package. Dwg. No. PH0145-3 in Appendix 5 clearly illustrates the general delineation of piezometric head across the site as calculated using the software package. The direction of groundwater flow is generally towards the north by northeast and reflects the overall topography across the site. Further analysis of PH0145-3 indicates that the piezometric head contours are evenly spaced across the site from TW1 to TW5 indicating a relatively constant groundwater gradient in the north-northeast direction.

An overburden aquifer exists below the surface of the ground and is anticipated to extend downward to the bedrock. The monitoring wells installed at various locations throughout the site (refer to Drawing No. PH0145-1 for locations) indicate significant variations in static water level elevations between the overburden aquifer and the deeper supply aquifer. This information provides further evidence that the lower aquifer is confined by the overburden and un-jointed bedrock strata above it.

DWG No. PH0145-4 in Appendix 5 is provided to illustrate a cross sectional profile of the general terrain and geologic conditions that exist across the subject site. The depths of the wells, aquifer elevations and overburden water levels have also been visually presented.

## 7.0 AQUIFER ANALYSIS

The results of the pumping tests performed on the test wells are presented in the following sections.

### 7.1 Evaluation of Water Quantity

Pump test data and analytical plots for the five pump tests conducted are provided in Appendix 4. Hydraulic properties, including pumping rate, available and maximum drawdown, transmissivity, and storativity for the water supply aquifer for each of the test wells are summarized in Table 3 below.

<b>TABLE 3 AQUIFER TEST RESULTS FROM PUMP TESTING OF FIVE WELLS</b>					
<b>ITEM</b>	<b>TW 1</b>	<b>TW 2</b>	<b>TW 3</b>	<b>TW 4</b>	<b>TW 5</b>
Pumping Rate (IGPM)	26.7	26.7	26.7	24	26.7
Depth of Well (Metres Below Existing Grade)	30.48	54.86	48.76	36.57	30.48
Static Water Level (Metres Below Existing Grade)	1.65	1.98	0.7	1.2	0.71
Available Drawdown (m)	28.83	52.88	48.06	35.37	29.77
Maximum Drawdown (Metres Below Existing Grade)	2.17	2.78	1.58	6.25	1.33
Available Drawdown (Expressed as Percentage)	92.5	94.7	96.7	82.3	95.5
Storativity	$3.01 \times 10^{-4}$	$1.16 \times 10^{-4}$	$5.5 \times 10^{-1}$	$3.73 \times 10^{-6}$	$5.33 \times 10^{-6}$
Transmissivity <sup>1</sup> (m <sup>2</sup> /min)	$1.60 \times 10^{-1}$	$2.1 \times 10^{-1}$	$1.65 \times 10^{-1}$	$2.0 \times 10^{-1}$	$1.31 \times 10^{-1}$

1. Transmissivity values listed in the table are numerical averages of those values obtained from all analytical methods used.

For TW2, TW3, TW4 and TW5, static water levels were recorded in the nearby monitoring wells to assess any potential for hydraulic response to pumping. Such response would indicate the presence of a hydraulic connection between the receiving aquifer and water supply aquifer. The monitoring well responses for each pump test are included in Appendix 4 with the rest of the pump test data. A static water level drop of 2 cm and 1cm was recorded in MW7 and MW 8, respectively,

while pump testing TW4. A static water level drop of 2 cm was recorded in both MW8 and MW9 while pump testing TW5. However, the static water levels in these monitoring piezometers did not continue to fall throughout the duration of the pump test, as observed in the observation well, nor did they recover at the conclusion of the tests. Furthermore, the individual responses of the monitoring piezometers could not be accurately modelled as they did not exhibit behaviour consistent with Neuman or Hantush, the established modelling methods for overburden aquifers and leaky aquifers respectively.

Considering that the receiving aquifer is unconfined, the aquifer is subject to barometric changes. On page 234 of Freeze & Cherry (1979), it states:

*"It has also been observed that changes in atmospheric pressure can cause small fluctuations in the water table in unconfined aquifers. As the air pressure increases, water tables fall.....Turk (1975) measured diurnal fluctuations of up to 6 cm in a fine grained aquifer with a shallow water table."*

The Environment Canada Hourly Data Reports (refer to Appendix 4) for the days on which the pump tests took place, indicate that the barometric pressure between June 21, 2005 and June 23, 2005 underwent several significant fluctuations that could easily account for a 1cm to 2 cm water level change in the monitoring piezometers.

## **7.2 Evaluation of Water Quality**

### **7.2.1 Test Well Analysis**

The results of the water quality analyses for the groundwater samples collected from the five test wells during pump testing for health and aesthetic parameters are presented in Table 4 and Tables 5A & 5B, respectively. Laboratory certificates of analysis are included in Appendix 3.

#### **7.2.1.1 Health Related Parameters**

The water quality in the test wells, with respect to the prescribed health related objectives of the Ontario Drinking Water Quality Standards (ODWS), is generally satisfactory, and is considered to be relatively typical for the area. Table 4 summarizes the concentration of health related parameters for each test well at the three hour and six hour intervals of the pump test.

**Turbidity** levels above 1 Nephelometric Turbidity Unit (NTU) were encountered at the end of the pump testing laboratory samples submitted for all of the test wells.



Field turbidity measurements using a turbidity meter, however, confirm that the turbidity was below 1 NTU in all test wells at the completion of the pump testing period, with the exception of TW4. The field turbidity meter malfunctioned during the first pump test, which occurred at TW4, and had to be replaced. As a result field turbidity data was not obtained for TW4. Considering the fact that TW4 and TW5 share similar water chemistry, the field turbidity is likely to be similar to the 0.11 NTU observed in TW5.

The elevated turbidity in the laboratory samples can easily be attributed to precipitation of soluble iron and manganese through oxidation reactions with free oxygen introduced during pumping and sample collection. This is particularly valid considering the concentrations of iron and manganese observed in TW4 and TW5.

**Total Coliform (TC)** concentrations were present in TW1, TW2, TW4 and TW5 and were observed to fluctuate throughout the pump testing period. Given that the Heterotrophic Plate Count was significantly low in all of the test wells throughout the duration of each pump test and, considering the absence of Faecal Coliform bacteria in each of the samples, it is anticipated that the TC concentrations observed are the direct result of residual soil and organic material left in the well as a direct result of insufficient well development prior to the start of the pump tests. This problem is easily rectified by further well development followed by adequate shock chlorination.

#### **7.2.1.2 Aesthetic Parameter (Non Health Related)**

The water quality of the test wells, with respect to aesthetic parameters of the ODWS, is generally satisfactory and is considered to be consistent with the geochemistry of the area and with the supply formation. Tables 5A and 5B below present a summary of the aesthetic parameter concentrations for the water samples taken from each test well.

Based on the detailed review of the analytical results for all test wells, the groundwater is considered to be **very hard**. Elevated hardness is not a health related parameter of the ODWS. It is a common issue in much of Eastern Ontario and, at the observed concentrations, can be easily treated with point of use water treatment equipment.

**Total Dissolved Solids (TDS)** concentration reported in the test wells varied considerably with values ranging from 787 mg/L to 1790 mg/L. All test wells have TDS concentrations above the ODWO aesthetic objective of 500 mg/L and these

concentrations must be factored when sizing point of use water treatment equipment.

**Iron (Fe)** concentrations were observed to be above the aesthetic objective of 0.3 mg/L in all test wells at the site. Similarly, **manganese (Mn)** concentrations were observed to be above the aesthetic objective of 0.05 mg/L in these same wells. At the measured concentrations for both iron and manganese, standard point of use water treatment devices, such as a potassium permanganate (greensand) filter, will be more than adequate to significantly reduce these concentrations.

**Sodium (Na)** concentrations in each of the test wells were noted to be generally **elevated** with values varying considerably between 39 mg/L and 383 mg/L. The sodium concentrations in TW1, TW2 and TW3, although quite elevated, were observed to fall by 4%, 27% and 2% respectively over the six hour pump testing period. Continued well development is expected to further reduce these concentrations.

Although sodium is not a chemical parameter of interest in Schedule 2 of the Ontario Regulation 169/03 (Ontario Drinking Water Quality Standards), consistent with the Technical Support Document for Ontario Drinking Water Quality Standards, Guidelines and Objectives, published June 2003 by the MOE, concentrations above 20 mg/L require that the Medical Officer of Health be notified so that this information may be passed on to local physicians for use in treatment of those requiring a sodium-restricted diet.

**Hydrogen Sulfide (H<sub>2</sub>S)** concentrations above the aesthetic objective of 0.05 mg/L were observed in TW4. At the reported concentrations, the signature "rotten egg" odour of this gas will be noticeable, but not overpowering. As H<sub>2</sub>S was observed only in TW4, the presence of this gas in future supply wells is expected to be uncommon.

**TABLE 4**  
**SUMMARY OF HEALTH RELATED PARAMETERS**

PARAMETER	TW1 WS5 (3 Hr)	TW1 WS6 (6 Hr)	TW2 WS7 (3 Hr)	TW2 WS8 (6 Hr)	TW3 WS9 (3 Hr)	TW3 WS10 (6 Hr)	TW4 WS1 (3 Hr)	TW4 WS2 (6 Hr)	TW5 WS3 (3 Hr)	TW5 WS4 (6 Hr)	Ontario Drinking Water Quality Objective
Fluoride	ND	0.15	0.13	0.96	0.18	0.17	0.33	0.50	0.16	0.15	1.5
Ammonia	0.20	0.03	0.10	0.06	0.10	0.10	0.09	0.10	0.02	0.02	-
Nitrite	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1
Nitrate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10
Turbidity (NTU)	1.8	1.6	9.3	9.6	2.5	4.5	17.7	62.3	27.6	28.5	1
Field Reading of Turbidity at completion of pump test (NTU)		0.89		0.40		0.62		N/A		0.11	1
E. Coli	0	0	0	0	0	0	0	0	0	0	0
Total Coliform <sup>1</sup>	0	0	0	0	0	0	0	0	0	0	0
Faecal Coliform	0	0	0	0	0	0	0	0	0	0	0
Faecal Streptococcus	0	0	0	0	0	0	0	0	0	0	0
HPC	0	1	4	1	0	1	0	2	0	1	500

1. Total Coliform concentrations reported in this table are compiled from retesting after further well development

**TABLE 5A**  
**SUMMARY OF AESTHETIC RELATED PARAMETERS**

PARAMETER	TW1 WS5 (3 Hr)	TW1 WS6 (6 Hr)	TW2 WS7 (3 Hr)	TW2 WS8 (6 Hr)	TW3 WS9 (3 Hr)	TW3 WS10 (6 Hr)	TW4 WS1 (3 Hr)	TW4 WS2 (6 Hr)	TW5 WS3 (3 Hr)	TW5 WS4 (6 Hr)	Ontario Drinking Water Quality Objective <sup>1</sup>
Conductivity (µS/cm)	2500	2530	2500	2510	2750	2680	1170	1030	1210	1210	-
Colour (TCU)	2	2	ND	3	2	2	2	ND	2	ND	5
Hardness	583	578	529	524	519	519	532	354	603	598	80 - 100
Alkalinity	313	312	289	287	274	268	271	220	307	307	500
Total Dissolved Solids	1630	1640	1630	1630	1790	1740	761	670	787	787	500
pH	7.58	7.63	7.93	7.96	8.03	8.05	7.60	7.80	7.76	7.77	6.5 to 8.5
Chloride	543	538	591	580	698	689	193	177	191	194	250
Sulphate	134	133	114	113	103	104	72	45	65	63	500
Calcium	151	149	131	129	127	127	142	71	164	162	-
Magnesium	50	50	49	49	49	49	43	43	47	47	-
Sodium	292	281	383	301	336	333	56	56	40	39	20

**TABLE 5B  
SUMMARY OF AESTHETIC RELATED PARAMETERS (CONT'D)**

PARAMETER	TW1 WS5 (3 Hr)	TW2 WS7 (3 Hr)	TW2 WS8 (6 Hr)	TW3 WS9 (3 Hr)	TW3 WS10 (6 Hr)	TW4 WS1 (3 Hr)	TW4 WS2 (6 Hr)	TW5 WS3 (3 Hr)	TW5 WS4 (6 Hr)	Ontario Drinking Water Quality Objective <sup>1</sup>
Potassium	4	5	5	7	7	4	4	2	2	-
TKN	0.21	0.14	0.15	0.15	0.13	0.21	0.21	0.33	0.28	-
Dissolved Organic Carbon	<0.5	1.1	1.2	1.1	1.8	1.2	1.1	0.5	1.4	5
Iron	0.68	0.74	0.72	0.65	0.64	1.65	1.71	2.31	2.46	0.3
Manganese	0.10	0.06	0.06	0.06	0.06	0.22	0.22	0.35	0.35	0.05
Hydrogen Sulphide	ND	ND	ND	ND	ND	0.17	0.15	ND	ND	0.05
Phenols	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Tannin & Lignin	ND	ND	ND	ND	ND	ND	ND	ND	ND	-

## **8.0 DEVELOPMENT RECOMMENDATIONS**

The following sections outline the recommendations for development which have been formulated from the data collected in this study.

### **8.1 Site Development**

Based on the results of our study, this site is considered to be suitable for the development of the 75 lots as described in the Section 1.0 of this report. The on-site sewage disposal can be handled with fully raised Class 4 septic systems, as per Part 8 of the Ontario Building Code, and an adequate water supply can be obtained with private drilled wells.

### **8.2 Lot Development Plan**

One objective of the hydrogeological study is to enhance development and minimize the effects of sewage systems on the surrounding environment. This is achieved through prevention of accumulation of surface water, by ensuring proper construction of water supply and sewage systems, and by coordinating the overall positioning of the services to maximize separations. A minimum separation of 18 m for fully-raised systems is required between a well and sewage system, whether they are servicing a single lot, or are on neighbouring lots.

The proposed Lot Development Plan, Dwg. No. PH0145-2, in Appendix 5 shows the proposed lot development plans for the site. The purpose of this drawing is to show that a typical home and private services will fit onto the proposed lot, and can meet all pertinent regulations without causing environmental constraints. The typical house shown in this drawing covers a plan area of 120 m<sup>2</sup>, assuming a two-storey 240 m<sup>2</sup> (2600 ft<sup>2</sup>) home, with a garage of 50 m<sup>2</sup>, and is serviced by a sewage system with the capacity of 3000 L/day. In actuality, the daily sewage flows will likely be significantly lower than this value.

It is not the intent of the drawing to restrict placement of the home on each lot. While the position of the home may change, the relative position of the home, sewage system and well should be maintained. In all cases, the separation criteria for the immediate and neighbouring lots should be followed.

The required separation distance from a fully raised leaching bed to surface water is 18 m.

### **8.3 Nitrate Impact Assessment**

#### **Hydrogeological Sensitivity**

In accordance with Section 5.0 of the MOE publication, entitled, "Procedure D-5-4 Technical Guidelines for Individual On-site Sewage Systems: Water Quality Impact Risk Assessment", the groundwater impacts from on-site sewage systems must be addressed in a step-wise manner. In order to establish the initial step, it is essential to demonstrate whether or not the site is considered hydrogeologically sensitive.

Given the low permeability and moderate thickness of the overburden, and considering the time for vertical seepage, **the subject property is not considered hydrogeologically sensitive.**

#### **Isolation of Supply Aquifer**

As established in Section 6.0 of this report, the supply aquifer is considered to be a confined aquifer with the overburden material and bedrock acting as an aquitard. By definition, "**..the term aquitard has been coined to describe the less-permeable beds in a stratigraphic sequence.**" (Freeze & Cherry, 1979) The surficial geology of the site, as detailed in Section 4.1, is predominantly clay to clayey silt soils with very low hydraulic conductivities. Hydrometer analysis on representative samples confirms clay contents of 45% to 74% in these soils; the test well data and published MOE water well records in surrounding wells confirms that the average overburden thickness in the area is more than 6 m. Furthermore, Section 6.0 also established that no hydraulic connection exists between the water supply aquifer and the receiving aquifer in the study area.

These factors combine to substantiate the claim that the overburden material is, in effect, an aquitard directly above the water supply aquifer. Based on these arguments, **the supply aquifer is sufficiently isolated from the overburden receiving aquifer.**

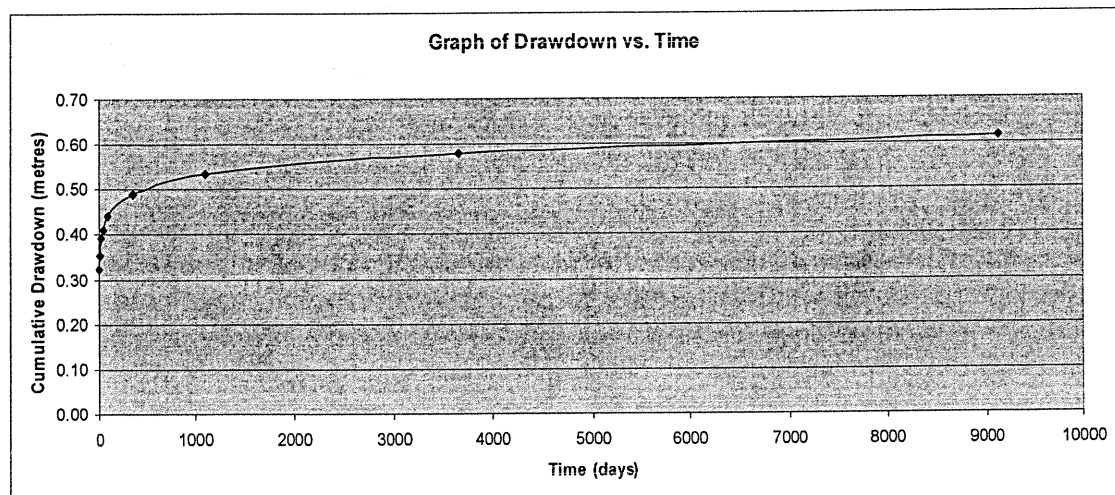


#### 8.4 Potential Well Interference

During the pump tests, nearby test wells were monitored to determine if there was any well interference taking place. No appreciable drawdown was observed in the observation wells during pumping.

The potential for cumulative drawdown was calculated using the Theis equation and the average of the transmissivities calculated from the pump tests. For the purpose of the analysis, it was assumed that 85 wells ( 10 more than were proposed) with an average concentric spacing of 15 metres would pump continuously, without interruption, at a rate of 2 m<sup>3</sup>/day. The summary of the well functions used for the well interference calculations is provided in Appendix 4. The cumulative drawdown curve is provided below.

It can be seen that over a 30 year period (measured at the centre of the study area), a cumulative drawdown of the order of 0.62 m could occur. In that the average available drawdown is at least 28.8 m, this would result in an approximate drawdown of the order of 2.2 % of the available drawdown. As such it is our opinion that the calculated well interference is considered acceptable for the proposed development.





## **8.5 Sewage System Design**

Sewage systems must be designed according to Part 8 of the Ontario Building Code. The regulations state that 0.9 m of suitable soil above an unacceptable layer (clay or bedrock) and 0.9 m of suitable soil above the high water table are required below absorption trenches.

A large 4 bedroom luxury residence may produce up to 3000 L/day of sewage effluent, although generally, design sewage flows will be less than 2500 L/day. It is anticipated that most of the leaching beds for the subdivision will be fully raised above existing grade. As such, a 250 mm thick imported sand mantle will be required to extend a minimum of 15 m beyond the ends of the absorption trenches in the direction of horizontal flow.

An imported soil with a percolation time (T) of between 6 and 8 min/cm will be required for raised tile bed and mantle construction. A length of absorption trench of 120 metres (i.e. 8 runs of 15 metres) is required for the design sewage flow of 3000 L/day. Given the configuration of most lots, absorption trench systems will be sufficient. Some of the lots, however, will require the installation of a Class 4 filter bed. Based on a daily flow of 3000 L/day, the filter bed will require a minimum stone area of 40 m<sup>2</sup>. Due to the low permeability of the underlying clay soils, a minimum extended contact base of filter media sand beneath the stone layer of 177 m<sup>2</sup> is needed. As with the absorption trench leaching bed, the filter bed will also require a 15 m imported sand mantle.

The Lot Development Plans illustrate the size of such tile beds. The sewage system should be placed down gradient of any nearby wells, where feasible.

## **8.6 Well Design**

Drilled wells, completed in the bedrock aquifer, should be used for the water supply in this development. The wells should be drilled by a licensed well contractor experienced in the study area, and should be completed in accordance with Ontario Regulation 903, as amended. A minimum well yield of 3 IGPM is recommended for an average residence.

A rotary drill has been proven to provide satisfactory water supply results in the test wells. Drilling should continue down into the bedrock so that the casing is seated firmly into the bedrock (i.e. 1.0 m into sound bedrock). The annular

space between the casing and hole should be cement grouted using a method permitted by Ontario Regulation 903, as amended.

After allowing the cement to set (24 hours for quick-set cement, 72 hours for regular cement), drilling should continue at a 150 mm diameter until the necessary water yield is intercepted. The well should be developed by surging or pumping until the water is developed to a sand free state. Chlorine should be introduced at the completion of well development in sufficient quantity to produce a free chlorine residual of 50 mg/L (ppm). The chlorine should be mixed with the standing water in the casing in such a manner as to ensure thorough vertical mixing of the chlorine over the entire depth of the well.

The well should be completed with a submersible pump, pitless adaptor and vermin proof well cap. The casing should project approximately 0.40 m above the mounded soil around the casing. The grading around the well casing should be slightly elevated to direct surface runoff away from the well.

All work related to the installation of the pump, pitless adapter and other pumping equipment is to be completed by a qualified well contractor possessing a valid Class 4 pump installer's license.

## 9.0 CONCLUSIONS

A terrain analysis and hydrogeological investigation were completed on a property identified as Part of Lot 73 and Part of Lot 74, Registrar's Compiled Plan 902, City of Ottawa (Osgoode), Ontario. The current proposed development calls for 75 residential lots with a typical lot size of 0.5 acres (1.24 hectares). Based on the data presented in the body of this report, the following conclusions can be drawn:

1. The terrain consists primarily of poorly draining soils with low hydraulic conductivity. This overburden material, combined with the underlying bedrock layers, act as an aquitard that effectively isolates the water supply aquifer from surface activities.
2. There is water of sufficient quantity present in the water supply aquifer beneath the site to support the development. Potential well interference within the subdivision is anticipated to result in a loss of only 2.2% of the available drawdown in the wells (i.e. 0.7 m) over a 25 year period.
3. The quality of the water in the supply aquifer meets all health related parameters of the ODWS for the parameters tested and all tested aesthetic related parameters are treatable.
4. A Class 4 sewage system can be adequately sited on each lot using a combination of fill based absorption trenches and filter media beds.

In summary, this site is suitable for development as a residential subdivision at the proposed density. The hydrogeological recommendations of this report, if followed, will ensure that the development takes place in an effective manner, with a minimal impact on the environment.

## 10.0 RECOMMENDATIONS


Based on the information presented in the body of this report, the following recommendations can be made:

1. TW2 is located within a proposed road allowance and TW4 and TW5 are located in proposed leaching bed areas. If development is to proceed in a similar manner as proposed on DWG. PH0145-2, both of these wells must be abandoned in strict accordance with Ontario Regulation 903 and abandonment should occur under the direct supervision of a qualified and licensed Professional Engineer of Ontario.
2. Any wells that are not to be used for the purposes of potable water taking in conjunction with lot development must be abandoned. Abandonment must be performed in accordance with Ontario Regulation 903.
3. Wells should be constructed such that the casings are at least 12 m in length and should extend 1.0 m into sound bedrock, whichever is greater. The annular space should be grouted with cement using pressure grouting techniques in accordance with Ontario Regulation 903.
4. Wells must advance to, and terminate in, the water bearing formations of the underlying Paleozoic Bedrock.
5. Fully raised Class 4 leaching beds, can be adequately sited and constructed on each of the proposed lots based on typical design assumptions. The use of tertiary treatment systems in this subdivision will offer greater diversity of house size and location within the lot boundaries.

Report Prepared by:

  
Robert A. Passmore, B.Eng.

Report Reviewed by:

  
Stephen J. Walker, P.Eng.



## **APPENDIX 1**

### **TERRAIN ANALYSIS DOCUMENTS**

1. Soil Profile & Test Pit Data Sheets
2. Grain Size Distribution and Classification Curves

DATUM Approximate geodetic

FILE NO.

PH0145

REMARKS

HOLE NO.

TP18/MW5

BORINGS BY Backhoe

DATE 3 JUN 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
GROUND SURFACE								20	40	60	80	
TOPSOIL	[Solid Black]					0	87.71					
----- 0.40												
Yellow-brown medium SAND	[Dotted]	G	1									
----- 0.80												
Stiff, brown-grey SILTY CLAY	[Diagonal Hatching]	G	2			1	86.71					
						2	85.71					∇
----- 2.50												
End of Test Pit (Water infiltration @ 2.0m depth)												

20 40 60 80 100  
Shear Strength (kPa)  
▲ Undisturbed    △ Remoulded

DATUM Approximate geodetic

FILE NO. **PH0145**

REMARKS

HOLE NO. **TP19**

BORINGS BY Backhoe

DATE 3 JUN 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %					
GROUND SURFACE								20	40	60	80		
TOPSOIL	[Solid Black]					0	88.00						
Red-brown fine SAND	[Dotted Pattern]	G	3			1	87.00						
Stiff, grey SILTY CLAY	[Diagonal Hatching]					2	86.00						
End of Test Pit (Water infiltration @ 2.6m depth)							2.90						

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed    △ Remoulded

DATUM Approximate geodetic

FILE NO.

**PH0145**

REMARKS

HOLE NO.

**TP20**

BORINGS BY Backhoe

DATE 3 JUN 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction		
		TYPE	NUMBER	% RECOVERY	N VALUE OR RQD			○ Water Content %	20	40	60		80	
GROUND SURFACE						0	88.51							
TOPSOIL	[Solid Black]													
Red-brown fine SAND	[Dotted Pattern]	G	4			1	87.51							
GLACIAL TILL: Compact to dense, grey silty sand with gravel, cobbles and boulders	[Cross-hatch Pattern]	G	5											
End of Test Pit		G	6			2	86.51							
(Water infiltration @ 1.5m depth)														

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded



DATUM Approximate geodetic

FILE NO.

PH0145

REMARKS

HOLE NO.

TP21/MW6

BORINGS BY Backhoe

DATE 3 JUN 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
GROUND SURFACE								20	40	60	80	
TOPSOIL	████████					0	88.26					
	0.20											
Stiff, grey-brown SILTY CLAY	▨▨▨▨▨▨▨▨▨▨	G	7			1	87.26					▽
	1.40											
Grey SILT	▨▨▨▨▨▨▨▨▨▨	G	8			2	86.26					
	3.00											
Grey SILTY CLAY	▨▨▨▨▨▨▨▨▨▨					3	85.26					
End of Test Pit	3.10											
(Water infiltration @ 1.1m depth)												

20 40 60 80 100  
Shear Strength (kPa)  
▲ Undisturbed    △ Remoulded

## SOIL PROFILE & TEST DATA

Hydrogeological Study and Terrain Analysis  
Greely Village Centre, Parkway Road  
Ottawa (Greely), Ontario

DATUM Approximate geodetic

FILE NO. **PH0145**

REMARKS

HOLE NO. **TP22**

BORINGS BY Backhoe

DATE 3 JUN 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
GROUND SURFACE						0	87.34	20	40	60	80	
TOPSOIL	[REDACTED]											
Dense, yellow-brown SILTY SAND with cobbles	[REDACTED]	G	9			1	86.34					
GLACIAL TILL: Dense, grey silty sand with gravel, cobbles	[REDACTED]	G	10			2	85.34					
End of Test Pit (TP dry upon completion)	[REDACTED]					3	84.34					

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded

DATUM Approximate geodetic

FILE NO. **PH0145**

REMARKS

HOLE NO. **TP23**

BORINGS BY Backhoe

DATE 3 JUN 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			20	40	60	80		
GROUND SURFACE						0	86.89						
TOPSOIL	0.28												
Yellow-brown medium to coarse SAND	1.40	G	11			1	85.89						
Dense, grey SILT	3.20					2	84.89						
End of Test Pit (Water infiltration @ 1.3m depth)						3	83.89						

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded

## SOIL PROFILE & TEST DATA

Hydrogeological Study and Terrain Analysis  
Greely Village Centre, Parkway Road  
Ottawa (Greely), Ontario

DATUM Approximate geodetic

FILE NO.

**PH0145**

REMARKS

HOLE NO.

**TP24**

BORINGS BY Backhoe

DATE 3 JUN 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			20	40	60	80		
GROUND SURFACE						0	86.15						
TOPSOIL	██████												
Red-brown medium SAND	░░░░	G	13										
Brown-grey SILTY CLAY	▨▨▨▨	G	14			1	85.15						14
End of Test Pit (Water infiltration @ 1.30m depth)						2	84.15						

○ Water Content %

▲ Undisturbed    △ Remoulded

DATUM Approximate geodetic

FILE NO. **PH0145**

REMARKS

HOLE NO. **TP25**

BORINGS BY Backhoe

DATE 3 JUN 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
GROUND SURFACE								20	40	60	80	
TOPSOIL	████████					0	86.25					
	0.30											
Brown SILTY CLAY	████████████████████					1	85.25					Piezometer Construction #7
- grey by 1.8m depth												
End of Test Pit	2.40					2	84.25					
(Water infiltration @ 1.7m depth)												
								20	40	60	80	100
								<b>Shear Strength (kPa)</b>				
								▲ Undisturbed    △ Remoulded				

DATUM Approximate geodetic

REMARKS

BORINGS BY Backhoe

DATE 3 JUN 05

FILE NO. **PH0145**

HOLE NO. **TP26**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
GROUND SURFACE						0	85.90	20	40	60	80	
TOPSOIL												
	0.50											
Brown SILT	3.20					1	84.90					
						2	83.90					
- grey by 2.9m depth						3	82.90					
	3.20	G	15									
GLACIAL TILL: Grey clayey sandy silt with gravel, cobbles and boulders	3.80	G	16									
End of Test Pit												
(Water infiltration @ 2.8m depth)												
								20	40	60	80	100
								<b>Shear Strength (kPa)</b>				
								▲ Undisturbed    △ Remoulded				

DATUM Approximate geodetic

FILE NO.

PH0145

REMARKS

HOLE NO.

TP27

BORINGS BY Backhoe

DATE 3 JUN 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
								20	40	60	80	
GROUND SURFACE						0	85.57					
TOPSOIL												
Red-brown fine SAND												
						1	84.57					
						2	83.57					
Brown SILT												
- grey by 2.6m depth						3	82.57					
						4	81.57					
End of Test Pit												
(Water infiltration @ 2.4m depth)												

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed    Δ Remoulded

DATUM Approximate geodetic

FILE NO. **PH0145**

REMARKS

HOLE NO. **TP28/MW7**

BORINGS BY Backhoe

DATE 3 JUN 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
GROUND SURFACE						0	85.72	20	40	60	80	
TOPSOIL	[Solid Black]											
Red-brown medium SAND	[Dotted Pattern]	G	17			1	84.72					▽
Grey-brown SILT	[Vertical Lines]	G	18			2	83.72					
- grey by 1.8m depth	[Vertical Lines]					3	82.72					
Grey SILTY CLAY	[Diagonal Lines]											
End of Test Pit												
(Water infiltration @ 1.2m depth)												

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded





DATUM Approximate geodetic

FILE NO.

PH0145

REMARKS

HOLE NO.

TP30/MW9

BORINGS BY Backhoe

DATE 3 JUN 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %					
GROUND SURFACE								20	40	60	80		
TOPSOIL	0.20					0	85.62						
Red-brown SILTY SAND	0.60												
Grey-brown SILT						1	84.62						
- grey by 1.4m depth													
						2	83.62						
						3	82.62						
End of Test Pit	3.60												
(Water infiltration @ 2.4m depth)													

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded

DATUM Approximate geodetic

FILE NO. **PH0145**

REMARKS

HOLE NO. **TP31**

BORINGS BY Backhoe

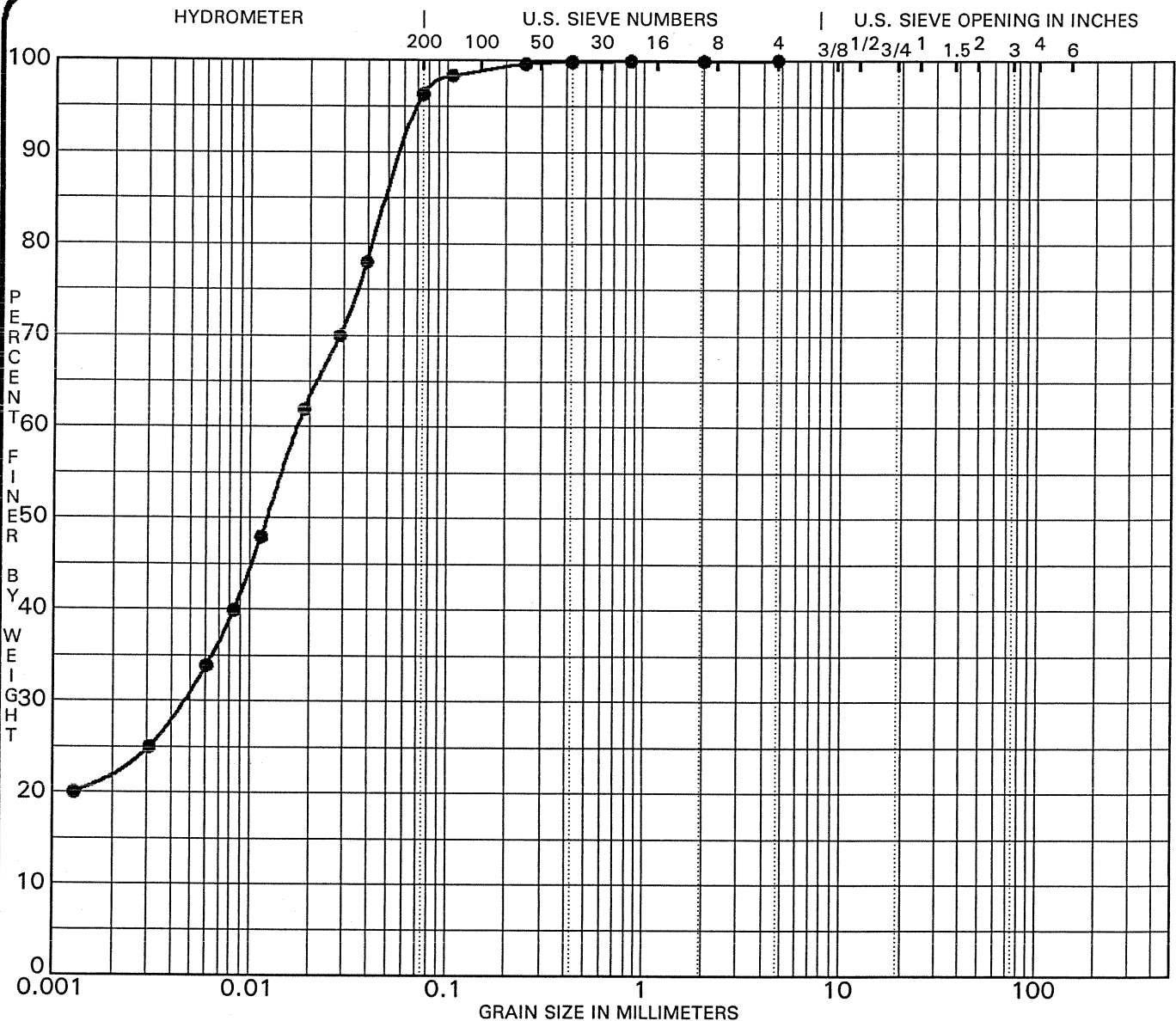
DATE 3 JUN 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %					
								20	40	60	80		
GROUND SURFACE						0	85.65						
TOPSOIL													
Red-brown fine SAND		G	21										
Brown-grey SILTY CLAY		G	22			1	84.65						
						2	83.65						
						3	82.65						
End of Test Pit (Water infiltration @ 1.8m depth)													

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed    △ Remoulded



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

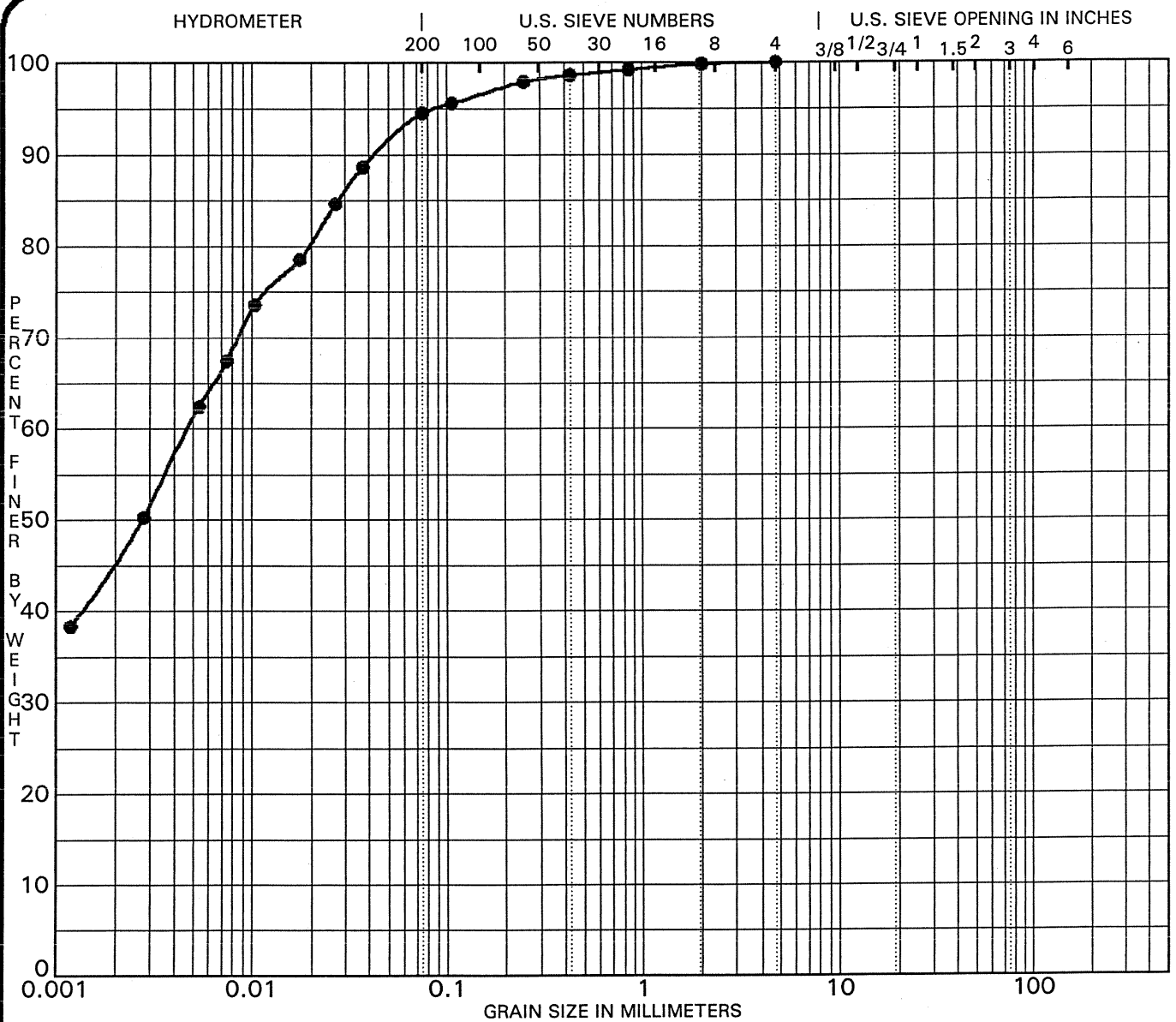
Specimen Identification	Classification					MC%	LL	PL	PI	Cc	Cu
● TP21/MW6 G7	INORGANIC SILT to CLAYEY SILT (ML)										
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay			
● TP21/MW6 G7	4.75	0.02	0.005		0.0	3.7					

CLIENT Sunset Lakes Development Corp.  
 PROJECT Hydrogeological Study and Terrain Analysis -  
Greely Village Centre, Parkway Road

FILE NO. PH0145  
 DATE 3 JUN 05

**patersongroup** Consulting Engineers  
 28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**GRAIN SIZE DISTRIBUTION**



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

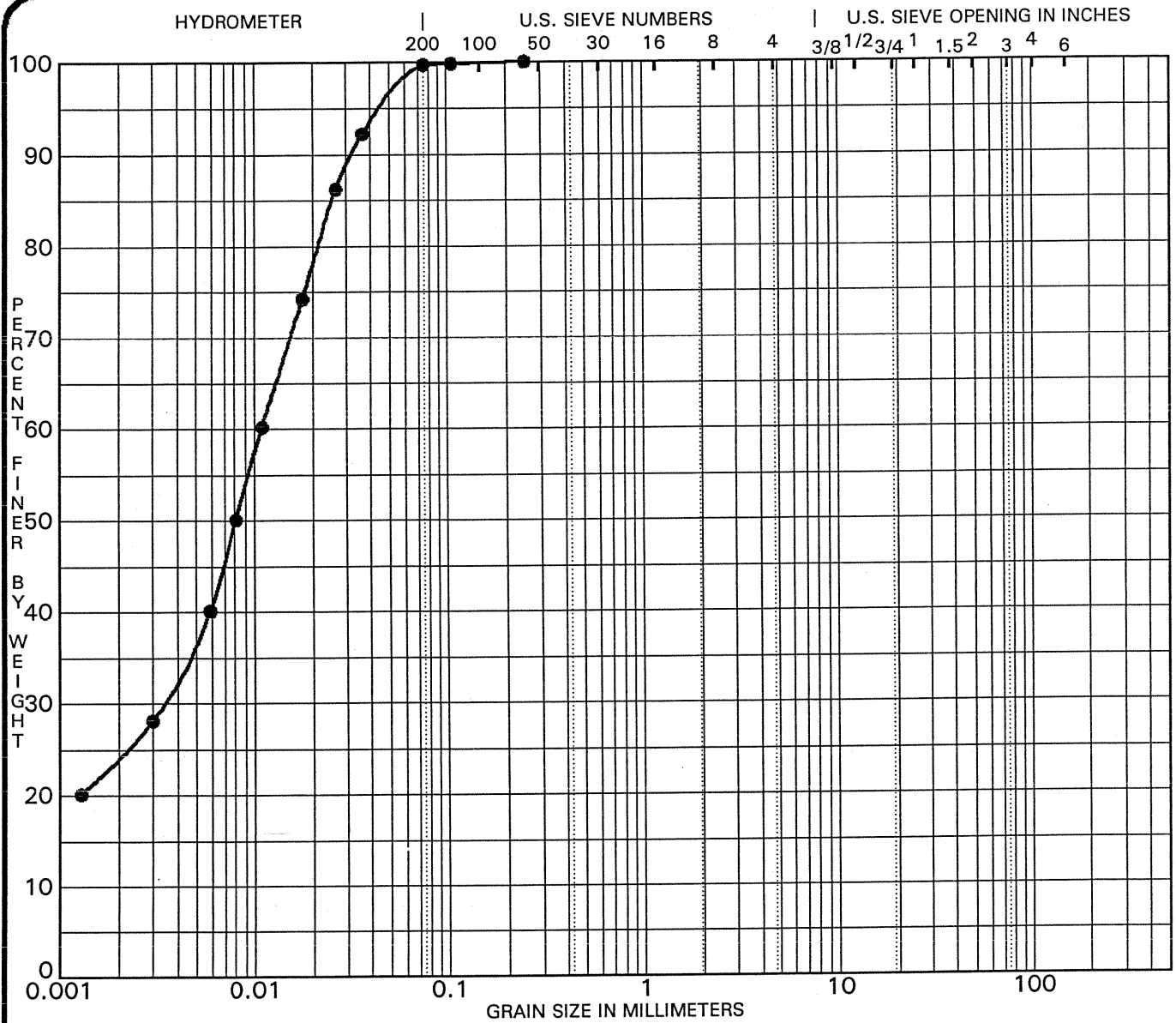
Specimen Identification	Classification				MC%	LL	PL	PI	Cc	Cu
● TP24 G14	SILTY CLAY (CL)									
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● TP24 G14	4.75	0.00			0.0	5.5				

CLIENT Sunset Lakes Development Corp.  
 PROJECT Hydrogeological Study and Terrain Analysis - Greely Village Centre, Parkway Road

FILE NO. PH0145  
 DATE 3 JUN 05

**patersongroup** Consulting Engineers  
 28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**GRAIN SIZE DISTRIBUTION**



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● TP28/MW7 G18	CLAYEY SILT to SILTY CLAY (MH)						

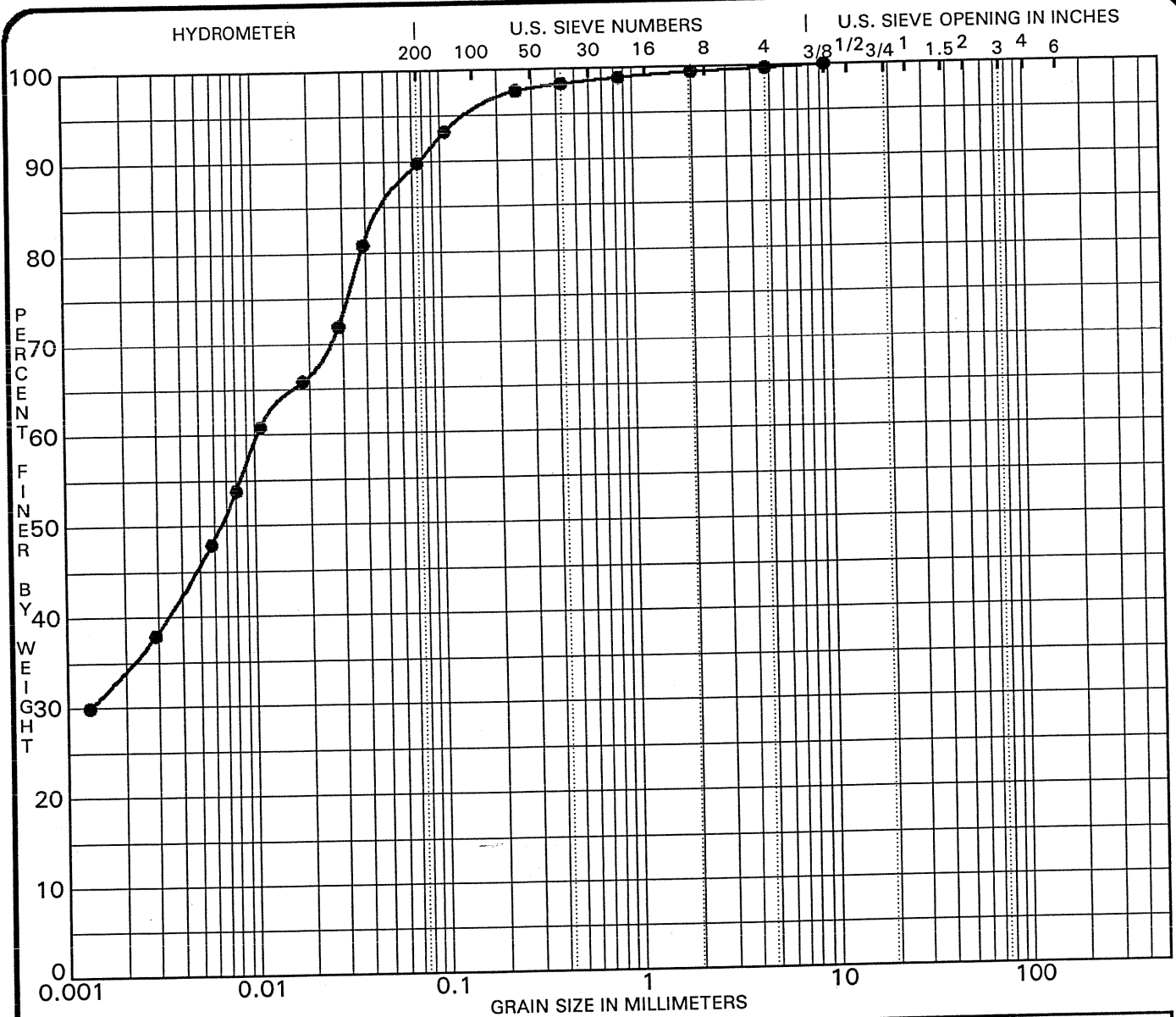
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP28/MW7 G18	0.25	0.01	0.003		0.0	0.3		

CLIENT Sunset Lakes Development Corp.  
 PROJECT Hydrogeological Study and Terrain Analysis - Greely Village Centre, Parkway Road

FILE NO. PH0145  
 DATE 3 JUN 05

**paterosongroup** Consulting Engineers  
 28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**GRAIN SIZE DISTRIBUTION**



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Specimen Identification	Classification				MC%	LL	PL	PI	Cc	Cu
● TP31 G22	SILTY CLAY (CH)									

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP31 G22	9.50	0.01	0.001		0.3	10.0		

CLIENT Sunset Lakes Development Corp.  
 PROJECT Hydrogeological Study and Terrain Analysis - Greely Village Centre, Parkway Road

FILE NO. PH0145  
 DATE 3 JUN 05

**patersongroup** Consulting Engineers  
 28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**GRAIN SIZE DISTRIBUTION**

## **APPENDIX 2**

### **WATER WELL RECORDS**

1. Water Well Records for Test Wells
2. MOE Published Water Well Records for Surrounding Wells
3. Graphical Presentation of Statistical Analysis of Regional Hydrogeology





Ministry of the Environment

Well Tag Num A 021474

Well Record Regulation 903 Ontario Water Resources Act

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Instructions for Completing Form

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

Well Owner's Information and Location of Well Information

Form fields for Well Owner's Information and Location of Well Information, including First Name, Last Name, Mailing Address, County/District/Municipality, Township/City/Town/Village, Province, Postal Code, Telephone Number, Address of Well Location, RR#/Street Number/Name, City/Town/Village, Site/Compartment/Block/Tract etc., GPS Reading, NAD, Zone, Easting, Northing, Unit Make/Model, Mode of Operation.

Log of Overburden and Bedrock Materials (see Instructions)

Table with columns: General Colour, Most common material, Other Materials, General Description, Depth From, Depth To. Includes handwritten entries for brown fill, gravel, limestone, and bedrock layers.

Construction Record and Test of Well Yield sections. Construction Record includes Hole Diameter, Inside diam, Material, Wall thickness, Depth, and Screen details. Test of Well Yield includes Pumping test method, Draw Down, Recovery, and various pumping rates.

Plugging and Sealing Record section. Includes Depth set at - Metres, Material and type, Volume Placed, Method of Construction, Water Use, and Final Status of Well.

Location of Well section. Includes a diagram showing distances of well from road, lot line, and building. Includes Audit No. and Date Well Completed.

Well Contractor/Technician Information section. Includes Name of Well Contractor, Business Address, Name of Well Technician, and Signature of Technician.

Ministry Use Only section. Includes Data Source, Date Received, Date of Inspection, Remarks, and Well Record Number.



Well Tag Nu **A 021473** (ROW)  
**A021473**

Well Record  
Regulation 903 Ontario Water Resources Act

page \_\_\_ of \_\_\_

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- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-8203.
- All metre measurements shall be reported to 1/10<sup>th</sup> of a metre.
- Please print clearly in blue or black ink only.

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

First Name: Sunset Lake Last Name: Development Co Mailing Address (Street Number/Name, RR, Lot, Concession): 6576 Apple Orchard Road

County/District/Municipality: Capleton Township/City/Town/Village: CRedy Province: Ontario Postal Code: K4P 1E5 Telephone Number (include area code): 613-860-1100

Address of Well Location (County/District/Municipality): Capleton Township: City of Oshawa Lot: 73-74 Concession: Plan 902

RR#/Street Number/Name: Highway 31 City/Town/Village: CRedy Site/Compartment/Block/Tract etc.: Plan 902

GPS Reading: NAD 83 Zone 11E Easting 455669.2 Northing 12280.0 Unit Make/Model: Magellan 4000 Mode of Operation:  Undifferentiated  Averaged  Differentiated, specify

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

General Colour	Most common material	Other Materials	General Description	Depth From	Metres To
BRON	fill	boulders	Hard	0	2.74
grey	gravel	sandy	Packed	2.74	7.92
grey	limestone		1/4 yard	7.92	36.57
pinkish	Sandstone		offered	36.57	40.23
grey	limestone		larger	40.23	58.86

**Hole Diameter**

Depth From	Metres To	Diameter Centimetres
0	9.14	21.23
9.14	54.86	15.53

**Construction Record**

Inside diam centimetres	Material	Wall thickness centimetres	Depth From	Metres To
15.53	<input checked="" type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized	0.49	50.60	9.14

**Test of Well Yield**

Pumping test method	Draw Down		Recovery	
	Time min	Water Level Metres	Time min	Water Level Metres
Pump intake set at (metres)	Static Level			
Pumping rate (litres/min)	1		1	
Duration of pumping (hrs + min)	2		2	
Final water level end of pumping (metres)	3		3	
Recommended pump type (Shallow/Deep)	4		4	
Recommended pump depth (metres)	5		5	
Recommended pump rate (litres/min)	10		10	
If flowing give rate (litres/min)	15		15	
	20		20	
	25		25	
If pumping discontinued, give reason.	30		30	
	40		40	
	50		50	
	60		60	

**Water Record**

Water found at: 5.2 m Kind of Water:  Fresh  Sulphur  Gas  Salty  Minerals  Other

After test of well yield, water was  Clear and sediment free  Other, specify

Chlorinated  Yes  No

**Plugging and Sealing Record**

Depth set at - Metres From	To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
0	9.14	Cement/Pneum grout	10 bags

**Method of Construction**

Cable Tool  Rotary (air)  Diamond  Digging  
 Rotary (conventional)  Air percussion  Jetting  Other  
 Rotary (reverse)  Boring  Driving

**Water Use**

Domestic  Industrial  Public Supply  Other  
 Stock  Commercial  Not used  
 Irrigation  Municipal  Cooling & air conditioning

**Final Status of Well**

Water Supply  Recharge well  Unfinished  Abandoned, (Other)  
 Observation well  Abandoned, insufficient supply  Dewatering  
 Test Hole  Abandoned, poor quality  Replacement well

**Location of Well**

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

Audit No. **2 21760** Date Well Completed **05 10 12** MM DD  
 Was the well owner's information package delivered?  Yes  No Date Delivered **05 10 12** MM DD

**Well Contractor/Technician Information**

Name of Well Contractor: Carles Bourgeois Well Contractor's Licence No.: 1414  
 Business Address (street name, number, city etc.): 57 A 16th av  
 Name of Well Technician (last name, first name): S. Dime Well Technician's Licence No.: 153  
 Signature of Technician/Contractor: [Signature] Date Submitted: **05 10 12** MM DD

**Ministry Use Only**

Date Source: \_\_\_\_\_ Contractor: \_\_\_\_\_  
 Date Received: \_\_\_\_\_ Date of Inspection: \_\_\_\_\_  
 Remarks: \_\_\_\_\_ Well Record Number: \_\_\_\_\_



Ministry of the Environment

Well Tag No. A 012199 (below) A012199

Well Record

Regulation 903 Ontario Water Resources Act

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All Sections must be completed in full to avoid delays in processing.
Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
All metre measurements shall be reported to 1/10th of a metre.
Please print clearly in blue or black ink only.

Well Owner's Information and Location of Well Information

Form containing well owner details: First Name (Sunset Lake), Last Name (Development Corp), Mailing Address (6576 Apple Orchard Road), Telephone Number (613-880-1100), County/District/Municipality (CARleton), Township/City/Town/Village (CReely), Province (Ontario), Postal Code (H4P 1E5), Address of Well Location (City of Ottawa), RR# (Hwy 31), GPS Reading (813, 1.8, 14155617555E, 15612191), Unit Make/Model (Magellan), Mode of Operation (Averaged).

Log of Overburden and Bedrock Materials (see instructions)

Table with columns: General Colour, Most common material, Other Materials, General Description, Depth From, Metres To. Handwritten entries include: 6.0m brown fill, 7.01m grey gravel, 7.01m grey limestone, Sand, Hard packed, lay sand.

Hole Diameter and Water Record sections. Hole Diameter table shows depth from 0 to 8.53m and diameter from 21.23 to 15.55cm. Water Record section includes water found at 1.5m, kind of water (Fresh), and other details.

Construction Record section. Includes Inside diam (15.55), Material (Steel), Wall thickness (0.48), Depth (7.06 to 8.53), and No Casing or Screen (Open hole).

Test of Well Yield table. Columns: Pumping test method, Draw Down (Time, Water Level), Recovery (Time, Water Level). Includes data for pumping rate (1 l/min), duration (2 min), and recommended pump rate (15 l/min).

Plugging and Seating Record, Method of Construction, Water Use, Final Status of Well, and Well Contractor/Technician Information sections. Includes details on casing material (concrete), construction method (rotary), water use (domestic), and contractor info (Willes Bourgeois).

Location of Well section. Includes a diagram showing well location relative to a road (Hwy 31) and a building. Also includes Audit No. (Z 21762) and Date Well Completed (05/05/02).

TW3

Instructions for Completing Form

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- All Sections must be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- All metre measurements shall be reported to 1/10<sup>m</sup> of a metre.
- Please print clearly in blue or black ink only.

**Ministry Use Only**

MUN: \_\_\_\_\_ CON: \_\_\_\_\_ LOT: \_\_\_\_\_

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

First Name: Sunset Lake Last Name: Development Corp Mailing Address: 6576 Apple Orchard Road  
 County/District/Municipality: Carleton Place Township/City/Town/Village: Greely Province: Ontario Postal Code: R4P 1E5 Telephone Number: 613-860-1100  
 Address of Well Location: Carleton Place Township: Greely City/Town/Village: Greely Lot: 102374 Concession: S/Le Barn Rd  
 RR#/Street Number/Name: S/Le Barn Rd Site/Compartment/Block/Tract etc.: Plan 902  
 GPS Reading: NAD: 83 Zone: 18 Easting: 4571180E Northing: 570126150 Unit Make/Model: Magellan Mode of Operation:  Undifferentiated  Averaged  Differentiated, specify \_\_\_\_\_

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

General Colour	Most common material	Other Materials	General Description	Depth Metres	
				From	To
brown	fill		Hard	0	1.82
grey	gravel	sand MIX	Packed	1.82	6.70
grey	limestone		layered	6.70	36.57

Hole Diameter			Construction Record				Test of Well Yield					
Depth From	Metres To	Diameter Centimetres	Inside diam centimetres	Material	Wall thickness centimetres	Depth From	Metres To	Pumping test method	Draw Down Time min	Recovery Water Level Metres	Time min	Water Level Metres
0	8.70	21.23										
		15.55	<input checked="" type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized				Pumping rate - (litres/min) _____ Duration of pumping _____ hrs + _____ min Final water level end of pumping _____ metres Recommended pump type: <input type="checkbox"/> Shallow <input type="checkbox"/> Deep Recommended pump depth _____ metres Recommended pump rate (litres/min) _____ If flowing give rate (litres/min) _____ If pumping discontinued, give reason. _____					
Water Record			Screen				Recommended pump rate (litres/min) _____ If flowing give rate (litres/min) _____ If pumping discontinued, give reason. _____					
Water found at	Metres	Kind of Water	Outside diam	Slot No.		No Casing or Screen		Recommended pump rate (litres/min) _____ If flowing give rate (litres/min) _____ If pumping discontinued, give reason. _____				
1.35		Fresh						10	10	10	10	10
		Sulphur						15	15	15	15	15
		Salty						20	20	20	20	20
		Minerals						25	25	25	25	25
		Other:						30	30	30	30	30
								40	40	40	40	40
								50	50	50	50	50
								60	60	60	60	60
After test of well yield, water was			<input checked="" type="checkbox"/> Open hole									
<input type="checkbox"/> Clear and sediment free			8.70				36.57					
<input type="checkbox"/> Other, specify _____												
Chlorinated <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No												

**Plugging and Sealing Record**  Annular space  Abandonment

Depth set at - Metres	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
0	8.70 cement grout	10 bags

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

**Method of Construction**

Cable Tool  Rotary (air)  Rotary (conventional)  Rotary (reverse)  Air percussion  Boring  Diamond  Jetting  Driving  Digging  Other

**Water Use**

Domestic  Stock  Irrigation  Industrial  Commercial  Municipal  Public Supply  Not used  Cooling & air conditioning  Other

**Final Status of Well**

Water Supply  Observation well  Test Hole  Recharge well  Abandoned, insufficient supply  Abandoned, poor quality  Unfinished  Dewatering  Replacement well  Abandoned, (Other)

**Well Contractor/Technician Information**

Name of Well Contractor: Gilles Bourgeois Well Contractor's Licence No.: 1414  
 Business Address (street name, number, etc.): 57 A 16th Ave  
 Name of Well Technician (last name, first name): S. A. me Well Technician's Licence No.: 0-193  
 Signature of Technician/Contractor: [Signature] Date Submitted: 05 10 13 YYY MM DD

**Ministry Use Only**

Audit No.: Z 21780 Date Well Completed: 05 10 13 YYY MM DD  
 Was the well owner's information package delivered?  Yes  No Date Delivered: 05 10 13 YYY MM DD

Data Source: \_\_\_\_\_ Contractor: \_\_\_\_\_  
 Date Received: \_\_\_\_\_ Date of Inspection: \_\_\_\_\_  
 Remarks: \_\_\_\_\_ Well Record Number: \_\_\_\_\_

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- All metre measurements shall be reported to 1/10<sup>th</sup> of a metre.
- Please print clearly in blue or black ink only.

Well Owner's Information and Location of Well Information				Ministry Use Only			
MUN		CON		LOT			
First Name <i>Sains et Development</i>		Last Name <i>CORPORATION</i>		Mailing Address (Street Number/Name, RR, Lot, Concession) <i>6576 apple orchard Road</i>			
County/District/Municipality <i>Carleton Place</i>		Township/City/Town/Village <i>Carleton Place</i>		Province <i>Ontario</i>		Postal Code <i>K4P 1E5</i>	
Address of Well Location (County/District/Municipality) <i>Carleton Place</i>		Township <i>City of Ottawa</i>		Lot <i>16475</i>		Concession <i>Plan 902</i>	
RR#/Street Number/Name <i>Parkway Rd</i>		City/Town/Village <i>Carleton Place</i>		Site/Compartment/Block/Tract/etc. <i>atm</i>			
GPS Reading <i>18.3</i>		NAD Zone <i>1181</i>		Easting <i>456942 E</i>		Northing <i>57012789</i>	
Unit Make/Model <i>Magellan</i>		Mode of Operation: <input type="checkbox"/> Undifferentiated <input checked="" type="checkbox"/> Averaged		<input type="checkbox"/> Differentiated, specify _____			

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

General Colour	Most common material	Other Materials	General Description	Depth From	Metres To
<i>brown</i>	<i>fill</i>		<i>Hard</i>	<i>0</i>	<i>2.13</i>
<i>grey</i>	<i>gravel</i>	<i>Sand mix</i>	<i>packed</i>	<i>2.13</i>	<i>2.92</i>
				<i>2.92</i>	<i>30.48</i>

<b>Hole Diameter</b>			<b>Construction Record</b>				<b>Test of Well Yield</b>					
Depth Metres	From	To	Inside diam centimetres	Material	Wall thickness centimetres	Depth From	Metres To	Pumping test method	Draw Down Time min	Recovery Time min	Water Level Metres	Water Level Metres
	<i>0</i>	<i>9.144</i>	<i>15.55</i>	<input checked="" type="checkbox"/> Steel <input type="checkbox"/> Fibreglass	<i>0.48</i>	<i>7.060</i>	<i>9.144</i>	Pump intake set at - (metres)	Static Level			
	<i>9.144</i>	<i>30.48</i>		<input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized				Pumping rate - (litres/min)	<i>1</i>	<i>1</i>		
<b>Water Record</b>			<b>Screen</b>									
Water found at Metres	Kind of Water		Outside diam	Slot No.								
<i>0.7</i>	<input checked="" type="checkbox"/> Fresh <input type="checkbox"/> Sulphur <input type="checkbox"/> Gas <input type="checkbox"/> Salty <input type="checkbox"/> Minerals <input type="checkbox"/> Other:		<input type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized									
	<input type="checkbox"/> Fresh <input type="checkbox"/> Sulphur <input type="checkbox"/> Gas <input type="checkbox"/> Salty <input type="checkbox"/> Minerals <input type="checkbox"/> Other:		<b>No Casing or Screen</b>									
	<input type="checkbox"/> Fresh <input type="checkbox"/> Sulphur <input type="checkbox"/> Gas <input type="checkbox"/> Salty <input type="checkbox"/> Minerals <input type="checkbox"/> Other:		<input type="checkbox"/> Open hole									
After test of well yield, water was												
<input type="checkbox"/> Clear and sediment free												
<input type="checkbox"/> Other, specify _____												
Chlorinated <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No												

<b>Plugging and Sealing Record</b>			<b>Location of Well</b>		
Depth set at - Metres	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)	In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.		
<i>0</i>	<i>Cement grout 9 bag</i>				
<b>Method of Construction</b>			<b>Water Use</b>		
<input type="checkbox"/> Cable Tool <input type="checkbox"/> Rotary (conventional) <input type="checkbox"/> Rotary (reverse)	<input checked="" type="checkbox"/> Rotary (air) <input type="checkbox"/> Air percussion <input type="checkbox"/> Boring	<input type="checkbox"/> Diamond <input type="checkbox"/> Jetting <input type="checkbox"/> Driving	<input checked="" type="checkbox"/> Domestic <input type="checkbox"/> Stock <input type="checkbox"/> Irrigation	<input type="checkbox"/> Industrial <input type="checkbox"/> Commercial <input type="checkbox"/> Municipal	<input type="checkbox"/> Public Supply <input type="checkbox"/> Not used <input type="checkbox"/> Cooling & air conditioning <input type="checkbox"/> Other
<b>Final Status of Well</b>			<b>Well Contractor/Technician Information</b>		
<input type="checkbox"/> Water Supply <input type="checkbox"/> Observation well <input checked="" type="checkbox"/> Test Hole	<input type="checkbox"/> Recharge well <input type="checkbox"/> Abandoned, insufficient supply <input type="checkbox"/> Abandoned, poor quality	<input type="checkbox"/> Unfinished <input type="checkbox"/> Dewatering <input type="checkbox"/> Replacement well	Name of Well Contractor <i>Gilles Bourgeois</i>	Well Contractor's Licence No. <i>1414</i>	
			Business Address (street name, number, city etc.) <i>57 Albert St</i>		
			Name of Well Technician (last name, first name) <i>S. Strome</i>	Well Technician's Licence No. <i>0-193</i>	
			Signature of Technician/Contractor <i>S. Strome</i>		
			Date Submitted <i>05/05/02</i>		

<b>Plugging and Sealing Record</b>		<b>Location of Well</b>	
Depth set at - Metres	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)	In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.
<i>0</i>	<i>Cement grout 9 bag</i>		
<b>Method of Construction</b>		<b>Water Use</b>	
<input type="checkbox"/> Cable Tool <input type="checkbox"/> Rotary (conventional) <input type="checkbox"/> Rotary (reverse)	<input checked="" type="checkbox"/> Rotary (air) <input type="checkbox"/> Air percussion <input type="checkbox"/> Boring	<input type="checkbox"/> Diamond <input type="checkbox"/> Jetting <input type="checkbox"/> Driving	<input checked="" type="checkbox"/> Domestic <input type="checkbox"/> Stock <input type="checkbox"/> Irrigation
<b>Final Status of Well</b>		<b>Well Contractor/Technician Information</b>	
<input type="checkbox"/> Water Supply <input type="checkbox"/> Observation well <input checked="" type="checkbox"/> Test Hole	<input type="checkbox"/> Recharge well <input type="checkbox"/> Abandoned, insufficient supply <input type="checkbox"/> Abandoned, poor quality	<input type="checkbox"/> Unfinished <input type="checkbox"/> Dewatering <input type="checkbox"/> Replacement well	Name of Well Contractor <i>Gilles Bourgeois</i>
		Well Contractor's Licence No. <i>1414</i>	
		Business Address (street name, number, city etc.) <i>57 Albert St</i>	
		Name of Well Technician (last name, first name) <i>S. Strome</i>	
		Well Technician's Licence No. <i>0-193</i>	
		Signature of Technician/Contractor <i>S. Strome</i>	
		Date Submitted <i>05/05/02</i>	

MUNICIPALITY CONCESSION ETC	LOT NO	NORTHING	ELEV	DATE	DRILLER	INS	WATER FEET	CSG KIND	WATER STAT	PUMP TEST	TEST TIME	WATER DEPTH	SCREEN DEPTH LENGTH	OWNER FORMATIONS EXTEND	
							FEET		FEET	GPM	HR:MN	USE	FEET		
CON	05	005	15- 455900	310	1968/10	1517	04	FR	0043	2	15	20	1 : 0	DO	TAILLEFER D LOAM MSND 0004 MSND 0038 LMSN 0044
CON	05	005	15- 456080	305	1970/10	1558	06	FR	0075	26	27	18	2 : 0	DO	LEE J BRWN GRVL STNS 0075
CON	05	005	15- 455635	328	1972/11	3504	06	FR	0065	5	40	10	1 : 0	DO	JOHNSTON S GRVL SAND 0040 LMSN 0065
CON	05	006	15- 999999	1993/09	3749	06	FR	0046	7	27	10	1 : 0	DO	BYLES GREY GRVL HPAN PCKD 0019 GREY LMSN 0055	
CON	05	006	15- 999999	1997/08	2348	06	FR	0090	15	125	5	1 : 0	DO	RACINE, CLAIR HPAN 0020 GRVL 0027 LMSN 0130	
CON	05	006	15- 999999	1989/07	3701	06	FR	0078	15	20	15	1 : 0	DO	PILARMAC DEV LTD BRWN LOAM 0001 BRWN CLAY BLDR DNSE 0038 GREY ROCK	
CON	05	006	15- 999999	1991/10	1558	06	UK	0096	12	20	10	1 : 0	DO	LMSN 0078 MCEVOY, PHILIP BRWN SAND BLDR 0014 GREY SAND BLDR 0027 GREY LMSN	
CON	05	006	15- 999999	1991/07	1517	06	FR	0048	8	20	20	1 : 0	DO	MR CONSELMAN BRWN SAND 0018 BRWN SAND GRVL 0048 GREY LMSN ROCK	
CON	05	006	15- 999999	1988/06	2348	06	FR	0070	15	75	7	1 : 0		STRABY, SHELDON SAND GRVL 0022 LMSN 0075	
CON	05	006	15- 999999	1987/10	4875	06	FR	0056	12	45	40	0 : 30	DO	MCGILLNARY, MR F X BRWN SAND 0008 GREY GRVL BLDR 0040 GREY LMSN SHLE	
CON	05	006	15- 999999	1987/07	4875	06	FR	0088	8	90	12	1 : 30	PS	0063 GREZY RE. ASSOC. BRWN CLAY FILL 0004 GREY SAND 0016 GREY SAND GRVL	
CON	05	006	15- 999999	1988/08	4875	06	FR	0056	9	40	20	0 : 45	AC	BLDR 0035 GREY LMSN SHLE 0102 GREELY LIONS CLUB BRWN SAND 0009 GREY TILL 0035 GREY GRVL BLDR 0048	
CON	05	006	15- 999999	1988/03	1558	06	UK	0070	12	25	30	1 : 0	DO	GREY LMSN SHLE 0065 VANDERYDT, JOHN BRWN SAND BLDR 0004 BRWN SAND GRVL 0030 GREY SAND	
CON	05	006	15- 999999	1988/08	4875	06	FR	0056	8	40	20	0 : 45	DO	GRVL BLDR 0047 GREY LMSN 0075 GREELY LIONS CLUB BRWN SAND 0008 GREY TILL 0032 GREY GRVL SAND BLDR	
CON	05	006	15- 456100	308	1974/11	3644	06	FR	0050	5	25	50	1 : 0	DO	0048 GREN LMSN SHLE 0065 HAMMOND GORD GREY CLAY STNS 0040 GREY HPAN GRVL 0050
CON	05	006	15- 456200	310	1976/07	3644	06	FR	0038	6	25	20	1 : 0	DO	GEEBAN CONSTRUCTION GREY SAND 0020 GREY SAND STNS 0032 GREY LMSN 0040
CON	05	006	15- 455698	322	1975/09	3644	06	FR	0073	15	50	20	1 : 0	DO	NORMAYLE CONST GREY HPAN STNS 0025 GREY SAND 0047 GREY LMSN 0075
CON	05	006	15- 455910	318	1976/06	1517	06	FR	0048	20	35	15	1 : 0	DO	JET B G BRWN SAND 0040 BLACK GRVL 0043 GREY SNDS 0049
CON	05	006	15- 456238	312	1975/06	1558	06	FR	0108	5	15	75	1 : 0	DO	ZERANSKY HELMUT BRWN SAND 0002 GREY SAND 0013 GREY LMSN BLDR 0016
CON	05	006	15- 455520	325	1976/07	1517	06	FR	0053	20	50	20	1 : 30	MN	GREY SAND 0018 GREY LMSN 0080 GREY SNDS 0100 GREY LMSN 0110 STASION FEUE BRWN GRVL 0027 GREY HPAN 0050 GREY SNDS 0051 UNKN
CON	05	006	15- 455883	320	1975/10	3644	06	FR	0051	15	30	100	1 : 0	DO	0055 GEEBAU CONSTRUCTION GREY HPAN SAND STNS 0050 GREY LMSN 0053

CONTINUING... OSGOODE TOWNSHIP

MUNICIPALITY CONCESSION ETC	LOT	NO	EASTING	ELEV	UTM	DATE	DRILLER	INS	WATER	FEET	STAT	PUMP	TEST	TEST	TIME	WATER	DEPTH	LENGTH	SCREEN	DEPTHS	IN	FEET	TO	WHICH	FORMATIONS	EXTEND
CON	05	006	15-	455922	318	1975/11	3644	06	FR	0052	6	25	50	1	:0	DO										
				15170	5011939																					
CON	05	006	15-	455990	315	1976/08	3658	06	FR	0064	3	25	75	2	:0	DO										
				15791	5011950																					
CON	05	006	15-	456540	297	1976/07	1558	06	FR	0044	6	20	60	1	:0	DO										
				15514	5011990																					
CON	05	006	15-	455939	316	1975/08	3644	06	FR	0045	8	30	40	1	:0	DO										
				15150	5011885																					
CON	05	006	15-	456126	300	1975/06	1558	06	FR	0121	20	75	7	1	:0	DO										
				14749	5012111																					
CON	05	006	15-	455883	325	1975/08	3644	06	FR	0048	8	40	20	1	:0	DO										
				14844	5011924																					
CON	05	006	15-	455921	316	1975/11	3644	06	FR	0073	15	50	10	1	:0	DO										
				15168	5011872																					
CON	05	006	15-	455817	325	1975/07	3644	06	FR	0053	10	25	20	1	:0	DO										
				14853	5011864																					
CON	05	006	15-	455810	320	1975/08	3644	06	FR	0034	5	25	50	1	:0	DO										
				14855	5011881																					
CON	05	006	15-	455940	315	1976/04	1517	06	FR	0055	18	25	20	1	:10	DO										
				15390	5011920																					
CON	05	006	15-	455977	316	1975/09	1517	06	FR	0048	8	25	15	1	:20	DO										
				15094	5011952																					
CON	05	006	15-	455910	316	1976/04	1517	06	FR	0058	15	30	15	1	:10	DO										
				15391	5011910																					
CON	05	006	15-	455935	316	1975/11	1558	06	FR	0058	10	30	20	1	:0	DO										
				15081	5011890																					
CON	05	006	15-	456240	311	1976/11	3644	06	FR	0051	8	25	50	1	:0	DO										
				15828	5011760																					
CON	05	006	15-	456180	310	1976/11	3644	06	FR	0061	10	40	50	1	:0	DO										
				15829	5011950																					
CON	05	006	15-	455905	322	1975/09	3644	06	FR	0062	15	30	30	1	:0	DO										
				15139	5011859																					
CON	05	006	15-	456234	310	1975/07	1558	06	FR	0070	15	20	25	1	:0	DO										
				14789	5012021																					
CON	05	006	15-	455880	320	1976/04	4788	06	FR	0060	20	30	6	1	:0	DO										
				15342	5011920																					
CON	05	006	15-	456600	280	1976/09	1517	05	FR	0025	6	18	25	1	:20	DO										
				15603	5011960																					
CON	05	006	15-	455840	322	1976/05	4788	06	FR	0060	20	35	6	1	:15	DO										
				15340	5011920																					
CON	05	006	15-	455599	325	1981/07	1414	06	FR	0040	12	25	30	1	:0	DO										
				17638	5011799																					
CON	05	006	15-	455499	325	1975/07	1517	06	FR	0049	18	28	25	1	:30	DO										
				17152	5011999																					

CONTINUING... OSGOODE TOWNSHIP

CABA BILL  
 GREY SAND STNS 0049 GREY LMSN 0054  
 GORE BRIAN  
 GREY GRVL 0010 GREY CLAY 0040 GREY HPAN 0055 GREY  
 LMSN 0065  
 PROULX ARMAN  
 BRWN CLAY STNS FILL 0003 BRWN SAND LOOS 0041 BLACK  
 LMSN FCRD 0045  
 GEEBAU CONSTRUCTION  
 GREY SAND STNS 0042 GREY GRVL 0045  
 GARRARD ROY  
 GRVL BLDR 0046 BLACK LMSN 0123  
 CROFT  
 GREY SAND 0045 GREY LMSN 0048 GREY GRVL 0050  
 DOWNEY  
 GREY SAND GRVL 0048 GREY LMSN 0075  
 HAARSWA J  
 BRWN SAND GRVL 0039 GREY LMSN 0055  
 LARICCIA MIKE  
 GREY SAND 0026 GREY HPAN STNS 0028 GREY LMSN 0033  
 GREY GRVL 0035  
 B G JET CO LTD  
 BRWN SAND GRVL BLDR 0040 BRWN SAND GRVL 0049 GREY  
 LMSN 0056  
 VEZINA CHARLES  
 BRWN SAND 0041 BLACK SHLE 0050  
 B G JET CO LTD  
 BRWN GRVL SAND BLDR 0050 BRWN GRVL 0052 UNKN 0059  
 ROMBOUGH JAMES  
 BRWN SAND PKCD 0025 BRWN GRVL BLDR PKCD 0046 GREY  
 LMSN 0060  
 ROCK GARY  
 GREY SAND STNS 0040 GREY LMSN 0055  
 BERT JERRY  
 GREY SAND 0045 GREY LMSN 0064  
 GULIK JOHN VAN  
 GREY HPAN STNS 0018 BRWN SAND 0040 GREY HPAN 0051  
 GREY LMSN 0065  
 ENGELS ALEXANDER  
 BRWN GRVL BLDR 0046 GREY LMSN 0073  
 MACACHERN J  
 BRWN SAND BLDR SOFT 0025 YLLW SAND SOFT 0046 GREY  
 LMSN HARD 0065  
 MCEVOYS PHILLIP  
 YLLW SAND 0021 BLACK SHLE 0028  
 PLOSENSKI PETER  
 BRWN SAND BLDR SOFT 0017 YLLW SAND SOFT 0048 GREY  
 LMSN HARD 0065  
 FRANZ H  
 YLLW CLAY SNDY SOFT 0031 BLACK SHLE SOFT 0041  
 KELSEY B  
 YLLW SAND 0035 BRWN HPAN SAND 0040 GREY LMSN 0051

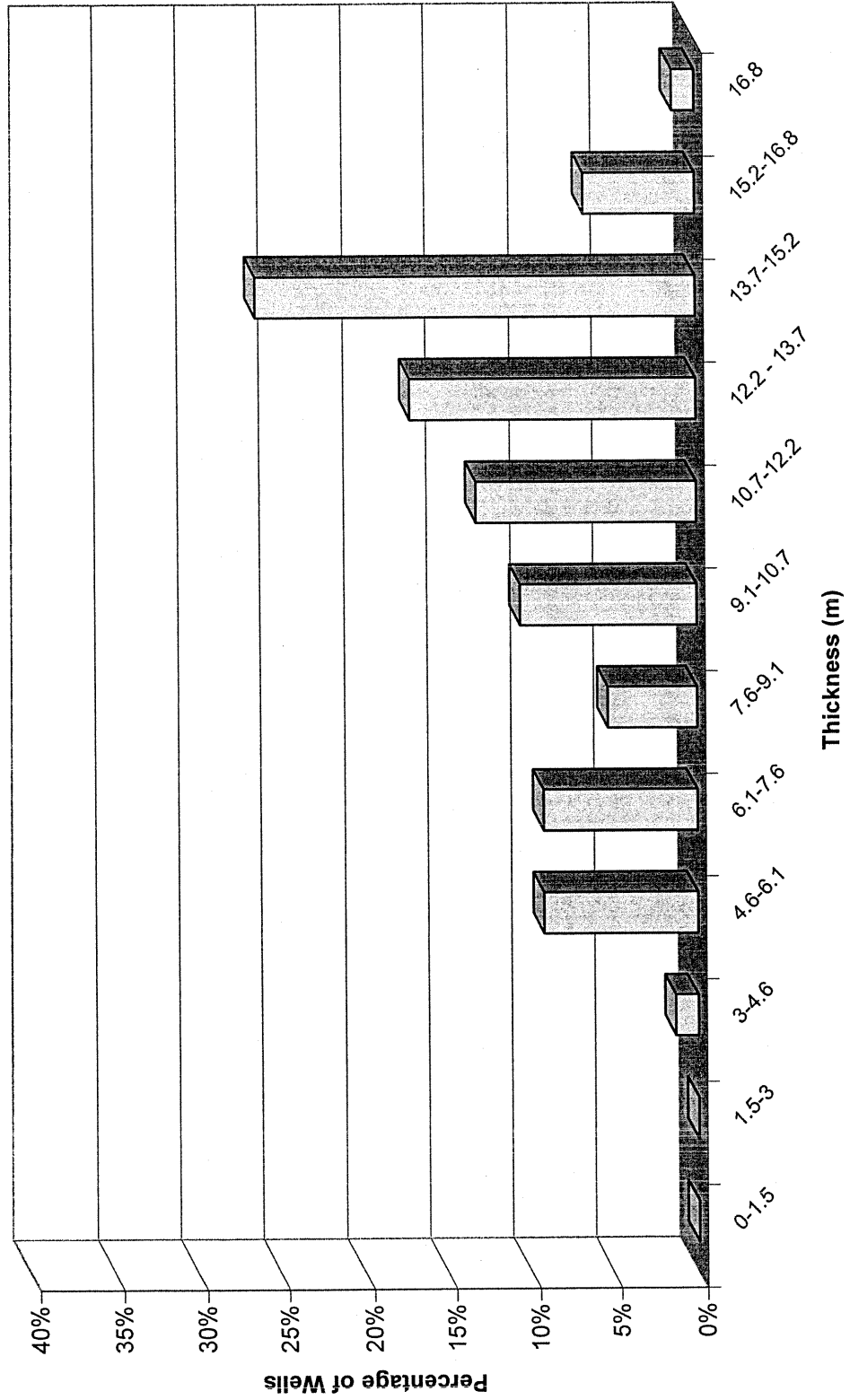
CONCESSION ETC	LOT	NO	EASTING	ELEV	DATE	DRILLER	INS	DIA	KIND	WATER	STAT	PUMP	TEST	TIME	WATER	DEPTH	LENGTH	SCREEN	OWNER			
																			FEET	FEET	HR:MN	USE
CONTINUING... OSGOODE TOWNSHIP																						
CON	05	006	15-	455499	325	1979/08	1517	06	FR	0049	20	30	18	1:30	DO					MC DONALD G	YLLW SAND 0043 GREY LMSN 0053	
CON	05	006	17154	5011999	320	1981/06	1414	06	FR	0046	7	20	30	1:0	DO					LEVESQUE C	RED CLAY SOFT 0012 GREY TILL BLDR HARD 0040 GREY LMSN HARD 0048	
CON	05	006	15-	455499	310	1976/03	1505	06	FR	0055	20	35	8	1:0	DO					DESCHAMPS D	BRWN FILL 0002 BRWN SAND GRVL BLDR 0030 BRWN SAND GRVL PKCD 0046 GREY LMSN HARD 0065	
CON	05	006	17024	5011999	325	1979/06	1517	06	FR	0048	20	26	20	1:30	DO					KINSELLA L	BRWN HPAN 0016 YLLW SAND 0045 BLCK GRVL 0047 GREY LMSN 0051	
CON	05	006	15-	455799	320	1981/07	1414	06	FR	0046	12	25	30	1:0	DO					MANNARINO R	RED CLAY SOFT 0003 GREY TILL BLDR HARD 0040 GREY STNS HARD 0048	
CON	05	006	17755	5011999	320	1981/08	1558	06	FR	0058	5	20	50	1:0	DO					GARRETT M	BRWN SAND BLDR 0005 BRWN SAND 0047 BRWN SAND GRVL 0048 GREY LMSN 0060	
CON	05	006	18216	5012599	280	1983/04	4006	08	FR	0056	0	7	8	1:0	DO					STOKEY C	BRWN SAND CLAY STNS 0004 GREY SAND GRVL CLAY 0018 GREY LMSN HARD 0064	
CON	05	006	17964	5011899	320	1982/05	1558	06	FR	0050	20	25	30	1:0	DO					JOHN VANDERYDT LTD	BRWN SAND BLDR 0014 GREY HPAN GRVL 0030 GREY GRVL SAND 0043 GREY LMSN 0055	
CON	05	006	18002	5011699	320	1982/10	1517	06	FR	0043	12	20	20	1:30	DO					MILLER J	BRWN SAND 0006 GREY QSND STNS MGRD 0042 GREY LMSN STNS HARD 0045	
CON	05	006	18291	5011699	320	1983/05	1414	06	FR	0047	12	35	10	1:0	PS DO					GREELY COM CTRE	RED SILT SOFT 0012 GREY TILL BLDR HARD 0039 BLACK STNS HARD 0048	
CON	05	006	17878	5011599	320	1982/06	2348	06	FR	0037	14	20	18	1:0	DO					SOHNSTON D	SAND 0020 GRVL 0034 LMSN 0039	
CON	05	006	18289	5011899	325	1983/05	1414	06	FR	0051	6	25	10	1:0	DO					LARABIE R	RED CLAY SOFT 0012 BLUE CLAY SNDY SOFT 0041 BLUE GRVL HARD 0048 BLUE STNS HARD 0053	
CON	05	006	19360	5011599	320	1984/09	1517	06	FR	0046	12	16	20	1:0	DO					BALISLE M	BRWN SAND 0004 GREY SAND GRVL 0021 GREY QSND 0040 GREY CSND GRVL 0045 GREY LMSN STNS 0048	
CON	05	006	17879	5011599	320	1982/06	2348	06	FR	0047	10	20	30	1:0	DO					BELANGER T	SAND 0033 GRVL 0042 LMSN 0049	
CON	05	006	30108	9999999	288	1998/05	2348	06	FR	0050	10	50	6	1:0	DO					RACIRE, CLAIRE	HPAN 0020 GRVL 0021 LMSN 0055	
CON	05	006	19914	9999999	325	1985/06	2307	06	FR	0063	21	63	10	4:0	DO					DONWELL CONST.	BRWN FILL LOOS STNS 0003 WHIT SAND 0031 GRVL LOOS 0049 GREY SHLE SOFT 0063	
CON	05	006	19915	9999999	325	1985/06	2307	06	FR	0078	20	70	10	1:0	DO					DONWEL CONST.	WHIT SAND STNS LOOS 0013 GREY SHLE SOFT 0085	
CON	05	006	20499	9999999	288	1958/02	1530	04	FR	0060	15	20	50	1:0	DO					SAND GRVL LMSN 0064	SCHAREFF B	LOAM MSND 0015 HPAN 0048 GRVL 0051 LMSN 0060
CON	05	006	07302	5012510	325	1966/10	3504	05	FR	0050	20	50	6	1:0	DO					KAUFMAN H	GRVL BLDR 0018 LMSN 0060	



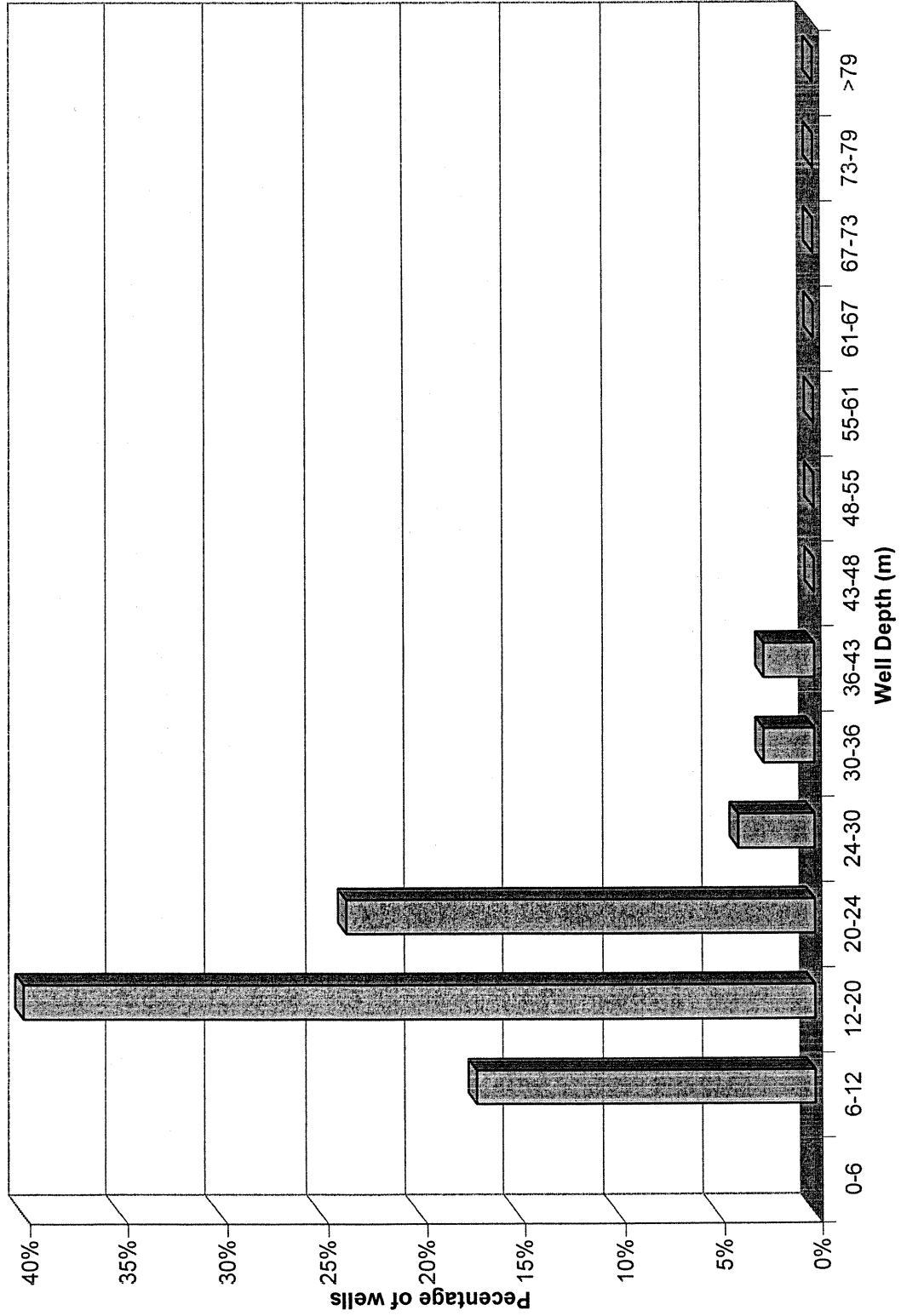
MUNICIPALITY	CONCESSION	LOT	NO	EASTING	ELEV	DATE	DRILLER	INS	WATER	FEET	STAT	PUMP	TEST	TIME	WATER	DEPTH	LENGTH	IN	FEET	TO	WHICH	FORMATIONS	EXTEND	OWNER
ETC													HR:	MIN	USE	FEET	FEET							
CON	05	006	15-	456160	305	1966/03	1503	05	SU	0056	19	40	10	1 : 0	DO									MORROW G CLAY MSND 0020 HPAN BLDR 0034 LMSN 0057
CON	05	006	15-	456230	305	1965/01	3601	05	FR	0035	8	10	10	1 : 0	DO									HERBERT C GRVL MSND 0024 LMSN 0035
CON	05	006	15-	456310	310	1962/10	4825	04	FR	0024	5	8	6	0 : 30	DO									SKRABS A CLAY 0016 LMSN 0025
CON	05	006	15-	456300	305	1962/09	4825	05	FR	0026	2	6	6	0 : 30	DO									WOUTERS A MSND 0021 LMSN 0027
CON	05	006	15-	456490	300	1961/08	1530	04	FR	0023	7	10	10	2 : 0	DO									MCEVOY P LOAM MSND 0012 QNSD 0015 MSND GRVL 0017 GREY LMSN 0023
CON	05	006	15-	456020	315	1961/05	1530	04	FR	0040	5	15	12	2 : 0	DO									WADELEK S LOAM MSND 0020 QNSD 0030 MSND 0038 LMSN 0042
CON	05	006	15-	456960	282	1958/02	1530	04	FR	0035	20	25	17	2 : 0	DO									MCEVOY P HPAN 0031 GREY LMSN 0036
CON	05	006	15-	456940	285	1958/02	1530	05	FR	0040	10	25	17	1 : 0	ST DO									SHIELD A HPAN 0031 LMSN 0042
CON	05	006	15-	455980	320	1960/04	1530	04	FR	0060	12	15	15	1 : 0	DO									SCHARFF A LOAM MSND 0020 QNSD 0030 MSND STNS 0049 ROCK 0060
CON	05	006	15-	455810	320	1962/09	1503	05	FR	0075	23	26	10	1 : 0	DO									CALIN D GRVL 0020 MSND 0043 BLUE LMSN 0077
CON	05	006	15-	456390	308	1968/10	1517	04	FR	0024	2	10	10	0 : 30	DO									MCEVOY PHILIP LOAM MSND 0003 QNSD 0021 BLCK LMSN 0026
CON	05	006	15-	456294	311	1972/10	1517	06	FR	0043	FLW	28	10	1 : 0	DO									JOHN LANDRIGAN GREY HPAN 0026 GREY LMSN ROCK 0045
CON	05	006	15-	456580	300	1970/10	1517	05	FR	0030	10	18	20	0 : 30	DO									MC EVOY P BRWN MSND 0015 GREY GRVL 0024 GREY MSND 0032
CON	05	006	15-	456458	300	1970/06	1517	05	FR	0086	25	38	10	1 : 0	DO									LLOYD TIERNEY BRWN MSND STNS 0040 GREY MSND 0080 GREY MSND GRVL 0084 GREY LMSN 0087
CON	05	006	15-	455573	325	1972/11	1558	06	FR	0046	12	30	20	1 : 0	DO									GEO ASTMA CONSTR BRWN SAND GRVL BLDR 0009 GREY SAND GRVL BLDR 0040
CON	05	006	15-	456160	309	1973/09	1517	05	FR	0025	4	10	25	1 : 0	DO									BLCK LMSN 0048 MCEVEALY PHILIP BRWN LOAM 0003 GREY QNSD 0016 UNKN 0026
CON	05	006	15-	455525	325	1973/08	1517	05	FR	0043	18	35	15	1 : 10	DO									SHIELD R BRWN HPAN BLDR 0043
CON	05	006	15-	455492	318	1973/08	1517	05	FR	0032	19	30	8	1 : 57	DO									DIFRANCESCO VAN BRWN HPAN BLDR 0025 GREY LMSN 0035
CON	05	007	15-	999999		1990/11	3323	06	FR	0202	12	175	15	1 : 0	DO									KRUCLELL DON CONST. BRWN SAND FILL 0005 BLCK LOAM 0030 GREY HPAN CLAY 0049 GREY LMSN 0207
CON	05	007	15-	999999		1996/11	6455	04	DRY															KAUFERT, HARRY PRDG 0032
CON	05	007	15-	999999		1989/09	4875	06	UK	0169	23	150	10	2 : 0	NU									DOWNELL, CONSTRUCTION BRWN CLAY FILL 0003 GREY SAND FGRD 0042 GREY SAND CGVL 0049 GREY LMSN SHLE HARD 0179
CON	05	007	15-	999999		1989/07	1558	06	FR	0037	20	30	30	1 : 0	DO									DOWNELL, CONSTRUCTION BRWN SAND 0010 GREY SAND GRVL BLDR 0026 GREY LMSN 0060
CON	05	007	15-	999999		1989/03	4875	06	UK	0232	26	200	20	1 : 0	DO									OHARA, MR WELDON BRWN SAND 0015 GREY GRVL SAND BLDR 0055 GREY LMSN SHLE 0215 GREY SNDS 0245

CONTINUING... OSGOODE TOWNSHIP

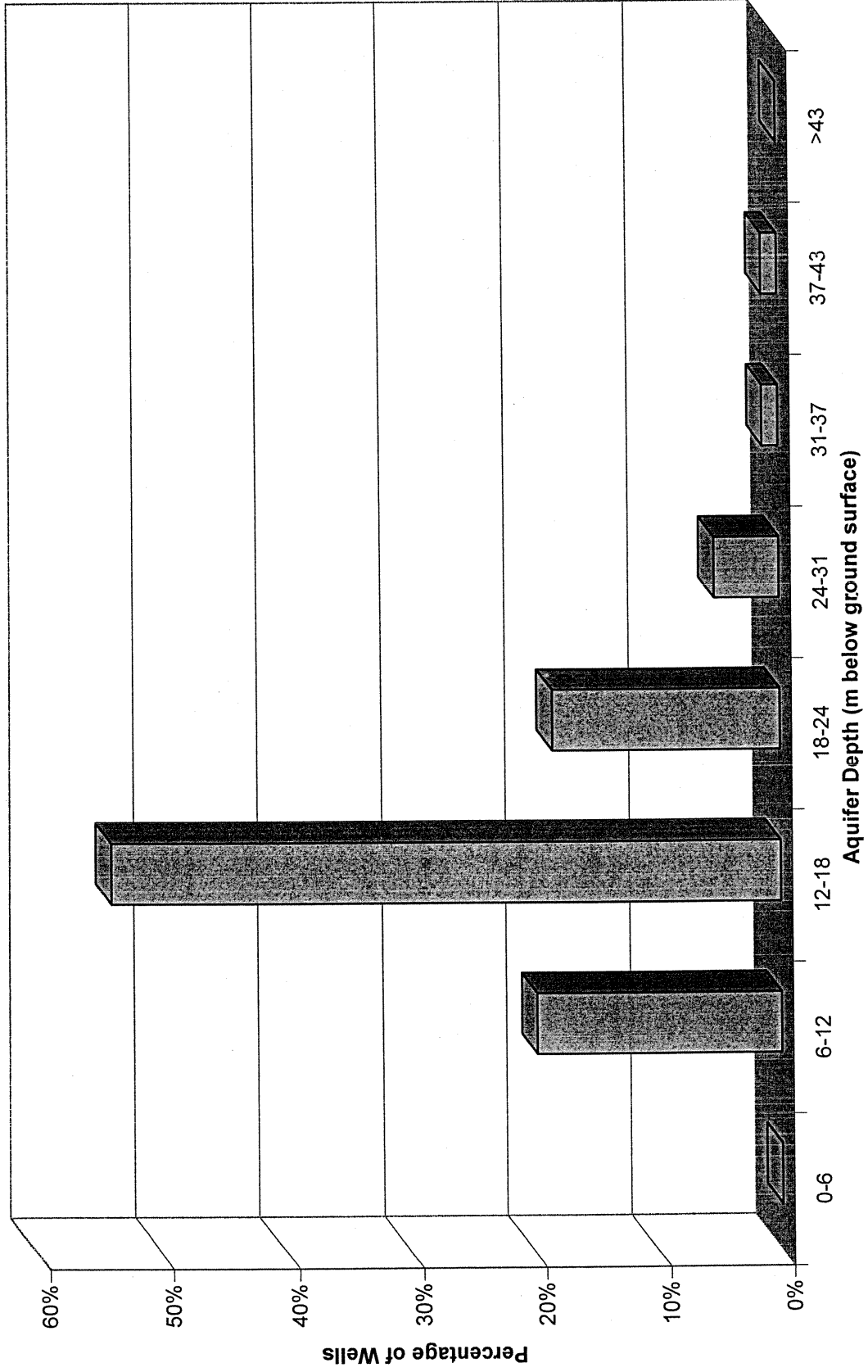
# Summary of Overburden Thickness Reported in Surrounding Water Wells



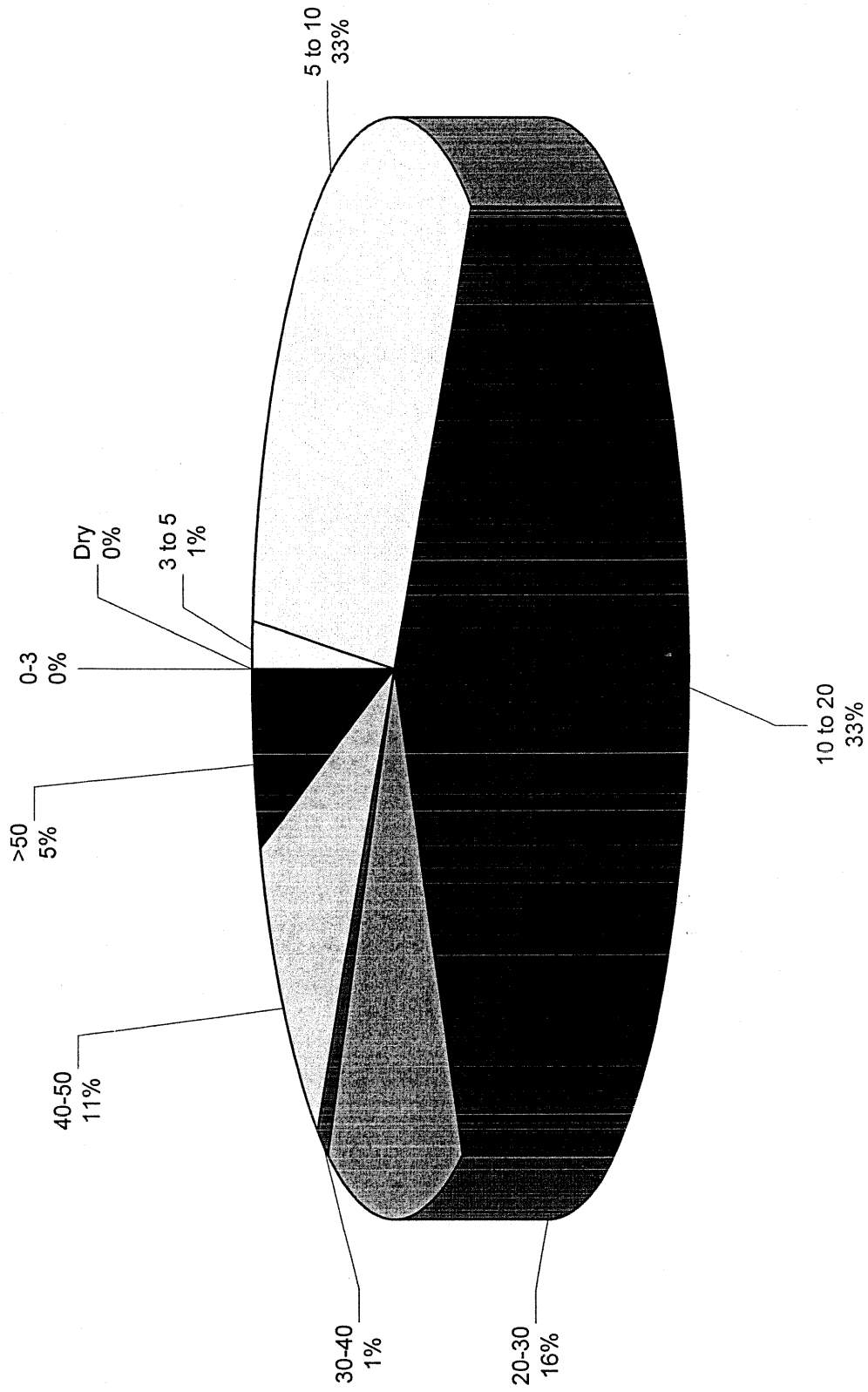
# Summary of Well Depths Reported in Surrounding Water Wells



# Summary of Reported Aquifer Depths In Surrounding Water Wells



**Summary of Well Yields Reported for Surrounding Water Wells**  
(Range of Well Yields in Imperial Gallons per Minute)



## **APPENDIX 3**

### **LABORATORY TEST DATA**

1. Reports of Analysis For Water Samples Collected During Pump Testing
2. Reports of Analysis For Water Samples Collected During Extended Well Development

**Client:** Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6

**Report Number:** 2512050  
**Date:** 2005-06-27  
**Date Submitted:** 2005-06-23

**Attention:** Robert Passmore

**Project:** PH0145


**P.O. Number:** PO# 2552  
**Matrix:** Water

**Chain of Custody Number:** 29556

PARAMETER	LAB ID:		MDL	UNITS	TYPE	LIMIT	UNITS
	Sample Date:	Sample ID:					
Total Coliforms	394207	394208		ct/100mL	MAC	0	ct/100mL
Escherichia Coli	2005-06-23	2005-06-23		ct/100mL	MAC	0	ct/100mL
Heterotrophic Plate Count	TW1, WS5	TW1, WS6		ct/1mL	MAC	500	ct/1mL
Faecal Coliforms				ct/100mL	MAC	0	ct/100mL
Faecal Streptococcus				ct/100mL	MAC	0	ct/100mL
MOE REG. 170/03							
GUIDELINE							

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline IMAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:   
 Tim McCooye  
 QC Manager

Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6

Report Number: 2512053  
 Date: 2005-07-06  
 Date Submitted: 2005-06-23

Attention: Robert Passmore


Project: PH0145

Chain of Custody Number: 29556

P.O. Number: PO# 2552  
 Matrix: Water

PARAMETER	LAB ID:		UNITS	MDL	Sample Date:	Sample ID:	TYPE	LIMIT	UNITS
	394213	394214							
Alkalinity as CaCO3	5	5	mg/L	0.001	2005-06-23	312	OG	500	mg/L
Chloride	1	1	mg/L	1	TW1, WS5	538	AO	250	mg/L
Colour	2	2	TCU	2	TW1, WS6	2	AO	5	TCU
Conductivity	5	5	uS/cm	2500		2530	AO	5	TCU
Dissolved Organic Carbon	0.5	0.5	mg/L	<0.5		0.9	MAC	1.5	mg/L
Fluoride	0.10	0.10	mg/L	<0.10		0.15	AO	0.05	mg/L
Hydrogen Sulphide	0.01	0.01	mg/L	<0.01		<0.01	MAC	1.0	mg/L
N-NH3 (Ammonia)	0.02	0.02	mg/L	0.20		0.03	MAC	10.0	mg/L
N-NO2 (Nitrite)	0.10	0.10	mg/L	<0.10		<0.10	AO	6.5-8.5	mg/L
N-NO3 (Nitrate)	0.10	0.10	mg/L	<0.10		<0.10	AO		mg/L
pH				7.58		7.63			
Phenols	0.001	0.001	mg/L	<0.001		<0.001	AO	500	mg/L
Sulphate	1	1	mg/L	134		133	AO		mg/L
Tannin & Lignin	0.1	0.1	mg/L	<0.1		<0.1	AO	500	mg/L
TDS (COND - CALC)	5	5	mg/L	1630		1640	AO		mg/L
Total Kjeldahl Nitrogen	0.05	0.05	mg/L	0.21		0.25	AO	1.0	mg/L
Turbidity	0.1	0.1	NTU	1.8		1.6	OG	100	NTU
Hardness as CaCO3	1	1	mg/L	583		578			mg/L
Ion Balance	0.01	0.01		1.00		0.99			mg/L
Calcium	1	1	mg/L	151		149			mg/L
Magnesium	1	1	mg/L	50		50			mg/L
Potassium	1	1	mg/L	4		4			mg/L
Sodium	2	2	mg/L	292		281	AO	20	mg/L
Iron	0.03	0.03	mg/L	0.68		0.69	AO	0.3	mg/L
Manganese	0.01	0.01	mg/L	0.10		0.10	AO	0.05	mg/L

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

APPROVAL:   
 Ewan McGeeble  
 Inorganic Lab Supervisor



Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6

Report Number: 2512305  
 Date: 2005-06-30  
 Date Submitted: 2005-06-27

Attention: Robert Passmore

Project: PG0145

Chain of Custody Number: 29934

P.O. Number: PO# 2348  
 Matrix: Water

PARAMETER	LAB ID:		UNITS	MDL	394847 2005-06-27 TW2, WS7	394848 2005-06-27 TW2, WS8	TYPE	LIMIT	UNITS	GUIDELINE
	Sample Date:	Sample ID:								
Total Coliforms			cf/100mL		0	2	MAC	0	cf/100mL	MOE REG. 170/03
Escherichia Coli			cf/100mL		0	0	MAC	0	cf/100mL	
Heterotrophic Plate Count			cf/1mL		4	1	MAC	500	cf/1mL	
Faecal Coliforms			cf/100mL		0	0	MAC	0	cf/100mL	
Faecal Streptococcus			cf/100mL		0	0	MAC	0	cf/100mL	

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

Comment:

APPROVAL:   
 Krista Quantrill  
 Microbiology Analyst

**Client:** Paterson Group  
1-28 Concourse Gate  
Ottawa, Ont.  
K1V 1T6

**Report Number:** 2512307  
**Date:** 2005-07-14  
**Date Submitted:** 2005-06-27

**Attention:** Robert Passmore

**Project:** PG0145

**P.O. Number:** PO# 2348  
**Matrix:** Water

**Chain of Custody Number:** 29934

PARAMETER	LAB ID:		MDL	UNITS	MOE REG. 170/03	GUIDELINE
	Sample Date:	Sample ID:				
Alkalinity as CaCO3	394850	394851	5	mg/L	287	500
Chloride	2005-06-27	2005-06-27	1	mg/L	580	250
Colour	TW2, WS7	TW2, WS8	2	TCU	3	5
Conductivity			5	uS/cm	2510	TCU
Dissolved Organic Carbon			0.5	mg/L	1.2	5
Fluoride			0.10	mg/L	0.13	1.5
Hydrogen Sulphide			0.01	mg/L	<0.01	0.05
N-NH3 (Ammonia)			0.02	mg/L	0.12	1.0
N-NO2 (Nitrite)			0.10	mg/L	<0.10	10.0
N-NO3 (Nitrate)			0.10	mg/L	<0.10	6.5-8.5
pH					7.96	
Phenols			0.001	mg/L	<0.001	500
Sulphate			1	mg/L	113	mg/L
Tannin & Lignin			0.1	mg/L	<0.1	mg/L
TDS (COND - CALC)			5	mg/L	1630	500
Total Kjeldahl Nitrogen			0.05	mg/L	0.15	mg/L
Turbidity			0.1	NTU	9.6	1.0
Hardness as CaCO3			1	mg/L	524	100
Iron Balance			0.01	mg/L	0.97	mg/L
Calcium			1	mg/L	129	mg/L
Magnesium			1	mg/L	49	mg/L
Potassium			1	mg/L	5	mg/L
Sodium			2	mg/L	301	20
Iron			0.03	mg/L	0.72	0.3
Manganese			0.01	mg/L	0.06	0.05

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

APPROVAL:

*Ewan MacRae*  
Ewan MacRae  
Inorganic Lab Supervisor

Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6

Attention: Robert Passmore

Report Number: 2512439  
 Date: 2005-07-08  
 Date Submitted: 2005-06-28

Project: PH0145

Chain of Custody Number: 29935

P.O. Number: PO# 2554  
 Matrix: Water

PARAMETER	LAB ID:		UNITS	MDL	395159	395160	TYPE	LIMIT	UNITS
	Sample Date:	Sample ID:							
Alkalinity as CaCO3	mg/L	5			274	268	OG	500	mg/L
Chloride	mg/L	1			688	689	AO	250	mg/L
Colour	TCU	2			2	2	AO	5	TCU
Conductivity	uS/cm	5			2750	2680			TCU
Dissolved Organic Carbon	mg/L	0.5			1.1	1.8	AO	5	mg/L
Fluoride	mg/L	0.10			0.18	0.17	MAC	1.5	mg/L
Hydrogen Sulphide	mg/L	0.01			<0.01	<0.01	AO	0.05	mg/L
N-NH3 (Ammonia)	mg/L	0.02			0.10	0.12	MAC	1.0	mg/L
N-NO2 (Nitrite)	mg/L	0.10			<0.10	<0.10	MAC	10.0	mg/L
N-NO3 (Nitrate)	mg/L	0.10			<0.10	<0.10	AO	6.5-8.5	mg/L
pH					8.03	8.05			
Phenols	mg/L	0.001			<0.001	<0.001			
Sulphate	mg/L	1			103	104	AO	500	mg/L
Tannin & Lignin	mg/L	0.1			<0.1	<0.1			
TDS (COND - CALC)	mg/L	5			1790	1740	AO	500	mg/L
Total Kjeldahl Nitrogen	mg/L	0.05			0.15	0.13	AO	1.0	mg/L
Turbidity	NTU	0.1			2.5	4.5	AO	100	NTU
Hardness as CaCO3	mg/L	1			519	519	OG		mg/L
Ion Balance		0.01			0.92	0.93			mg/L
Calcium	mg/L	1			127	127			mg/L
Magnesium	mg/L	1			49	49			mg/L
Potassium	mg/L	1			7	7			mg/L
Sodium	mg/L	2			336	333	AO	20	mg/L
Iron	mg/L	0.03			0.65	0.64	AO	0.3	mg/L
Manganese	mg/L	0.01			0.06	0.06	AO	0.05	mg/L

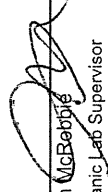
MOE REG. 170/03

GUIDELINE

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

Comment:

APPROVAL:

  
 Ewan McGeeble  
 Inorganic Lab Supervisor

Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6

Report Number: 2512441  
 Date: 2005-07-04  
 Date Submitted: 2005-06-28

Attention: Robert Passmore

Project: PH0145

Chain of Custody Number: 29935

P.O. Number: PO# 2554  
 Matrix: Water

PARAMETER	LAB ID:		MDL	UNITS	TYPE	LIMIT	UNITS	GUIDELINE
	Sample Date:	Sample ID:						
Total Coliforms	395162	395163	0	cf/100mL	MAC	0	cf/100mL	MOE REG. 170/03
Escherichia Coli	2005-06-28 TW3, WS9	2005-06-28 TW3, WS10	0	cf/100mL	MAC	0	cf/100mL	
Heterotrophic Plate Count			0	cf/1mL	MAC	500	cf/1mL	
Faecal Coliforms			0	cf/100mL	MAC	0	cf/100mL	
Faecal Streptococcus			0	cf/100mL	MAC	0	cf/100mL	

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration  
 Comment:

APPROVAL:

Peter Haulena  
 Analytical Services Manager

Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6

Report Number: 2511732  
 Date: 2005-06-24  
 Date Submitted: 2005-06-21

Attention: Robert Passmore

Project: PH0145

Chain of Custody Number: 29548

P.O. Number: PO# 2550  
 Matrix: Water

PARAMETER	LAB ID:		UNITS	MDL	TYPE	LIMIT	UNITS
	Sample Date:	Sample ID:					
Total Coliforms	393561	393562	ct/100mL		MAC	0	ct/100mL
Escherichia Coli	2005-06-21	2005-06-21	ct/100mL		MAC	0	ct/100mL
Heterotrophic Plate Count	TW4, WS1	TW4, WS2	ct/1mL		MAC	500	ct/1mL
Faecal Coliforms			ct/100mL		MAC	0	ct/100mL
Faecal Streptococcus			ct/100mL		MAC	0	ct/100mL
MOE REG. 170/03							
GUIDELINE							

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

Comment:

APPROVAL: *Krista Quantill*  
 Krista Quantill  
 Microbiology Analyst

Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6

Report Number: 2511735  
 Date: 2005-06-28  
 Date Submitted: 2005-06-21

Attention: Robert Passmore

Project: PH0145

P.O. Number: PO# 2550  
 Matrix: Water

Chain of Custody Number: 29548

PARAMETER	LAB ID:		UNITS	MDL	393567	393568	TYPE	LIMIT	UNITS
	Sample Date:	Sample ID:							
Alkalinity as CaCO3	mg/L	5			271	220	OG	500	mg/L
Chloride	mg/L	1			193	177	AO	250	mg/L
Colour	TCU	2			2	<2	AO	5	TCU
Conductivity	uS/cm	5			1170	1030	AO	5	TCU
Dissolved Organic Carbon	mg/L	0.5			1.2	1.1	AO	5	mg/L
Fluoride	mg/L	0.10			0.33	0.50	MAC	1.5	mg/L
Hydrogen Sulphide	mg/L	0.01			0.17	0.15	AO	0.05	mg/L
N-NH3 (Ammonia)	mg/L	0.02			0.09	0.10	MAC	1.0	mg/L
N-NO2 (Nitrite)	mg/L	0.10			<0.10	<0.10	MAC	10.0	mg/L
N-NO3 (Nitrate)	mg/L	0.10			<0.10	<0.10	AO	6.5-8.5	mg/L
pH					7.60	7.80			
Phenols	mg/L	0.001			<0.001	<0.001	AO	500	mg/L
Sulphate	mg/L	1			72	45	AO	500	mg/L
Tannin & Lignin	mg/L	0.1			<0.1	<0.1	AO	500	mg/L
TDS (COND - CALC)	mg/L	5			761	670	AO	500	mg/L
Total Kjeldahl Nitrogen	mg/L	0.05			0.21	0.21	AO	1.0	NTU
Turbidity	NTU	0.1			17.7	62.3	OG	100	mg/L
Hardness as CaCO3	mg/L	1			532	354			mg/L
Ion Balance		0.01			1.06	0.93			mg/L
Calcium	mg/L	1			142	71			mg/L
Magnesium	mg/L	1			43	43			mg/L
Potassium	mg/L	1			4	4			mg/L
Sodium	mg/L	2			56	56	AO	20	mg/L
Iron	mg/L	0.03			1.65	1.71	AO	0.3	mg/L
Manganese	mg/L	0.01			0.22	0.22	AO	0.05	mg/L

MOE REG. 170/03

GUIDELINE

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

APPROVAL:

Ewan McRobbie  
 Inorganic Lab Supervisor

Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6

Report Number: 2511886  
 Date: 2005-06-27  
 Date Submitted: 2005-06-22

Attention: Robert Passmore

Project: PH0145

P.O. Number: PO# 2551  
 Matrix: Water

Chain of Custody Number: 28540

PARAMETER	UNITS	MDL	LAB ID:		TYPE	LIMIT	UNITS	GUIDELINE
			Sample Date:	Sample ID:				
Total Coliforms	cf/100mL		393928	393929	MAC	0	cf/100mL	MOE REG. 170/03
Escherichia Coli	cf/100mL		2005-06-22	2005-06-22	MAC	0	cf/100mL	
Heterotrophic Plate Count	cf/1mL		TW5, WS3	TW5, WS4	MAC	500	cf/1mL	
Faecal Coliforms	cf/100mL				MAC	0	cf/100mL	
Faecal Streptococcus	cf/100mL				MAC	0	cf/100mL	

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

Comment:

APPROVAL:   
 Tim McCooney  
 QC Manager

**Client:** Paterson Group  
1-28 Concourse Gate  
Ottawa, Ont.  
K1V 1T6

**Report Number:** 2511889  
**Date:** 2005-06-29  
**Date Submitted:** 2005-06-22

**Attention:** Robert Passmore

**Project:** PH0145

**Chain of Custody Number:** 28548

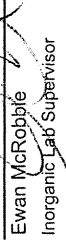
**P.O. Number:**  
**Matrix:**

Water

PARAMETER	LAB ID:		MDL	UNITS	Sample Date:	Sample ID:	393937	393938	TYPE	LIMIT	UNITS
	2005-06-22	2005-06-22									
Alkalinity as CaCO3	5	307	5	mg/L	2005-06-22	TW5, WS3	307	307	OG	500	mg/L
Chloride	1	191	1	mg/L	2005-06-22	TW5, WS4	194	194	AO	250	mg/L
Colour	2	2	2	TCU	2005-06-22	TW5, WS4	<2	<2	AO	5	TCU
Conductivity	5	1210	5	uS/cm	2005-06-22	TW5, WS4	1210	1210	AO	5	TCU
Dissolved Organic Carbon	0.5	0.5	0.5	mg/L	2005-06-22	TW5, WS4	1.4	1.4	AO	5	mg/L
Fluoride	0.10	0.16	0.10	mg/L	2005-06-22	TW5, WS4	0.15	0.15	MAC	1.5	mg/L
Hydrogen Sulphide	0.01	<0.01	0.01	mg/L	2005-06-22	TW5, WS4	<0.01	<0.01	AO	0.05	mg/L
N-NH3 (Ammonia)	0.02	0.02	0.02	mg/L	2005-06-22	TW5, WS4	0.02	0.02	MAC	1.0	mg/L
N-NO2 (Nitrite)	0.10	<0.10	0.10	mg/L	2005-06-22	TW5, WS4	<0.10	<0.10	MAC	10.0	mg/L
N-NO3 (Nitrate)	0.10	<0.10	0.10	mg/L	2005-06-22	TW5, WS4	<0.10	<0.10	AO	6.5-8.5	mg/L
pH		7.76			2005-06-22	TW5, WS4	7.77	7.77			
Phenols	0.001	<0.001	0.001	mg/L	2005-06-22	TW5, WS4	<0.001	<0.001	AO	500	mg/L
Sulphate	1	65	1	mg/L	2005-06-22	TW5, WS4	63	63	AO	500	mg/L
Tannin & Lignin	0.1	<0.1	0.1	mg/L	2005-06-22	TW5, WS4	<0.1	<0.1	AO	500	mg/L
TDS (COND - CALC)	5	787	5	mg/L	2005-06-22	TW5, WS4	787	787	AO	500	mg/L
Total Kjeldahl Nitrogen	0.05	0.33	0.05	mg/L	2005-06-22	TW5, WS4	0.28	0.28	AO	1.0	mg/L
Turbidity	0.1	27.6	0.1	NTU	2005-06-22	TW5, WS4	28.5	28.5	AO	100	mg/L
Hardness as CaCO3	1	603	1	mg/L	2005-06-22	TW5, WS4	598	598	OG	100	mg/L
Ion Balance	0.01	1.07	0.01		2005-06-22	TW5, WS4	1.06	1.06			
Calcium	1	164	1	mg/L	2005-06-22	TW5, WS4	162	162			
Magnesium	1	47	1	mg/L	2005-06-22	TW5, WS4	47	47			
Potassium	1	2	1	mg/L	2005-06-22	TW5, WS4	2	2			
Sodium	2	40	2	mg/L	2005-06-22	TW5, WS4	39	39	AO	20	mg/L
Iron	0.03	2.31	0.03	mg/L	2005-06-22	TW5, WS4	2.46	2.46	AO	0.3	mg/L
Manganese	0.01	0.35	0.01	mg/L	2005-06-22	TW5, WS4	0.35	0.35	AO	0.05	mg/L

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration  
Comment:

APPROVAL:

  
Ewan McRobbie  
Inorganic Lab Supervisor



**Client:** Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6

**Report Number:** 2517679  
**Date:** 2005-09-06  
**Date Submitted:** 2005-09-02

**Attention:** Robert Passmore

**Project:** PH0145

**Chain of Custody Number:** 23283

**P.O. Number:** PO# 2587

**Matrix:** Water

PARAMETER	UNITS	MDL	LAB ID:				GUIDELINE		
			409025	409026	409027	409028			
			2005-09-02	2005-09-02	2005-09-02	2005-09-02	MCE REG. 170/03		
			TW1, WS R1	TW2, WS R1	TW4, WS R1	TW5, WS R1			
Total Coliforms	cf/100mL		1	82	7	0	MAC	0	cf/100mL
Escherichia Coli	cf/100mL		0	0	0	0	MAC	0	cf/100mL
Heterotrophic Plate Count	cf/1mL		1	3	3	0	MAC	500	cf/1mL
Faecal Coliforms	cf/100mL		0	0	0	0	MAC	0	cf/100mL
Faecal Streptococcus	cf/100mL		0	0	0	0	MAC	0	cf/100mL

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

Comment:

APPROVAL:

Peter Haulena  
 Analytical Services Manager

**Client:** Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6

**Report Number:** 2518550  
**Date:** 2005-09-16  
**Date Submitted:** 2005-09-14

**Attention:** Robert Passmore

**Project:** PH0145

**Chain of Custody Number:** 21891

**P.O. Number:** PO# 2591  
**Matrix:** Water

PARAMETER	LAB ID:		Sample Date:		Sample ID:		UNITS	MDL	TYPE	LIMIT	UNITS
	411404	411405	411406	2005-09-14	2005-09-14	2005-09-14					
Total Coliforms	0	0	0	0	0	0	0	MAC	0	0	cf/100mL
Escherichia Coli	0	0	0	0	0	0	0	MAC	0	0	cf/100mL
Heterotrophic Plate Count	4	0	36	0	0	0	0	MAC	500	500	cf/1mL
Faecal Coliforms	0	0	0	0	0	0	0	MAC	0	0	cf/100mL
Faecal Streptococcus	0	0	0	0	0	0	0	MAC	0	0	cf/100mL

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

Comment:

APPROVAL: Krista Quantrill  
 Microbiology Analyst

## **APPENDIX 4**

### **AQUIFER ANALYSIS DATA**

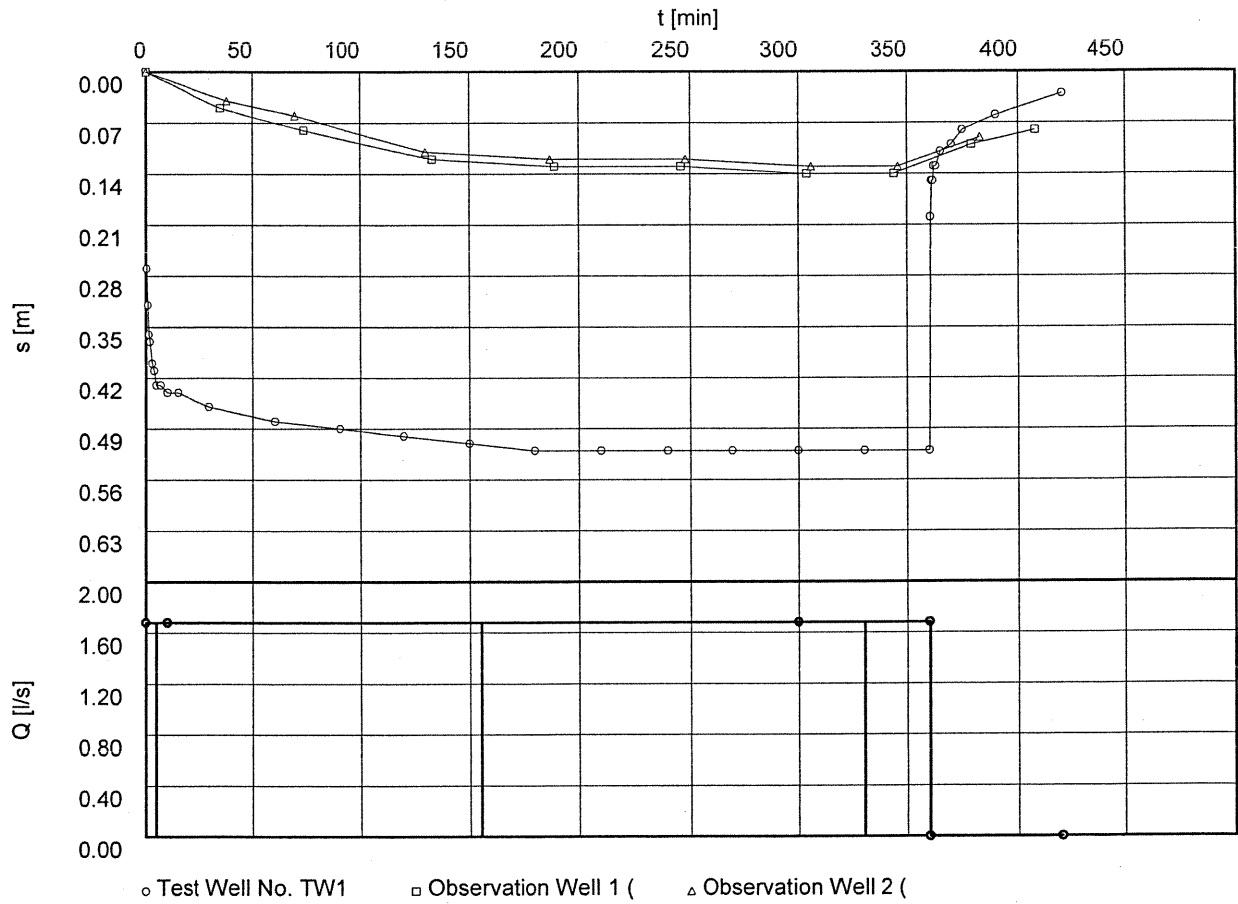
1. Pump Test Data & Aquifer Analysis Curves for Test Wells
2. Cumulative Drawdown Curve for Potential Well Interference
3. Environment Canada Hourly Data Reports for June 21 to June 23, 2005

Pumping Test No. 1

Test conducted on: June 23, 2005

TW1

Discharge 1.44 l/s











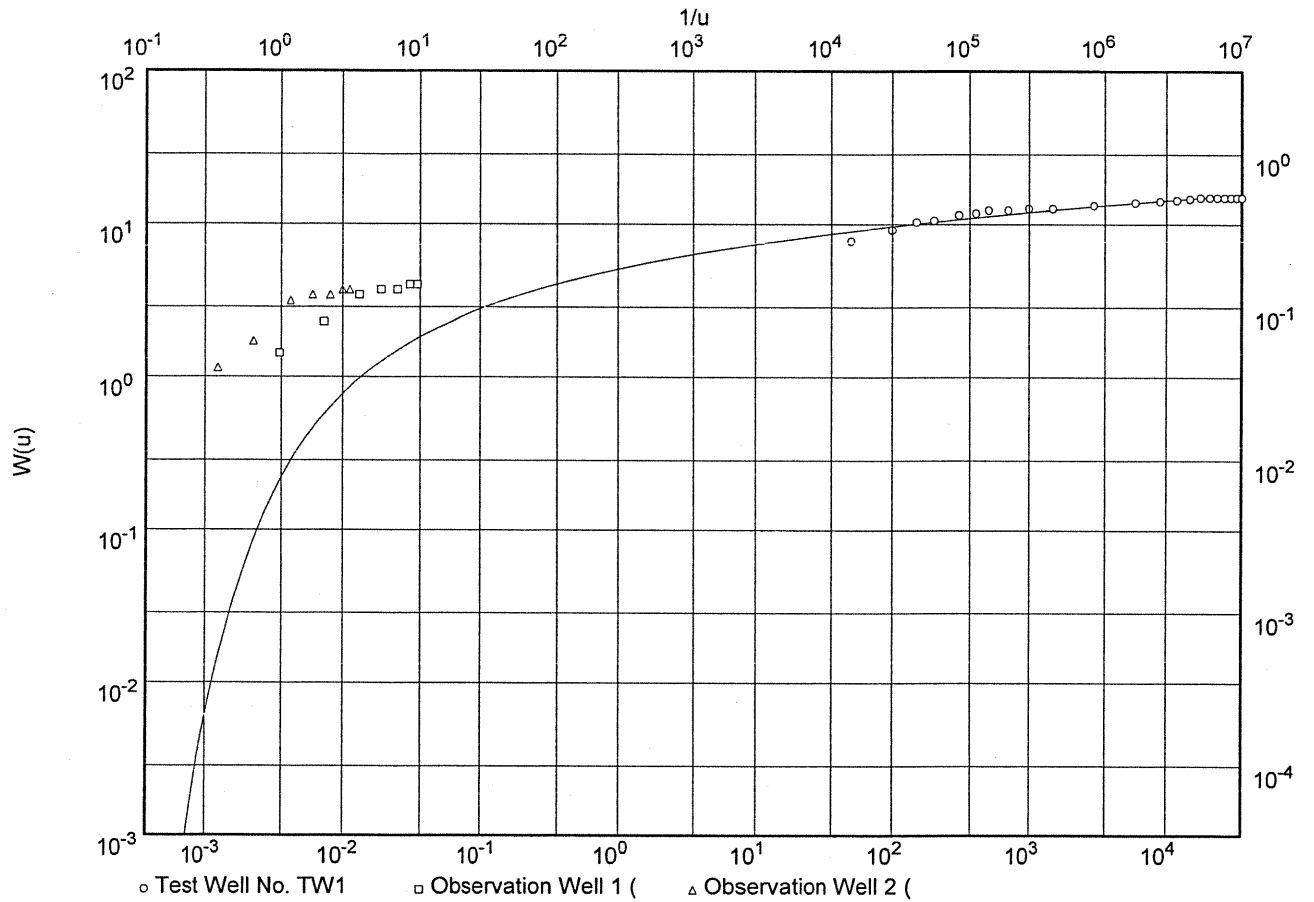


Pumping Test No. 1

Test conducted on: June 23, 2005

TW1

Discharge 1.44 l/s



Transmissivity [ $m^2/min$ ]:  $1.96 \times 10^{-1}$

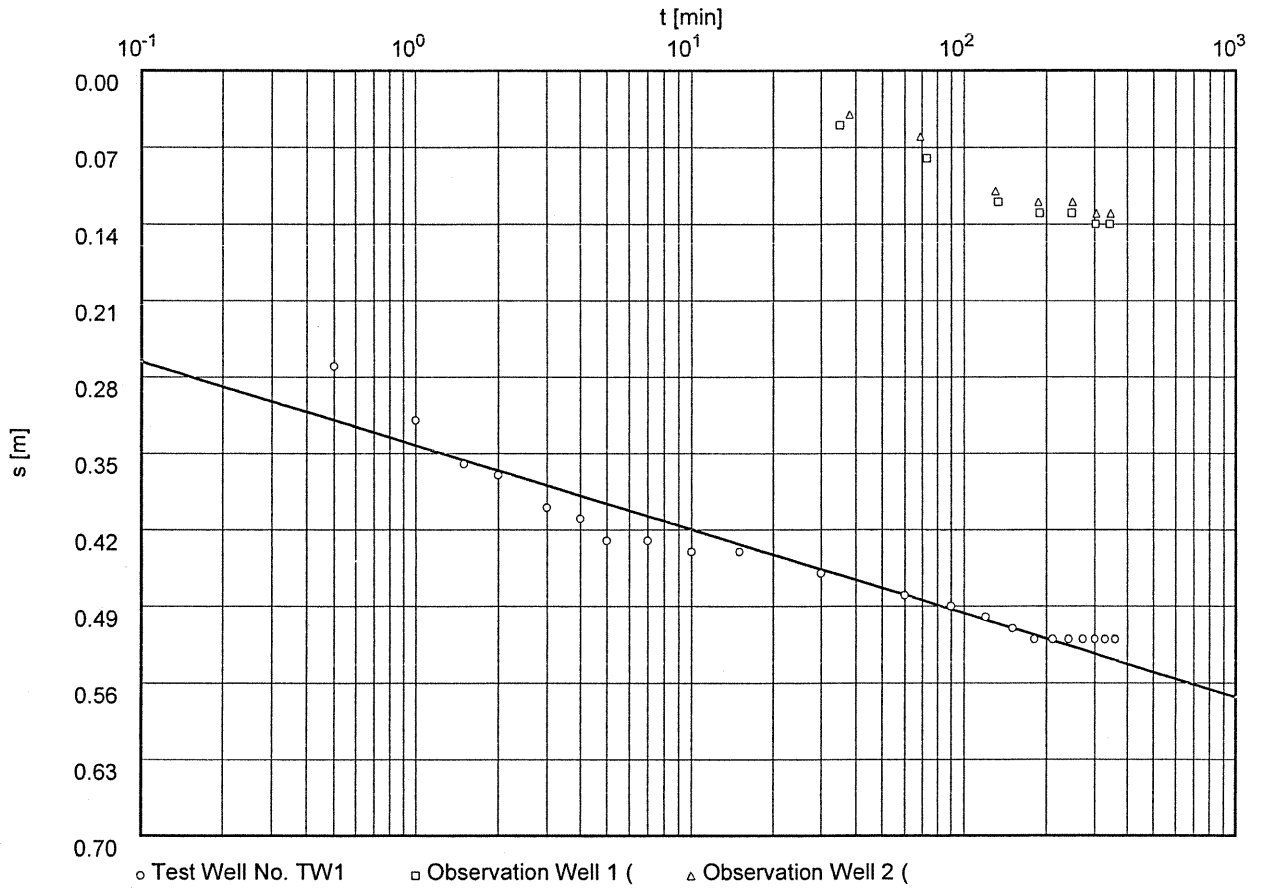
Storativity:  $2.82 \times 10^{-3}$

Pumping Test No. 1

Test conducted on: June 23, 2005

TW1

Discharge 1.44 l/s



Transmissivity [m<sup>2</sup>/min]:  $2.05 \times 10^{-1}$

Storativity:  $1.61 \times 10^{-3}$

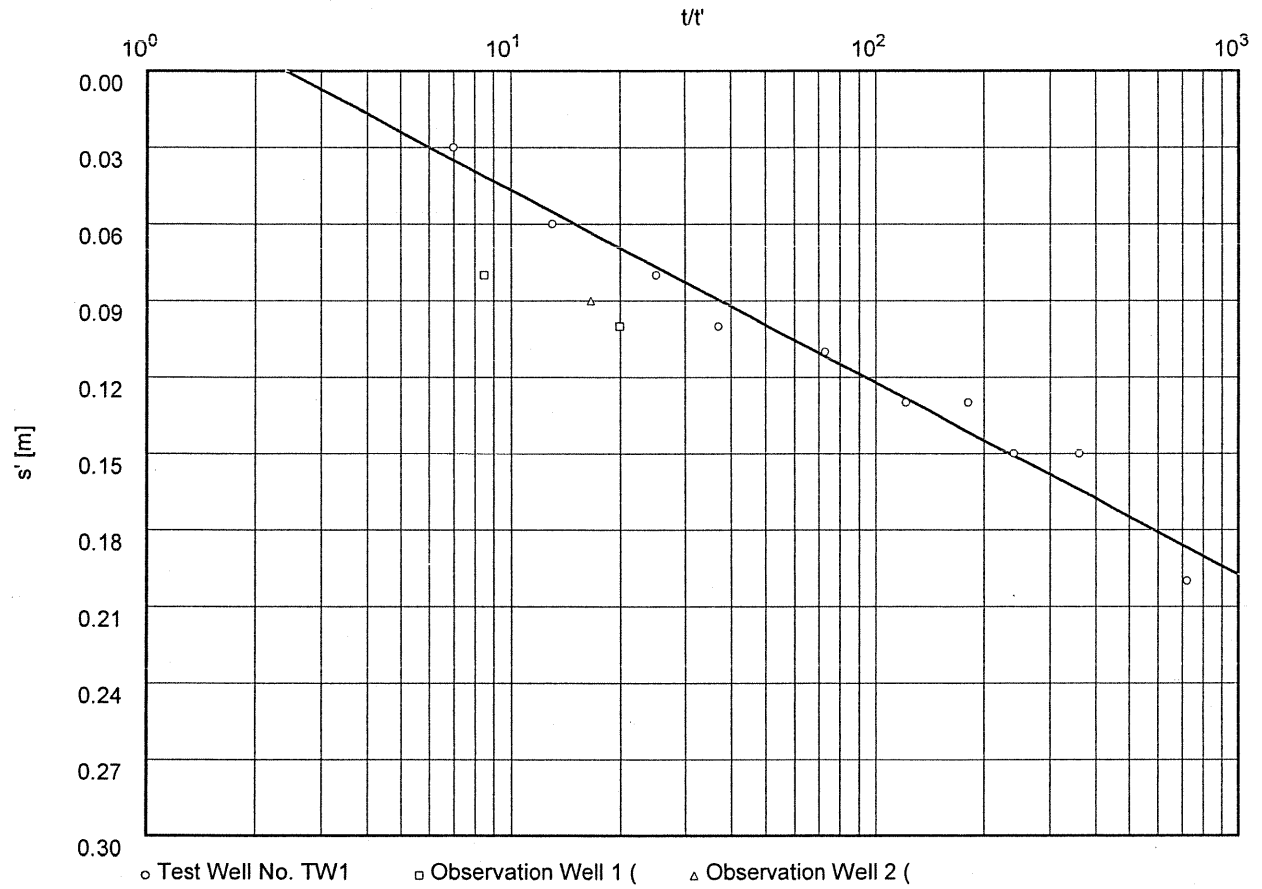
Pumping Test No. 1

Test conducted on: June 23, 2005

TW1

Discharge 1.44 l/s

Pumping test duration: 360.00 min



Transmissivity [m<sup>2</sup>/min]:  $2.09 \times 10^{-1}$

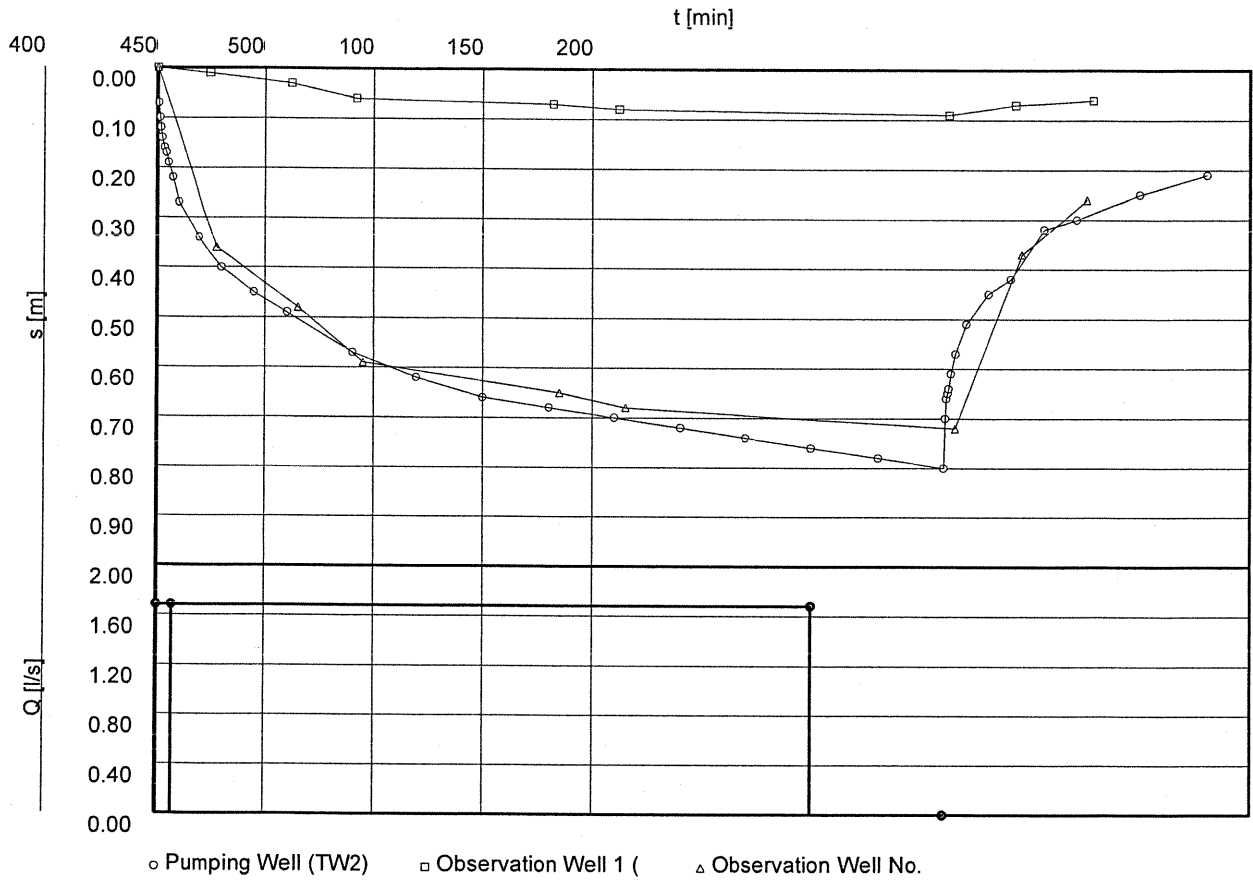
Pumping Test No. 2

Test conducted on: June 27, 2005

TW2

Discharge 1.40 l/s

350











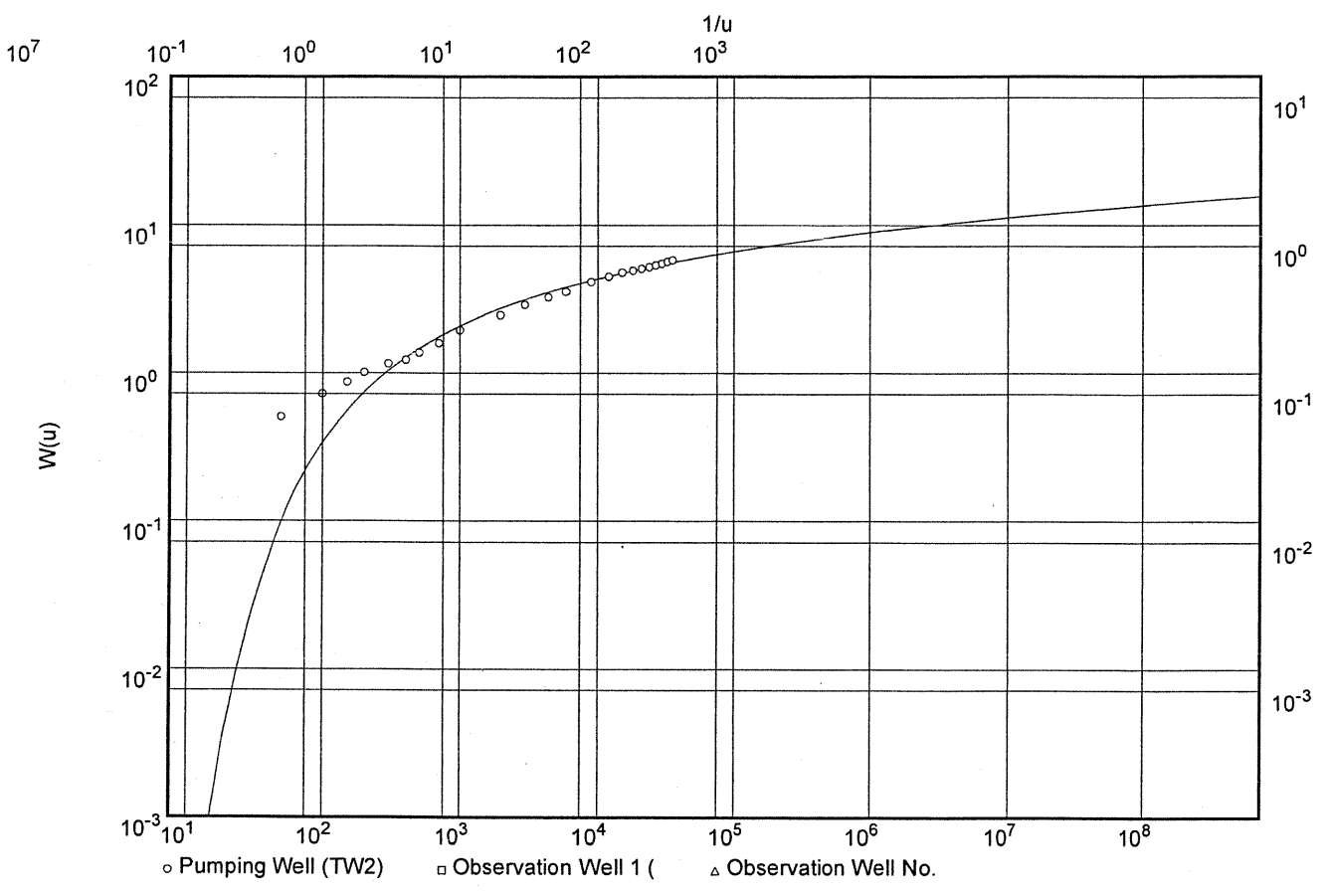


Pumping Test No. 2

Test conducted on: June 27, 2005

TW2

Discharge 1.40 l/s



Transmissivity [m<sup>2</sup>/min]:  $4.83 \times 10^{-2}$

Storativity:  $1.45 \times 10^1$

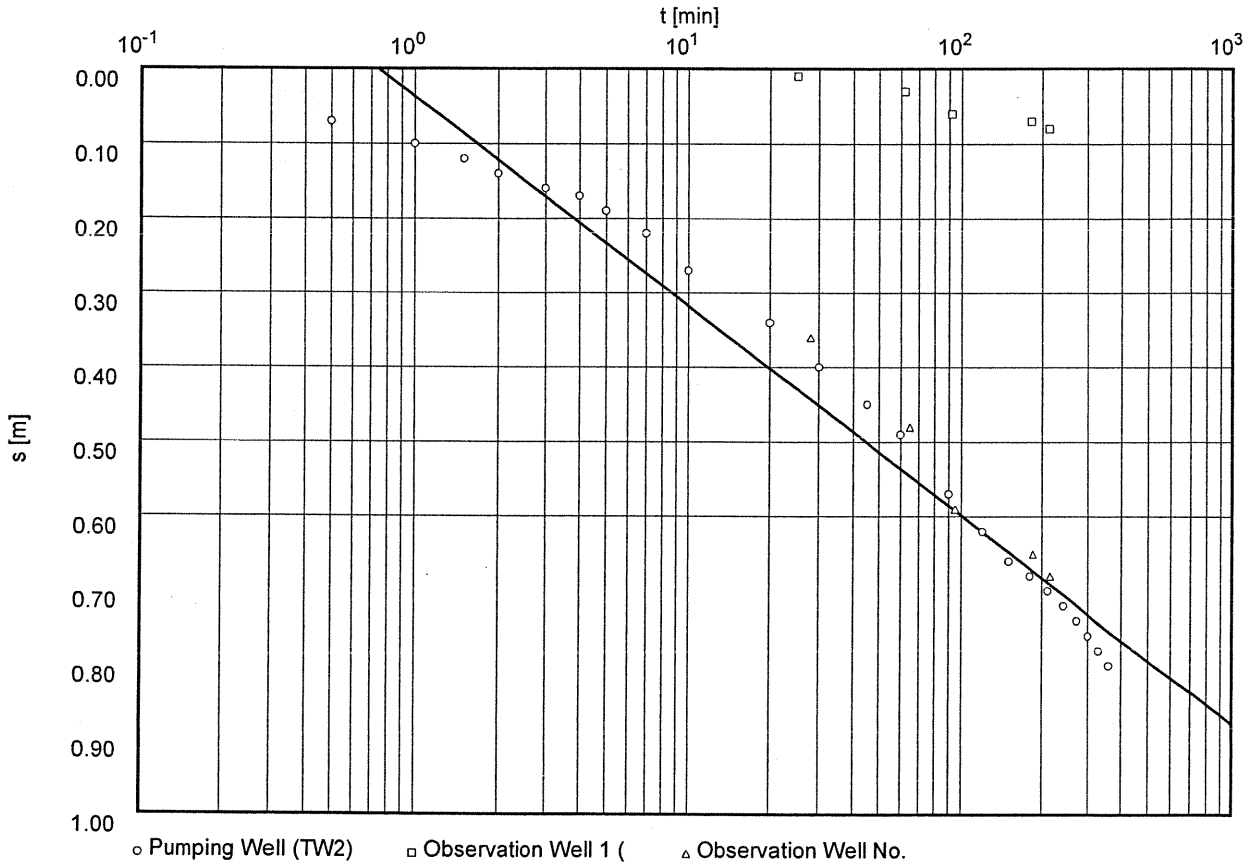
10<sup>6</sup>

Pumping Test No. 2

Test conducted on: June 27, 2005

TW2

Discharge 1.40 l/s



Transmissivity [ $m^2/min$ ]:  $5.47 \times 10^{-2}$

Storativity:  $9.11 \times 10^0$

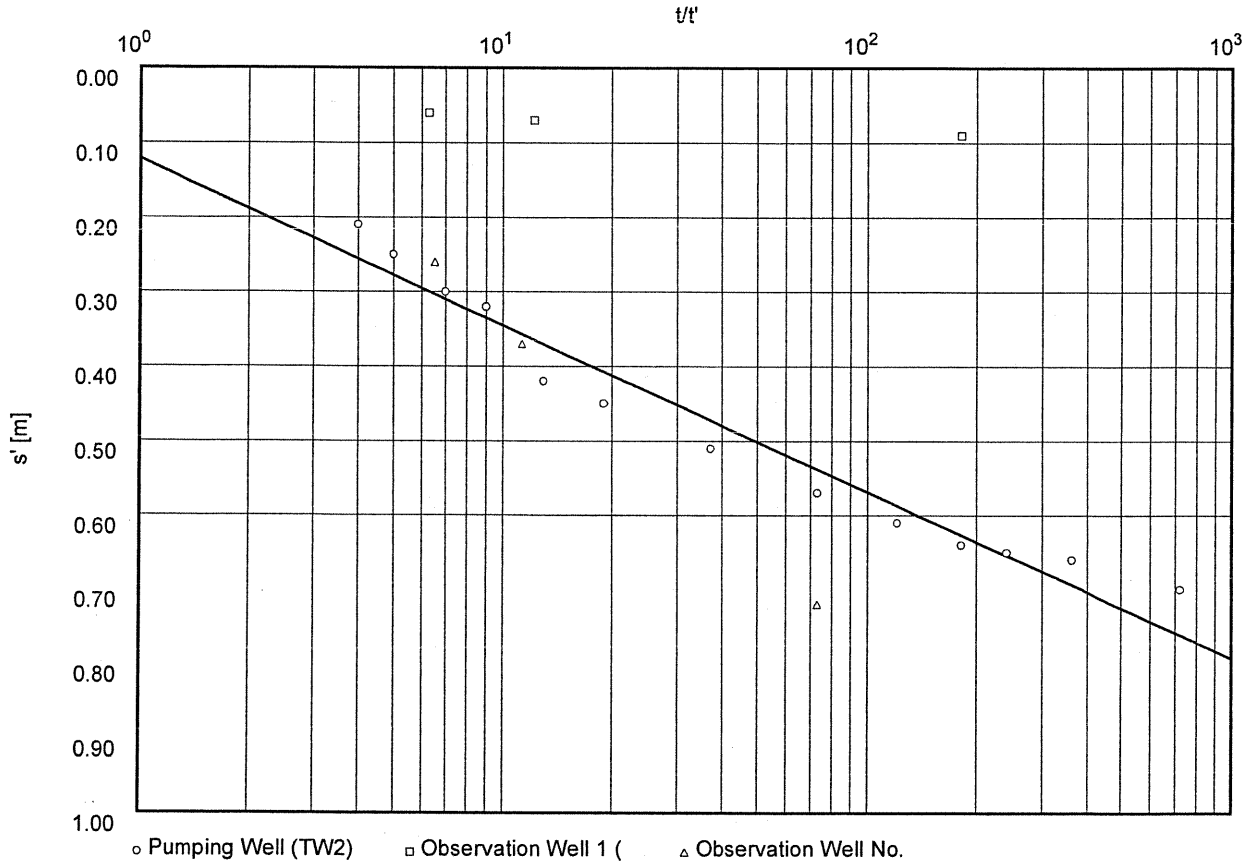
Pumping Test No. 2

Test conducted on: June 27, 2005

TW2

Discharge 1.40 l/s

Pumping test duration: 360.00 min



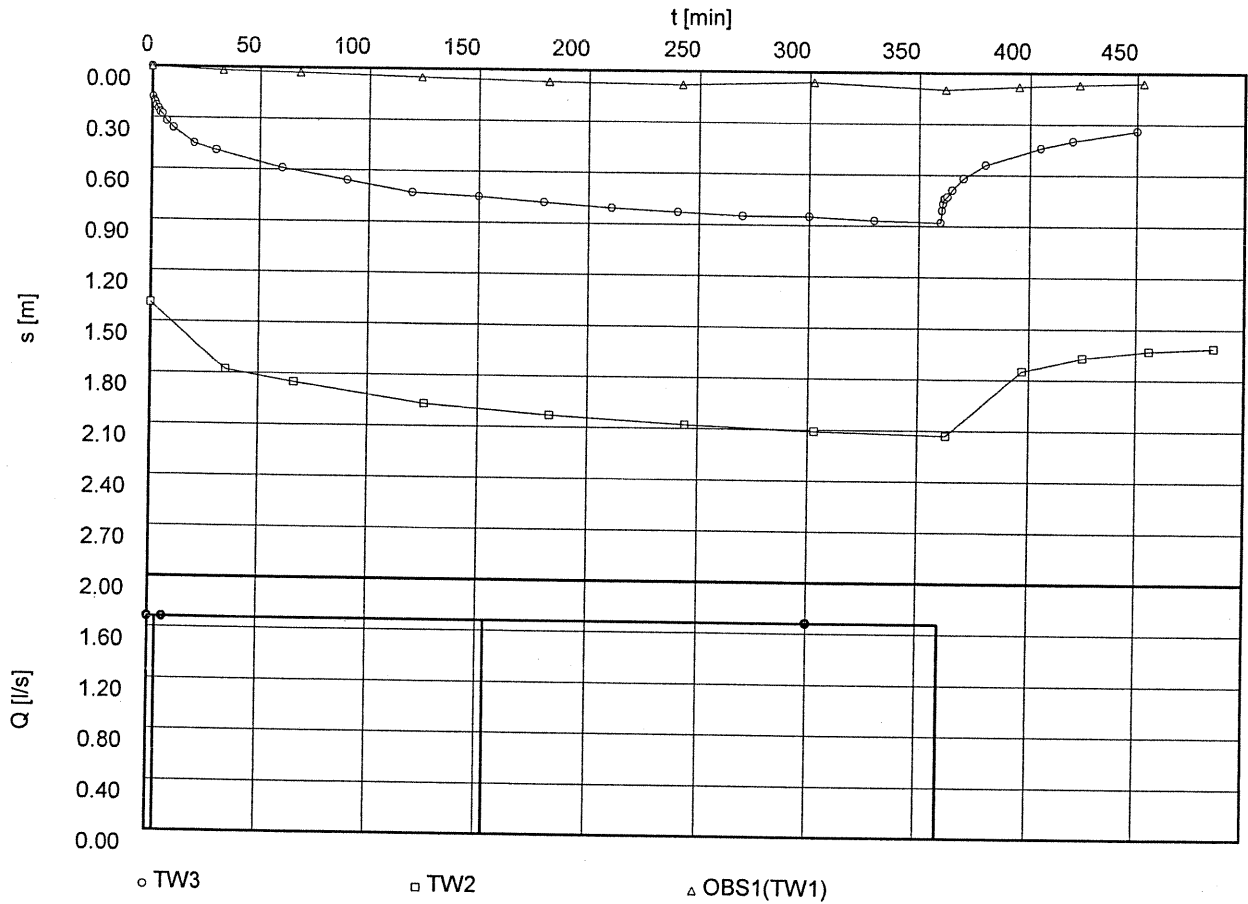
Transmissivity [ $m^2/min$ ]:  $6.87 \times 10^{-2}$

Pumping Test No. 3

Test conducted on: June 28, 2005

TW 3

Discharge 1.68 l/s











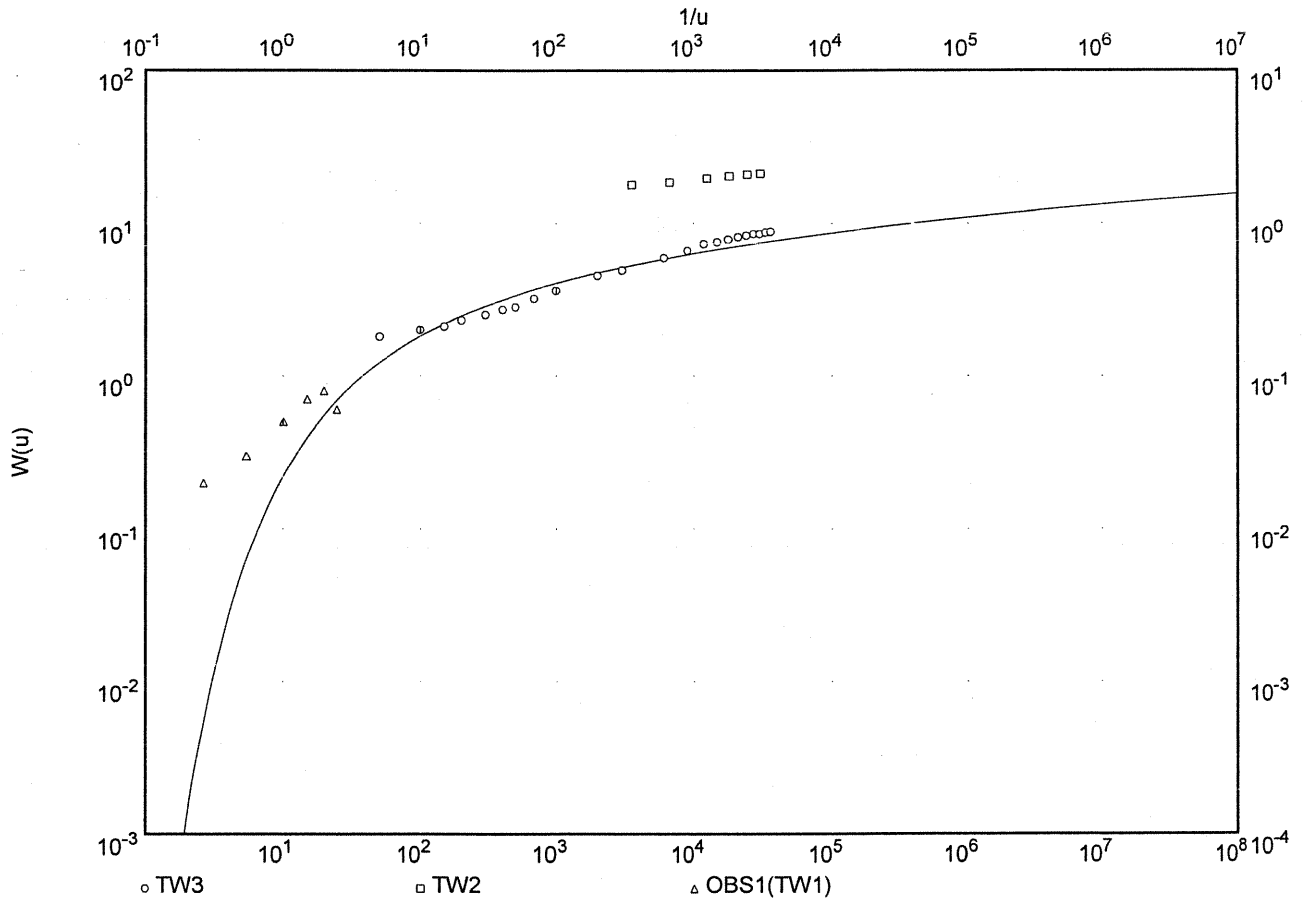


Pumping Test No. 3

Test conducted on: June 28, 2005

TW 3

Discharge 1.68 l/s



Transmissivity [m<sup>2</sup>/min]:  $8.02 \times 10^{-2}$

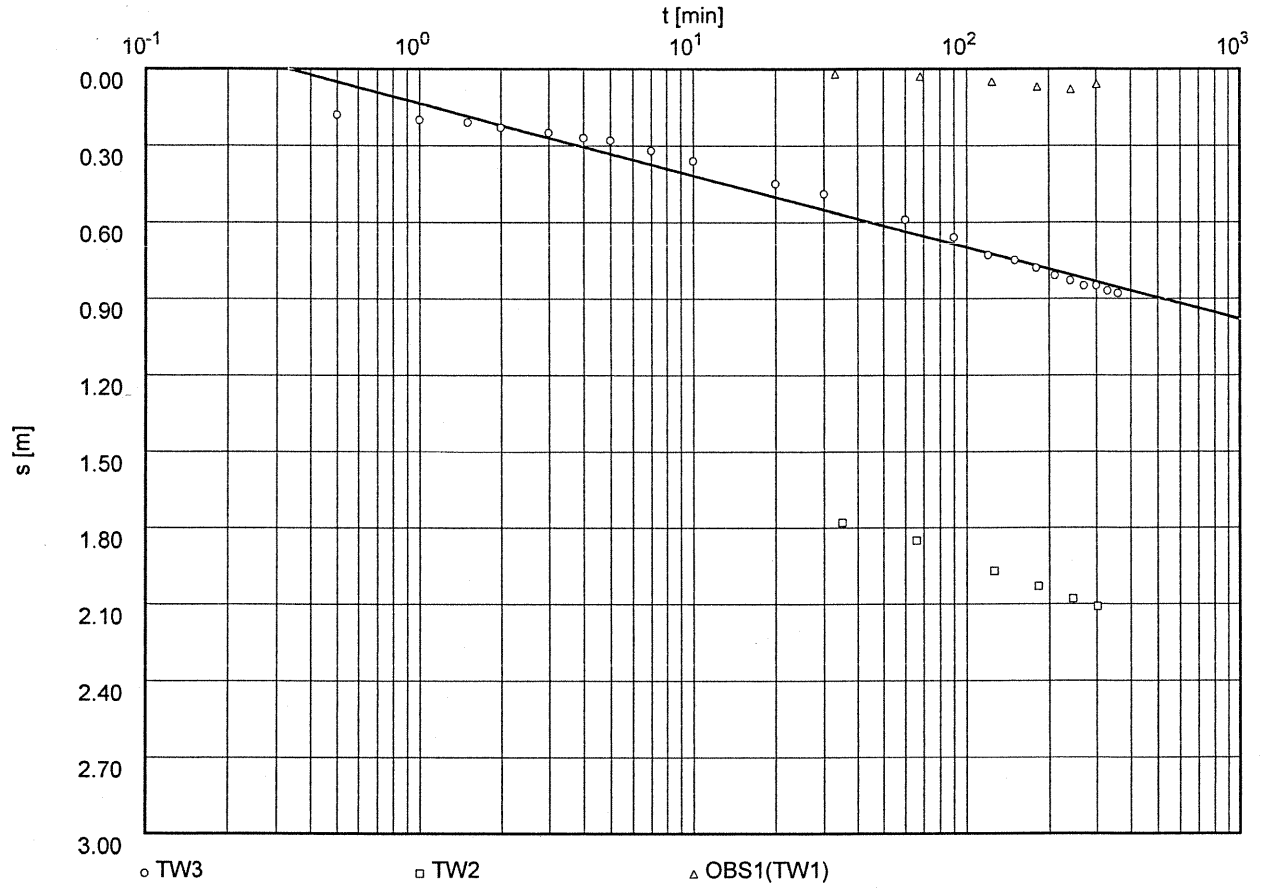
Storativity:  $3.20 \times 10^0$

Pumping Test No. 3

Test conducted on: June 28, 2005

TW 3

Discharge 1.68 l/s



Transmissivity [m<sup>2</sup>/min]:  $6.55 \times 10^{-2}$   
 Storativity:  $4.88 \times 10^0$

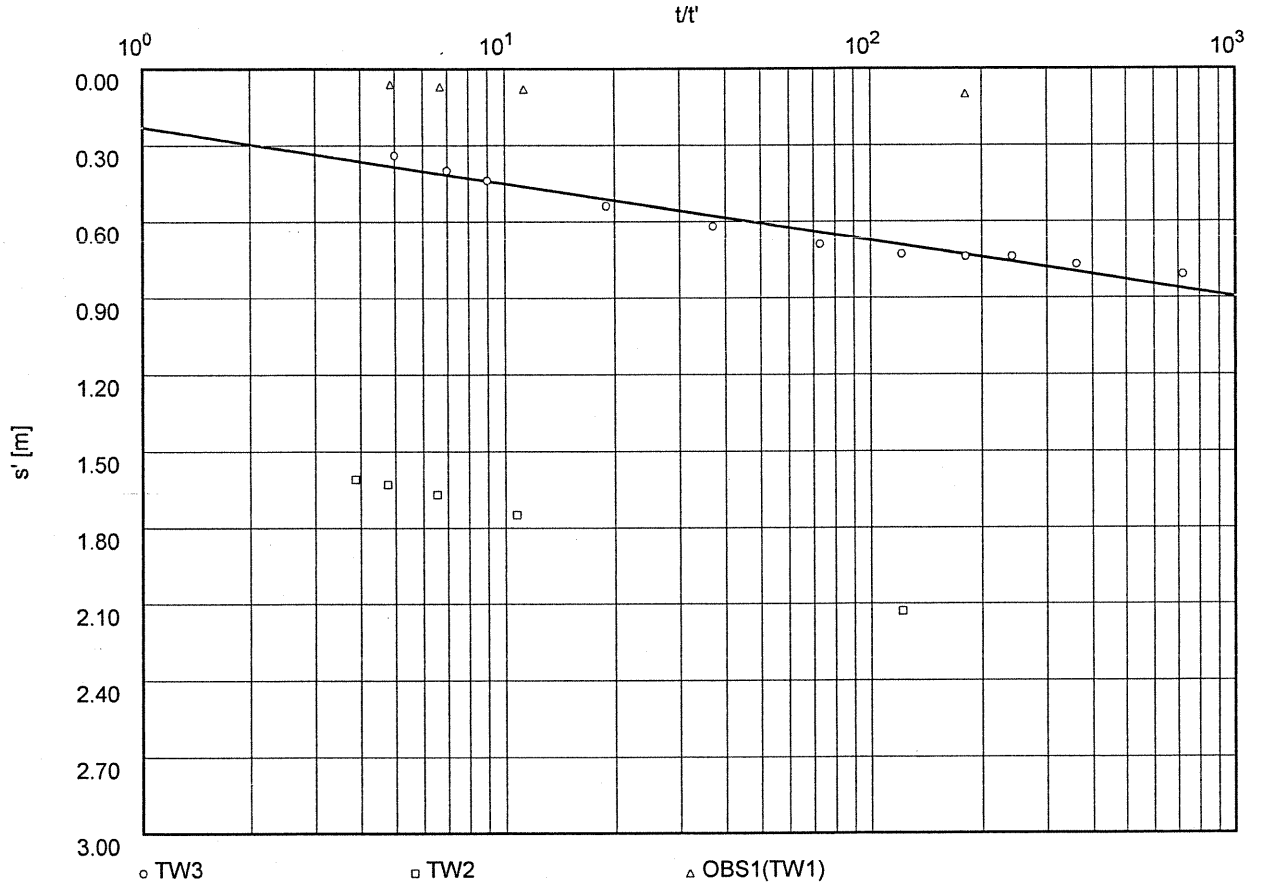
Pumping Test No. 3

Test conducted on: June 28, 2005

TW 3

Discharge 1.68 l/s

Pumping test duration: 360.00 min



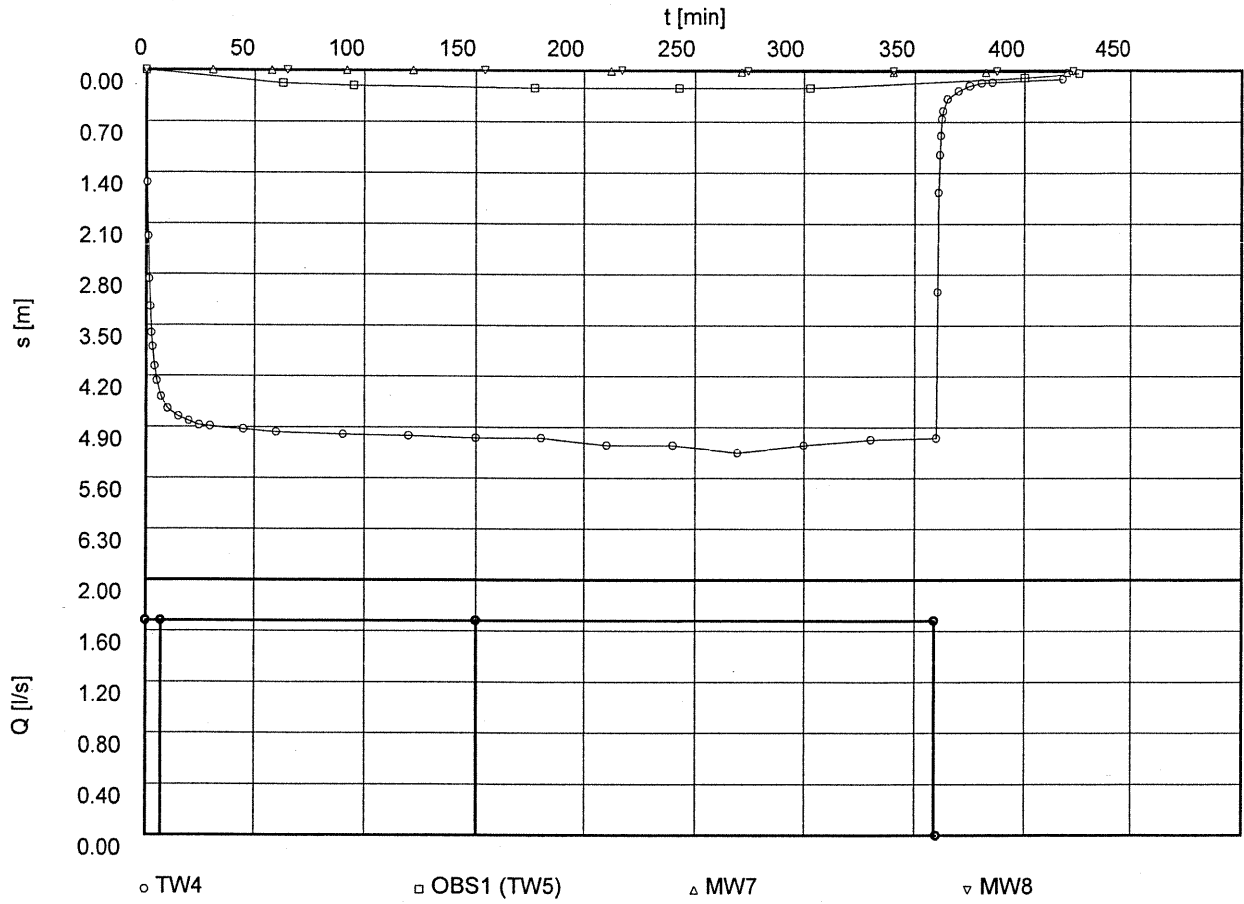
Transmissivity [ $m^2/min$ ]:  $8.30 \times 10^{-2}$

Pumping Test No. 1

Test conducted on: June 21, 2005

TW4

Discharge 1.68 l/s













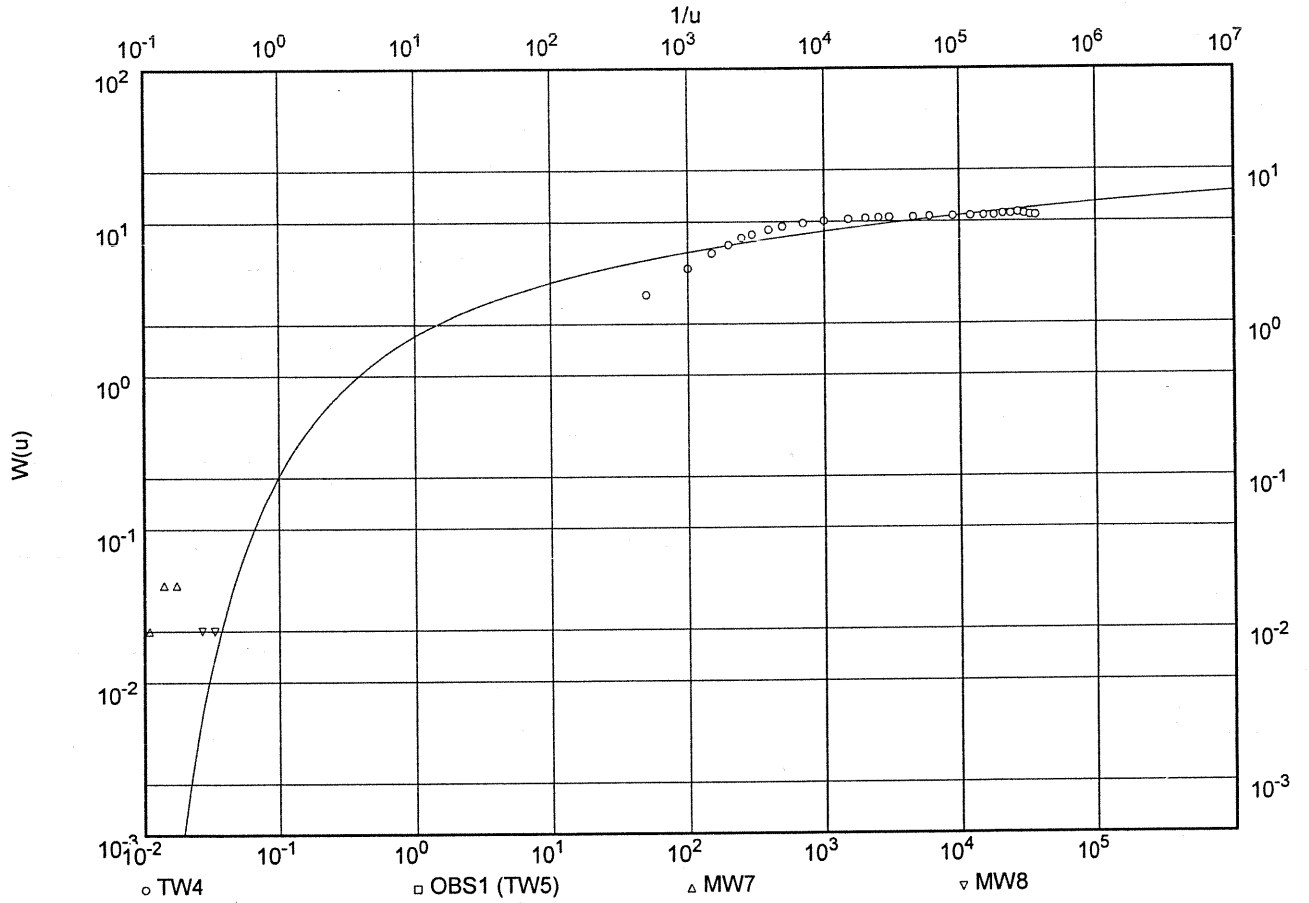


Pumping Test No. 1

Test conducted on: June 21, 2005

TW4

Discharge 1.68 l/s



Transmissivity [ $m^2/min$ ]:  $1.73 \times 10^{-2}$

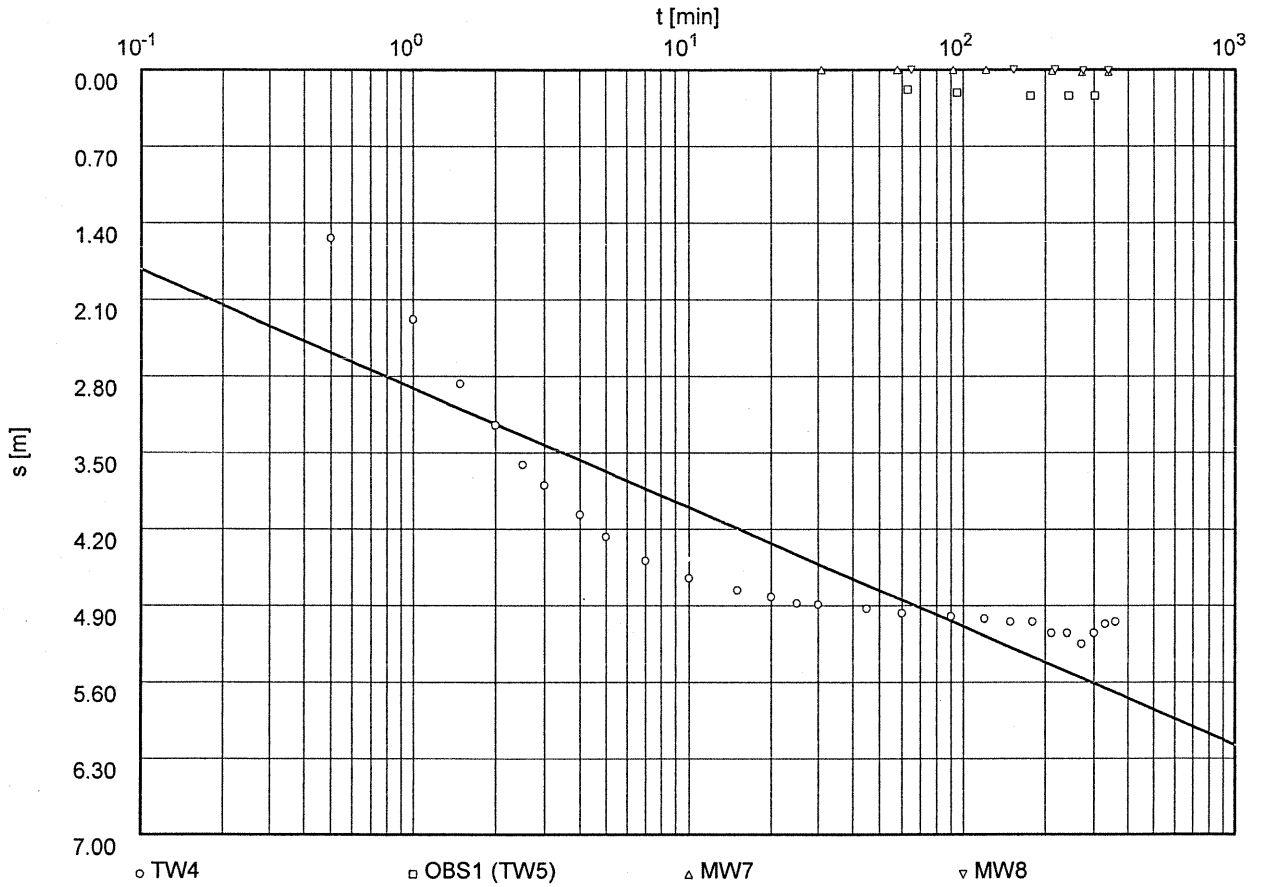
Storativity:  $6.86 \times 10^{-3}$

Pumping Test No. 1

Test conducted on: June 21, 2005

TW4

Discharge 1.68 l/s



Transmissivity [m<sup>2</sup>/min]:  $1.68 \times 10^{-2}$

Storativity:  $8.11 \times 10^{-3}$

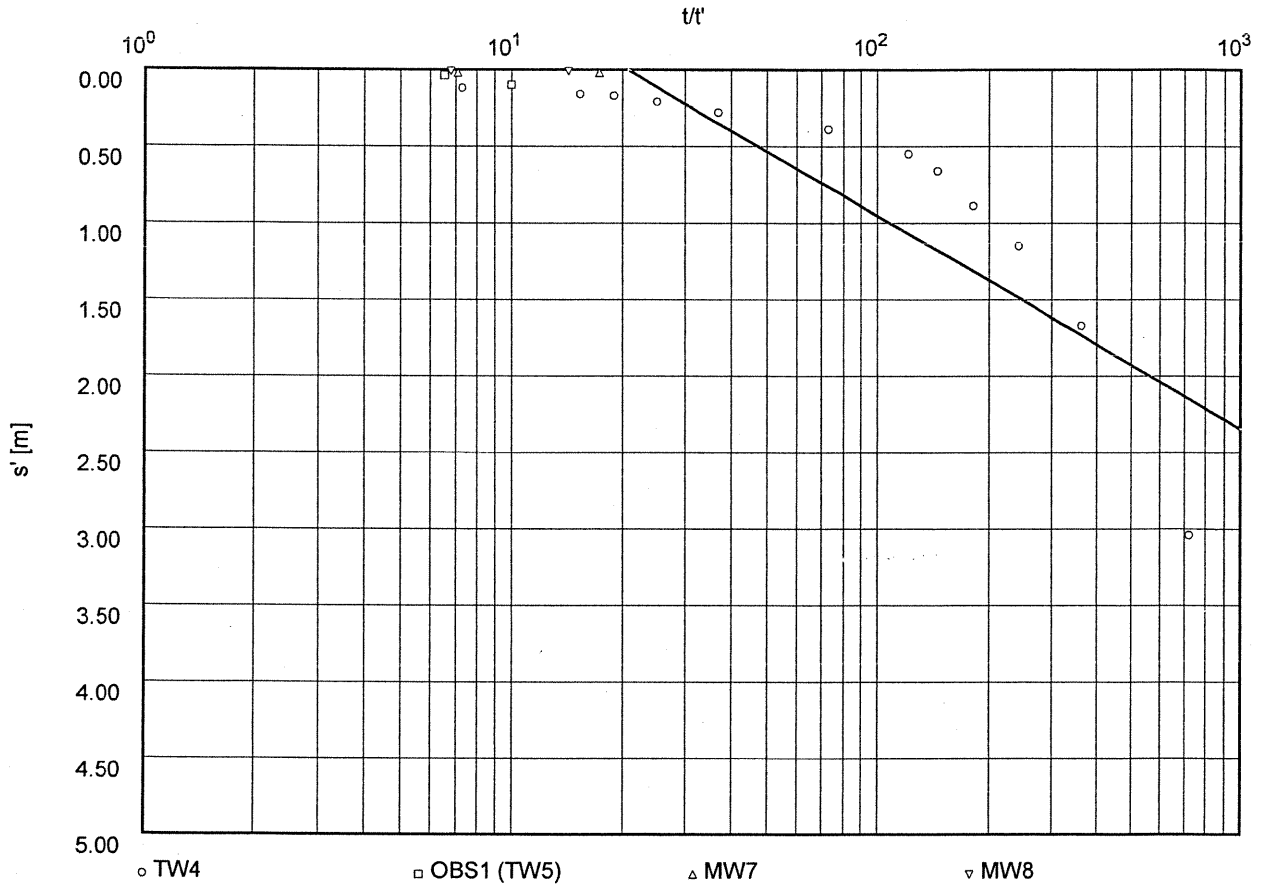
Pumping Test No. 1

Test conducted on: June 21, 2005

TW4

Discharge 1.68 l/s

Pumping test duration: 360.00 min



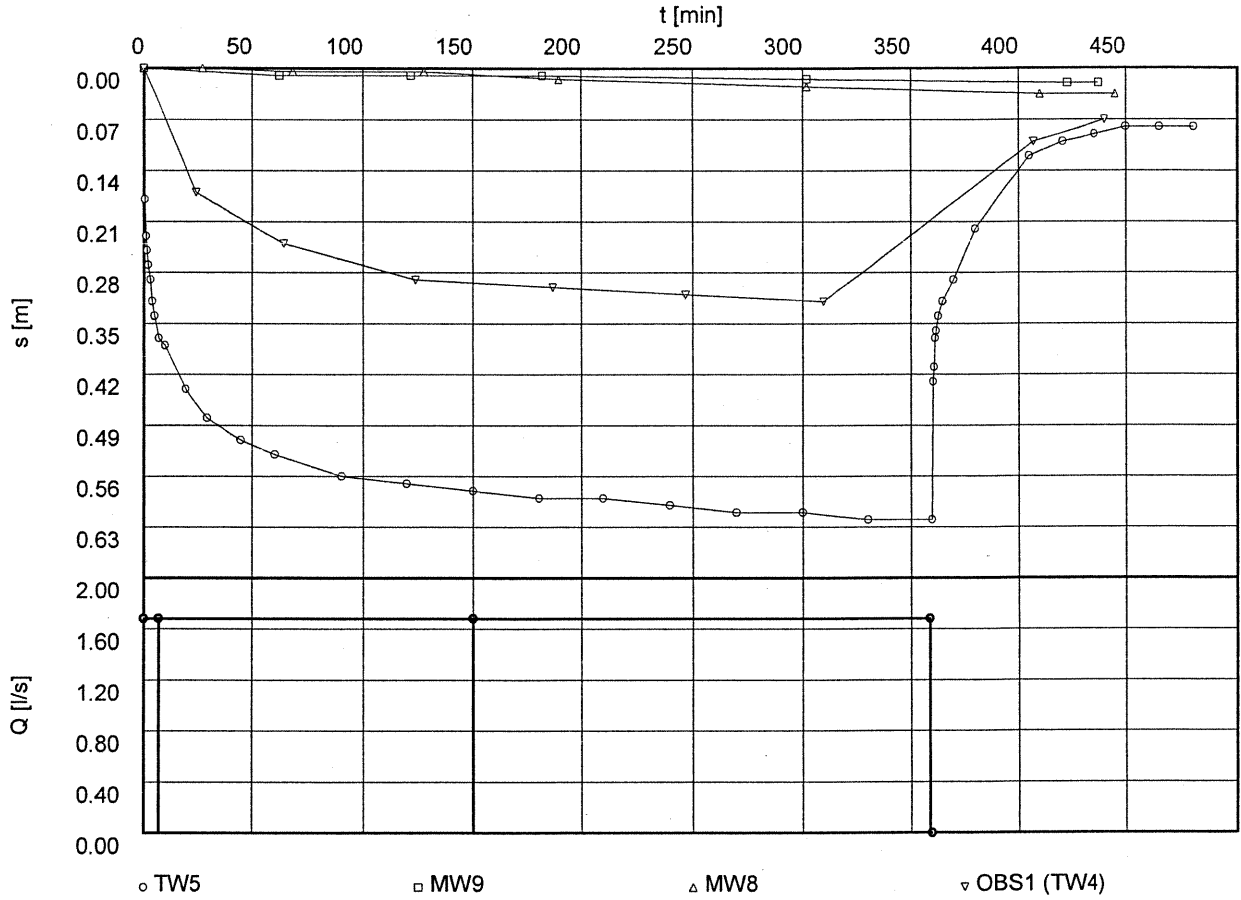
Transmissivity [ $m^2/min$ ]:  $1.31 \times 10^{-2}$

Pumping Test No. 2

Test conducted on: June 22, 2005

TW5

Discharge 1.68 l/s













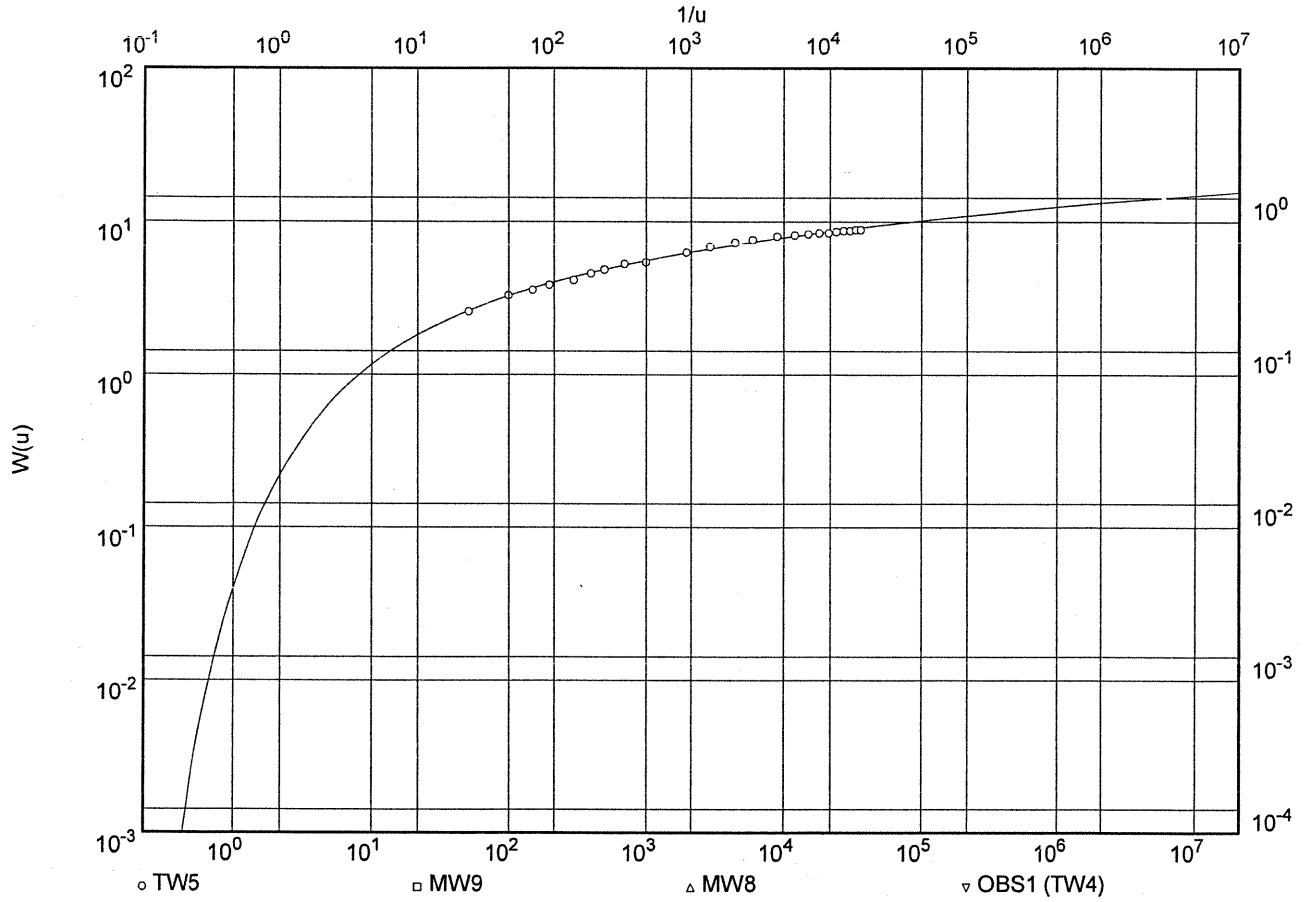


Pumping Test No. 2

Test conducted on: June 22, 2005

TW5

Discharge 1.68 l/s



Transmissivity [ $m^2/min$ ]:  $1.14 \times 10^{-1}$

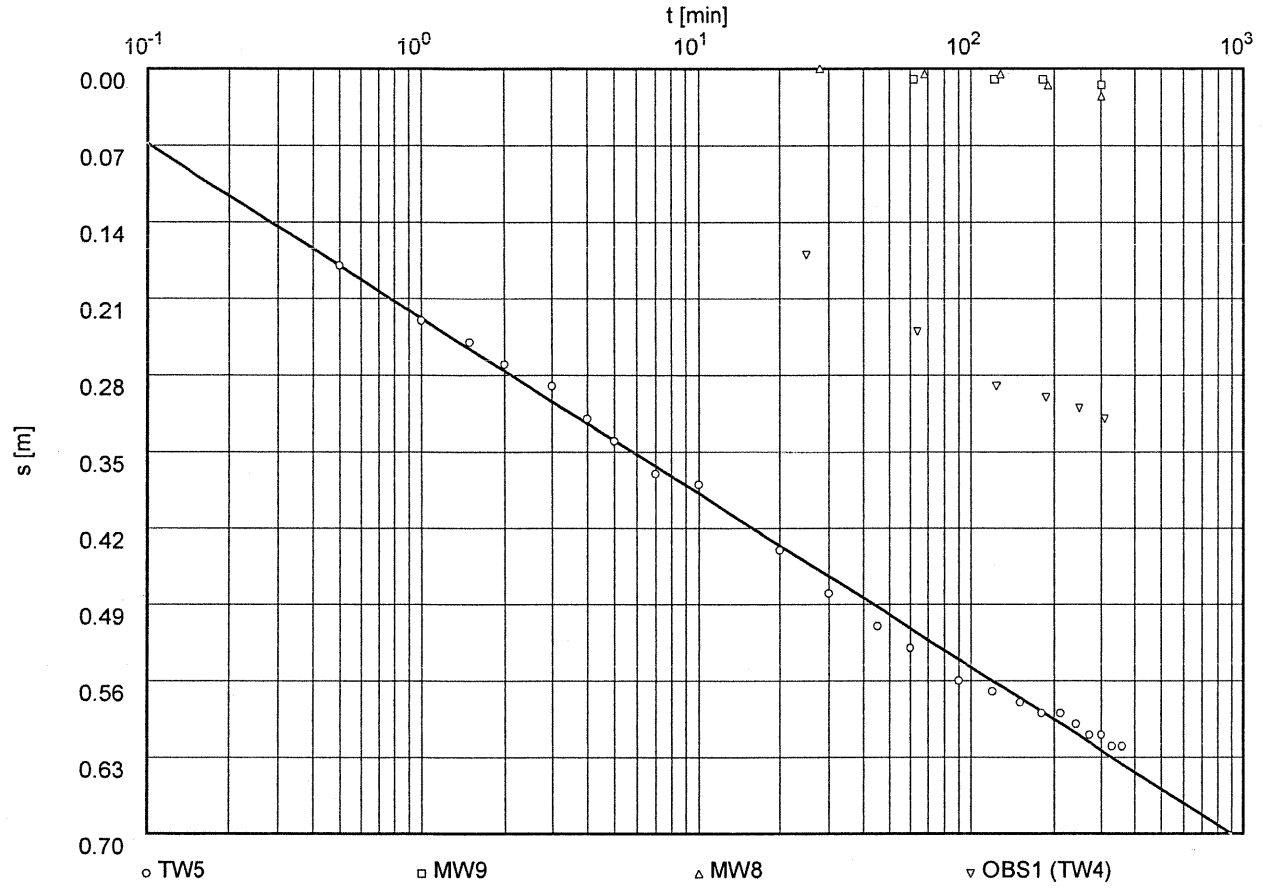
Storativity:  $9.83 \times 10^{-1}$

Pumping Test No. 2

Test conducted on: June 22, 2005

TW5

Discharge 1.68 l/s



Transmissivity [m<sup>2</sup>/min]:  $1.15 \times 10^{-1}$   
 Storativity:  $9.71 \times 10^{-1}$

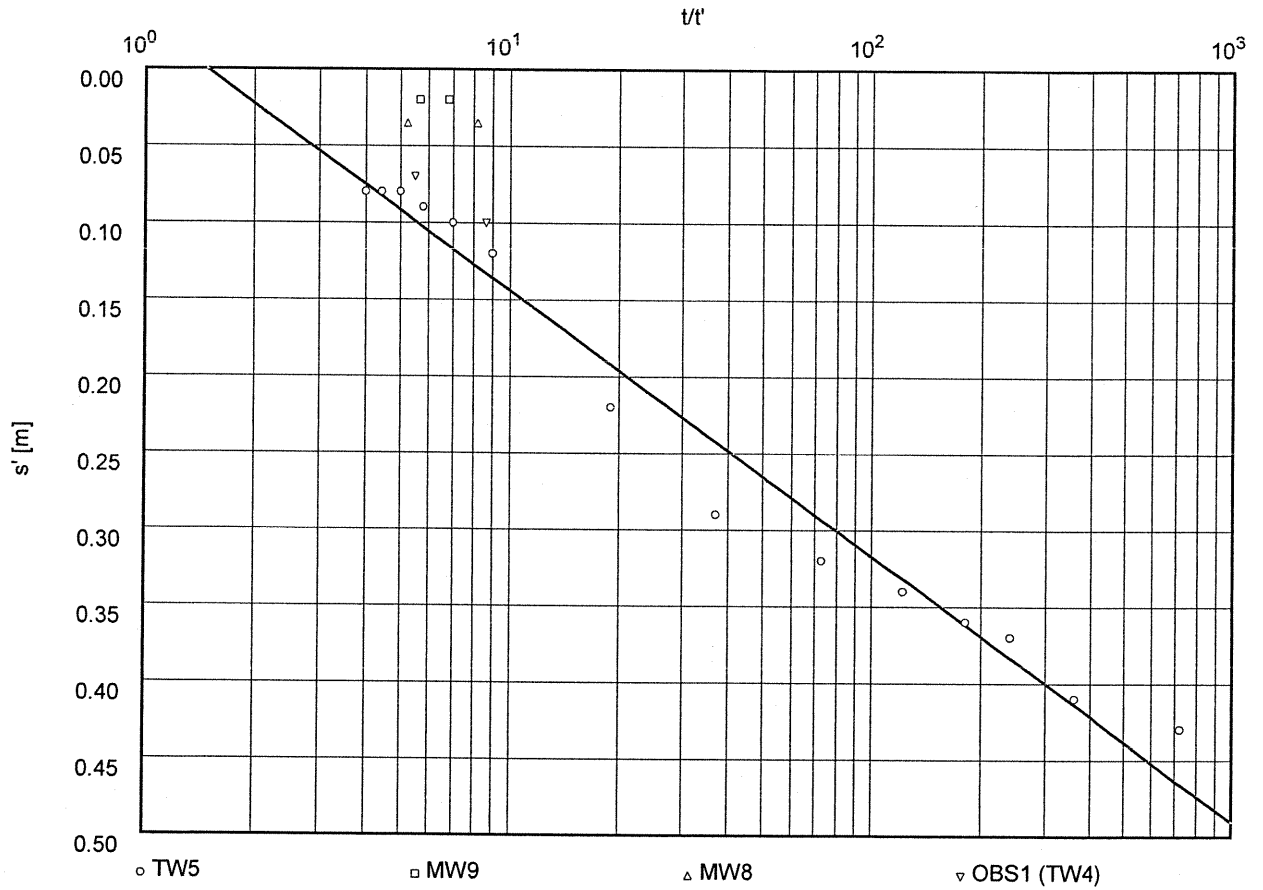
Pumping Test No. 2

Test conducted on: June 22, 2005

TW5

Discharge 1.68 l/s

Pumping test duration: 360.00 min



Transmissivity [m<sup>2</sup>/min]:  $1.06 \times 10^{-1}$

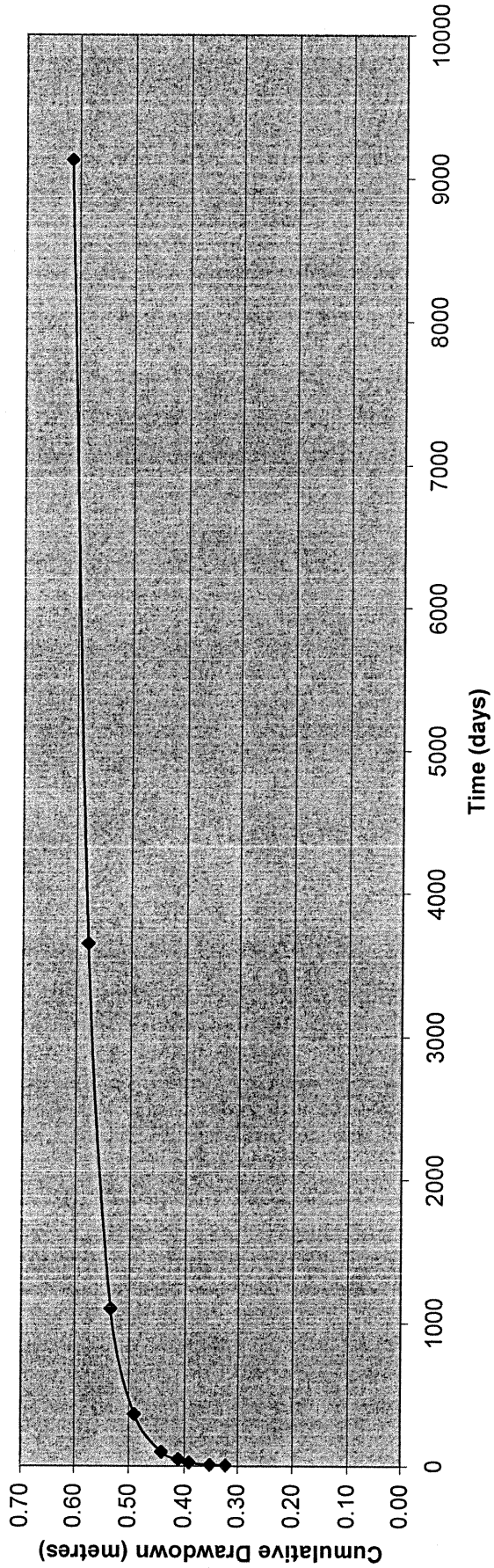
# Determination of Potential Well Interference

Pumping Rate (Q) m<sup>3</sup>/day 2  
 Transmissivity (T) m<sup>2</sup>/day 249  
 Average Well Spacing (m) r 15  
 Coefficient of Storage S 0.001

Notes: Analysis Assumes Continuous Pumping of 85 Wells

Time (days)	1st Well Grouping u	W(u)	2nd Well Grouping u	W(u)	3rd Well Grouping u	W(u)	4th Well Grouping u	W(u)	Drawdown
5	2E-05	10.24	7E-05	8.99	1E-04	8.63	2E-04	7.94	0.32
10	1E-05	10.94	3E-05	9.84	6E-05	9.14	8E-05	8.86	0.35
25	5E-06	11.63	1E-05	10.94	2E-05	10.24	3E-05	9.84	0.39
50	2E-06	12.55	7E-06	11.29	1E-05	10.94	2E-05	10.24	0.41
100	1E-06	13.24	3E-06	12.14	6E-06	11.45	8E-06	11.16	0.44
365	3E-07	14.44	9E-07	13.34	2E-06	12.55	2E-06	12.55	0.49
1100	1E-07	15.54	3E-07	14.44	5E-07	13.93	7E-07	13.60	0.53
3650	3E-08	16.74	9E-08	15.65	2E-07	14.85	2E-07	14.85	0.58
9125	1E-08	17.84	4E-08	16.46	6E-08	16.05	9E-08	15.65	0.61

Graph of Drawdown vs. Time



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**Notes on Data Quality.**
**OTTAWA MACDONALD-CARTIER INT'L A  
ONTARIO**
Latitude: 45° 19' NLongitude: 75° 40' WElevation: 114.00 mClimate ID: 6106000WMO ID: 71628TC ID: YOW

Hourly Data Report for June 22, 2005										
T i m e	Temp °C 	Dew Point Temp °C 	Rel Hum % 	Wind Dir 10's deg	Wind Spd km/h 	Visibility km 	Stn Press kPa 	Hmdx	Wind Chill	Weather
00:00	18.7	17.9	95		0	12.9	99.83			Rain Showers
01:00	18.0	17.6	98		0	16.1	99.87			Cloudy
02:00	18.4	17.0	92	3	15	25.0	99.94			Mostly Cloudy
03:00	16.7	11.1	70	4	17	25.0	100.02			Mainly Clear
04:00	15.7	9.6	67	2	19	24.1	100.09			Mainly Clear
05:00	14.9	8.2	64	1	22	24.1	100.17			Mainly Clear
06:00	14.4	6.4	59	36	26	24.1	100.26			Clear
07:00	15.0	5.4	53	36	19	24.1	100.36			Clear
08:00	15.4	5.1	50	36	19	24.1	100.42			Clear
09:00	16.6	5.8	49	1	15	24.1	100.43			Clear
10:00	17.4	7.0	50	31	11	24.1	100.45			Clear
11:00	18.6	7.4	48	33	19	24.1	100.46			Clear
12:00	19.6	8.7	49	31	19	24.1	100.45			Clear
13:00	20.0	5.2	38	1	24	24.1	100.44			Clear
14:00	20.9	6.1	38	1	17	24.1	100.44			Clear
15:00	20.6	5.1	36	34	20	24.1	100.42			Clear
16:00	20.6	4.6	35	36	19	24.1	100.43			Clear
17:00	20.4	4.9	36	35	15	24.1	100.43			Clear
18:00	19.9	5.3	38	34	17	32.2	100.47			Mainly Clear
19:00	18.7	5.7	42	34	15	32.2	100.51			Mainly Clear
20:00	16.2	5.6	49	34	11	32.2	100.55			Mainly Clear
21:00	15.7	5.7	51	32	7	25.0	100.58			Mainly Clear
22:00	15.8	6.1	52	31	6	25.0	100.62			Clear
23:00	15.1	6.1	55	35	4	25.0	100.64			Clear

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Reviewed : 2004-01-21

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**Notes on Data Quality.**

**OTTAWA MACDONALD-CARTIER INT'L A  
ONTARIO**

Latitude: 45° 19' NLongitude: 75° 40' WElevation: 114.00 mClimate ID: 6106000WMO ID: 71628TC ID: YOW

## Hourly Data Report for June 21, 2005

<u>T i m e</u>	<u>Temp</u> °C	<u>Dew Point Temp</u> °C	<u>Rel Hum</u> %	<u>Wind Dir</u> 10's deg	<u>Wind Spd</u> km/h	<u>Visibility</u> km	<u>Stn Press</u> kPa	<u>Hmdx</u>	<u>Wind Chill</u>	<u>Weather</u>
00:00	17.1	13.5	79	22	11	24.1	100.29			Clear
01:00	16.4	13.2	81	22	13	24.1	100.31			Clear
02:00	15.6	13.0	85	23	13	24.1	100.28			Clear
03:00	15.0	13.0	88	23	9	24.1	100.23			Clear
04:00	14.2	12.8	91	22	11	24.1	100.18			Clear
05:00	14.5	13.0	91	20	11	24.1	100.17			Clear
06:00	15.6	13.9	90	21	11	24.1	100.14			Mainly Clear
07:00	18.0	14.7	81	22	15	24.1	100.14			Mainly Clear
08:00	19.7	15.0	74	22	13	24.1	100.09			Cloudy
09:00	20.2	14.9	72	22	13	24.1	100.04			Cloudy
10:00	22.0	15.6	67	23	15	24.1	99.99			Cloudy
11:00	23.6	16.4	64	24	17	24.1	99.95	28		Mostly Cloudy
12:00	25.8	17.7	61	27	15	24.1	99.86	32		Cloudy
13:00	25.8	17.7	61	22	17	24.1	99.80	32		Cloudy
14:00	26.6	18.5	61	23	13	24.1	99.74	33		Cloudy
15:00	25.2	17.2	61	24	20	24.1	99.72	31		Cloudy
16:00	21.0	18.4	85	27	19	19.3	99.71			Rain Showers
17:00	20.6	19.0	91	23	19	19.3	99.67			Rain Showers
18:00	20.0	18.5	91	24	15	8.0	99.71			Rain Showers, Fog
19:00	19.5	18.6	95	23	13	8.0	99.71			Rain, Fog
20:00	19.5	18.6	95	24	13	9.7	99.71			Fog
21:00	19.2	18.1	93	25	11	12.9	99.75			Cloudy
22:00	19.0	18.0	94	26	9	16.1	99.78			Mostly Cloudy
23:00	18.8	17.9	95	26	4	12.9	99.82			Cloudy

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All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed.

**Notes on Data Quality.**
**OTTAWA MACDONALD-CARTIER INT'L A  
ONTARIO**
**Latitude:** 45° 19' N**Longitude:** 75° 40' W**Elevation:** 114.00 m**Climate ID:** 6106000**WMO ID:** 71628**TC ID:** YOW

Hourly Data Report for June 28, 2005										
Time	Temp °C 	Dew Point Temp °C 	Rel Hum % 	Wind Dir 10's deg	Wind Spd km/h 	Visibility km 	Stn Press kPa 	Hmdx	Wind Chill	Weather
00:00	24.9	16.8	61	19	7	19.3	100.40	30		Mainly Clear
01:00	23.5	17.0	67	18	9	19.3	100.43	29		Mainly Clear
02:00	23.1	16.8	68	20	6	19.3	100.40	28		Mainly Clear
03:00	21.7	17.1	75	27	9	19.3	100.43			Mainly Clear
04:00	21.7	17.1	75	18	9	19.3	100.46			Mainly Clear
05:00	21.2	16.7	76	18	7	19.3	100.44			Mainly Clear
06:00	22.5	18.0	76	20	9	19.3	100.43			Mainly Clear
07:00	24.3	20.0	77	21	11	16.1	100.43	32		Mainly Clear
08:00	26.0	21.1	74	21	9	16.1	100.40	34		Mainly Clear
09:00	27.3	22.2	74	18	11	16.1	100.31	37		Mainly Clear
10:00	29.1	22.8	69	18	11	16.1	100.27	39		Mainly Clear
11:00	30.4	23.3	66	18	11	19.3	100.23	41		Mostly Cloudy
12:00	30.8	23.0	63	18	13	19.3	100.15	41		Mostly Cloudy
13:00	31.9	23.0	59	17	17	19.3	100.10	42		Mostly Cloudy
14:00	32.1	23.1	59	20	15	19.3	100.01	42		Mostly Cloudy
15:00	31.2	22.4	60	20	11	19.3	99.92	41		Mostly Cloudy
16:00	31.0	22.5	61	20	17	19.3	99.87	41		Mainly Clear
17:00	30.6	21.8	59	22	13	16.1	99.78	40		Mainly Clear
18:00	29.6	21.4	61	22	9	9.7	99.80	38		Haze
19:00	28.2	21.7	68	21	7	8.0	99.85	37		Haze
20:00	27.2	21.4	71	21	7	8.0	99.84	36		Haze
21:00	26.5	21.2	73	20	7	12.9	99.87	35		Cloudy
22:00	25.2	20.8	77	19	6	12.9	99.84	33		Cloudy
23:00	24.8	20.9	79	21	7	11.3	99.80	33		Cloudy

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Created : 2002-06-21

Modified : 2004-01-21

Reviewed : 2004-01-21

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## **APPENDIX 5**

### **DRAWINGS & SPECIFICATIONS**

1. PH0145-1: TEST HOLE LOCATION PLAN
2. PH0145-2: LOT DEVELOPMENT PLAN
3. PH0145-3: PIEZOMETRIC HEAD DELINATION
4. PH0145-4: STRATIGRAPHIC CROSS SECTION A-A
5. FIGURE 1: TYPICAL TEST WELL CONSTRUCTION DRAWING

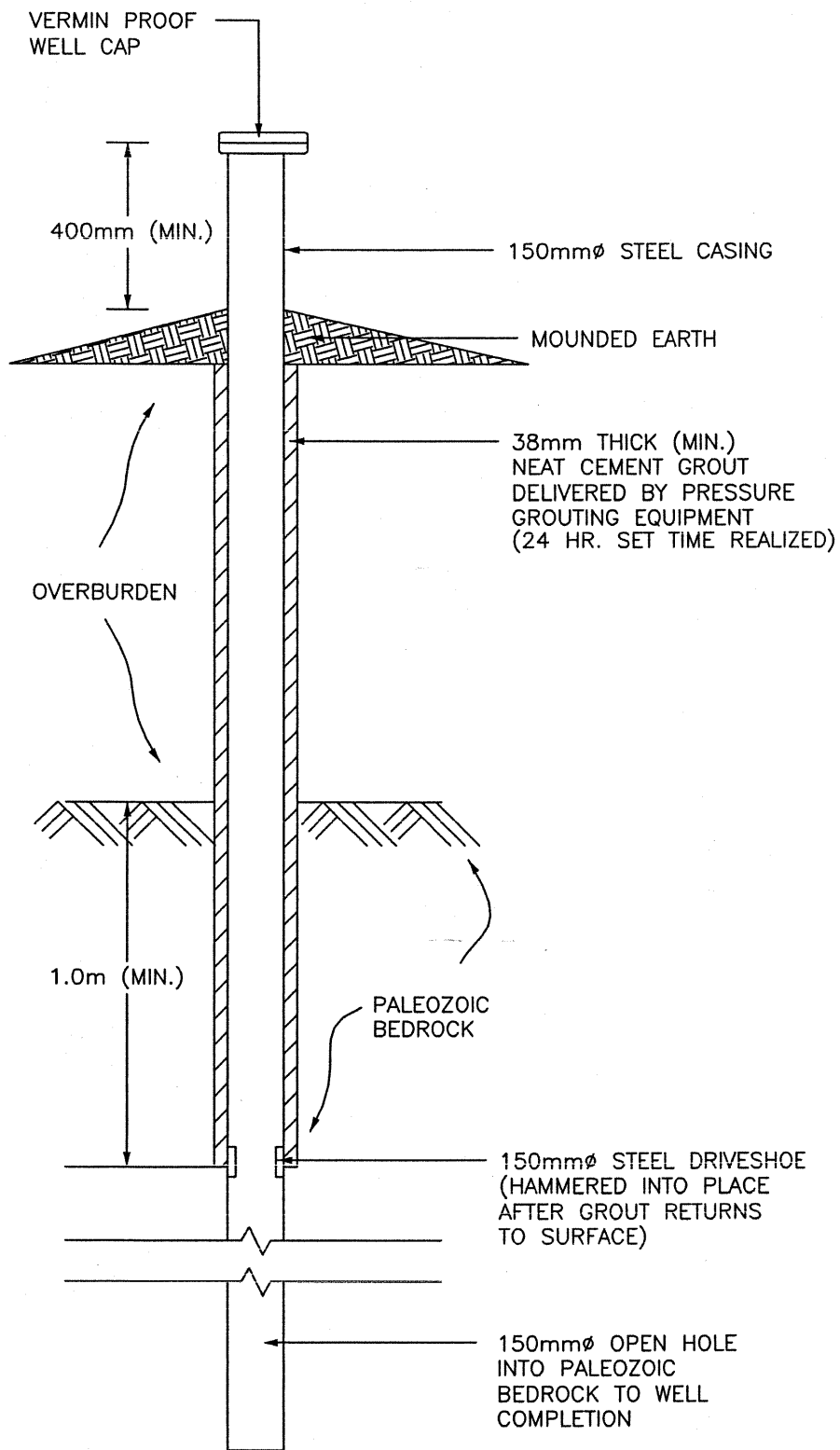
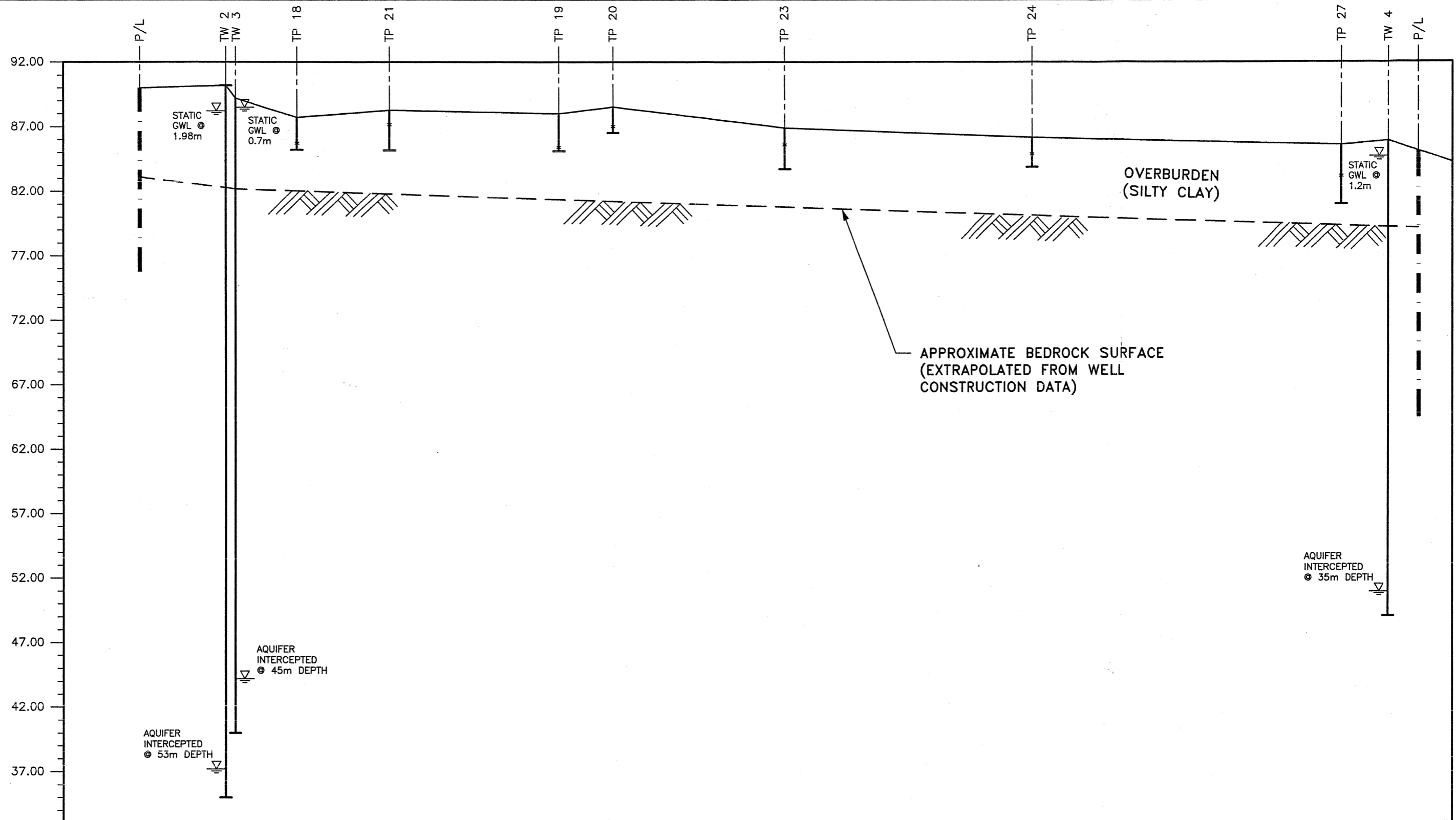


FIGURE 1:  
AS-BUILT CONSTRUCTION DETAIL  
FOR TEST WELL NO. 1



**paterson**group  
 consulting engineers  
 28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

Scale: 1:300 V  
 1:2000 H  
 Des.: RAP  
 Dwn: MPG  
 Chkd: RAP

SUNSET LAKES DEVELOPMENT CORP.  
 PROPOSED VILLAGE CENTRE SUBDIVISION  
 SALES BARN ROAD

OTTAWA,

ONTARIO

CROSS-SECTION A-A  
 (GENERAL SITE STRATIGRAPHY)

Dwg. No.  
**PH0145-4**  
 Report No.: PH0145-01  
 Date: 09/2005

**Geotechnical  
Engineering**

**Environmental  
Engineering**

**Hydrogeology**

**Geological  
Engineering**

**Materials Testing**

**Building Science**

## **Terrain Analysis and Hydrogeological Study Addendum No. 1**

**Greely Village Centre Subdivision  
Part of Lot 73 and Part of Lot 74,  
Registrar's Compiled Plan 902  
Ottawa (Osgoode), Ontario**

**Prepared For**

**Sunset Lakes  
Development Corporation**

**Paterson Group Inc.  
Consulting Engineers  
28 Concourse Gate - Unit 1  
Ottawa (Nepean), Ontario  
Canada K2E 7T7**

**Tel: (613) 226-7381  
Fax: (613) 226-6344  
[www.patersongroup.ca](http://www.patersongroup.ca)**

**June 19, 2006**

**Report No. PH0145-REP.02**

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1.0 INTRODUCTION.....	1
2.0 RESPONSE TO COMMENTS	
2.1 COMMENTS BY GOLDER ASSOCIATES LTD.....	1
2.2 COMMENTS BY SOUTH NATION CONSERVATION.....	2

## APPENDICES

- Appendix 1 Terrain Analysis Documents
- Appendix 2 Water Wells
- Appendix 3 Laboratory Test Data
- Appendix 4 Aquifer Test Data
- Appendix 5 Revised Drawings & Specifications

## 1.0 INTRODUCTION

The following documentation is provided in response to the comments received from:

1. A peer review conducted by Golder Associates Ltd. (Golder), submitted to the City of Ottawa in a letter dated December 29, 2005; and
2. A technical review performed by the South Nation Conservation (SNC) submitted to the City of Ottawa in a letter dated February 2, 2006.

These comments relate to the terrain analysis and hydrogeological study performed by this firm in support of the subdivision development (Paterson Report No. PH0145-REP.01). The following addendum addresses issues related to each comment received from Golder and SNC with the intent to alleviate any outstanding issues or concerns.

The original report identified the proposed use of the site as containing a 75 lot residential subdivision and a 6 unit professional office park, where applicable for analysis. Accordingly, we have divided the site into two sectors: residential sector and office park sector. The ODWS health parameters of the well water samples were not on a communal site. The aesthetic parameters are addressed herein. The health parameters and aesthetic parameters were met on the residential site.

## 2.0 RESPONSE TO COMMENTS

### 2.1 Comments Received by Golder Associates Ltd.

- 2.1.1 "Total coliform bacteria were detected in 4 of the 5 test wells and confirmed in the second sampling in 3 of the 5 test wells. Chlorine residual measurements at the time of the sampling of the test wells were not reported and there is no indication provided in the report that chlorine residual testing was conducted. Procedure D-5-5 states that, "chlorine residual must be zero before any bacteriological sample can be taken".**

**In light of the total coliform bacteria detected in 4 of the 5 test wells and confirmed in the second sampling in 3 of the 5 wells, measurement and reporting of chlorine residuals is crucial in order to have confidence that the data reflects natural conditions**

**unaffected by chlorine. Considering the comment in the report that the coliform concentrations “fluctuate”, we recommend additional testing to confirm the report conclusion that the presence of bacteria is associated with well construction and insufficient well development. Additional bacteriological results must be supported with chlorine residual data.”**

### Response

It is established practice by this firm to confirm the absence of free chlorine residual at the well head prior to collecting water samples for analysis. Free chlorine residual is measured either by a chlorine meter or test strips. Test strips were used to check for the absence of free chlorine residual in the test wells. Although not reported in the body of the report, all test wells did not contain free chlorine residual at the time of collection of the water samples at both the three (3) hour and six (6) hour time intervals. Furthermore, the same methodology was utilized during the collection of subsequent water samples collected from the well that required additional disinfection due to poor well development.

With respect to the statements made concerning total coliform concentrations in the test wells, the report clearly indicates that total coliform concentrations fluctuated during pump testing of the five(5) test wells. The laboratory data contained within Appendix 3 of the report clearly indicates that total coliform concentrations increased slightly between the three and six hour sampling intervals for TW1, TW2, and TW4. The actual increase was only 1, 2 and 9 counts per 100 mL, respectively. While TW3 had no detectable total coliform concentrations, the samples received from TW5 were noted to decline from 24 to 7 counts per 100 mL. Subsequent diligent disinfection and flushing of the wells by Paterson resulted in a complete absence of total coliform from all test wells. This, combined with the absence of other pathogenic indicators, confirms the statement in the report that poor well development was the initial cause of the presence of total coliform bacteria.

In carrying out follow-up work on the site, additional water samples were collected by Paterson, using established water sampling protocols, for all of the original test wells and one new test well, referred to hereafter as TW6. (Laboratory test data reports are provided in Appendix 1). A chlorine residual of approximately 50 mg/L was established in the test wells and maintained for a duration of not less than 12 hours. The test wells were pumped at rates upwards of 30 IGPM until free chlorine residual was not detected in the discharge water (i.e. one to two hours). The laboratory reports for the bacteriological parameters indicate that original test wells (i.e. TW1 to TW5) are free of all pathogenic bacteriological parameters after more than six (6) months without use.



Furthermore, TW6 exhibited the exact response as TW1, TW2 and TW4 with respect to an increase in total coliform concentrations in the absence of other pathogenic indicators. This evidence confirms the theory, originally presented in the report, that poor well development was responsible for the fluctuations of total coliform bacteria as surface debris (i.e. soil and organic matter) was not adequately removed from the wells.

Based on the evidence provided above, it is clear that the test wells and water supply aquifer are clear of all bacteriological indicators.

**2.1.2 "Laboratory measured turbidity samples exceeded 1 NTU in all wells and 5 NTU in three of the five wells. The turbidity increased over time for four of the five pump tests, with results as high as 62 NTU. Levels above 1 NTU can be considered a health concern, and levels above 5 NTU are not considered reasonably treatable, according to D-5-5.**

The report indicates that field measurements using a turbidity meter confirm that results were below 1 NTU in all wells except TW4 (no field data from TW4 due to equipment problems), however, none of the field data was provided in the report. This data should be provided for review. The report attributes the elevated turbidity in the laboratory samples to oxidation of iron and manganese. The aesthetic objectives for iron and manganese outlined in D-5-5 are 0.3 mg/L and 0.05 mg/L, respectively. The concentrations measured in all of the five wells exceeded these limits. The report indicates that these parameters can be treated by potassium permanganate (greensand) filters.

Based on the assumption presented in the report that turbidity increased due to oxidation reactions, turbidity could increase in the water supply with some treatment processes (i.e. chlorination) or at fixtures (i.e. aerators), which could create health and aesthetic concerns. As such, the higher turbidity measured after oxidation would be relevant. Procedure D-5-5 indicates that the levels of turbidity measured in the laboratory are not reasonably treatable."

## Response

Field measurements for turbidity were recorded over the duration of each pump test (with the exception of TW4 due to equipment malfunction). It is widely accepted that the most relevant data is the field turbidity readings at the time of sample collection for water quality analysis. The reason for the importance of

measurements made at these specific instances comes from the fact that the sampled water at the point of discharge of the pump testing piping represents the point of discharge of the distribution system in a residence. The other data points only identify potential trending of turbidity and this data is only useful if there are significant fluctuations in turbidity during pumping. In the monitored test wells, there were no significant fluctuations and, hence, there is no rationale to include the data in the body of the report. As required from the peer review, the field turbidity data recorded during each pumping test of the original five (5) test wells is provided in Appendix 2.

We now address the conjecture related to the potential increase in turbidity in the water supply with some treatment processes and at fixtures. The importance of the field test data, as established in the previous section, is such that it reasonably reflects the condition of the water at the point of discharge or consumption. The oxidation of concentrations of soluble iron and manganese at the point of discharge is too slow to result in the formation of precipitates visible to the naked eye during normal water use that would lead to a negative aesthetic impact. However, water that is drawn from the point of discharge and allowed to sit for a moderate period of time, will likely contain metal precipitates in the bottom of the container. Again this does not negatively impact the aesthetic pleasure of the water for consumption, but will result in staining of porcelain, etc. Although the levels of laboratory turbidity reported in the test wells is not reasonably treatable under the constraints of Table 3 of Procedure D-5-5, the concentrations of iron and manganese are. Since the iron and manganese are contributing to the turbidity, and both of these parameters are readily treatable, the turbidity is also reasonably treatable as is the theoretical problem with it.

Further to the argument presented in the previous paragraph, the turbidity poses no apparent health issues related to either water treatment processes or point of use consumption. Once the test wells were adequately disinfected and flushed, there were no further reports of the presence of bacteriological parameters in the water supply aquifer. As such there is no requirement to utilize chlorine for disinfection. If chlorination is to be chosen to be used in conjunction with iron and manganese removal, then the sand filter positioned after the chlorine contact chamber will remove the iron, manganese and residual turbidity. Accordingly, the ODWS for turbidity have been met.

**2.1.3 "Total dissolved solids (TDS) concentrations were above the aesthetic objectives in five of the test wells and sodium and chloride were above the aesthetic objective in three of the five test wells (TW1, TW2 and TW3). Hardness was measured in excess of 500 mg/L in all of the test wells. As stated in Procedure D-5-5, hardness in excess of 500 mg/L is unacceptable for most domestic purposes. The elevated chloride concentrations were not addressed in the report. The report suggests that sodium would be expected to decline with well development, the technical basis for this assumption should be provided. It is our opinion that the source of the elevated sodium is likely anthropogenic. TDS concentrations were measured in TW1, TW2 and TW3 at more than three times the aesthetic limit and chloride concentrations were more than two times the aesthetic limit. According to Procedure D-5-5, the sodium and chloride concentrations measured in test wells TW1, TW2 and TW3 are not reasonably treatable. Further, with elevated TDS, hardness, chloride and sodium, issues of mineral deposition, and corrosion are a concern."**

#### Response

As indicated in the Section 1.0 of this report, the residential and commercial areas will be dealt with separately in addressing this comment.

#### Residential Area

The residential area consists of 75 lots located on the eastern part of the subject property. TW4 and TW5 are contained within the residential area while the newly constructed TW6 is located along the western edge (refer to the revised Lot Development Plan contained in Drawing No. PH0145-2).

The water quality in the residential area of the subject site, as defined by the water quality results from TW4 and TW5 in the original report, exceeds the Ontario Drinking Water Standards only for the following aesthetic parameters: iron, manganese, hardness and total dissolved solids (TDS). As well, sodium is present in concentrations in excess of 20 mg/L and, as such, require notification of the medical officer of health. The concentrations of sodium and chloride in the water from TW4 and TW5 does not indicate anthropogenic sources.

Additional analysis of water quality of the aquifer intercepted by these wells was conducted during additional field work at the subject site. The laboratory analyses are provided in Appendix 1. The following is a discussion of the outstanding aesthetic water quality issues and Table 2.1.3 summarizes the

reasonable treatable limits, possible treatment technologies and associated capital cost to install and operate.:

### **Iron and Manganese**

The concentrations of iron and manganese, which are anticipated to be causing the post field test turbidity, are both present in concentrations that are considered to be reasonably treatable even under the antiquated values presented in Table 3 of Procedure D-5-5. Removal of these parameters can easily be accomplished through the use of water treatment technologies employing ion exchange (softener) or absorption/oxidation (greensand filters) technologies.

### **Hardness**

The water contained within the water supply aquifer intercepted by TW4 and TW5 is considered to be very hard. As there are no maximum treatable limits set for hardness, the degree of hardness removal is ultimately a function of the capacity of the water softener. It is anticipated, based on average hardness concentrations of approximate 473 mg/L that reduction to the ODWS Operation Guideline (OG) of hardness of 100 mg/L is easily achievable. Given that water softeners operate based on the ion exchange principle, if sodium chloride is used to charge the resin, sodium concentrations in the treated water will increase. Individuals requiring control of sodium intake can easily substitute potassium chloride to recharge the resin. As there is no discharge of sodium into the treated water when potassium chloride is used, sodium concentrations will not increase.

### **TDS**

The total dissolved solids (TDS) of the water supply aquifer intercepted by TW4 and TW5 is present at a concentration of between 670 and 825 mg/L. The water is slightly alkaline with moderate buffering potential with a pH of between 7.6 and 7.98 and the alkalinity between 220 and 300 mg/L. Based on this information, corrosion of the distribution piping is not likely, even in cases where the water is softened. Encrustation is only anticipated where unsoftened water is heated. In heating the water, calcium carbonate will be precipitated. Typically the precipitate, noted as a dense white scale, forms on heating elements in kettles, electric fired hot water tanks, etc.

Table 2.1.3 below presents a summary of the aesthetic parameters and the recognized concentrations that the water treatment industry acknowledges as being treatable as well as the associated standard treatment technology available to achieve the necessary level of treatment.

## Chloride and Sodium

There are no concerns with either chloride or sodium in the test wells located within the residential area of the proposed development given that both of these parameters are well below the aesthetic objectives. With respect to sodium, the concentrations in the TW4 and TW5 are above 20 mg/L. As a result, it is required, under Procedure D-5-5, that the Medical Officer of Health be notified to allow the information to be disseminated to local physicians.

Parameter	ODWS Aesthetic Objective (mg/L)	D-5-5 <sup>1</sup> Maximum Reasonable Treatable Limit (mg/L)	WQA <sup>2</sup> Maximum Reasonable Treatable Limit (mg/L)	Most Commonly Available Treatment Technologies <sup>2</sup>
Iron	0.30	10	30	Water softeners, air oxidation combined with filtration
Manganese	0.05	1.0	2.0	Water softeners, air oxidation combined with filtration
Hardness (as CaCO <sub>3</sub> )	500	N/A	1105	Water softeners
TDS <sup>3</sup>	500	N/A	5000	Point of Use Reverse Osmosis

1. From Table 3 of MOE Procedure D-5-5.
2. Information based on summary letter by Water Quality Association certified water treatment professional (TechnaLinks Letter Dated June 7, 2006 –refer to Appendix 3)
3. TDS = total dissolved solids. TDS is largely based on dissolved ions, namely sodium and chloride. Removal of these ions will reduce TDS.

## Office Park

TW1, TW2, TW3 are all located in the proposed office park portions of the subject site. TW6, a well constructed April 21, 2006, is located at the edge of the office park area, immediately adjacent to the residential area.

Based on the most recent water quality data from these wells (refer to laboratory analysis records in Appendix 1) that, like the residential part of the development, the water has elevated concentrations of sodium, hardness, and TDS. Unlike the residential portion of the site, the water supply aquifer intercepted by these test wells also has elevated chloride concentrations. Please note, there is no sodium

or chloride issue with the residential portion. The six (6) units abutting the highway proposed for office use are affected.

### **Sodium**

Sodium concentrations are higher in TW1, TW2, TW3 and TW6 than in TW4 and TW5 with values ranging from 270 to 318 mg/L. Sodium, as noted in the discussion in the residential portion of the site, will require notification of the Medical Officer of Health. Furthermore, as explained in the Technical Support Document for Ontario Drinking Water-Standards, Objectives and Guidelines (June 2003);

"The aesthetic objective for sodium in drinking water is 200 mg/L at which it can be detected by a salty taste. Sodium is not toxic. Consumption of sodium in excess of 10 grams per day by normal adults does not result in any apparent adverse health effects. In addition, the average intake of sodium from water is only a small fraction of that consumed in a normal diet. A maximum acceptable concentration for sodium in drinking water has, therefore, not been specified."

It has been suggested that the source of the sodium is anthropogenic in nature. The water supply aquifer(s) beneath the site, as detailed in the original report, and supplemented with the work summarized in Section 2.1.10 of this addendum, are hydraulically isolated from the surface. As such, the source of the sodium must be offsite and hydraulically up-gradient of the subject property. It should be noted that in the final report by Jacques Whitford Ltd., entitled *Final Draft Groundwater Study Interim Report #1 (City of Ottawa-Shields Creek Subwatershed Study)*, dated 2002, concluded that chloride "appears to tend higher along major roadways", which supports the offsite sources of sodium and chloride.

Sodium can be easily removed using membrane technology (i.e. reverse osmosis) for drinking water need in the office park areas. As the buffering potential of the water is moderate, corrosion of the distribution system is not anticipated, even with the elevated TDS values and, hence, total water treatment (i.e. all incoming water) will not be required.

### **Chloride**

The chloride concentrations in TW1, TW2, TW3 and TW6, all located within the office park portion of the development, are above the aesthetic objective of 250 mg/L with values ranging between 527 and 650 mg/L. As detailed in the section above concerning sodium, the subject site is hydraulically isolated from the water supply aquifer. As such, the source of the chlorides is offsite and hydraulically

up-gradient of the subject site. Furthermore, as chlorides are generally unattenuated in the natural environment, the chloride concentration would be expected to increase with depth in the water supply aquifer. This would also provide a natural explanation for the concentrations of chloride and sodium reported in TW2, TW3 and TW6.

The concentrations of chloride in the office park portion of the development, although generally elevated, are within the range of values observed from samples collected in neighbouring wells located close to the western and northern portions of the development. Refer to Table 2.1.4.1 in section 2.1.4 for the summary of neighbouring water quality analysis and Drawing No. PH0145-5 for the sample locations.

By conducting comparative analysis on the neighbouring sample locations, it is apparent that a source of contamination exists beyond the site to the north and west. Given the pressures placed on the City of Ottawa to reduce salt application to Regional Roads, it is anticipated that chloride (and sodium) concentrations will fall in the future as new de-icing technologies (such as liquid brine application) become mainstream.

Like sodium, chloride can be easily removed with membrane technology for the drinking water supplies in the office park portions of the site. There is no need for treatment in the residential portion.

### **Hardness**

As the concentrations of hardness in the commercial portions of the site are similar to those of the residential, the same treatment options as those used for the residential part of the site can be utilized.

### **TDS**

As the concentrations of TDS and levels of pH and alkalinity are similar to those of the residential portion of the subject site, encrustation may occur on heating elements. When using membrane treatment technologies, the units should be sized to accommodate the TDS concentrations to increase the time between membrane maintenance intervals.

### **Summary**

Based on the water quality information, especially with respect to the information obtained from the new TW6 located in the commercial area, adjacent to the residential development, well construction in the residential portion of the site should be revised to target the upper part of the water supply aquifer. It is clearly

apparent, when comparing the water quality from TW4 and TW5 to the other four (4) test wells, that TW4 and TW5 have lower concentrations of aesthetic parameters. As such, it would appear prudent to recommend the depth of the wells in the residential and commercial areas, where possible, to no more than approximately 37 m below the surface of the ground.

With respect to maximum treatable limits, as imposed by the antiquated values contained within Procedure D-5-5, current technologies are such that the maximum treatable limits no longer accurately reflect available treatment technologies. As such, based on the information presented in this section, the aesthetic parameters can be easily treated to meet the ODWS. As there are no health related issues with the water supply aquifer in the office park portion of the site and the indicated aesthetic parameters can be easily treated, if required, there is no scientific basis to prevent the development of the office park.

**2.1.4 "Results of groundwater sampling from existing developments were not provided. Section 4.4.1 in Procedure D-5-5 indicates that sampling from the existing developments should be obtained and analysed."**

Response

Samples were collected from six (6) neighbouring developments under the supervision of Paterson. The samples were collected on May 4, 2005 and submitted for analysis to Accutest Laboratories Ltd. (Accutest). The laboratory records of analysis are provided in Appendix 1. The geographical locations relative to the subject site are depicted in Drawing No. PH0145-5 in Appendix 5.



TABLE 2.1.4.1 – SUMMARY OF NEIGHBOURING WATER QUALITY ANALYSIS								
Parameter	Units	ODWS	1508	7164	7200	7281	7377	Sale Barn
<b>Microbiological Parameters</b>								
Total Coliforms	ct/100mL	0	0	0	0	0	0	0
E.Coli	ct/100mL	0	0	0	0	0	0	0
HPC	ct/1mL	500	1	2	12	185	16	0
Faecal Coliforms	ct/100mL	0	0	0	0	0	0	0
Faecal Streptococcus	ct/100mL	0	0	0	0	0	0	0
<b>Chemical Parameters (Health Related)</b>								
Fluoride	mg/L	2.4	0.17	0.11	0.11	0.17	0.59	0.51
Nitrite	mg/L	1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nitrate	mg/L	10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Turbidity	NTU	1	10.4	6.8				
<b>Chemical Parameters with Aesthetic Objectives/ Operational Guidelines</b>								
Alkalinity	mg/L	500	340	316	307	0.17	218	299
Chloride	mg/L	250	136	175	228	1536	316	399
Colour	TCU	5	<2	<2	<2	<2	<2	<2
DOC	mg/L	5	1.1	<0.5	<0.5	<0.5	<0.5	<0.5
Hydrogen Sulfide	mg/L	0.05	0.13	<0.01	<0.01	<0.01	1.40	1.10
pH		6.5-8.5	8.01	7.88	7.88	7.89	7.99	8.07
Sulphate	mg/L	500	81	91	98	87	47	69
Hardness	mg/L	100	466	463	486	617	342	5
Sodium	mg/L	20	56	82	105	807	159	418
Iron	mg/L	0.3	1.24	0.57	0.32	0.26	0.41	<0.03
Manganese	mg/L	0.05	0.05	0.10	0.06	0.06	0.03	<0.01

**2.1.5 “Under Procedure D-5-5 section 4.3.1, recovery measurements following pump testing must continue until 95 % recovery, or for 24 hours, whichever is less. Data from three of the pump tests indicate that recovery monitoring data provided stops at approximately 60 to 80% recovery even though the study methodology section indicates that 95% recovery was observed in all wells. All recovery data should be provided for review.”**

**Response**

A 120 minute recover period of constant recording of water levels was performed on all wells as a standard monitoring protocol. Where 95% recover has not been achieved in a particular well at the completion of the 120 minute period, additional measurements are taken either at 18 hours or 24 hours after completion of pumping. Three test wells, TW2, TW3 and TW5 had slower recovery rates during pump testing resulting in water levels not recovering to at least 95% within the allotted time period. As such, Paterson recorded drawdown

measurements for these wells within 24 hours of completion of pumping. The recovery data for these wells is provided below, as the data points were omitted from the water level data used to conduct the aquifer analysis since they were irrelevant to the analysis of the aquifer parameters.

In conjunction with supplemental field work carried out to address other comments contained within this report, TW4, TW5, and a newly constructed well, TW6, were pump tested. The drawdown data for these pump tests appear in Appendix 1. Analysis of the drawdown and recovery data indicates full recovery in less than a 24 hour period and confirms that no mining of the water supply aquifers has occurred.

**2.1.6 "As per Procedure D-5-5 Section 4.3, hydraulic gradients were provided for the water supply aquifer. Hydraulic gradients for the receiving aquifer should also be provided."**

#### Response

The receiving aquifer exists in the silty sand layer overlying the silty clay to clayey silt soils present above the bedrock. This is confirmed by water infiltrating downward through the sand being held up on the underlying low-permeable soils resulting in a perched water table. As the water exists in a perched condition, the slope of the low permeable soils and drainage network generally governs the hydraulic gradient of the receiving aquifer. Most of the drainage ditches, which form the primary drainage network, are incised into the underlying low permeable soils. This provides an outlet of water trapped within the sand layer above the low permeable soils. The hydraulic gradients for the receiving aquifer have been added to Drawing No. PH0145-3 and reflect the general trending of the perched water in the sand layer.

**2.1.7 "The report does not discuss the water or sewage requirements for the proposed commercial "Professional Office Park" or the associated potential impacts. An estimate of water demand, yield and interference potential as per D-5-5, leaching bed space requirements, and sewage system impacts as per D-5-4 Section 5.6.3 should be provided."**

#### Response

With respect to the anticipated water demand for the Professional Office Park, each building to be located on each business lot is proposed to have a gross floor area of approximately 200 m<sup>2</sup> (2000-2100 ft<sup>2</sup>). The proposed use of these building is intended for office space as indicated in the application for zoning

amendment. As such, using total daily design sanitary sewage flow values contained within Table 8.2.1.b of the Ontario Building Code (OBC) a value of 75 L/day/9.3 m<sup>2</sup> of office area is applicable. Using this value, each office building is anticipated to have a total daily design sanitary sewage flow of approximately 1650 L/day. The daily water demand for each office building will be approximately 1650 L/day; this value is one half of the quantities of water anticipated for each of the proposed dwellings within the residential subdivision. As such, for the purpose of analysis, two lots within the office park can be considered to behave as a residential lot with respect to sewage system sizing and potential well interference. Since peak water use in an office building is generally two hours in the morning followed by two hours at lunch, water demand and well interference will also be similar to a residential dwelling, however, much residential usage (nights, weekends) will differ from office use (day time).

With respect to leaching bed sizing, given that the daily design sanitary sewage flows expected from the proposed office buildings are similar to residential flows, similar leaching bed sizes to those in the residential subdivision, are expected. The lot development plan (Drawing No. PH0145-2) has been revised to reflect the proposed building footprint, well and sewage system locations for the professional office park.

**2.1.8 "It is commonly accepted practice that new subdivisions have sufficient space to accommodate at least one Class 4 leaching bed (largest system area) such that the lot owner has space for a complete range of sewage system options when developing the property, or for replacement space in the event of a problem with the installed system. The proposed plan includes six lots with filter beds proposed. We recommend that the lots be revised to accommodate Class 4 leaching beds for the above noted reasons. Further, loading rates as defined by the Code and Guide for Sewage Systems, 1997, should be based on Percolation Time (T) > 50 min/cm associated with the presence of silty clays on the site. These calculations should be provided.**

In addition to the above, the narrow mantles proposed may not be able to accommodate the horizontal flow into and through the mantle, based on the proposed system layout and design parameters provided for flow, percolation rate (permeability) and mantle dimensions. The layout of the sewage system and the mantle design should address potential mounding based on the assumption that negligible flow will enter the native subsurface soils to ensure the systems will function properly. The rationale and calculations should be provided."

## Response

1. The six lots referred to are able to accommodate a Class 4 absorption trench leaching bed and a full range of sewage system options. The Lot Development Plan ( Drawing PH0145-2) has been revised to reflect absorption trench installations.

2. Under the OBC, R.S.O. 1997, a filter bed is considered to be a Class 4 sewage system; this is the same category as an absorption trench leaching bed. When leaching bed fill is used to raise the distribution piping above high ground water table, bedrock or soils having a  $T > 50$  min/cm, it becomes a fill based leaching bed. The OBC prescribes that the leaching bed fill occupy an area of sufficient size to achieve a specific effluent loading rate for a particular range of T-times of the receiving soil. From Table 8..7.4.1.A, the maximum loading rate for a soil having a  $T > 50$  min/cm. is  $4 \text{ L/m}^2/\text{day}$ . Based on a flow of  $3000 \text{ L/day}$ , the minimum contact area of leaching bed fill required to meet the maximum loading rate of  $4 \text{ L/m}^2/\text{day}$  is  $750 \text{ m}^2$ . The absorption trench leaching beds shown on Drawing No. PH0145-2 have a contact area of approximately  $761 \text{ m}^2$  and a loading rate of  $3.9 \text{ L/m}^2/\text{day}$ .

It is likely that all of the sewage systems will be installed onto the silty sand overlying the low permeable soils due to the perched water table condition. As such, the leaching bed areas shown on Drawing No. PH0145-2 reflect the absolute maximum contact area requirements. More room is also available by moving the house back on the lot. Proposed zoning for the rear yard set back is 10.5m.

With respect to the mantle configuration, the mantles are not considered to be narrow. The width of the leaching bed and mantle areas provide sufficient lateral dispersal of effluent beneath an artificially constructed subgrade to prevent significant mounding beneath the distribution pipes. Furthermore, the OBC considers only hydraulic loading rates onto the soils and not mounding beneath the leaching bed. Given this fact, the design of the sewage systems is considered to be in total compliance with OBC requirements.

It is expected that, where low permeable soils are encountered in the preparation of the subgrade for the leaching bed, that the subgrade surface will be suitably sloped and scarified. The subgrade slope, ideally at a minimum of 2%, is expected to extend from upper edge of the bed (header end) and slope through the bed and mantle. The toe of the mantle must be free draining into permeable native soils, or imported topsoil. Given that all of the sewage systems are designated for the front yard and will slope towards to the road side ditches, effluent mounding will be minimal and should not impede the flow of oxygen into

the leaching bed fill beneath the clear stone layer. As always, care must be taken to ensure that the mantles are kept free from compaction and the surface of the leaching beds shaped to shed surface water away from the bed area.

**2.1.9 “Some of the proposed sewage systems are shown with the mantle direction extending up slope or side slope and not in the direction of flow, based on the existing topography. Additional details on how these systems will be constructed regarding site topography should be provided.”**

Response

This comment has been addressed in response to Comment No. 8.

It is imperative to note that, in accordance with the City of Ottawa policies regarding subdivision planning, that it is preferred to maintain consistency with respect to the positioning of leaching beds relative to the wells on each lot. This is to avoid a “flip-flop” scenario where leaching beds alternate from front to rear of the lot depending on site topography. It is considered to be a superior design solution where road side ditches and rear yard swales can be utilized to achieve consistent leaching bed positioning regardless of site topography. The post development drainage patterns have been taken into account and the overall subdivision design is good and is expected to function successfully in a manner similar to other Greely developments.

**2.1.10 “Potential hydraulic connections between the receiving overburden and the water supply aquifer were investigated in the report. Monitoring wells (MW) were installed in five test pits. TP18/MW5 and TP21/MW6 were installed in relatively close proximity to TW2 and TW3. No data was provided from these monitoring wells during any of the pump tests. TP28/MW7, TP28/MW8 and TP30/MW9 were installed in relatively close proximity to TW4 and TW5. Data from these MW’s collected during pumping of TW4 and TW5 was provided. In summary, water levels dropped between 1 to 3.5 cm in those MW’s during TW4 and TW5 pumping tests.**

The report indicates that the decline in water levels could be associated with barometric fluctuations and not due to interconnection between aquifers. Barometric pressure data from Environment Canada was provided in the report. The hourly barometric pressure data corresponding with the pumping of TW4 (June 21, 2005) indicates that pressure was falling continuously

throughout the day. A drop in pressure would be expected to cause a rise in water levels. Therefore, due to barometric influences, the hydraulic interconnection may be more significant than the water level data suggests. The hourly barometric pressure data that corresponds with the pumping of TW5 (June 22, 2005) indicates that pressure was stable throughout the day. This may suggest that barometric pressure would not have significantly affected the water level data.

The report also concludes that the aquifer is a confined aquifer due to significant pressure on the aquifer; however, examining the data provided indicates no significant pressure differential between the water supply aquifer and the overburden wells (approximately 0.10 to 0.30 metres difference). As such, the conclusion that the water supply aquifer is hydraulically isolated, or that the supply aquifer is confined is not well supported by the data provided.

Without sufficient evidence of hydrogeological isolation, an impact assessment based on dilution methodology is recommended for the residential and commercial portions of the proposed development. Given that the silty clay unit is discontinuous across the site and that the elevated sodium and chloride in test wells TW1, TW2, and TW3 indicates anthropogenic impacts to the bedrock groundwater, it is our opinion that hydrogeological isolation has not been adequately demonstrated for this site."

### Response

Additional field work has been carried out on the site in order to demonstrate that the water supply aquifer is isolated from the receiving aquifer via an aquitard consisting of low permeable soils and unfractured bedrock above the water supply aquifers located deep beneath the site. The methodology utilized to conduct this additional work was first utilized in the determination of isolation for the South Village and Woodstream (JDPA Report NO. G8105-12). The methodology data, results and conclusion were confirmed to be valid and accepted by the Ontario Municipal Board Order No. 1725 dated November 1, 2004.

The methodology is summarized below and Drawing No. PH0145-1 has been updated to reflect the new monitoring well and borehole information:

Three monitoring wells, consisting of 38 mm diameter PVC piping with end caps and a slotted 3 m section, were installed within 5 m of each of TW4, TW5 and

TW6. The nomenclature of each monitoring well was established relative to the test well it surrounded. For example, for TW4, the monitoring wells were numbered MW4-1, MW4-2 and MW4-3.

All of the monitoring wells, with the exception of MW6-3, were installed into the silty clay to clayey silt soils underlying the silty sand layer. The average depth of these monitoring wells were 2.5 m below ground surface. In the case of MW6-3, the well was advanced to the bedrock. The casing above the screened portion was sealed with clay and the casing extended above the ground surface. The depth of MW6-3 is approximately 8.5 m below ground surface.

A constant rate pump test was conducted for each of TW4, TW5 and TW6. The duration of the pumping was for six (6) hours. The pumping rate was set at between 1.88 and 2.14 L/s corresponding to between 40,600 L and 46,200 L pumped from the aquifer during each test. The drawdown was periodically monitored in the surrounding test wells, monitoring wells adjacent to the pumped well and in the monitoring wells surrounding the other test wells.

Water levels in each test well and monitoring well were recorded for several days before, during, and after, the pump testing to establish a baseline of water level fluctuations on the site. This data is summarized in Figure A-1-1 (refer to Appendix 1).

Analysis of Figure A-1-1 illustrates the behaviour of the water levels in the monitoring wells was independent of the pump testing.

The discharge from each pumped well was carefully directed to functional drainage ditches located on the subject site. The minimum discharge distance was 50 m from the pumping well with no water being allowed to discharge onto the surface of the ground.

Table 2.1.10.1 below summarizes the results of each pump test with respect to pumping rates, volumes pumped and drawdown in pumping and monitoring wells.

TABLE 2.1.10.1- SUMMARY OF HYDRAULIC INTERFERENCE TESTS				
Pumping Well	Pump Rate (L/min)	Quantity Pumped (L)	Total Drawdown Measured in Pumped Well (m)	Overburden Monitoring Well Drawdown (m)
TW4	112.5	40,500	7.03	0.01 m in MW4-1 0 m in MW4-2 0 m in MW4-3 0 m in MW6-1 0 m in MW6-2 0 m in MW6-3
TW5	115.2	41,472	0.46	0 m in MW5-1 0 m in MW5-2 0.01 m in MW5-3 0 m in MW4-1 0 m in MW4-2 0.01 m in MW4-3
TW6	128.4	46,224	0.78	-0.02 m in MW6-1 -0.04 m MW6-2 0 m in MW6-3 -0.01 m in MW4-1 -0.01 m in MW4-2 0 m in MW4-3

Analysis of Table 2.1.10.1 reveals that there was no drawdown observed in the monitoring wells surrounding the pumped well and the surrounding monitoring wells. Furthermore, as supported by Figure A-1-1, the water levels in the monitoring wells behaved in a manner independent of pumping.

Drawdown was observed, however, in most of the test wells during each pump test. As the test wells were located over 200 m apart, the cone of influence easily extended this distance considering over 40,000 L was removed during each pump test. As such, the monitoring wells located within 5 m of the test well being pumped, the monitoring wells, especially MW6-3 located on the face of the bedrock, should have recorded some appreciable drawdown if a hydraulic interconnection exists between the overburden and the water supply aquifer.

The lack of drawdown in any of the monitoring wells during pumping, combined with the absence of nitrates and other indicators of surface water influence on the water supply aquifer provides sufficient evidence to the isolation argument established in the original report.

In addition to the monitoring well installation and pump testing works performed at the site, a series of test pits were put down in the proposed residential and



office park areas. The test pits put down in the residential area, denoted on Drawing No. PH0145-1 as TP32 and TP33 (refer to Appendix 1 for Soil Profile Records), encountered similar deposits as had been ascertained in the terrain analysis in the original report. Specifically, the presence of a thick deposit of low permeable silty clay soil was encountered and confirms the lateral extent of the layer.

Based on the results of the testing performed in the original report (refer to Appendix 1 for grain size and hydrometer analyses), the silty clay soils, are "practically impervious". This based on cross-referencing the estimated hydraulic conductivity from Table 1 of Report No. PH0145-REP.01 with the Casagrande and Fadum classification system.

An additional test pit, TP34 was put down in the office park area (refer to Appendix 1 for Soil Profile Report and Drawing PH0145-1 in Appendix 5 for location). The purpose of constructing this test pit was to determine the exact nature of the glacial till deposits in this portion of the subject site. Based on field observations, supported by the grain size distribution curve created from samples of the glacial till (refer to Appendix 1 for grain size distribution curve), the glacial till deposit increases in density with depth and has a predominant matrix of fine grained sandy clay soils. Based on the degree of compaction present in the layer, and considering the dominant sandy clay matrix, the hydraulic conductivity of the glacial till layer tends closer to that of sandy clay, at between  $1 \times 10^{-4}$  to less than  $1 \times 10^{-6}$  cm/sec. Based on these hydraulic conductivities, and considering the very dense soil structure, the till is considered to be "practically impervious" according to the Casagrande and Fadum classification system.

## 2.2 Comments Received from South Nation Conservation

**2.2.1 "The impacts on the watershed environment occurring due to the septic effluent migration have not been evaluated. Report has also not commented on the presence of any hydrogeological sensitive features around the site that may be impacted by this development."**

### Response

In reviewing the requirements of Procedure D-5-5, there is no reference to impacts on the watershed environment. The migration of septic effluent, as it pertains to Procedure D-5-5 only, can be addressed. As detailed in the response to comments made by Golder in Section 2.1.10, it has been established that the water supply aquifer is hydraulically isolated from the proposed development. As such, septic effluent migration is limited to the receiving aquifer which exists as a perched water table condition within the silty sand layer overlying the low permeable soils present over bedrock. Since the design of the septic systems is based on subsurface dispersal of the treated effluent, the effluent will move downward until it encounters the perched groundwater. There, the effluent will move with the hydraulic gradient as established in the response to the comment by Golder detailed in Section 2.1.6. The post treatment flows will benefit from additional dilution with the stormwater management systems employed by this developer. The receiving aquifer moves in a gradual direction easterly and all post treatment flows are cut off from any offsite impact by the existence of a hydraulic barrier in the form of Shields Municipal Drain, along the entire eastern boundary of the site. The deep ditch located perpendicular to the hydraulic gradient of the receiving aquifer and stretching across the width of the development, will act as a hydraulic barrier to offsite migration of septic system effluent. This coupled with the fact that there are no hydrogeologically sensitive features within 500 m in the down-gradient direction of the site, the requirements of Procedure D-5-5 have been met.

**2.2.2 "The groundwater flow directions in the aquifer receiving the septic effluent have not been established. This information is necessary to determine the direction of septic effluent migration and whether the impacts are expected on the down-gradient land uses."**

### Response

This comment has been previously addressed in responses detailed in Section 2.1.6 and 2.2.1 of this addendum report.

**2.2.3 “The submission has commented on the potential well interference and has calculated maximum drawdown within the development resulting from the pumping of on-site wells. However, report does not make it clear as to how far the drawdown influence is expected to extend from pumping in the on-site wells and if this will be impacting the neighbouring wells in the surrounding developments. The underlying assumptions and rationales for use of parameters values in the calculations for max drawdown are also not very clearly discussed in the report.”**

Response

Analysis of the constant rate pump test data for test wells located along the perimeter of the residential and commercial areas, using the Cooper-Jacobs graphical analysis of Distance-Drawdown, indicates that the water supply aquifer has high transmissivity and moderate storativity values. The cones of influence created at the pumping rates used for the pumping tests (1.4 to 1.88 L/s) are not representative of actual pumping rates and durations of pumping at the site. Interpretation of the Distance-Drawdown data for pumping of the test wells at rates of 0.035 L/s (3000 L/day), combined with the rates of recharge observed during recovery, and potential well interference calculations contained within the original report, suggest the cone of influence will not extend more than 10 to 20 m under extended pumping events of any single well. As such, neighbouring offsite wells will remain unaffected by pumping of the wells along the perimeter of the development.

**2.2.4 “The hydrogeological study report has not provided any information on the recharge areas for the on-site wells. This information is [a] critical part of site hydrogeological characterization and is necessary for establishing vulnerability of the aquifer.”**

Response

As established in the original report, and substantiated with additional testing, as summarized in Section 2.1.10 of this addendum, the site is hydraulically isolated from the water supply aquifers beneath. The overburden soils act as an aquitard preventing contaminant migration to the water supply aquifer. This, combined with the Theis-like response to pumping, and the established confining pressures acting on the water supply aquifer, confirms that the water supply aquifer is confined. As such, the location of the recharge area must be offsite. In any event, following a review of the Jacques Whitford well sampling study and the modeling study, there is no area in and around the Village of Greely which represents a problem with respect to recharge for the subject site.

**2.2.5 “The estimates of conductivities for soils are based on the grain size/hydrometer analysis in lab and in-situ hydraulic conductivity tests were not conducted to support the isolation theory and to establish the characteristics of the designated isolating layer. Also, the lab reports for hydrometer analysis are not attached with the report.”**

The grain size distribution curves for the silty clay and silt soils were provided in the original report. These curves are provided, again, in Appendix 1.

With respect to in-situ hydraulic conductivity tests, it is our experience that estimates of hydraulic conductivity are more accurate when grain size analysis is used. Although the argument that fissures, wormholes, etc. can exist in the soil that cause short circuiting from the surface to the bedrock, this is seldom evidenced where the depth of overburden is thicker than a few metres. The subject site is covered with approximately 7 m of very low permeable soil overlying competent bedrock.

The lower 4 to 6 m of silty clay overburden was visually inspected by a qualified Paterson engineer during installation of MW6-3 and during the construction of numerous exploratory test pits and excavations in the till areas and in the vicinity of the proposed surface water ponds. Based on these observations, the silty clay to clayey silt soil is very stiff and generally exhibits homogeneous structure at depths 2 m into the low permeable soils with no apparent fissures. The borehole logs for these holes are provided in Appendix 1.

With respect to the south west portion of the site noted to contain deposits of fluvioglacial till deposits, the till exists as a silty clay till with cobbles and boulders held tightly into a very dense structure. Hydrometer analysis was performed on samples of the till and the results of the analysis appear in Appendix 1.

An estimate of the residence time required for infiltrating effluent to migrate through the overburden to the top of the bedrock can be estimated. However, it must be noted that the permeability of the sand layer overlying the low permeable soils is at least four (4) magnitudes greater than the most permeable estimates of the hydraulic conductivity of the low permeable soils, and as a result, will direct infiltrating surface water and septic effluent along the surface with minimal deep infiltration. That having been stated, based on a hydraulic conductivity of  $10^{-6}$  cm/s, and given a vertical distance of travel of 6.5 m, the time required for effluent to migrate to the face of the bedrock will be approximately 75 years. Moreover, it is much more likely that, based on the stiffness and homogeneity of the low permeable soils present over the rock, the hydraulic conductivity is less than  $10^{-6}$  cm/s making the residence time somewhere from 75 to much more than 750 years.

**2.2.6 "Information provided on the depths of the various soil layers especially the silty clay layer was not confirmed by drilling deeper test pits or boreholes. The only soil information available [from] deeper depths is from the test well records which do not indicate encountering any silty clay layer. Establishing the depth and extent of the isolation layer is an important part of the site investigations and is necessary to determine if indeed the isolation deposits are massive and of sufficient depth to prevent downward migration of the septic effluent to the water supply aquifers. Report has also not provided any information whether the isolation is deemed as extending beyond the site boundaries to at least 500m in all directions."**

#### Response

The issues related to the extent, hydraulic conductivity and homogeneity of the isolative layers existing on this site have been detailed in Section 2.2.5 of this addendum.

We do not rely on the observations of well drillers as an accurate or reliable source of information with respect to subsurface soil conditions. These observations are personal, anecdotal and not based upon grain size analysis. The simple fact is that, to the well driller, silty clay, silt and clayey till having low residual moisture contents, will often appear as silt to fine sand with the only discernable material being the portions of pulverized gravel and boulders in the case of till. As TW1 TW2 and TW3 were the first wells constructed, and these wells intercepted the glacial till layers, it is likely that the well driller did not take careful notes while drilling through the overburden material (largely unimportant to the driller) and went by memory to complete the well records.

That is why it is important for the hydrogeologist to conduct his own collection of research data, observations, laboratory tests and reach accurate conclusions. According to Procedure D-5-5, the hydrogeological consultant, "must clearly define those portions of the subsurface which will be affected by the effluent." Clearly, in this case, the portions of the subsurface that could, potentially, be affected would be down-gradient from the site. However, there is a deep ditch stretching along Salebarn Road to the east of the site, which acts as a hydraulic barrier to the movement of surface water and shallow groundwater (i.e. water moving through the sand above the low permeable soils). Since it has been established that the subsurface dispersal of effluent will take place within the silty sand layer, the effluent cannot move into lands to the east of the site. Therefore, the site is isolated both vertically from infiltration into the water supply aquifer and

horizontally from down-gradient migration into lands to the east of the site. As such, it is conclusively established that there will be no offsite impacts.

**2.2.7 “Hydraulic response monitoring was conducted to determine if interconnection is present between the water supply aquifer and overlying deposits. Based on the observations [from] 6 hours pump test and monitors installed close to the surface, the report has concluded that no interconnection is present. However, accounting for depth of the pumping wells and the surficial monitors, the 6 hour monitoring/pumping period is considered very small for any significant changes to show up in the monitors. Normally for a hydraulic interconnectivity study involving multiple aquifers, the multilevel piezom[e]ters are installed at the minimum in all geological formations present above the aquifer being pumped.**

Since the overburden was not explored to the full extent (up to bedrock), it is not clear if any other significant aquifer or formations are present on the site which might need to be monitored to establish the extent of the hydraulic response.

Also, for hydraulic response study, the pumping is continued for far longer time than [than] was done in this case; followed by an even longer time of monitoring to observe the changes in vertical hydraulic gradients. Due to the mentioned shortcomings, the results of the hydraulic response monitoring are considered inconclusive.”

#### Response

This comment has been previously addressed in Sections 2.1.10 and 2.2.5 of this Addendum report.

**2.2.8 “The report documents that during the monitoring for the hydraulic response to pumping in water supply aquifer, the water level fluctuations were observed in the monitoring wells installed close to the surface. Although [the] report has attributed these changes to the barometric pressure changes in the atmosphere and provided raw data from Environment Canada, however, due to the non-availability of observed barometric pressures vs drawdown graphs during pumping and non-pumping events, it is not entirely clear if the water table fluctuations were indeed corresponding to the barometric changes.”**

Response

The retesting of to confirm hydraulic isolation has been summarized in Section 2.1.10 of this Addendum.

**2.2.9 “The drawdown vs time graphs shown in the appendix 4 are missing identifiers for observation wells which were used for watertable monitoring during pumping of test wells. Observation wells/monitoring wells No. 1-5 are not mentioned in [the] report nor marked on figure PH0145-1.”**

Response

The revised original aquifer analysis information, as well as the aquifer analysis conducted on repeat pumping of TW4 and TW5 and the pumping of TW6, are all provided in Appendix 1. Furthermore, Drawing No. PH0145-1 has been revised to reflect all of the test well and monitoring well locations used in the confirmation testing for hydraulic isolation.

**2.2.10 “The test wells 1, 4, and 5 (and corresponding monitored test wells) showing signs of recharge indicating that even for a single well, the 6 hour pumping duration has resulted in the hydraulic head changes to initiate recharge contributions into [the] aquifer being pumped (and also in aquifer for corresponding monitored test wells). Therefore, the statement made in the report that supply aquifer is sufficiently isolated from the overburden receiving aquifer is not considered to be holding for protecting the water supply aquifer from septic effluent as implied by the report especially during pumping events. Once the sub-division is fully built and all wells are pumping (even more frequently), far more hydraulic gradient changes will occur in the aquifer being pumped resulting in more leakage into the water supply aquifer.**

**Report has not commented on this behaviour noted during the pump tests and neither installed multilevel piezom[e]ters at strategic elevations in the geologic formations to see the extent of the hydraulic head changes. This info is necessary to characterize the aquitard response and to establish if post development changes are of such a degree in the overlying aquifers/aquitards that contamination released in the aquifer receiving the septic effluent will start migrating towards the water supply aquifer. The multilevel piezometer installation would have also helped to clarify as to which**

**formation is contributing to the aquifer and what is the extent of isolation.”**

Response

To further the explanation and findings detailed in Section 2.1.10 of this Addendum, the original “recharge” noted in TW1, TW4 and TW5 was not from the overburden. Rather, given the high transmissivity of the aquifer, the pumping rate was insufficient to reduce pressure in the aquifer over the duration of the pump test. As a result, the effect of recharge can actually be attributed to the movement of water into the cone of depression as the test wells were being pumped. This is known as stabilization. Often as wells begin to stabilize as they are pumped the water level will exhibit signs of recovery as an equilibrium is established.

The findings of the follow-up testing, performed under very controlled conditions, confirms that the recharge in the original testing was related to the pressure differential and not vertical movement. Furthermore, graphical analysis using Hantush modeling for aquifer analysis in the follow up testing, confirmed that the TW4, TW5 and TW6 exhibit Theis-like response with no significant deviation that would indicate leaky aquifer conditions.

**2.2.11 “Water chemistry analysis shows the presence of Dissolved Organic Carbon (DOC), Ammonia, Sodium and Organic Nitrogen. Report has not commented on the sources of these parameters neither established if this is an indication of surficial impacts.”**

Response

The neighbouring water quality analysis, detailed in Section 2.1.4 of this Addendum, indicates similar levels of these parameters in the surrounding wells. The presence of minimal traces of DOC, ammonia and organic nitrogen are typically found in anaerobic groundwater. This lends further evidence to hydraulic isolation as surface water infiltrating directly from the surface above the water supply aquifers at the site would be aerobic if it moved quickly downward. Rather, it is likely that, given the neighbouring analyses, these parameters are merely indicative of the water bearing formations and signify isolated groundwater. The absence of other indicators of surface water influence, such as nitrates and bacteria, in the water supply aquifer further evidences this .



**2.2.12 “Exceedances in Hydrogen Sulphide (TW4), Iron, Manganes[e], Hardness, Turbidity and Total Dissolved Solids were noted in water chemistry analysis and report has concluded that this is consistent with the geo-chemistry of the are[a] and with supply formation. The basis of this conclusion is not entirely supportable by report as no additional area wide geo-chemistry data or regional study references have been presented to support this conclusion.**

**The report also did not analyse sufficient water samples from surrounding wells and neither any interviews were conducted with well owners to [establish] if any incidences of adverse water quality have happened in the past. In any case, due to the exceedances in the already mentioned parameters above the Ontario Drinking Water Standards, the raw water is not considered to be meeting the required potability criteria.”**

Response

The updated water quality analyses for the test wells, and neighbouring wells have been provided in Appendix 1 and the analysis was summarized in Section 2.1.4 of this report.

Interviews were conducted with the residents where the water samples were collected, with copies of these interviews provided in Appendix 1. A review of the interviews confirms the absence of adverse water quality. Furthermore, most residents indicate the water is plentiful, but quite hard. This appears indicative of the water quality results for the area.

The water quality from both the surrounding wells and the test wells put down on the subject site meet all health related parameters in the ODWS. The only issues related to exceedances of the ODWS is in aesthetic parameters. The aesthetic parameters have been demonstrated to be easily treatable to achieve the aesthetic objectives as the concentrations of these parameters do not exceed current treatable limits, as confirmed by the Water Quality Association.

**2.1.13 “The water quality analysis did not include the pesticides and herbicides parameters to determine if any impacts from the historic agricultural practices on-site and in surrounding, as indicated in the report, have occurred on the water supply aquifer. Surrounding well owners were not interviewed for adverse water quantity shortages and/or to determine if cases of septic malfunction have occurred in**

**the past. Report has not indicated if Chlorine measurements were taken during the well sampling.”**

Response

It is noted that there is no scientific justification for this comment. The half life of the herbicides is sufficiently brief to pose no known risk at this location. The consultant is not aware of any precedent for such testing in any subdivision in the Greely area. Furthermore, it is noted that in the JWEL well sampling study conducted in 2002, a single well sample was tested for a range of contaminants. No contamination was detected even though the sample was located in an active agricultural area, immediately east of the subject site. There is no recommendation for this type of testing in the JWEL sampling or modeling studies nor any historical practices which would indicate a need for such testing.

Notwithstanding the foregoing, through a series of interviews, it was ascertained that the property has, in the past, had herbicides applied to the land. Specifically, an Atrazine derivative was used. A water sample was collected from TW4, located at the down-gradient end of the site, which is most reflective of possible water supply aquifer contamination. The laboratory analysis report is provided in Appendix 2.

The analysis did not reveal any presence of Atrazine in the water supply aquifer intercepted by TW4.

With respect to interviews with surrounding well owners, this issue was addressed in Section 2.1.12 of this Addendum.

With respect to the issues surrounding chlorine measurements, the clarification of the sampling methodology has been provided in Section 2.1.1. of this Addendum.

**2.1.14 “Site cross-section in appendix 5 has grouped all the overburden above the bedrock as silty clay. This cross-section is not considered representative of site conditions as test pit logs show the presence of other soil types and the confirmatory information on soils below 4.6m was not carried out. In addition, central and northern portions of the site do not have sufficient test pit to establish the soil conditions. The same portions of the site do not have test wells or other deep boreholes to establish the site conditions in those parts and to support the impermeable layer presence.”**

---

**Response**

This comment has been addressed in several different sections of this Addendum. No further comment is required in this matter.

The cross-section of the site, as depicted in Drawing PH0145-4 has been revised to reflect the additional test well, monitoring well and test pit information obtained from the central and northern portions of the site.

**2.1.15 "Lot development plan showing progression of phases and lot sizes is not available. The report has not outlined a monitoring program [t]hat will be implemented for recommendation of the subsequent phase of development."**

**Response**

The phasing of the lots has been established as follows: 1-17, 34-47, 64, 65, and 69-75. Phase 2 would be the balance of the lots.

The monitoring program for the release of Phase 2 will be the same established for Sunset Lakes and according to written correspondence with former MOE director, Kirk Hansen indicating the need for 20% of the wells to be completed and sampled in Phase 1. Certificates of Completion for the sewage systems for a total of eight (8) lots will be provided as well as observations made from field inspection by a qualified engineer. Furthermore, well compliance certificates will be provided as part of the report. Two (2) original test wells will be tested for the usual parameters, if available. Six (6) wells will be tested for Total Coliform, E.coli, and nitrates only.

Prepared by:



Robert A. Passmore, B.Eng.



Stephen J. Walker, P.Eng.

## **APPENDIX 1**

### **SUPPORTING DOCUMENTATION TERRAIN ANALYSIS DOCUMENTS**

1. Soil Profile & Test Pit Data Sheets
2. Grain Size Distribution and Classification Curves

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

Hydrogeological Study and Terrain Analysis  
Greely Village Centre, Parkway Road  
Ottawa (Greely), Ontario

DATUM Approximate geodetic

FILE NO. **PH0145**

REMARKS

HOLE NO. **TP32**

BORINGS BY Backhoe

DATE 26 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or ROD			○ Water Content %				
GROUND SURFACE								20	40	60	80	
TOPSOIL	0.25					0	86.15					
Brown medium SAND, trace silt	1.60					1	85.15					
SILTY CLAY	4.20					2	84.15					
						3	83.15					
End of Test Pit						4	82.15					
(Water infiltration @ 2.8m depth)												

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

Hydrogeological Study and Terrain Analysis  
Greely Village Centre, Parkway Road  
Ottawa (Greely), Ontario

DATUM Approximate geodetic

FILE NO.

**PH0145**

REMARKS

HOLE NO.

**TP33**

BORINGS BY Backhoe

DATE 26 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
								20	40	60	80	
GROUND SURFACE												
TOPSOIL	0.30					0	86.80					
Brown medium SAND, trace silt	2.10					1	85.80					
SILTY CLAY to SILT	4.60					2	84.80					
End of Test Pit (Water infiltration @ 2.6m depth)						3	83.80					
						4	82.80					

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

Hydrogeological Study and Terrain Analysis  
Greely Village Centre, Parkway Road  
Ottawa (Greely), Ontario

DATUM Approximate geodetic

FILE NO. **PH0145**

REMARKS

HOLE NO. **TP34**

BORINGS BY Backhoe

DATE 26 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %					
GROUND SURFACE								20	40	60	80		
TOPSOIL						0	89.80						
Brown SILTY SAND													
Brown SAND, trace silt						1	88.80						
						2	87.80						
GLACIAL TILL						3	86.80						
						4	85.80						
End of Test Pit													
(Water infiltration @ 3.1m depth)													

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

Hydrogeological Study and Terrain Analysis  
Greely Village Centre, Parkway Road  
Ottawa (Greely), Ontario

DATUM Approximate geodetic

FILE NO.

PH0145

REMARKS

HOLE NO.

MW 4-1

BORINGS BY Backhoe

DATE 25 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			20	40	60	80		
GROUND SURFACE													
TOPSOIL	0.25					0	85.88						
Brown medium SAND, trace silt						1	84.88						
End of Monitoring Well	1.94												
Monitoring well terminated on silty clay @ 1.94m depth (GWL @ 1.55m-May 5/06)													

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded



28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

Hydrogeological Study and Terrain Analysis  
Greely Village Centre, Parkway Road  
Ottawa (Greely), Ontario

DATUM Approximate geodetic

FILE NO.

PH0145

REMARKS

HOLE NO.

MW 4-2

BORINGS BY Backhoe

DATE 25 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
GROUND SURFACE								20	40	60	80	
TOPSOIL	0.25				0	85.91						
Brown medium SAND, trace silt					1	84.91						
End of Monitoring Well	2.27				2	83.91						
Monitoring well terminated on silty clay @ 2.27m depth (GWL @ 1.25m-May 5/06)												

20 40 60 80 100  
Shear Strength (kPa)  
▲ Undisturbed    △ Remoulded

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

Hydrogeological Study and Terrain Analysis  
Greely Village Centre, Parkway Road  
Ottawa (Greely), Ontario

DATUM Approximate geodetic

FILE NO.

PH0145

REMARKS

HOLE NO.

MW 4-3

BORINGS BY Backhoe

DATE 25 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
								20	40	60	80	
GROUND SURFACE												
TOPSOIL	0.22					0	85.86					
Brown medium SAND, trace silt						1	84.86					
End of Monitoring Well	2.28					2	83.86					
Monitoring well terminated on silty clay @ 2.28m depth (GWL @ 1.48m-May 5/06)												

20 40 60 80 100  
Shear Strength (kPa)  
▲ Undisturbed    △ Remoulded

DATUM Approximate geodetic

FILE NO.

PH0145

REMARKS

HOLE NO.

MW 5-1

BORINGS BY Backhoe

DATE 26 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
								20	40	60	80	
GROUND SURFACE												
TOPSOIL	0.25					0	85.57					
Brown medium SAND, trace silt						1	84.57					
End of Monitoring Well	1.81											
Monitoring well terminated on silty clay @ 1.81m depth (GWL @ 0.86m-May 5/06)												

20 40 60 80 100  
Shear Strength (kPa)  
▲ Undisturbed    Δ Remoulded

# pater songroup

Consulting  
Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

## SOIL PROFILE & TEST DATA

Hydrogeological Study and Terrain Analysis  
Greely Village Centre, Parkway Road  
Ottawa (Greely), Ontario

DATUM Approximate geodetic

FILE NO.

PH0145

REMARKS

HOLE NO.

MW 5-2

BORINGS BY Backhoe

DATE 26 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RGD			○ Water Content %				
GROUND SURFACE								20	40	60	80	
TOPSOIL	0.30					0	85.58					
Brown medium SAND, trace silt	2.00					1	84.58					
End of Monitoring Well	2.00					2	83.58					
Monitoring well terminated on silty clay @ 2.00m depth  (GWL @ 0.82m-May 5/06)												

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed    △ Remoulded

DATUM Approximate geodetic

REMARKS

BORINGS BY Backhoe

DATE 26 APR 06

FILE NO.

PH0145

HOLE NO.

MW 5-3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
GROUND SURFACE								20	40	60	80	
TOPSOIL						0	85.52					
Brown medium SAND, trace silt						1	84.52					
End of Monitoring Well												
Monitoring well terminated on silty clay @ 1.69m depth												
(GWL @ 0.80m-May 5/06)												

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed    △ Remoulded

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

Hydrogeological Study and Terrain Analysis  
Greely Village Centre, Parkway Road  
Ottawa (Greely), Ontario

DATUM Approximate geodetic

FILE NO.

PH0145

REMARKS

HOLE NO.

MW 6-1

BORINGS BY Backhoe

DATE 25 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			20	40	60	80	
GROUND SURFACE												
TOPSOIL	0.20					0	87.50					
Brown medium SAND, trace silt						1	86.50					
End of Monitoring Well	1.40											
Monitoring well terminated on silty clay @ 1.40m depth  (GWL @ 1.25-May 5/06)												

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed    △ Remoulded

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

Hydrogeological Study and Terrain Analysis  
Greely Village Centre, Parkway Road  
Ottawa (Greely), Ontario

DATUM Approximate geodetic

FILE NO. **PH0145**

REMARKS

HOLE NO. **MW 6-2**

BORINGS BY Backhoe

DATE 25 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			20	40	60	80		
GROUND SURFACE						0	87.57						
TOPSOIL	0.20												
Brown medium SAND, trace silt						1	86.57						
End of Monitoring Well	1.90												
Monitoring well terminated on silty clay @ 1.90m depth (GWL @ 1.43m-May 5/06)													

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded

DATUM Approximate geodetic

FILE NO. **PH0145**

REMARKS

HOLE NO. **MW 6-3**

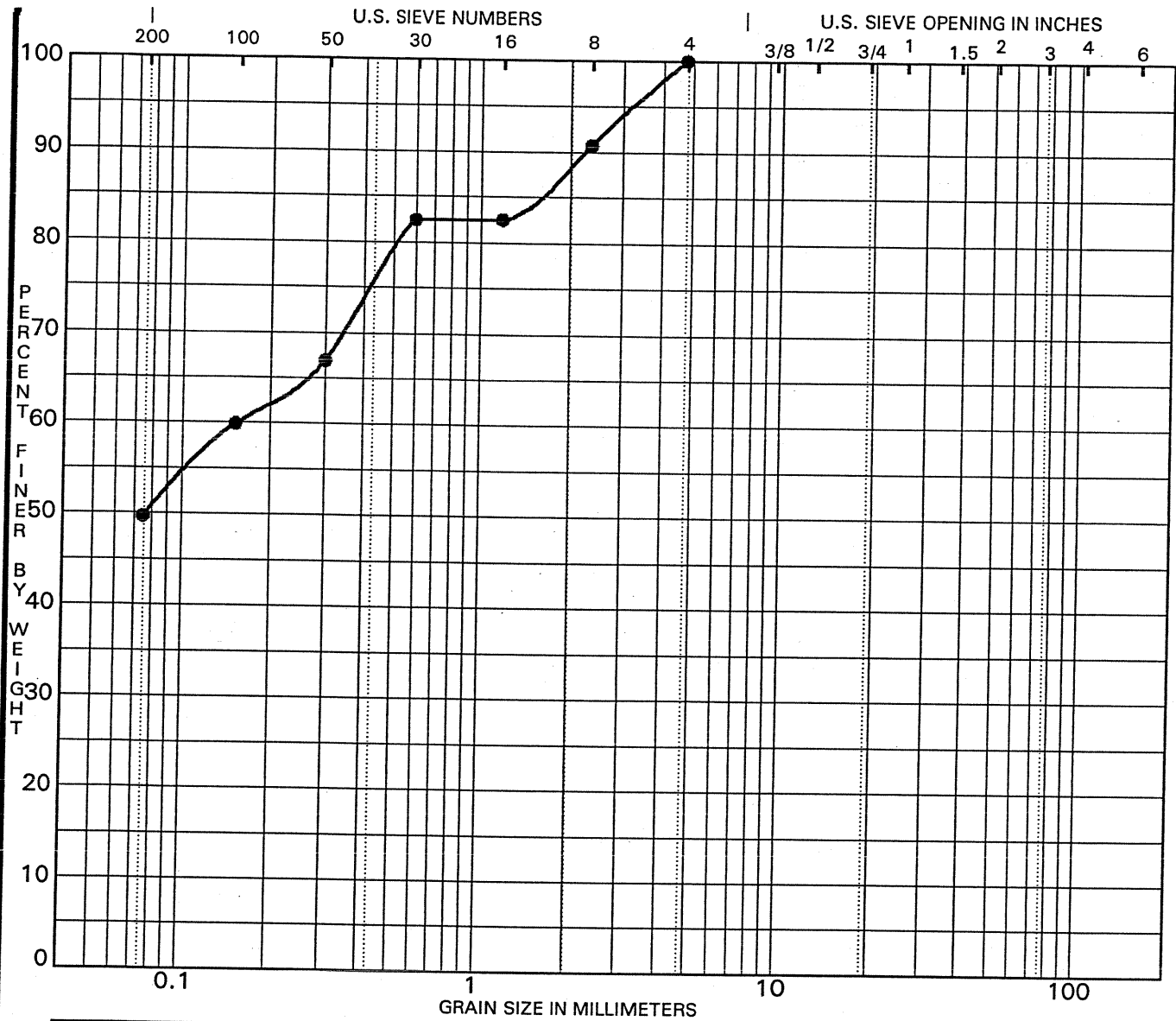
BORINGS BY Backhoe

DATE 25 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
								20	40	60	80	
GROUND SURFACE						0	87.66					
TOPSOIL	0.20											
Brown medium SAND, trace silt						1	86.66					
	1.78											
SILTY CLAY						2	85.66					
	4.00											
CLAYEY SILT						6	81.66					
	8.20											
End of Monitoring Well (GWL @ 1.62m-May 5/06)						8	79.66					

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded





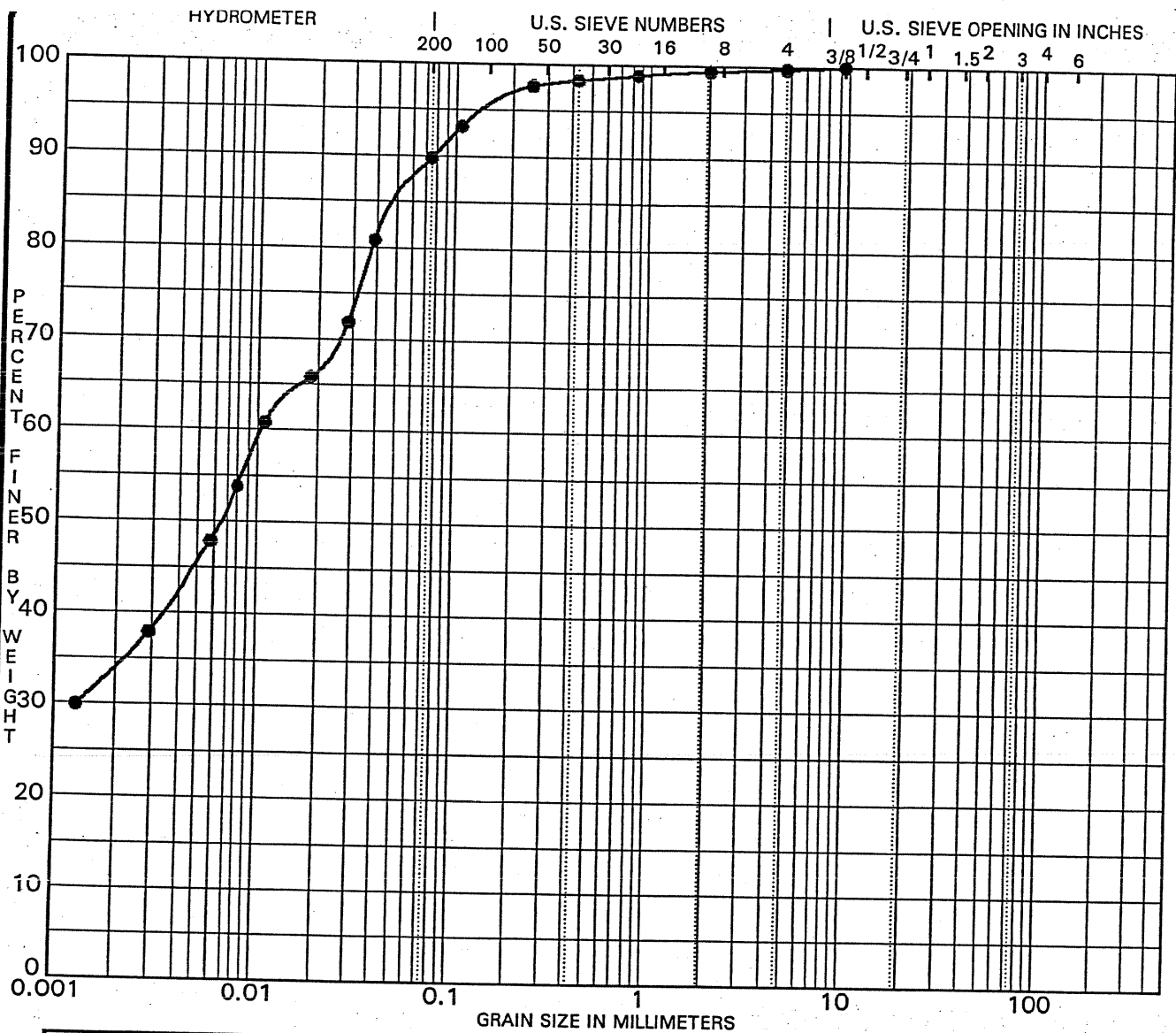
SILT	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Specimen Identification	Classification				MC%	LL	PL	PI	Cc	Cu
● TP34	GLACIAL TILL									
NOTE: Sample screened for material coarser than the No. 4 Sieve to isolate the matrix of the till layer										
Based on ASTM D 2487										

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP34	4.75	0.15			0.0	50.3	49.7	

CLIENT	Sunset Lakes Development Corp.	FILE NO.	PH0145
PROJECT	Hydrogeological Study and Terrain Analysis - Greely Village Centre, Parkway Road	DATE	26 APR 06

<p><b>paterongroup</b> Consulting Engineers</p> <p>28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7</p>	<p><b>GRAIN SIZE DISTRIBUTION</b></p>
---	---------------------------------------



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● TP31 G22	SILTY CLAY (CH)						

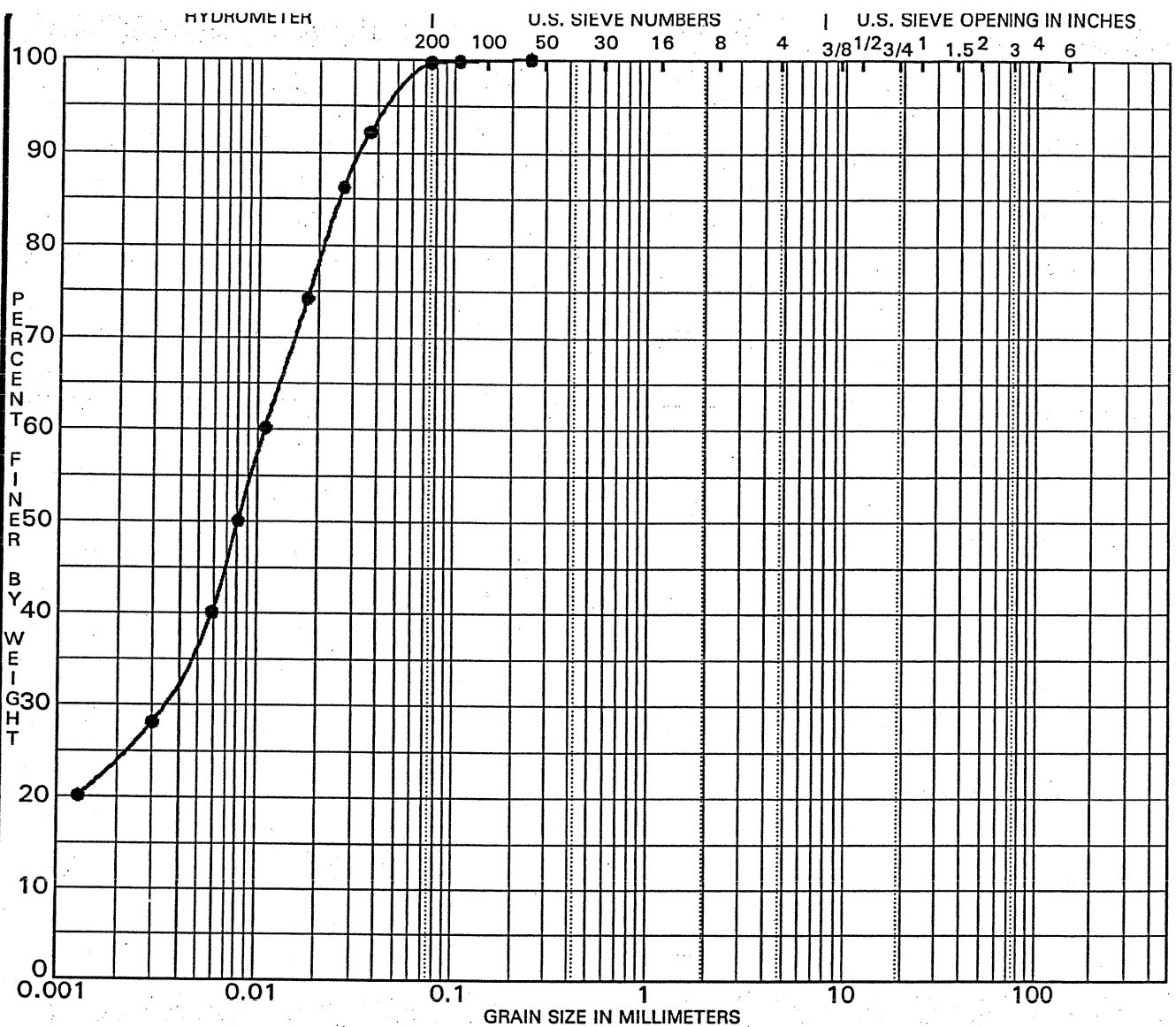
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP31 G22	9.50	0.01	0.001		0.3	10.0		

CLIENT Sunset Lakes Development Corp.  
 PROJECT Hydrogeological Study and Terrain Analysis -  
 Greely Village Centre, Parkway Road

FILE NO. PH0145  
 DATE 3 JUN 05

**patersongroup** Consulting Engineers  
 28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**GRAIN SIZE DISTRIBUTION**



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

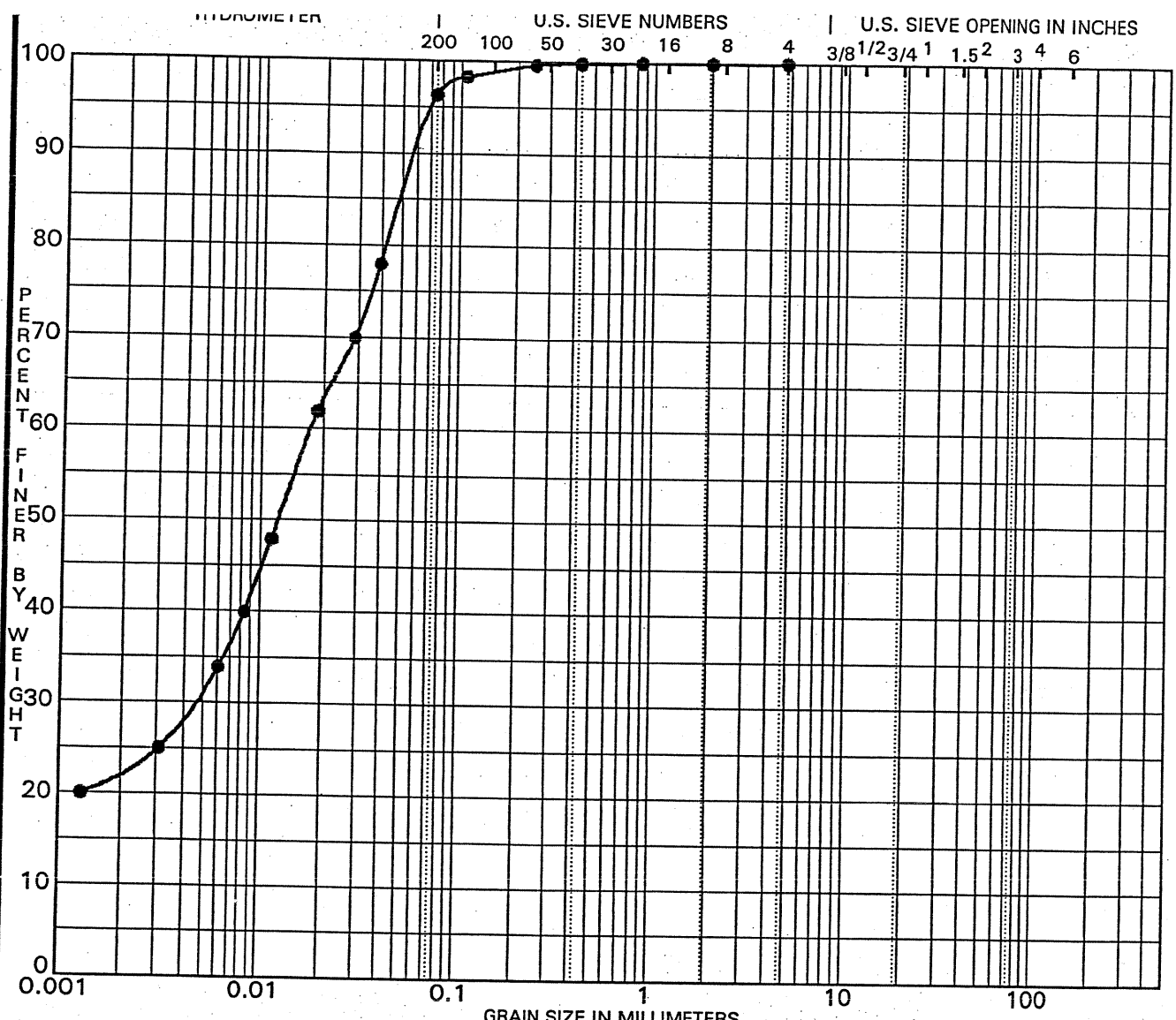
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● TP28/MW7 G18	CLAYEY SILT to SILTY CLAY (MH)						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP28/MW7 G18	0.25	0.01	0.003		0.0	0.3		

CLIENT Sunset Lakes Development Corp. FILE NO. PH0145  
 PROJECT Hydrogeological Study and Terrain Analysis - DATE 3 JUN 05  
Greely Village Centre, Parkway Road

**paterongroup** Consulting Engineers  
 28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**GRAIN SIZE DISTRIBUTION**



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

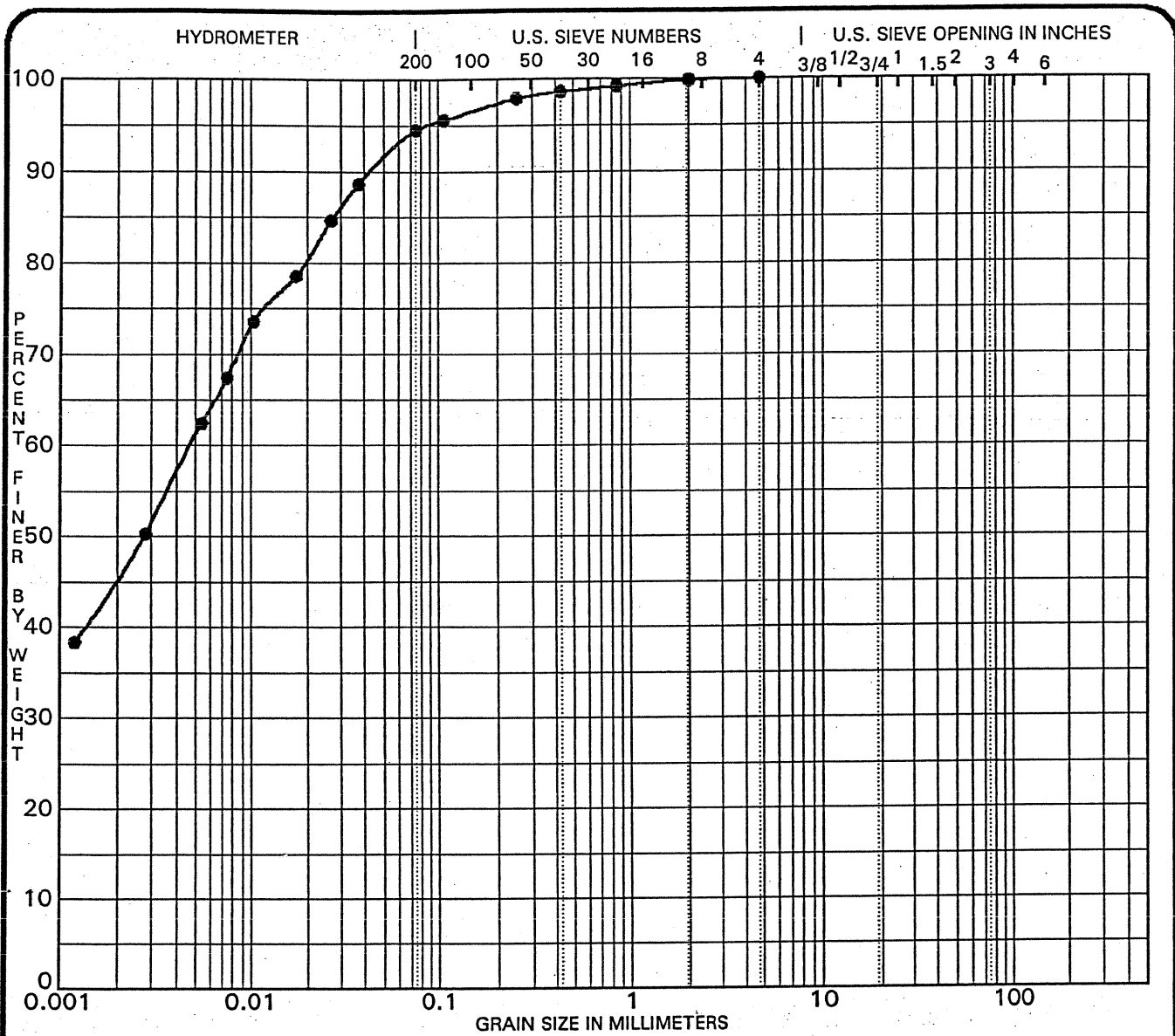
Specimen Identification	Classification					MC%	LL	PL	PI	Cc	Cu
● TP21/MW6 G7	INORGANIC SILT to CLAYEY SILT (ML)										
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay			
● TP21/MW6 G7	4.75	0.02	0.005		0.0	3.7					

CLIENT Sunset Lakes Development Corp.  
 PROJECT Hydrogeological Study and Terrain Analysis - Greely Village Centre, Parkway Road

FILE NO. PH0145  
 DATE 3 JUN 05

**patersongroup** Consulting Engineers  
 28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**GRAIN SIZE DISTRIBUTION**



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● TP24 G14	SILTY CLAY (CL)						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP24 G14	4.75	0.00			0.0	5.5		

CLIENT Sunset Lakes Development Corp.  
 PROJECT Hydrogeological Study and Terrain Analysis -  
Greely Village Centre, Parkway Road

FILE NO. PH0145  
 DATE 3 JUN 05

**paterosongroup** Consulting Engineers  
 28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**GRAIN SIZE DISTRIBUTION**

## **APPENDIX 2**

### **SUPPORTING DOCUMENTATION WATER WELLS**

1. Water Well Record for Test Well No. 6
2. Completed Well Interview forms from Neighbouring Residences

Instructions for Completing Form

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

Well Owner's Information and Location of Well Information
MUN: [ ] CON: [ ] LOT: [ ]
First Name: [ ] Last Name: [ ] Mailing Address: 6576 Goble Orchard Road
County: [ ] Township: [ ] City/Town/Village: [ ] Province: Ontario Postal Code: [ ] Telephone Number: [ ]
Address of Well Location: [ ] Township: [ ] Lot: [ ] Concession: [ ]
R# / Street Number/Name: [ ] City/Town/Village: [ ] Site/Compartment/Block/Tract etc: [ ]
GPS Reading: [ ] NAD: [ ] Zone: [ ] Easting: [ ] Northing: [ ] Unit Make/Model: [ ] Mode of Operation: [ ]

Log of Overburden and Bedrock Materials (see instructions)
Table with columns: General Colour, Most common material, Other Materials, General Description, Depth From, Metres To.
Handwritten entries: Sand boulders, Grey Limestone, Grey Sandstone.

Hole Diameter, Construction Record, Test of Well Yield, Water Record, Plugging and Sealing Record, Method of Construction, Water Use, Final Status of Well, Well Contractor/Technician Information, Location of Well.
Includes diagrams and detailed data for well construction and testing.

Ministry Use Only
Data Source, Date Received, Date of Inspection, Remarks, Well Record Number.
Contractor's Copy, Ministry's Copy, Well Owner's Copy.

Client: _____	
Project: <u>PHO 45</u>	
Location: _____	
Address: <u>1508 HEDROW DR</u>	Field Supervisor: <u>DBM</u>
Homeowner Interviewed? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N	Date: <u>MAY 3, 06</u>
Well Inspected? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N	
Quality Comments:	
Taste: <u>Good</u>	Odour: <u>No</u>
Colour: <u>Good</u>	Hardness: <u>VERY HARD</u>
Bacteria Testing: <u>No</u>	
Quantity Comments:	
Flow Rate: <u>LOTS OF WATER</u>	Pump: _____
Pump Depth: _____	Problems: _____
Well Details:	
Type of Well: <u>DRILLED</u>	Depth of Well: _____
Age of Well: _____	Driller: _____
Well Record Available: <u>N/A</u>	
Environmental Concerns:	
Surface Water: _____	
Septic System: _____	
Land Use: _____	
Neighbouring Properties: _____	
Sketch:	
<u>RENTAL</u>	



Client: <u>Greely Animal Hospital.</u>	
Project: _____	
Location: _____	
Address: <u>7200 Parkway Road</u>	Field Supervisor: <u>CHRISTOPHER FISCHER</u>
Homeowner Interviewed? <u>YIN</u>	Date: <u>3<sup>rd</sup> May 06.</u>
Well Inspected? <u>YIN N/A</u>	
Quality Comments:	
Taste: <u>N/A</u>	Odour: <u>N/A</u>
Colour: <u>N/A</u>	Hardness: <u>YES, SOME RUST.</u>
Bacteria Testing: <u>~ every 1-2 years</u>	
Quantity Comments:	
Flow Rate: <u>—</u>	Pump: <u>—</u>
Pump Depth: <u>—</u>	Problems: <u>—</u>
Well Details:	
Type of Well: <u>drilled</u>	Depth of Well: <u>?</u>
Age of Well: <u>18 years</u>	Driller: _____
Well Record Available: <u>+</u>	
Environmental Concerns:	
Surface Water: _____	
Septic System: _____	
Land Use: _____	
Neighbouring Properties: _____	
Sketch:	



Client: <u>Nina Jencz</u>	
Project: _____	
Location: _____	
Address: <u>7377 Parkway Road</u>	Field Supervisor: <u>Christopher Fischer</u>
Homeowner Interviewed? <input checked="" type="radio"/> Y <input type="radio"/> N	Date: <u>3rd May 06</u>
Well Inspected? <input checked="" type="radio"/> Y <input type="radio"/> N	
Quality Comments:	
Taste: <u>yes</u>	Odour: <u>yes</u>
Colour: <u>No</u>	Hardness: <u>NO</u>
Bacteria Testing: <u>1 year ago</u>	
Quantity Comments:	
Flow Rate: _____	Pump: _____
Pump Depth: _____	Problems: _____
Well Details:	
Type of Well: <u>Drilled Well</u>	Depth of Well: _____
Age of Well: _____	Driller: _____
Well Record Available: _____	
Environmental Concerns:	
Surface Water: _____	
Septic System: _____	
Land Use: _____	
Neighbouring Properties: _____	
Sketch:	

# patersongroup

Consulting Engineers  
28 Concourse Gate, Unit 1, Nepean, Ontario, K2E 7T7  
Tel: (613) 226-7381 Fax: (613) 226-6344

## Well Inspection

use same well as  
Pentecostal church

Client: <u>Joyce Bicker</u>	
Project: _____	
Location: _____	
Address: <u>7281 Parkway Rd.</u>	Field Supervisor: <u>Christopher Fischer</u>
Homeowner Interviewed? <u>Y/N</u>	Date: <u>3<sup>rd</sup> May 06.</u>
Well Inspected? <u>Y/N</u>	
Quality Comments:	
Taste: <u>Hardwater.</u>	Odour: <u>Sulfer.</u>
Colour: _____	Hardness: <u>✓</u>
Bacteria Testing: _____	
Quantity Comments:	
Flow Rate: _____	Pump: _____
Pump Depth: _____	Problems: _____
Well Details:	
Type of Well: _____	Depth of Well: _____
Age of Well: _____	Driller: _____
Well Record Available: _____	
Environmental Concerns:	
Surface Water: _____	
Septic System: _____	
Land Use: _____	
Neighbouring Properties: _____	
Sketch:	

## **APPENDIX 3**

### **SUPPORTING DOCUMENTATION LABORATORY TEST DATA**

1. Reports of Analysis For Water Samples Collected During Pump Testing of TW4, TW5 and TW6
2. Reports of Analysis For Water Samples Collected During Flushing of TW1, TW2, and TW3
3. Reports of Analysis For Water Samples Collected From Neighbouring Residences
4. Report of Analysis for Atrazine in TW4
5. Letter From TechnaLinks Concerning Maximum Treatable Limits for Aesthetic Parameters in Ground Water

Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6

Attention: Robert Passmore

Report Number: 2608758  
 Date: 2006-05-05  
 Date Submitted: 2006-05-02

Project: PH0145

P.O. Number: 4241  
 Matrix: Water

Chain of Custody Number: 22517

PARAMETER	UNITS	MDL	LAB ID:				GUIDELINE	
			459810 2006-05-02 TW1, WS- 05/06	459819 2006-05-02 TW2, WS05/06	459820 2006-05-02 TW3, WS 05/06	459821 2006-05-02 TW5, WS 05/06		
Total Coliforms	cd/100mL		0	0	0	0	MAC 0	cd/100mL
Escherichia Coli	cd/100mL		0	0	0	0	MAC 0	cd/100mL
Heterotrophic Plate Count	cd/1mL		0	1	0	0	MAC 500	cd/1mL
Faecal Coliforms	cd/100mL		0	0	0	0	MAC 0	cd/100mL
Faecal Streptococcus	cd/100mL		0	0	0	0		

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

APPROVAL: *Krista Quantill*  
 Krista Quantill  
 Microbiology Analyst

Results relate only to the parameters tested on the samples submitted for analysis.

Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T8  
 Attention: Robert Passmore

Report Number: 2608757  
 Date: 2006-05-05  
 Date Submitted: 2006-05-02  
 Project: PH0145


Chain of Custody Number: 22517

P.O. Number: 4241  
 Matrix: Water

PARAMETER	UNITS	MDL	LAB ID:				GUIDELINE	LIMIT	UNITS
			459814 2006-05-02 TW1, WS- 05/06	459815 2006-05-02 TW2, WS 05/06	459816 2006-05-02 TW3, WS 05/06	459817 2006-05-02 TW5, WS 05/06			
Alkalinity as CaCO3	mg/L	5	327	289	288	301	OG	mg/L	
Chloride	mg/L	1	527	625	650	156	AO	mg/L	
Colour	TCU	2	3	<2	<2	3	AO	TCU	
Conductivity	uS/cm	5	2370	2640	2720	1120	AO	mg/L	
Dissolved Organic Carbon	mg/L	0.5	<0.5	2.1	<0.5	1.9	MAC	mg/L	
Fluoride	mg/L	0.10	0.11	0.17	0.18	0.16	AO	mg/L	
Hydrogen Sulphide	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	AO	mg/L	
N-NH3 (Ammonia)	mg/L	0.02	0.09	0.09	0.13	0.07	MAC	mg/L	
N-NO2 (Nitrite)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	MAC	mg/L	
N-NO3 (Nitrate)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	AO	mg/L	
pH			7.75	7.78	7.80	7.74	AO	pH Units	
Phenols	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	AO	mg/L	
Sulphate	mg/L	1	115	98	97	64	AO	mg/L	
Tannin & Lignin	mg/L	0.1	<0.1	<0.1	<0.1	<0.1	AO	mg/L	
TDS (COND - CALC)	mg/L	5	1540	1720	1770	728	AO	mg/L	
Total Kjeldahl Nitrogen	mg/L	0.05	<0.05	<0.05	0.09	<0.05	AO	mg/L	
Turbidity	NTU	0.1	1.9	2.7	6.1	17.7	AO	NTU	
Hardness as CaCO3	mg/L	1	511	536	536	474	OG	mg/L	
Ion Balance		0.01	0.93	0.96	0.95	0.98			
Calcium	mg/L	1	132	134	134	124			
Magnesium	mg/L	1	44	49	49	40			
Potassium	mg/L	1	4	5	5	2			
Sodium	mg/L	2	270	311	318	40			
Iron	mg/L	0.01	0.63	0.63	0.64	1.92			
Manganese	mg/L	0.01	0.08	0.05	0.05	0.27			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective CG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:   
 Ewan McRobbie  
 Inorganic Lab Supervisor

Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6  
 Attention: Robert Passmore

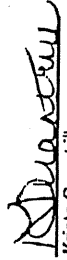
Report Number: 2608628  
 Date: 2006-05-04  
 Date Submitted: 2006-05-02  
 Project: PH0145

Chain of Custody Number: 43328

P.O. Number:  
 Matrix: Water

PARAMETER	UNITS	MDL	LAB ID: 459572		GUIDELINE
			Sample Date: 2006-05-01	Sample ID: TW4, W51-06	
			TYPE	LIMIT	UNITS
Total Coliforms	cf/100mL	0			
Escherichia Coli	cf/100mL	0			
Heterotrophic Plate Count	cf/1mL	1			
Faecal Coliforms	cf/100mL	0			
Faecal Streptococcus	cf/100mL	0			

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

APPROVAL:   
 Krista Quantill  
 Microbiology Analyst

Results relate only to the parameters tested on the samples submitted for analysis.



Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont  
 K1V 1T6

Report Number: 2608662  
 Date: 2006-05-06  
 Date Submitted: 2006-05-02

Attention: Robert Passmore

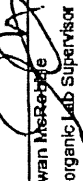
Project: PH0145

P.O. Number: 4241  
 Matrix: Water

Chain of Custody Number: 43328

PARAMETER	UNITS	MDL	LAB ID: 459635		TYPE	LIMIT	UNITS
			Sample Date: 2006-05-01	Sample ID: TW4 WS1-06			
Alkalinity as CaCO3	mg/L	5					
Chloride	mg/L	1	274				
Colour	TGU	2	227				
Conductivity	uS/cm	5	3				
Dissolved Organic Carbon	mg/L	0.5	1270				
Fluoride	mg/L	0.10	1.5				
Hydrogen Sulphide	mg/L	0.01	0.29				
N-NH3 (Ammonia)	mg/L	0.02	0.15				
N-NO2 (Nitrite)	mg/L	0.10	0.12				
N-NO3 (Nitrate)	mg/L	0.10	<0.10				
pH			<0.10				
Phenols	mg/L	0.001	7.79				
Sulphate	mg/L	1	<0.001				
Tannin & Lignin	mg/L	0.1	62				
TDS (COND - CALC)	mg/L	5	<0.1				
Total Kjeldahl Nitrogen	mg/L	0.05	825				
Turbidity	NTU	0.1	0.44				
Hardness as CaCO3	mg/L	1	17.9				
Ion Balance		0.01	472				
Calcium	mg/L	1	0.97				
Magnesium	mg/L	1	116				
Potassium	mg/L	1	43				
Sodium	mg/L	2	4				
Iron	mg/L	0.03	74				
Manganese	mg/L	0.01	1.41				
			0.20				

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Intermittent Maximum Allowable Concentration

APPROVAL:   
 Ewan McRobbie  
 Inorganic Lab Supervisor

**REPORT OF ANALYSIS**

**ACCUTEST LABORATORIES LTD**

Report Number: 2806509  
 Date: 2006-05-02  
 Date Submitted: 2006-04-28  
 Project: PHD145

Client: Paterson Group  
 1-28 Concourse Gale  
 Ottawa, Ont  
 K1V 1T6

Attention: Robert Passmore

P.O. Number:  
 Matrix:

Chain of Custody Number: 41093

Water

PARAMETER	LAB ID:		UNITS	MDL	TYPE	LIMIT	UNITS
	Sample Date:	Sample ID:					
Total Coliforms	459177	459178	cf/100mL		MAC	0	cf/100mL
Escherichia Coli	2006-04-28	2006-04-28	cf/100mL		MAC	0	cf/100mL
Heterotrophic Plate Count	TW6, WS1	TW6, WS2	cf/1mL		MAC	500	cf/1mL
Faecal Coliforms			cf/100mL		MAC	0	cf/100mL
Faecal Streptococcus			cf/100mL		MAC	0	cf/100mL
GUIDELINE							
ODWSOG							

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration  
 Comment:

APPROVAL: *Krista Quentrell*  
 Krista Quentrell  
 Microbiology Analyst

Results relate only to the parameters tested on the samples submitted for analysis.





Client: Sunset Lakes Development Corporation  
 6576 Apple Orchard Road  
 Greely, ON  
 K4P 1E5

Report Number: 2608987  
 Date: 2006-05-08  
 Date Submitted: 2006-05-04

Attention: Dave Meikle

Project: PH0145

Chain of Custody Number: 22827

P.O. Number:  
 Matrix:

Water

PARAMETER	UNITS	MDL	GUIDELINE	
			TYPE	LIMIT
Total Coliforms	cf/100mL	0		
Escherichia Coli	cf/100mL	0		
Heterotrophic Plate Count	cf/1mL	1		
Faecal Coliforms	cf/100mL	0		
Faecal Streptococcus	cf/100mL	0		

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration  
 Comment:

APPROVAL:

Tim McCooye  
 QC Manager

**Client:** Sunset Lakes Development Corporation  
 6576 Apple Orchard Road  
 Greely, ON  
 K4P 1E5

**Report Number:** 2608975  
**Date:** 2006-05-10  
**Date Submitted:** 2006-05-04

**Attention:** Dave Meikle

**Project:** PH0145

**Chain of Custody Number:** 22827  
**P.O. Number:**  
**Matrix:** Water

PARAMETER	LAB ID:		UNITS	MDL	TYPE	LIMIT	UNITS
	Sample Date:	Sample ID:					
Alkalinity as CaCO3	460361	2006-05-03	mg/L	5			
Chloride		1508	mg/L	1			
Colour			TCU	2			
Conductivity			uS/cm	5			
Dissolved Organic Carbon			mg/L	0.5			
Fluoride			mg/L	0.10			
Hydrogen Sulphide			mg/L	0.01			
N-NH3 (Ammonia)			mg/L	0.02			
N-NO2 (Nitrite)			mg/L	0.10			
N-NO3 (Nitrate)			mg/L	0.10			
pH							
Phenols			mg/L	0.001			
Sulphate			mg/L	1			
Tannin & Lignin			mg/L	0.1			
TDS (COND - CALC)			mg/L	5			
Total Kjeldahl Nitrogen			mg/L	0.05			
Turbidity			NTU	0.1			
Hardness as CaCO3			mg/L	1			
Ion Balance				0.01			
Calcium			mg/L	1			
Magnesium			mg/L	1			
Potassium			mg/L	1			
Sodium			mg/L	2			
Iron			mg/L	0.03			
Manganese			mg/L	0.01			

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

APPROVAL:

Ewan McRobbie  
 Inorganic Lab Supervisor

Client: Sunset Lakes Development Corporation  
 6576 Apple Orchard Road  
 Greely, ON  
 K4P 1E5  
 Attention: Dave Meikle

Report Number: 2608988  
 Date: 2006-05-08  
 Date Submitted: 2006-05-04  
 Project: PH0145

Chain of Custody Number: 22826 P.O. Number: Matrix: Water

PARAMETER	UNITS	MDL	LAB ID:	Sample Date:	Sample ID:	GUIDELINE		
						TYPE	LIMIT	UNITS
Total Coliforms	cf/100mL		460378	2006-05-03				
Escherichia Coli	cf/100mL			7164				
Heterotrophic Plate Count	cf/1mL							
Faecal Coliforms	cf/100mL							
Faecal Streptococcus	cf/100mL							

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

APPROVAL: Tim McCooney  
 QC Manager

**Client:** Sunset Lakes Development Corporation  
 6576 Apple Orchard Road  
 Greely, ON  
 K4P 1E5

**Report Number:** 2608976  
**Date:** 2006-05-10  
**Date Submitted:** 2006-05-04

**Attention:** Dave Meikle

**Project:** PH0145

**Chain of Custody Number:** 22826

**P.O. Number:**  
**Matrix:**

Water

PARAMETER	LAB ID:		UNITS	MDL	TYPE	LIMIT	UNITS
	Sample Date:	Sample ID:					
Alkalinity as CaCO3	460362		mg/L	5	OG	500	mg/L
Chloride	2006-05-03		mg/L	1	AO	250	mg/L
Colour	716A		TCU	2	AO	5	TCU
Conductivity			uS/cm	5			
Dissolved Organic Carbon			mg/L	0.5	AO	5	mg/L
Fluoride			mg/L	0.10	MAC	1.5	mg/L
Hydrogen Sulphide			mg/L	0.01	AO	0.05	mg/L
N-NH3 (Ammonia)			mg/L	0.02	MAC	1.0	mg/L
N-NO2 (Nitrite)			mg/L	0.10	MAC	10.0	mg/L
N-NO3 (Nitrate)			mg/L	0.10	AO	6.5-8.5	pH Units
pH							
Phenols			mg/L	0.001			
Sulphate			mg/L	1	AO	500	mg/L
Tannin & Lignin			mg/L	0.1			
TDS (COND - CALC)			mg/L	819	AO	500	mg/L
Total Kjeldahl Nitrogen			mg/L	0.05			
Turbidity			NTU	0.1	AO	1.0	NTU
Hardness as CaCO3			mg/L	1	OG	100	mg/L
Ion Balance				0.01			
Calcium			mg/L	1			
Magnesium			mg/L	1			
Potassium			mg/L	1			
Sodium			mg/L	2	AO	20	mg/L
Iron			mg/L	0.03	AO	0.3	mg/L
Manganese			mg/L	0.01	AO	0.05	mg/L

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

**APPROVAL:**  
 Ewan McRobbie  
 Inorganic Lab Supervisor



Client: Sunset Lakes Development Corporation  
 6576 Apple Orchard Road  
 Greely, ON  
 K4P 1E5

Report Number: 2608990  
 Date: 2006-05-08  
 Date Submitted: 2006-05-04

Attention: Dave Meikle

Project: PH0145

Chain of Custody Number: 22826

P.O. Number:

Matrix: Water

PARAMETER	UNITS	MDL	LAB ID: 460380		TYPE	LIMIT	UNITS
			Sample Date: 2006-05-03	Sample ID: 7200			
Total Coliforms	cf/100mL						
Escherichia Coli	cf/100mL						
Heterotrophic Plate Count	cf/1mL						
Faecal Coliforms	cf/100mL						
Faecal Streptococcus	cf/100mL						

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

APPROVAL:

Tim McCooye  
 QC Manager

**Client:** Sunset Lakes Development Corporation  
 6576 Apple Orchard Road  
 Greely, ON  
 K4P 1E5  
**Attention:** Dave Meikle

**Report Number:** 2608978  
**Date:** 2006-05-10  
**Date Submitted:** 2006-05-04  
**Project:** PH0145

**P.O. Number:**  
**Matrix:** Water

**Chain of Custody Number:** 22825

PARAMETER	UNITS	MDL	LAB ID:		GUIDELINE
			Sample Date:	Sample ID:	
Alkalinity as CaCO3	mg/L	5	460364		
Chloride	mg/L	1	2006-05-03		
Colour	TCU	2	7200		
Conductivity	uS/cm	5			
Dissolved Organic Carbon	mg/L	0.5			
Fluoride	mg/L	0.10			
Hydrogen Sulphide	mg/L	0.01			
N-NH3 (Ammonia)	mg/L	0.02			
N-NO2 (Nitrite)	mg/L	0.10			
N-NO3 (Nitrate)	mg/L	0.10			
pH					
Phenols	mg/L	0.001			
Sulphate	mg/L	1			
Tannin & Lignin	mg/L	0.1			
TDS (COND - CALC)	mg/L	5			
Total Kjeldahl Nitrogen	mg/L	0.05			
Turbidity	NTU	0.1			
Hardness as CaCO3	mg/L	1			
Ion Balance		0.01			
Calcium	mg/L	1			
Magnesium	mg/L	1			
Potassium	mg/L	1			
Sodium	mg/L	2			
Iron	mg/L	0.03			
Manganese	mg/L	0.01			
			307		
			228		
			<2		
			1390		
			<0.5		
			0.11		
			<0.01		
			<0.02		
			<0.10		
			<0.10		
			7.88		
			<0.001		
			98		
			<0.1		
			904		
			0.10		
			2.4		
			486		
			0.98		
			132		
			38		
			3		
			105		
			0.32		
			0.06		

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

**APPROVAL:**  
 Ewan McRobbie  
 Inorganic Lab Supervisor



**Client:** Sunset Lakes Development Corporation  
 6576 Apple Orchard Road  
 Greely, ON  
 K4P 1E5

**Report Number:** 2608977  
**Date:** 2006-05-10  
**Date Submitted:** 2006-05-04

**Attention:** Dave Meikle

**Project:** PH0145

**P.O. Number:**  
**Matrix:**

**Chain of Custody Number:** 22824

**Water**

PARAMETER	UNITS	MDL	LAB ID: Sample Date: Sample ID:	460363 2006-05-03 7281	TYPE	LIMIT	UNITS	GUIDELINE
								Water
Alkalinity as CaCO3	mg/L	5		247				
Chloride	mg/L	1		1536				
Colour	TCU	2		<2				
Conductivity	uS/cm	5		5030				
Dissolved Organic Carbon	mg/L	0.5		<0.5				
Fluoride	mg/L	0.10		0.17				
Hydrogen Sulphide	mg/L	0.01		<0.01				
N-NH3 (Ammonia)	mg/L	0.02		0.14				
N-NO2 (Nitrite)	mg/L	0.10		<0.10				
N-NO3 (Nitrate)	mg/L	0.10		<0.10				
pH				7.89				
Phenols	mg/L	0.001		<0.001				
Sulphate	mg/L	1		87				
Tannin & Lignin	mg/L	0.1		<0.1				
TDS (COND - CALC)	mg/L	5		3270				
Total Kjeldahl Nitrogen	mg/L	0.05		0.29				
Turbidity	NTU	0.1		2.1				
Hardness as CaCO3	mg/L	1		617				
Ion Balance		0.01		0.95				
Calcium	mg/L	1		158				
Magnesium	mg/L	1		54				
Potassium	mg/L	1		10				
Sodium	mg/L	2		807				
Iron	mg/L	0.03		0.26				
Manganese	mg/L	0.01		0.06				

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

**APPROVAL:** Ewan McRobbie  
 Inorganic Lab Supervisor

**Client:** Sunset Lakes Development Corporation  
 6576 Apple Orchard Road  
 Greely, ON  
 K4P 1E5

**Report Number:** 2608991  
**Date:** 2006-05-08  
**Date Submitted:** 2006-05-04

**Attention:** Dave Meikle

**Project:** PH0145

**Chain of Custody Number:** 22829

**P.O. Number:**

**Matrix:** Water

PARAMETER	UNITS	MDL	LAB ID:		TYPE	LIMIT	UNITS
			460381	2006-05-03			
Total Coliforms	cf/100mL		0	7377			
Escherichia Coli	cf/100mL		0				
Heterotrophic Plate Count	cf/1mL		19				
Faecal Coliforms	cf/100mL		0				
Faecal Streptococcus	cf/100mL		0				

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

**APPROVAL:**

Tim McCooye  
 QC Manager

Client: Sunset Lakes Development Corporation  
 6576 Apple Orchard Road  
 Greely, ON  
 K4P 1E5

Report Number: 2608979  
 Date: 2006-05-10  
 Date Submitted: 2006-05-04

Attention: Dave Meikle

Project: PH0145

P.O. Number:  
 Matrix:

Water

Chain of Custody Number: 22825

PARAMETER	UNITS	MDL	LAB ID:		TYPE	LIMIT	UNITS
			Sample Date:	Sample ID:			
			460365				
			2006-05-03				
			7377				
Alkalinity as CaCO3	mg/L	5	218				
Chloride	mg/L	1	316				
Colour	TCU	2	<2				
Conductivity	uS/cm	5	1460				
Dissolved Organic Carbon	mg/L	0.5	<0.5				
Fluoride	mg/L	0.10	0.59				
Hydrogen Sulphide	mg/L	0.01	1.40				
N-NH3 (Ammonia)	mg/L	0.02	0.39				
N-NO2 (Nitrite)	mg/L	0.10	<0.10				
N-NO3 (Nitrate)	mg/L	0.10	<0.10				
pH			7.99				
Phenols	mg/L	0.001	<0.001				
Sulphate	mg/L	1	47				
Tannin & Lignin	mg/L	0.1	<0.1				
TDS (COND - CALC)	mg/L	5	949				
Total Kjeldahl Nitrogen	mg/L	0.05	0.46				
Turbidity	NTU	0.1	3.5				
Hardness as CaCO3	mg/L	1	342				
Ion Balance		0.01	0.98				
Calcium	mg/L	1	71				
Magnesium	mg/L	1	40				
Potassium	mg/L	1	11				
Sodium	mg/L	2	159				
Iron	mg/L	0.03	0.41				
Manganese	mg/L	0.01	0.03				

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration  
 Comment:

APPROVAL: Ewan McRobbie  
 Inorganic Lab Supervisor

**Client:** Sunset Lakes Development Corporation  
 6576 Apple Orchard Road  
 Greely, ON  
 K4P 1E5

**Attention:** Dave Meikle

**Report Number:** 2608992  
**Date:** 2006-05-08  
**Date Submitted:** 2006-05-04

**Project:** PH0145

**P.O. Number:**  
**Matrix:**

**Chain of Custody Number:** 22828

**Water**

PARAMETER	UNITS	MDL	LAB ID: Sample Date: Sample ID:	460382 2006-05-03 Sale Barn	GUIDELINE		
					TYPE	LIMIT	UNITS
Total Coliforms	cf/100mL						
Escherichia Coli	cf/100mL						
Heterotrophic Plate Count	cf/1mL						
Faecal Coliforms	cf/100mL						
Faecal Streptococcus	cf/100mL						

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

**APPROVAL:** Tim McCooye  
 QC Manager

**Client:** Sunset Lakes Development Corporation  
 6576 Apple Orchard Road  
 Greely, ON  
 K4P 1E5

**Report Number:** 2608980  
**Date:** 2006-05-10  
**Date Submitted:** 2006-05-04

**Attention:** Dave Meikle

**Project:** PH0145

**Chain of Custody Number:** 22825

**P.O. Number:**  
**Matrix:**

Water

PARAMETER	UNITS	MDL	LAB ID:		TYPE	LIMIT	UNITS
			Sample Date:	Sample ID:			
Alkalinity as CaCO3	mg/L	5	460366				
Chloride	mg/L	1	2006-05-03				
Colour	TCU	2	Sale Barn				
Conductivity	uS/cm	5					
Dissolved Organic Carbon	mg/L	0.5					
Fluoride	mg/L	0.10					
Hydrogen Sulphide	mg/L	0.01					
N-NH3 (Ammonia)	mg/L	0.02					
N-NO2 (Nitrite)	mg/L	0.10					
N-NO3 (Nitrate)	mg/L	0.10					
pH							
Phenols	mg/L	0.001					
Sulphate	mg/L	1					
Tannin & Lignin	mg/L	1.0					
TDS (COND - CALC)	mg/L	5					
Total Kjeldahl Nitrogen	mg/L	0.05					
Turbidity	NTU	0.1					
Hardness as CaCO3	mg/L	1					
Ion Balance		0.01					
Calcium	mg/L	1					
Magnesium	mg/L	1					
Potassium	mg/L	1					
Sodium	mg/L	2					
Iron	mg/L	0.03					
Manganese	mg/L	0.01					

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

APPROVAL: Ewan McRobbie  
 Inorganic Lab Supervisor





1294 Leeds Ave., Ottawa, Ontario K1B 3W3  
Phone: (877) 805-1220 Fax: (613) 842-5100



International Pump  
Technology Inc.  
Distributor of Grout Pumps  
Fergus, Ontario Phone: (800) 265-9355



ASM Industries  
of Canada  
Manufacturer of the "Ground Hog" Grout  
Pump Puller & the Ultimate Vermin Proof Wall Cap  
Fergus, Ontario Phone: (800) 265-9355

Paterson Group  
28 Concourse Gate, Unit 1  
Ottawa, Ontario K2E 7T7

June 7, 2006

Attention: Robert Passmore

Re: Maximum treatable limits for Aesthetic Parameters in Ground Water

Dear Robert,

Based on my experience in the industry selling, sizing and designing water treatment systems for the last 10 years, using knowledge gathered through education as a certified member of The Water Quality Association of America, I am providing a reference as to the maximum reasonable treatable limits for the most common (nuisance) parameters of a Secondary nature. Please keep in mind that no consideration is given to cost of these recommendations as it is usually at the discretion of the end user whether or not the system is implemented.

I will denote the MOE aesthetic objective (AO) or operational guideline (OG) first followed by the reasonable maximum treatable limit derived from past experience using various field proven and industry accepted methods of treatment.

1. Hardness OG: 80 – 100 ppm. Maximum reasonable treatable limit 1105 ppm by ion exchange cation method. Other factors which influence the success of this method is presence of iron, sodium, or sodium chloride in the water
2. Iron AO: 0.30 ppm. Maximum reasonable treatable limit can be up to 30 ppm by method of oxidization by either air or chemical injection followed by depth filtration by a backwashing filter. PH can affect success of this method
3. PH OG: 6.5 – 8.5 Maximum reasonable treatable limits can be from 5 to 10. Method of treatment is either acid injection for high PH or calcite injection for low PH.
4. Manganese AO: 0.05 ppm. Maximum treatable limit 2 ppm. Effective methods of treatment are chlorination, manganese greensand filters or air injection. The presence of iron and sulfur in the water will affect the success of the treatment.
5. Tannins (organics) AO: 5.0 Maximum reasonable treatable limit 3 ppm. Having the characteristics of, or derived from, plant, living organism or animal, usually comprised of a carbon-hydrogen structure, the preferred method of treatment is organic specific anion resin. System works on the same principle as hardness removal and uses sodium as a regenerant. Chlorination can also be used but care must be exercised when treating this symptom by chlorination as THM's (trihalomethanes) are a by-product of oxidizing the organics.
6. T.D.S. ( total dissolved solids) AO: 500 ppm Maximum reasonable treatable limit is 5000 ppm. In order to treat TDS effectively a Reverse Osmosis system would be necessary. This type of membrane filtration requires that the water be relatively soft and free of minerals such as iron, manganese and sulfur. Whole house systems can be quite costly, as a repressurization system would be required as well as storage tanks and plastic piping throughout the house for a distribution system would be a consideration. Point of use systems for drinking and cooking are much more economical but would not eliminate some of the harmful effects of TDS on appliances and fixtures
7. Hydrogen Sulfide AO detectable as low as .1 ppm Maximum reasonable treatable limit 10 ppm. Various methods such as full line chlorination or aeration are effective as long as sufficient contact time is allowed. Many times if an aeration system is required for iron a bonus is that it will act on the sulfur as well.

All of the above parameters are very common in the RMOC and outlying areas. When good practices combined with accurate water analysis and proper treatment are applied, these nuisances can be controlled.

Sincerely

Peter Misner CWS III  
GM Technalinks

---

Pumps - Grout Machines - Pump Pullers - Water Treatment

---

## **APPENDIX 4**

### **SUPPORTING DOCUMENTATION AQUIFER ANALYSIS DATA**

1. New Pump Test Data & Aquifer Analysis Curves for TW4, TW5 and TW6
2. Original Pump Test Data & Aquifer Analysis Curves for TW1, TW2 and TW3



















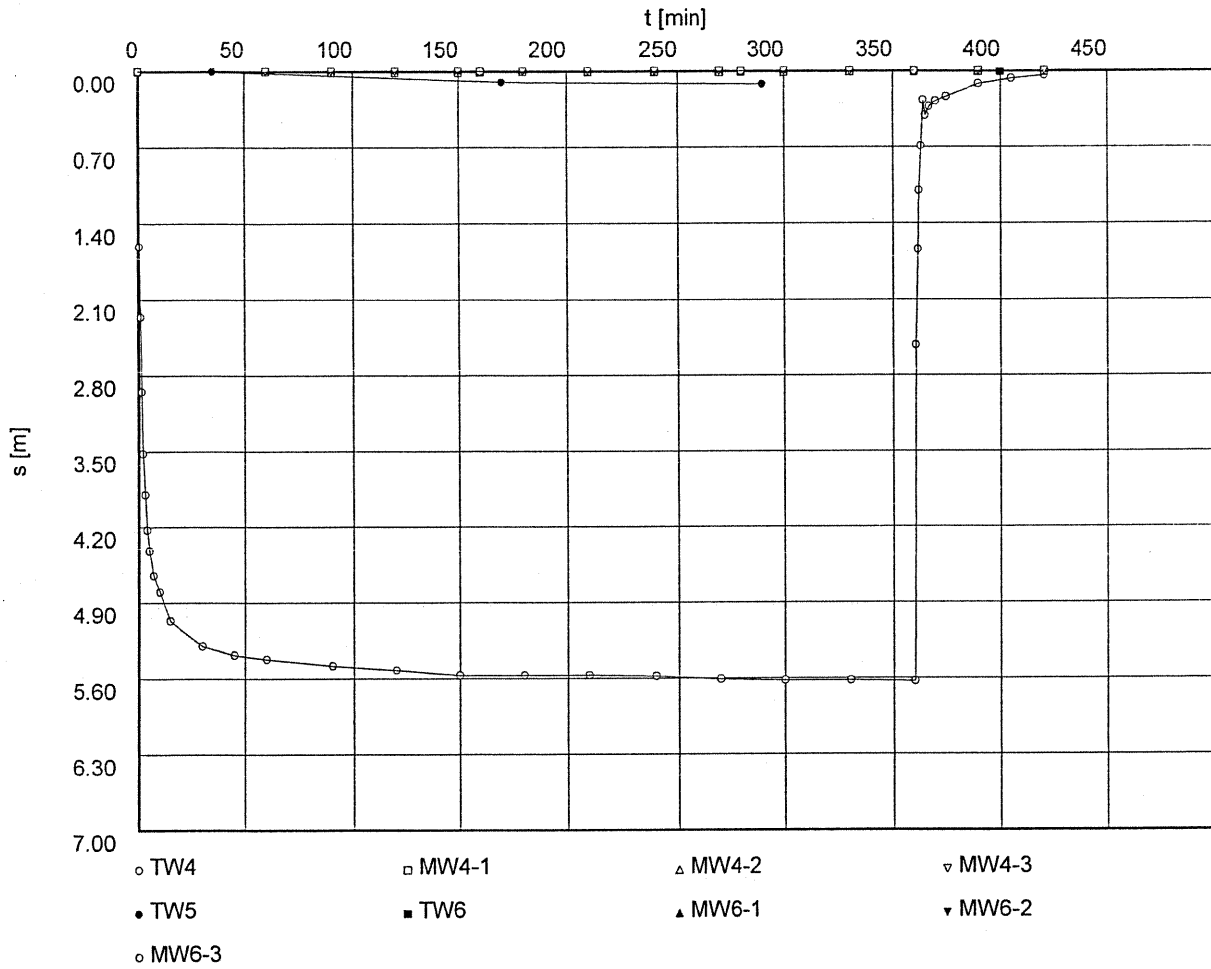


Pumping Test No. 06-2

Test conducted on: May 1, 2006

TW4

Discharge 1.88 l/s

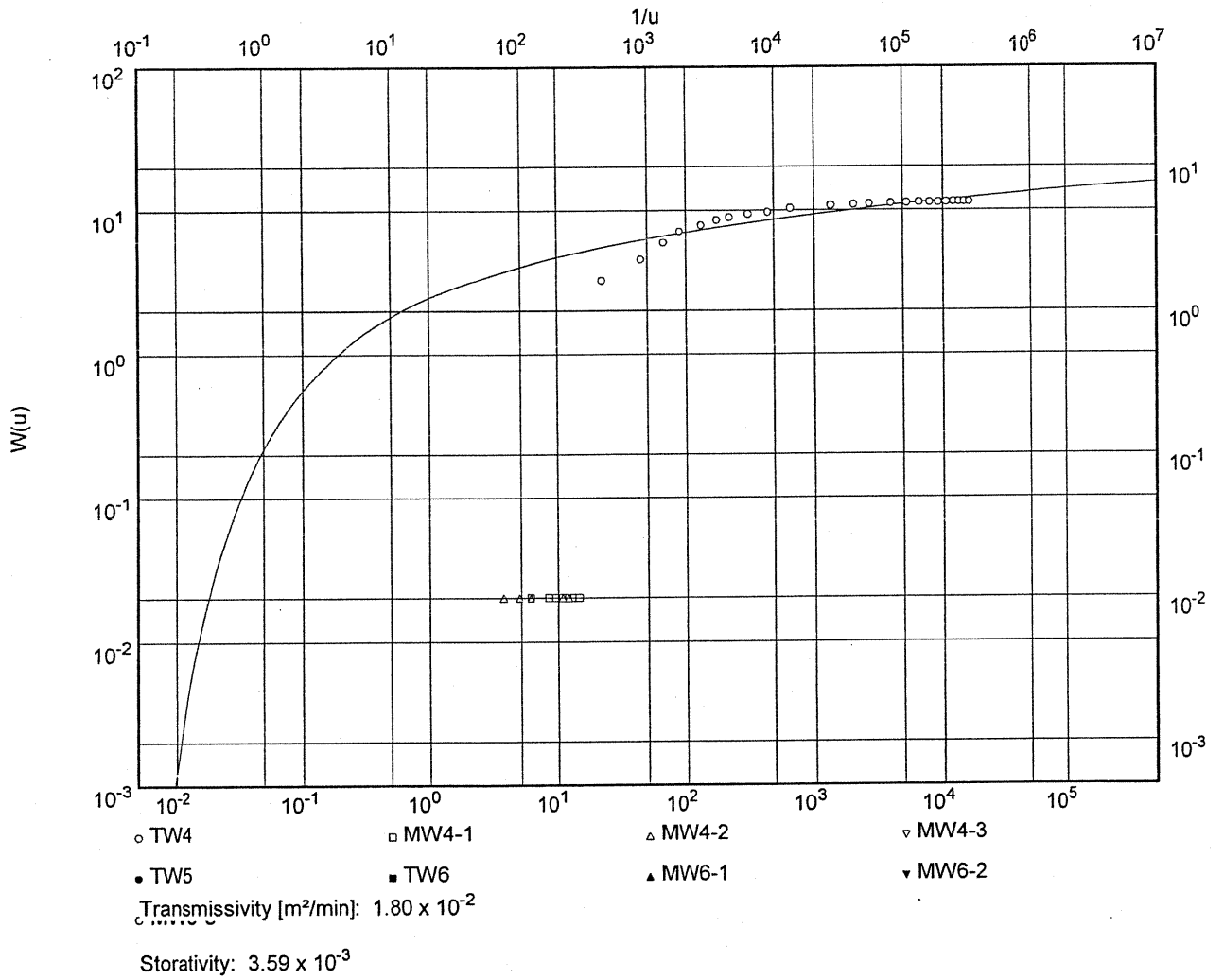


Pumping Test No. 06-2

Test conducted on: May 1, 2006

TW4

Discharge 1.88 l/s

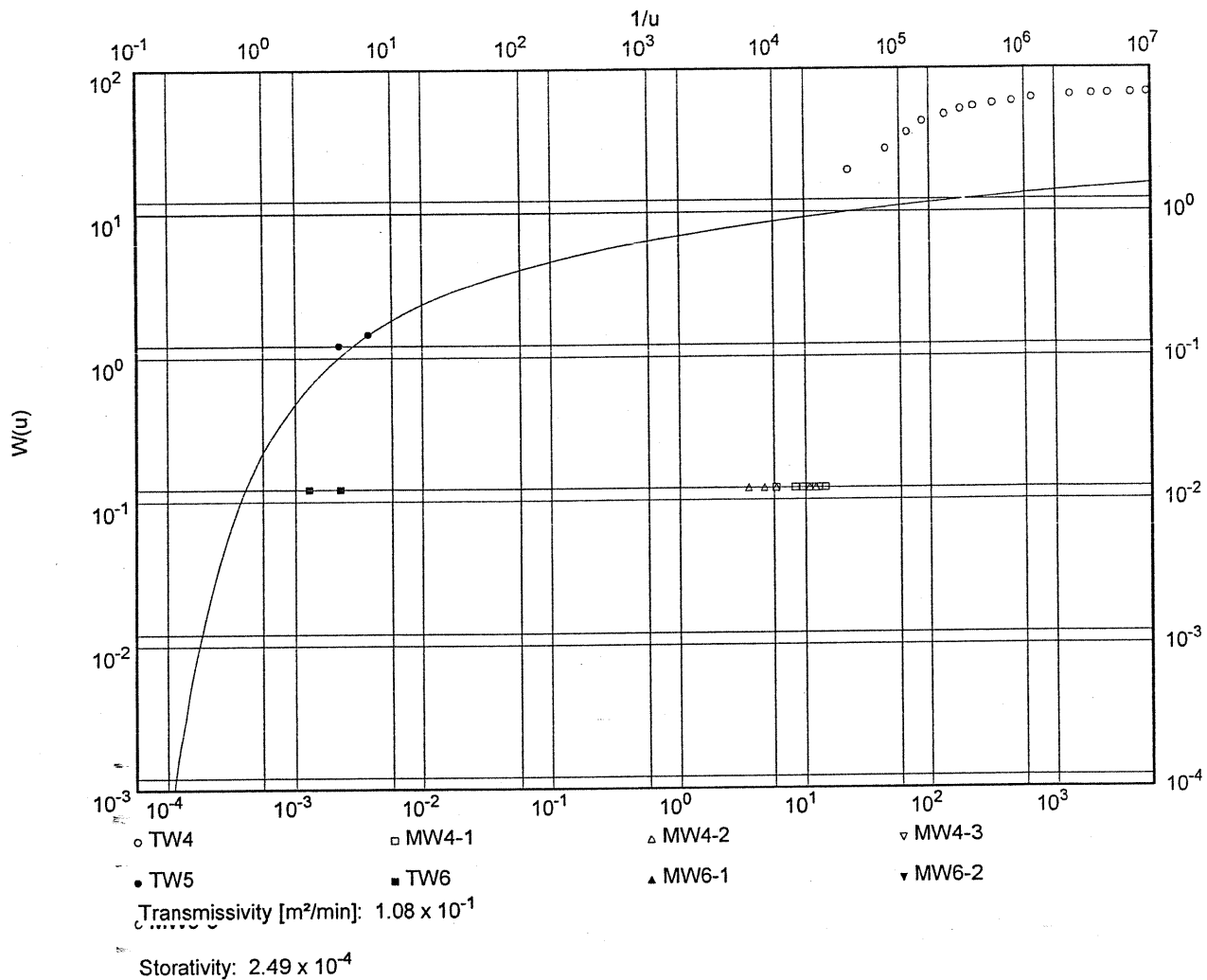


Pumping Test No. 06-2

Test conducted on: May 1, 2006

TW4

Discharge 1.88 l/s

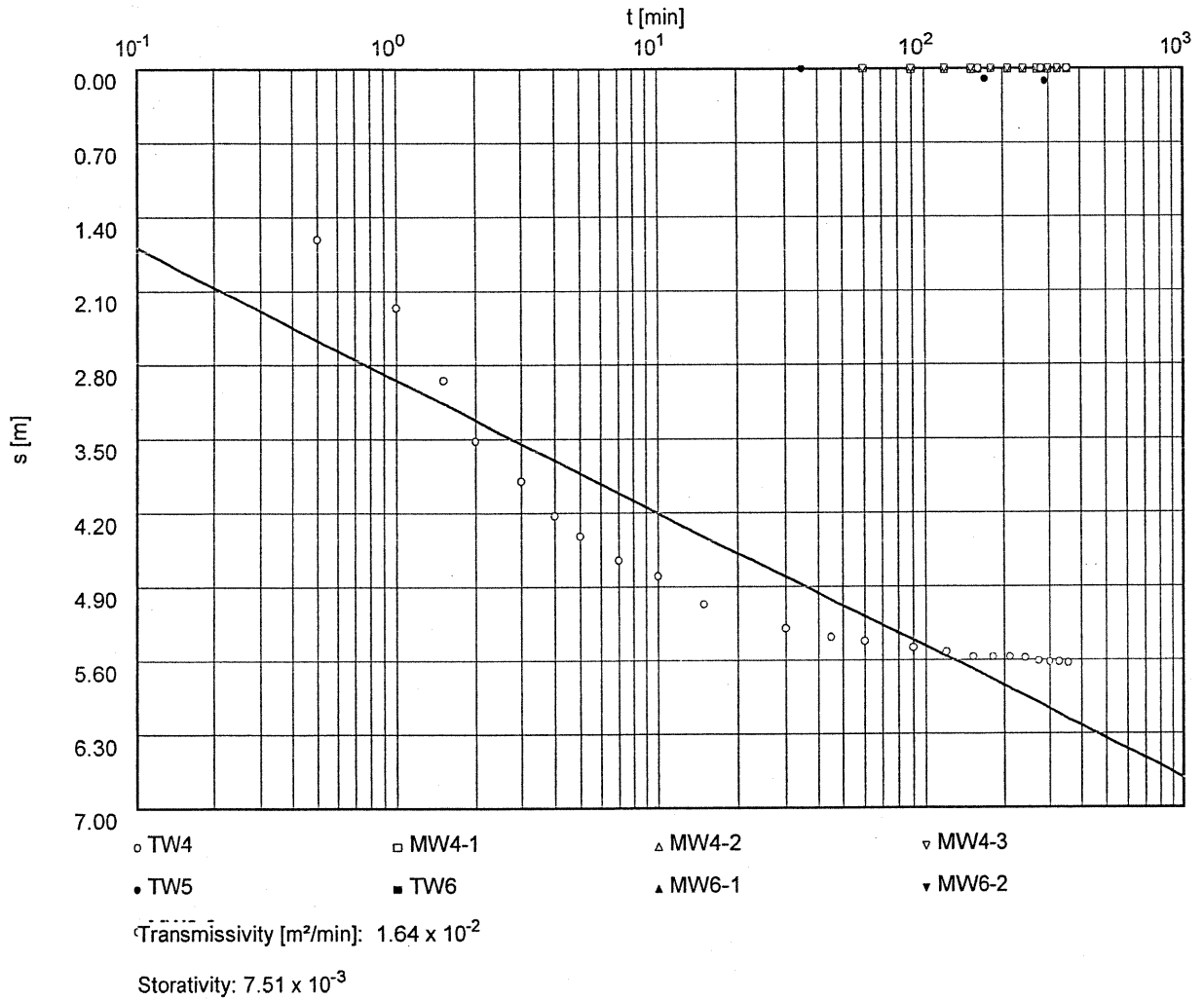


Pumping Test No. 06-2

Test conducted on: May 1, 2006

TW4

Discharge 1.88 l/s



















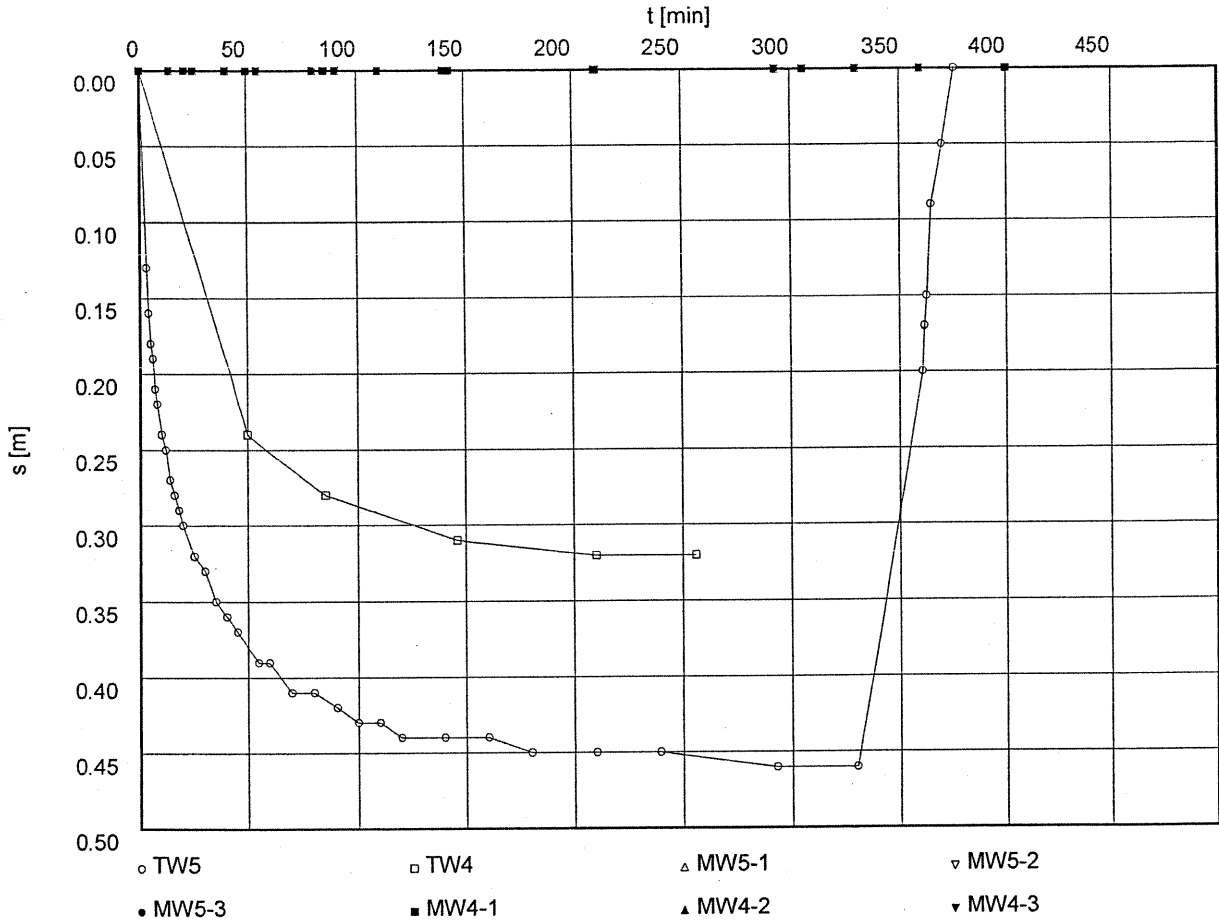


Pumping Test No. 3

Test conducted on: May 2, 2006

TW5

Discharge 1.92 l/s



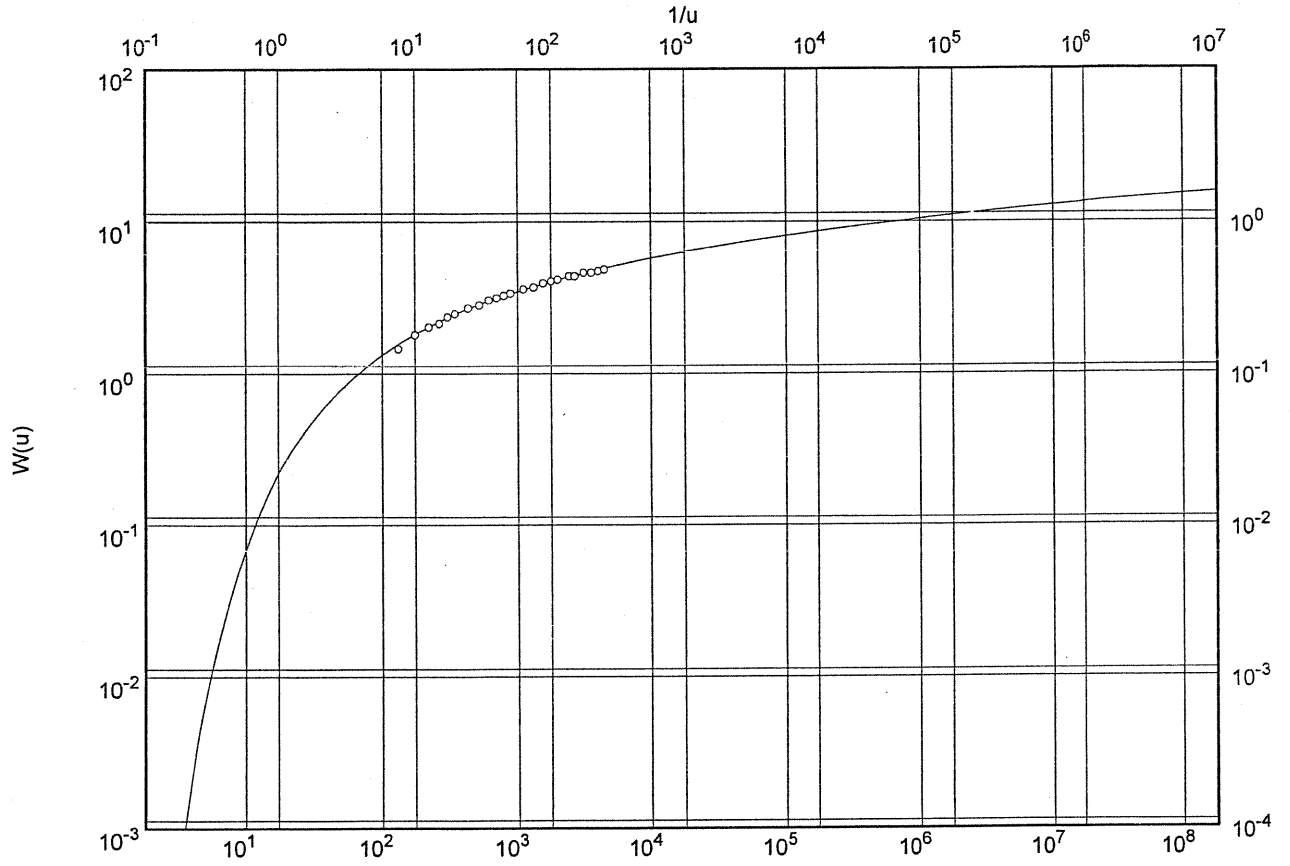


Pumping Test No. 3

Test conducted on: May 2, 2006

TW5

Discharge 1.92 l/s



- TW5
- TW4
- △ MW5-1
- ▽ MW5-2
- MW5-3
- MW4-1
- ▲ MW4-2
- ▼ MW4-3

Transmissivity [ $m^2/min$ ]:  $1.03 \times 10^{-1}$

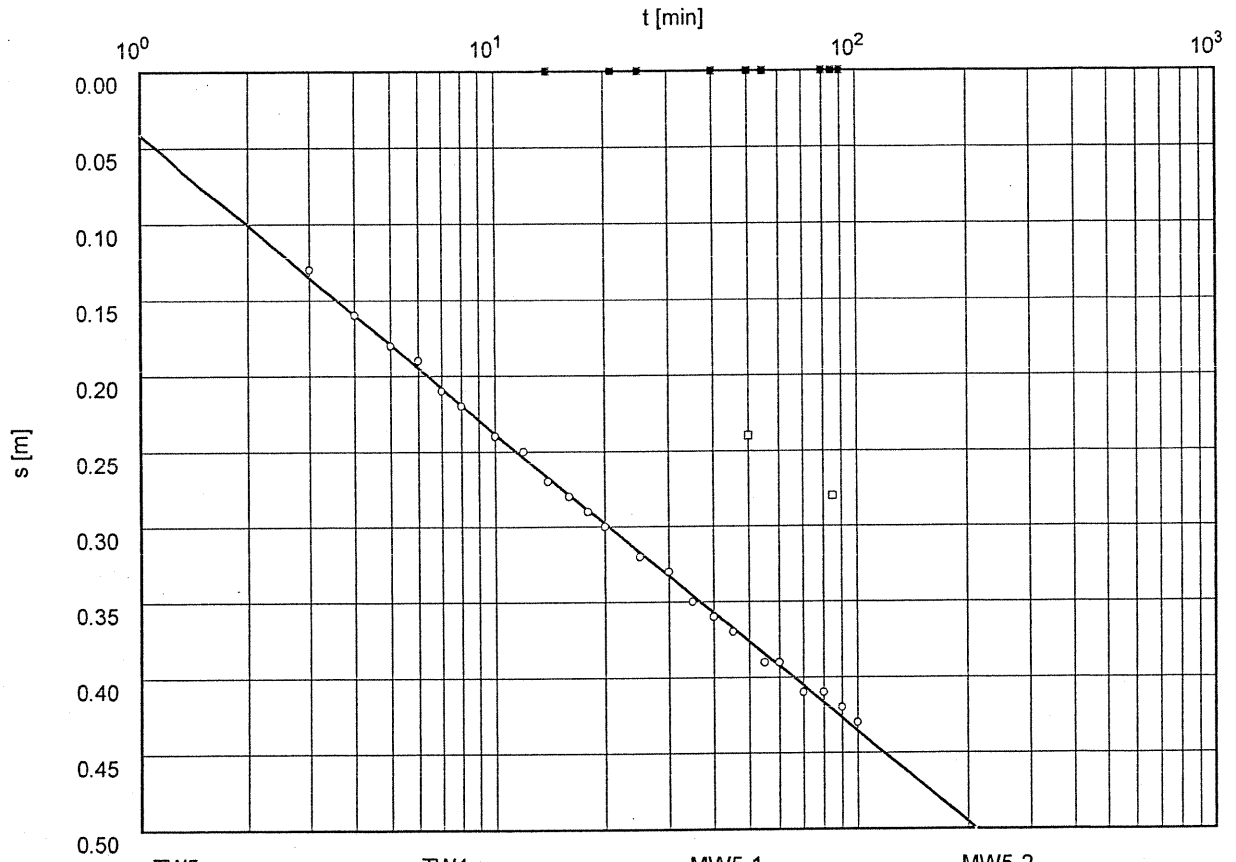
Storativity:  $7.27 \times 10^0$

Pumping Test No. 3

Test conducted on: May 2, 2006

TW5

Discharge 1.92 l/s



○ TW5                      □ TW4                      △ MW5-1                      ▽ MW5-2  
 ● MW5-3                      ■ MW4-1                      ▲ MW4-2                      ▼ MW4-3

Transmissivity [ $m^2/min$ ]:  $1.06 \times 10^{-1}$

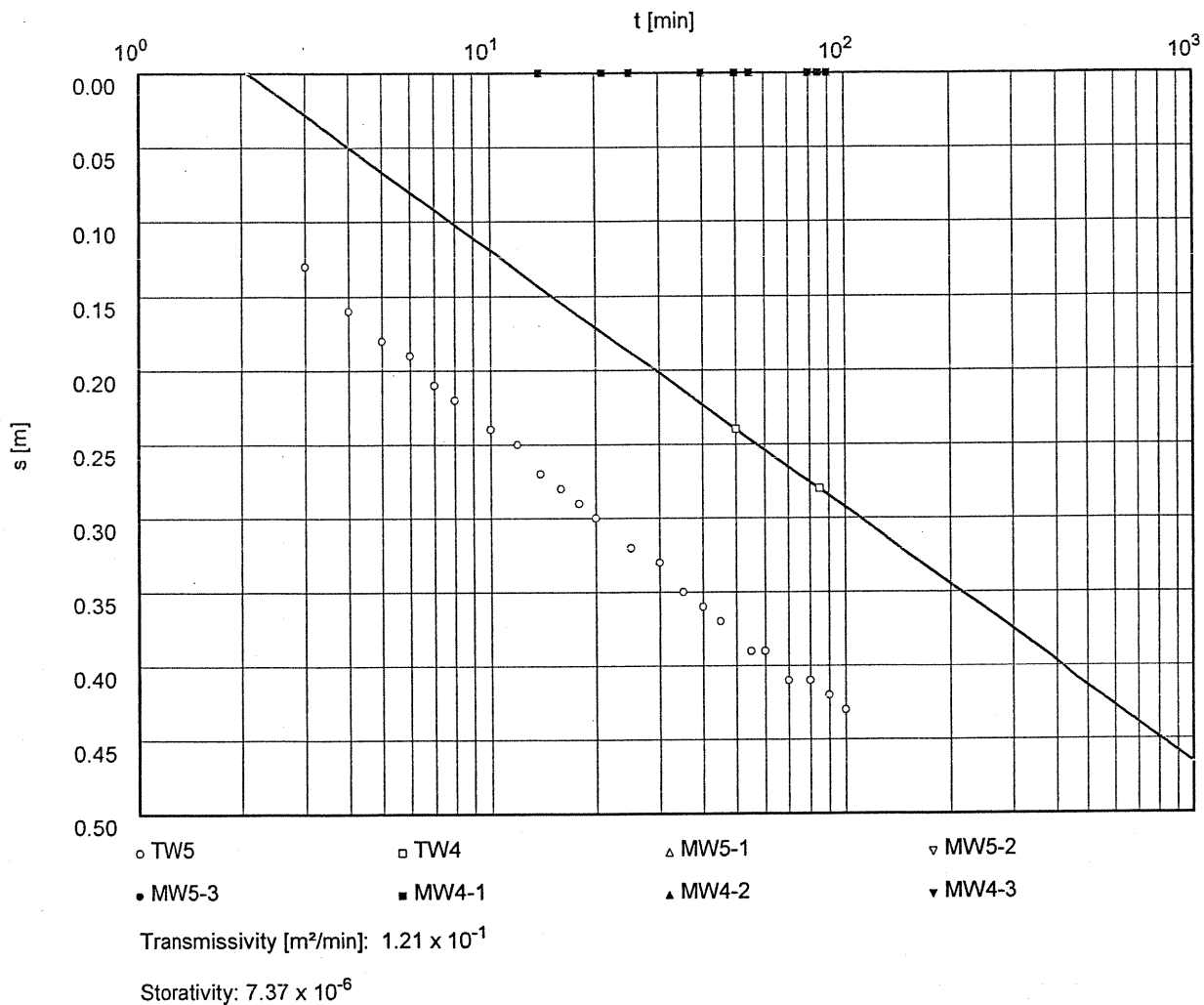
Storativity:  $6.61 \times 10^0$

Pumping Test No. 3

Test conducted on: May 2, 2006

TW5

Discharge 1.92 l/s

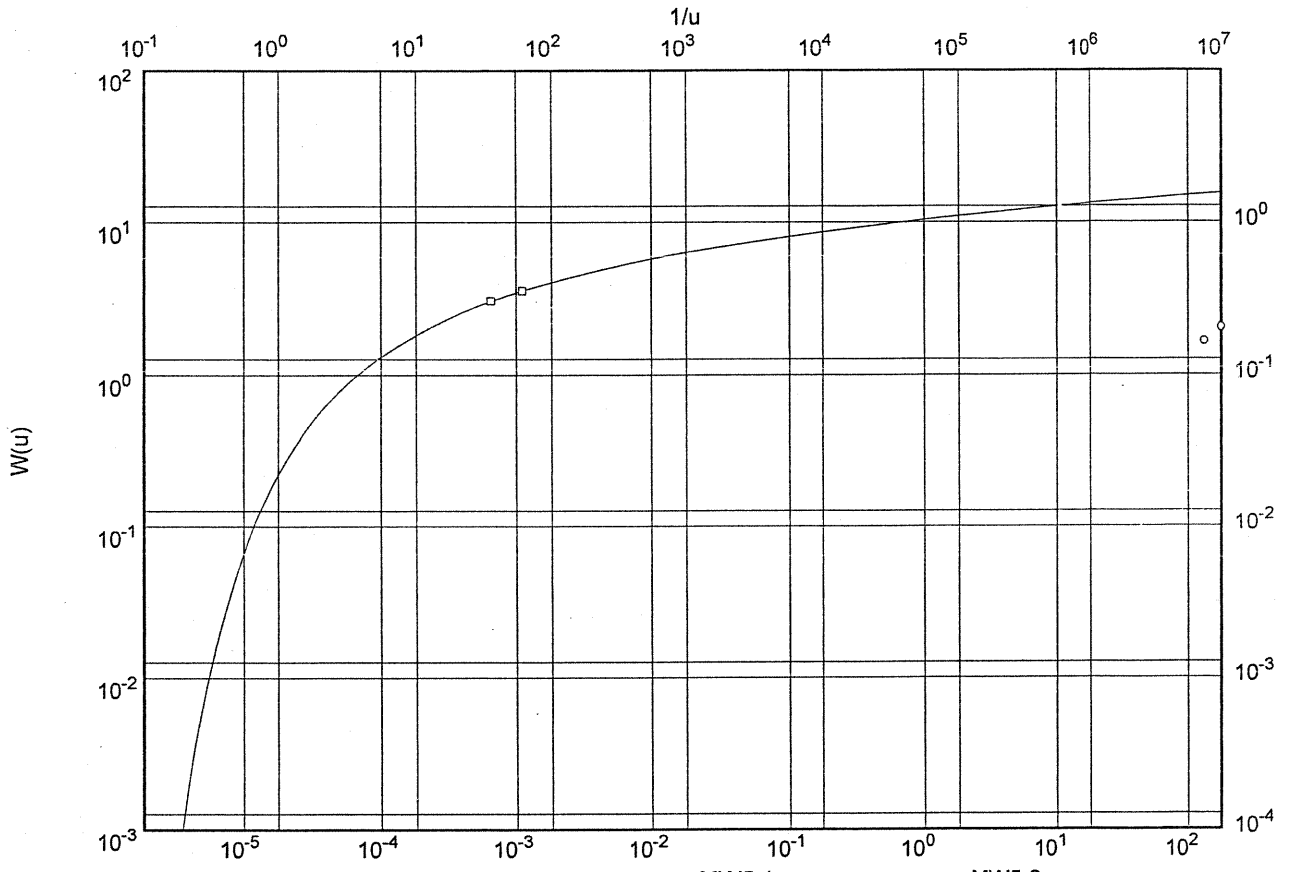


Pumping Test No. 3

Test conducted on: May 2, 2006

TW5

Discharge 1.92 l/s



- TW5
- TW4
- △ MW5-1
- ▽ MW5-2
- MW5-3
- MW4-1
- ▲ MW4-2
- ▼ MW4-3

Transmissivity [m<sup>2</sup>/min]:  $1.16 \times 10^{-1}$

Storativity:  $8.34 \times 10^{-6}$























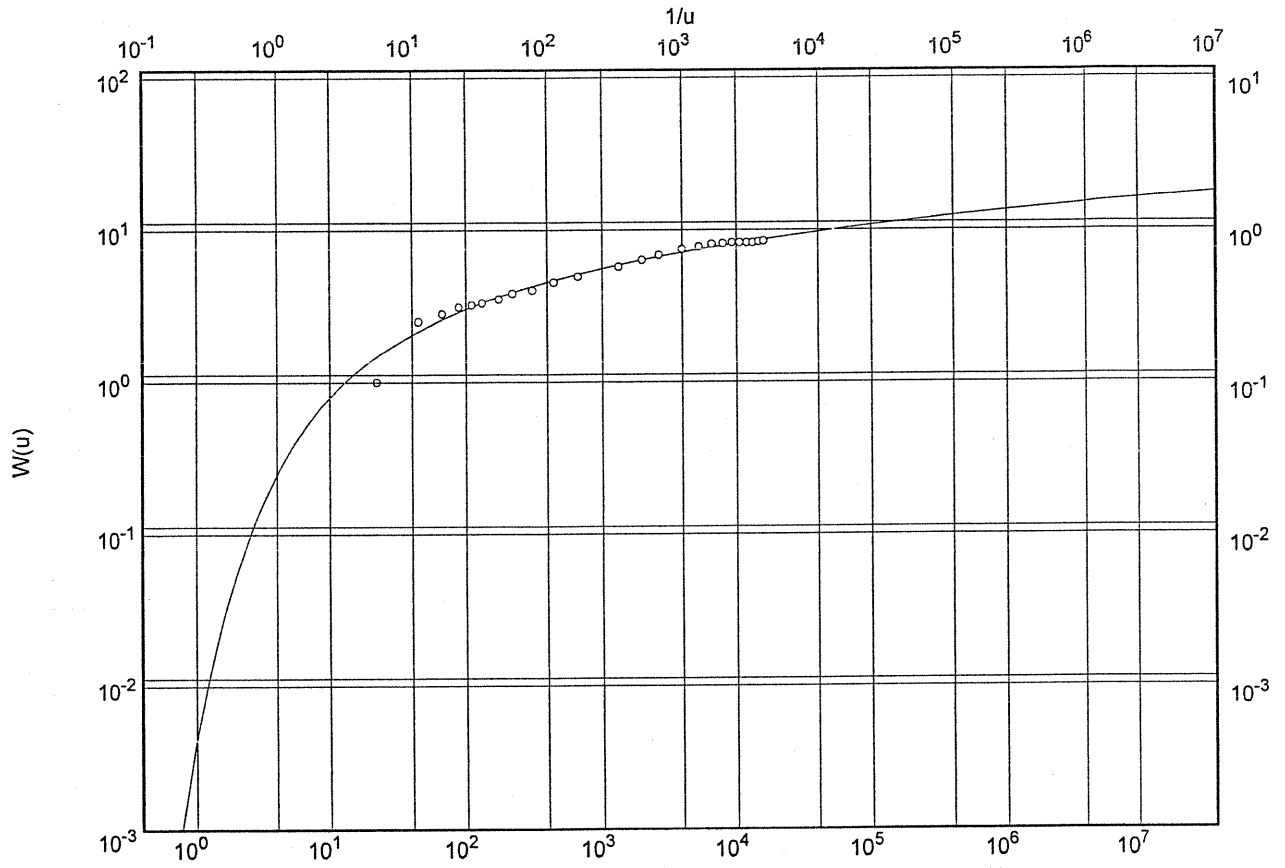


Pumping Test No. O6/01

Test conducted on: April 28, 2006

TW6

Discharge 2.14 l/s



- Test Well 6                      □ TW4                      ▲ TW2                      ▼ TW3
- MW6-1                              ■ MW6-2                      ▲ MW6-3                      ▼ MW4-1

Transmissivity [ $m^2/min$ ]:  $9.12 \times 10^{-2}$

Storativity:  $1.44 \times 10^0$

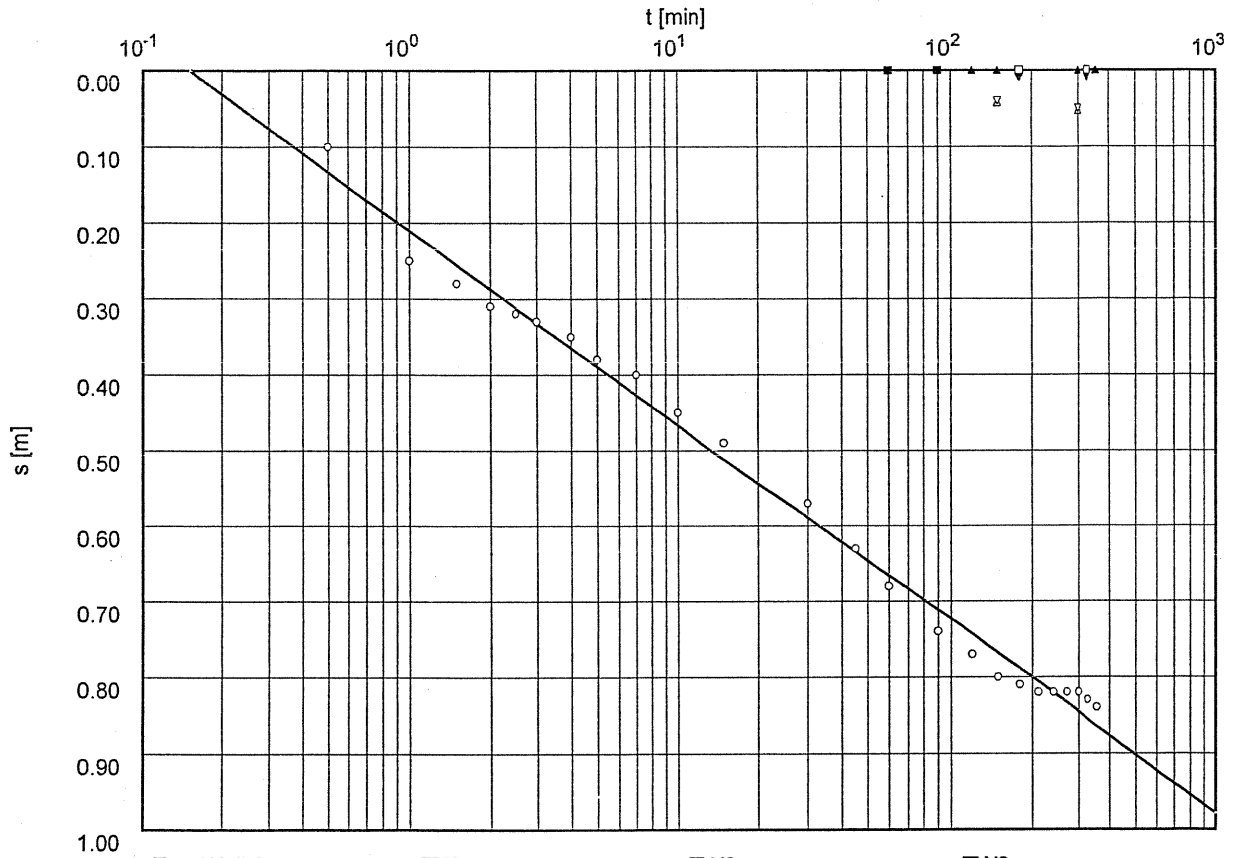


Pumping Test No. O6/01

Test conducted on: April 28, 2006

TW6

Discharge 2.14 l/s



- Test Well 6
- TW4
- △ TW2
- ▽ TW3
- MW6-1
- MW6-2
- ▲ MW6-3
- ▼ MW4-1

Transmissivity [ $m^2/min$ ]:  $9.16 \times 10^{-2}$

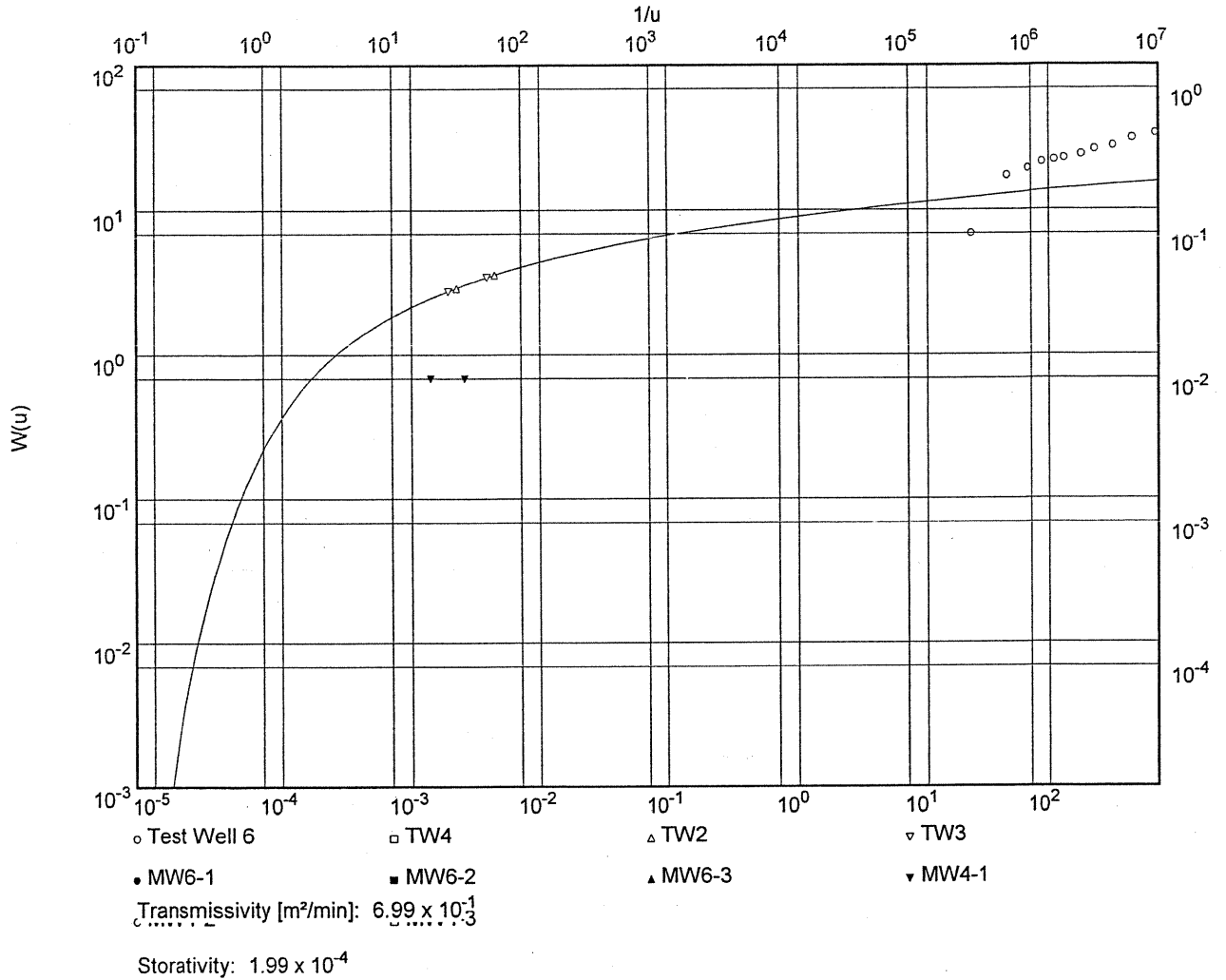
Storativity:  $1.39 \times 10^0$

Pumping Test No. O6/01

Test conducted on: April 28, 2006

TW6

Discharge 2.14 l/s

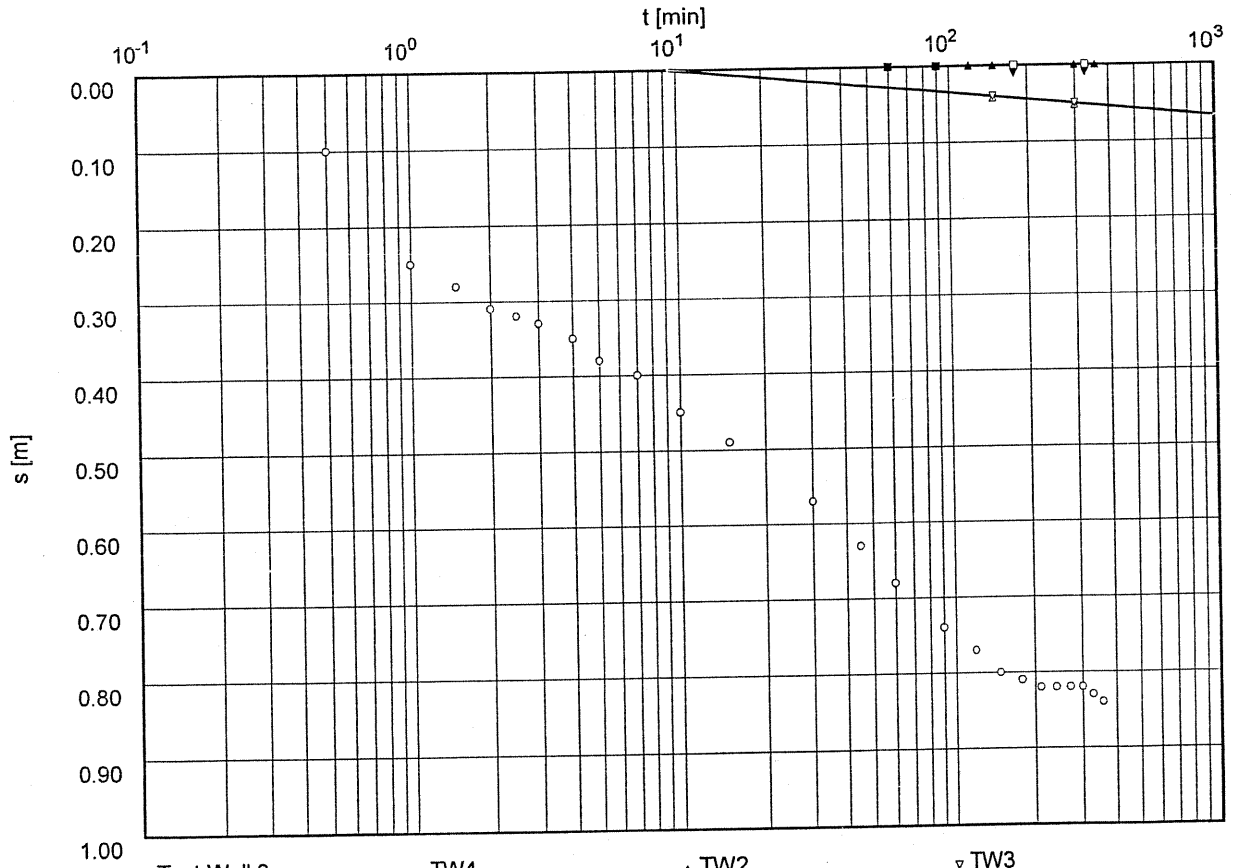


Pumping Test No. O6/01

Test conducted on: April 28, 2006

TW6

Discharge 2.14 l/s



○ Test Well 6      □ TW4      △ TW2      ▽ TW3  
 ● MW6-1      ■ MW6-2      ▲ MW6-3      ▼ MW4-1

Transmissivity [ $m^2/min$ ]:  $7.07 \times 10^{-1}$

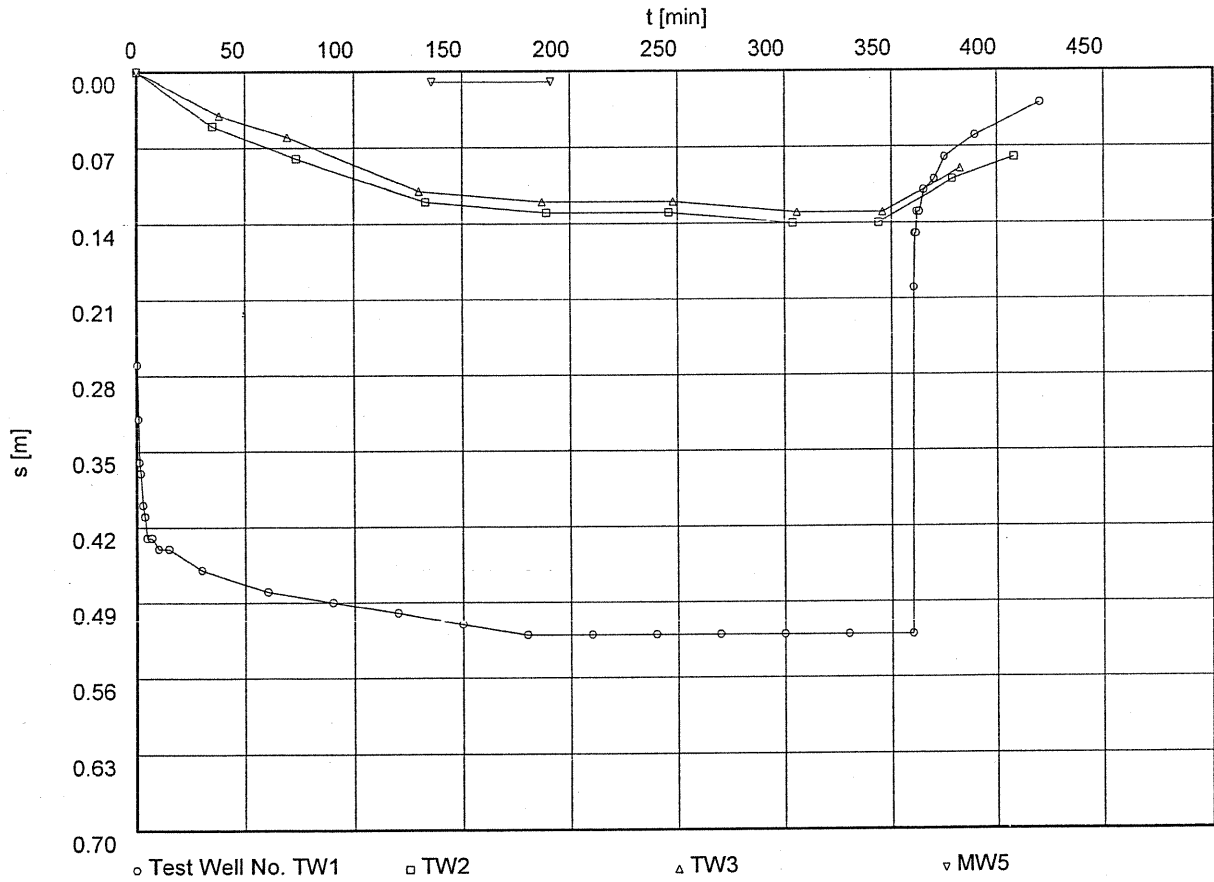
Storativity:  $1.90 \times 10^{-4}$

Pumping Test No. 1

Test conducted on: June 23, 2005

TW1

Discharge 1.44 l/s













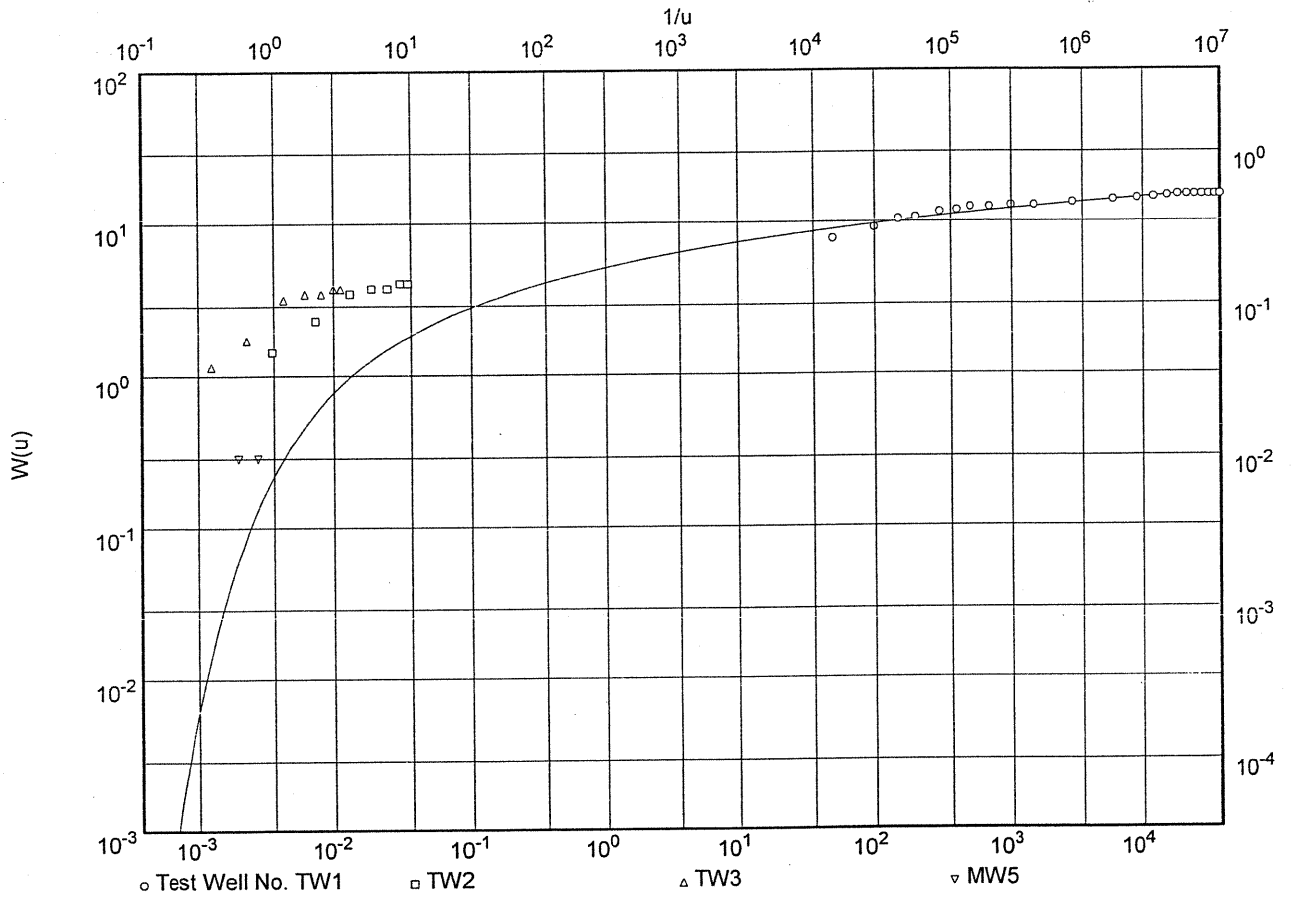


Pumping Test No. 1

Test conducted on: June 23, 2005

TW1

Discharge 1.44 l/s



Transmissivity [ $m^2/min$ ]:  $1.96 \times 10^{-1}$

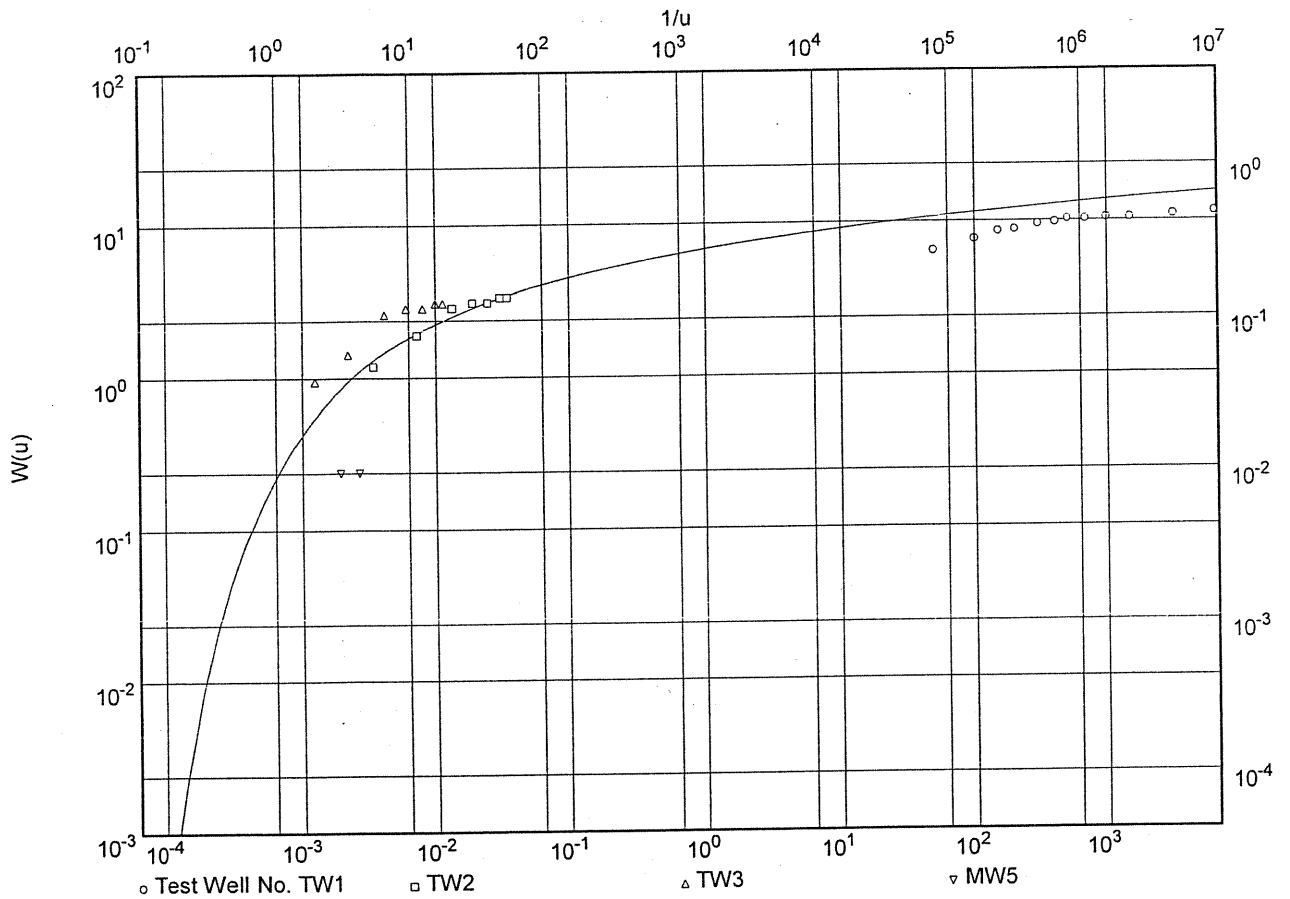
Storativity:  $2.82 \times 10^{-3}$

Pumping Test No. 1

Test conducted on: June 23, 2005

TW1

Discharge 1.44 l/s



Transmissivity [ $m^2/min$ ]:  $1.62 \times 10^{-1}$

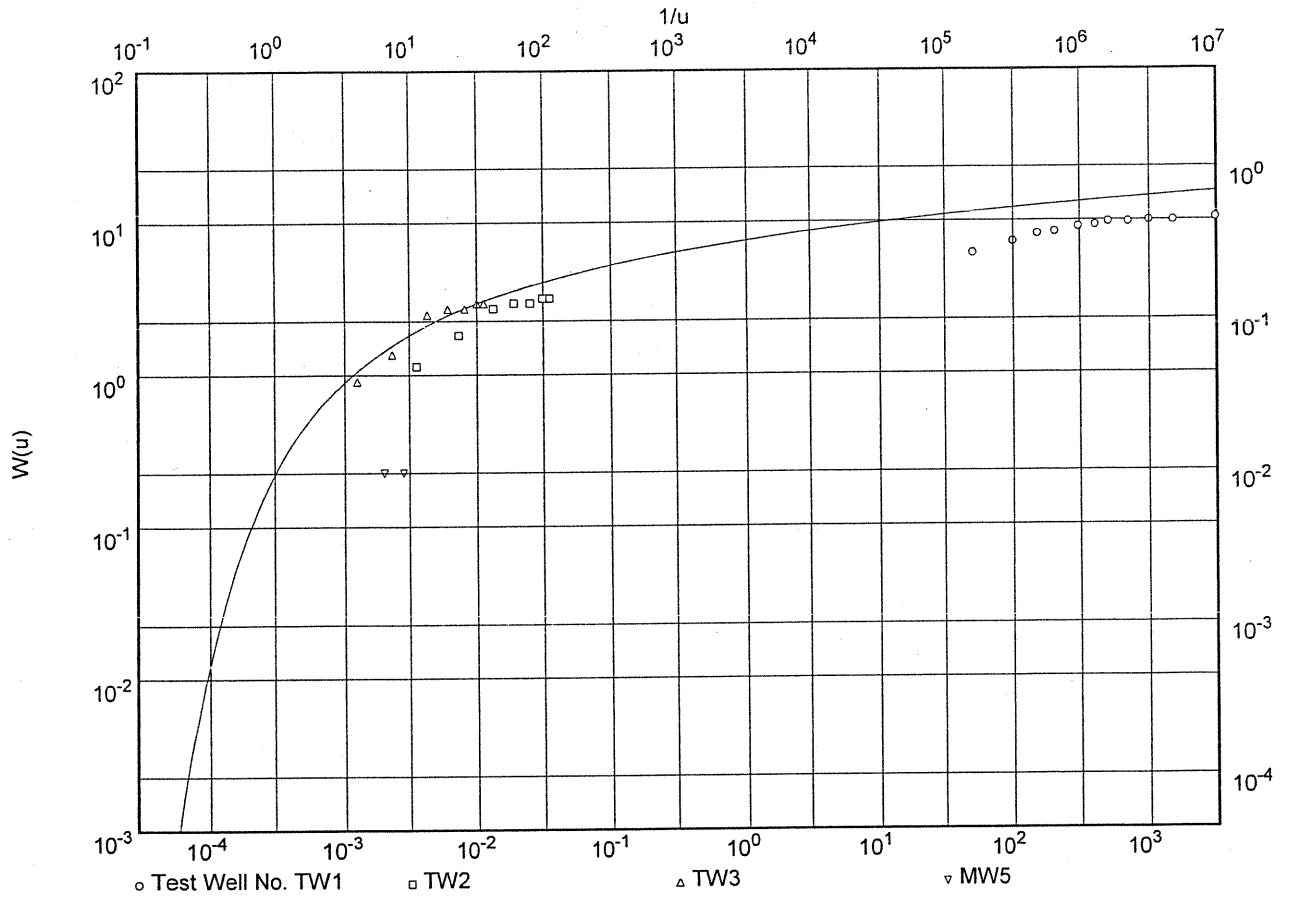
Storativity:  $4.13 \times 10^{-4}$

Pumping Test No. 1

Test conducted on: June 23, 2005

TW1

Discharge 1.44 l/s



Transmissivity [ $m^2/min$ ]:  $1.55 \times 10^{-1}$

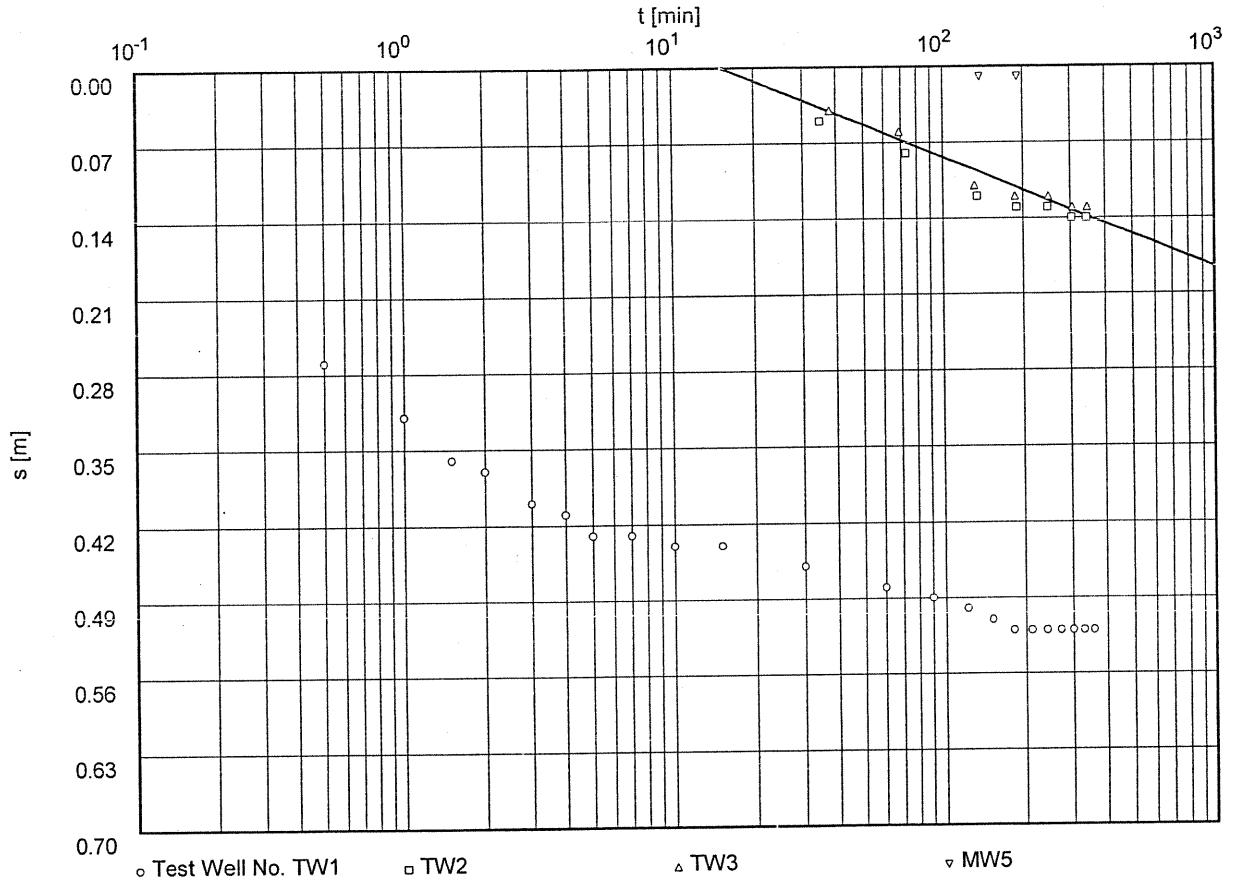
Storativity:  $1.89 \times 10^{-4}$

Pumping Test No. 1

Test conducted on: June 23, 2005

TW1

Discharge 1.44 l/s



Transmissivity [ $m^2/min$ ]:  $1.55 \times 10^{-1}$

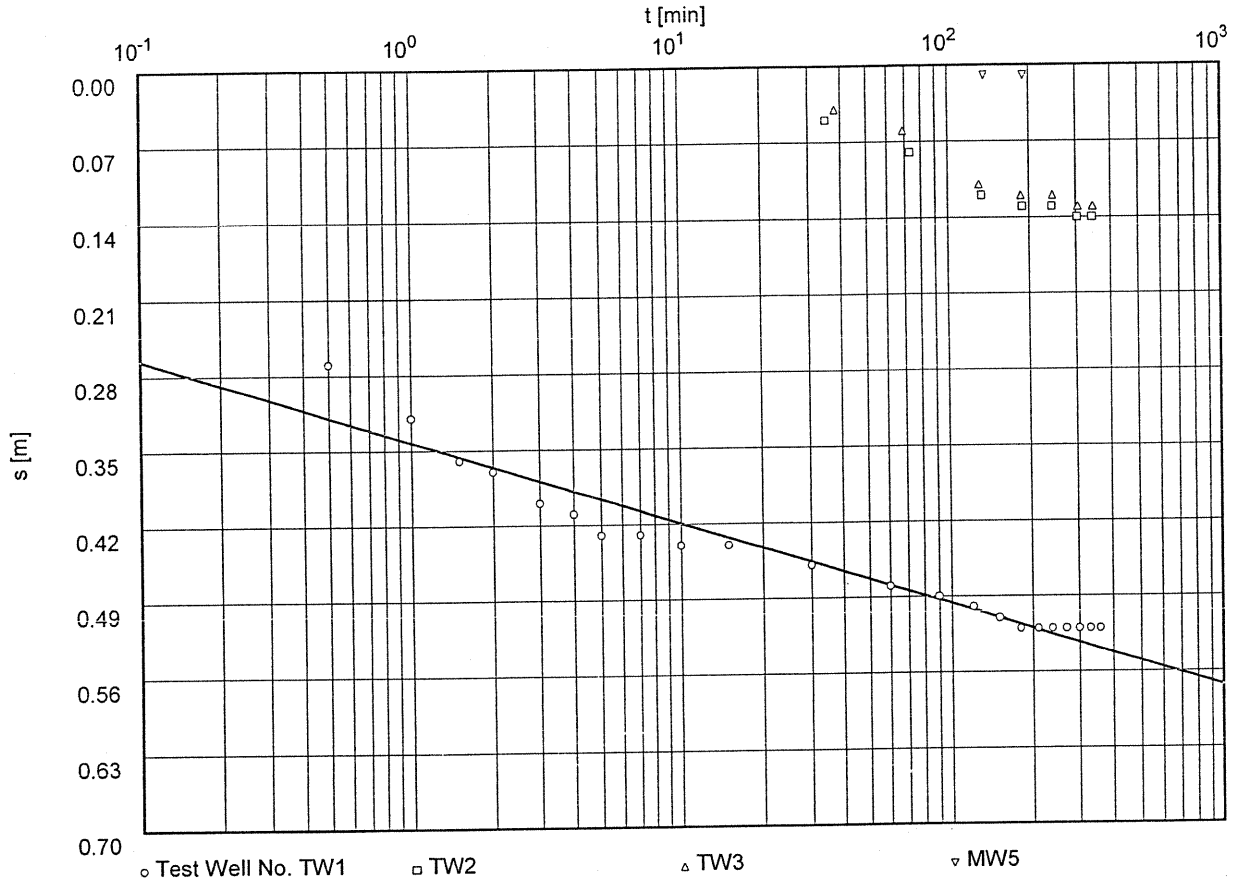
Storativity:  $1.72 \times 10^{-4}$

Pumping Test No. 1

Test conducted on: June 23, 2005

TW1

Discharge 1.44 l/s



Transmissivity [m<sup>2</sup>/min]:  $2.05 \times 10^{-1}$

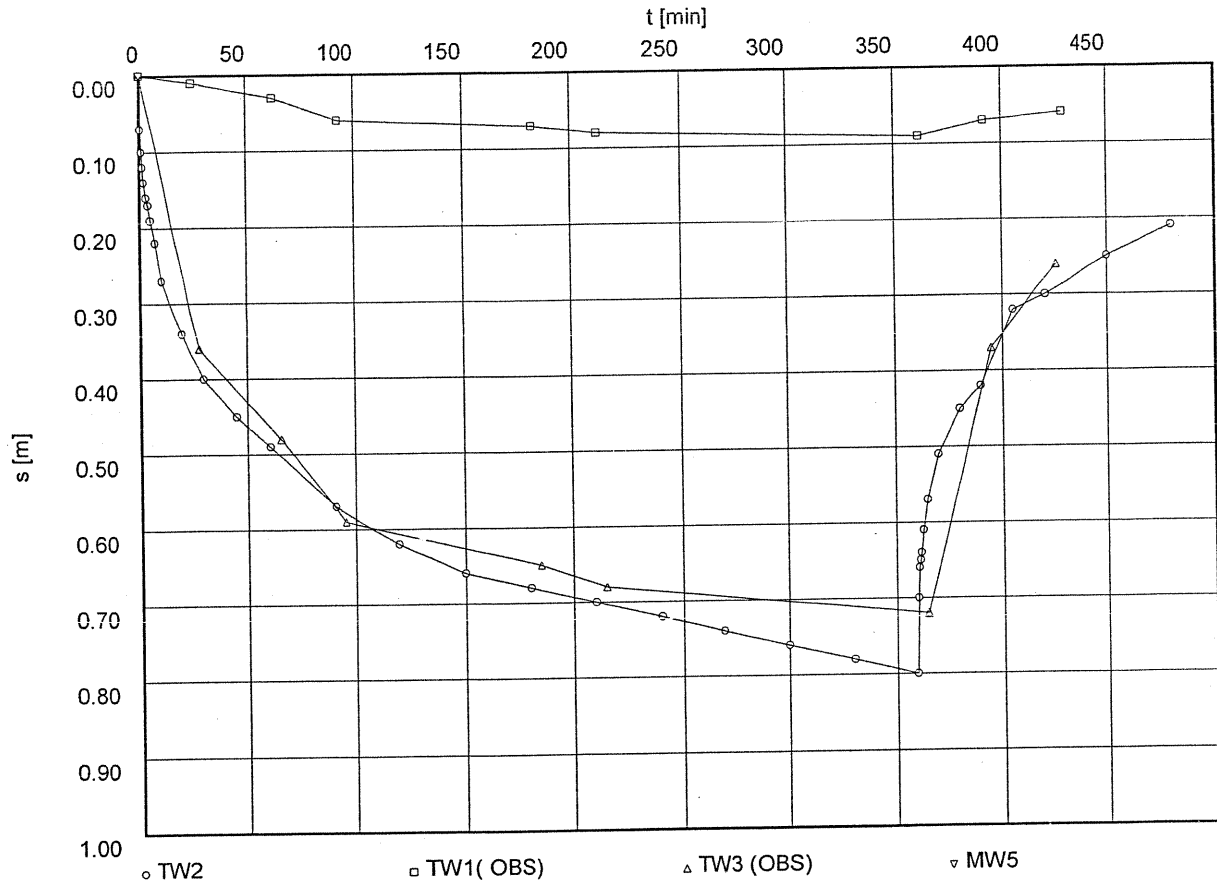
Storativity:  $1.61 \times 10^{-3}$

Pumping Test No. 2

Test conducted on: June 27, 2005

TW2

Discharge 1.40 l/s













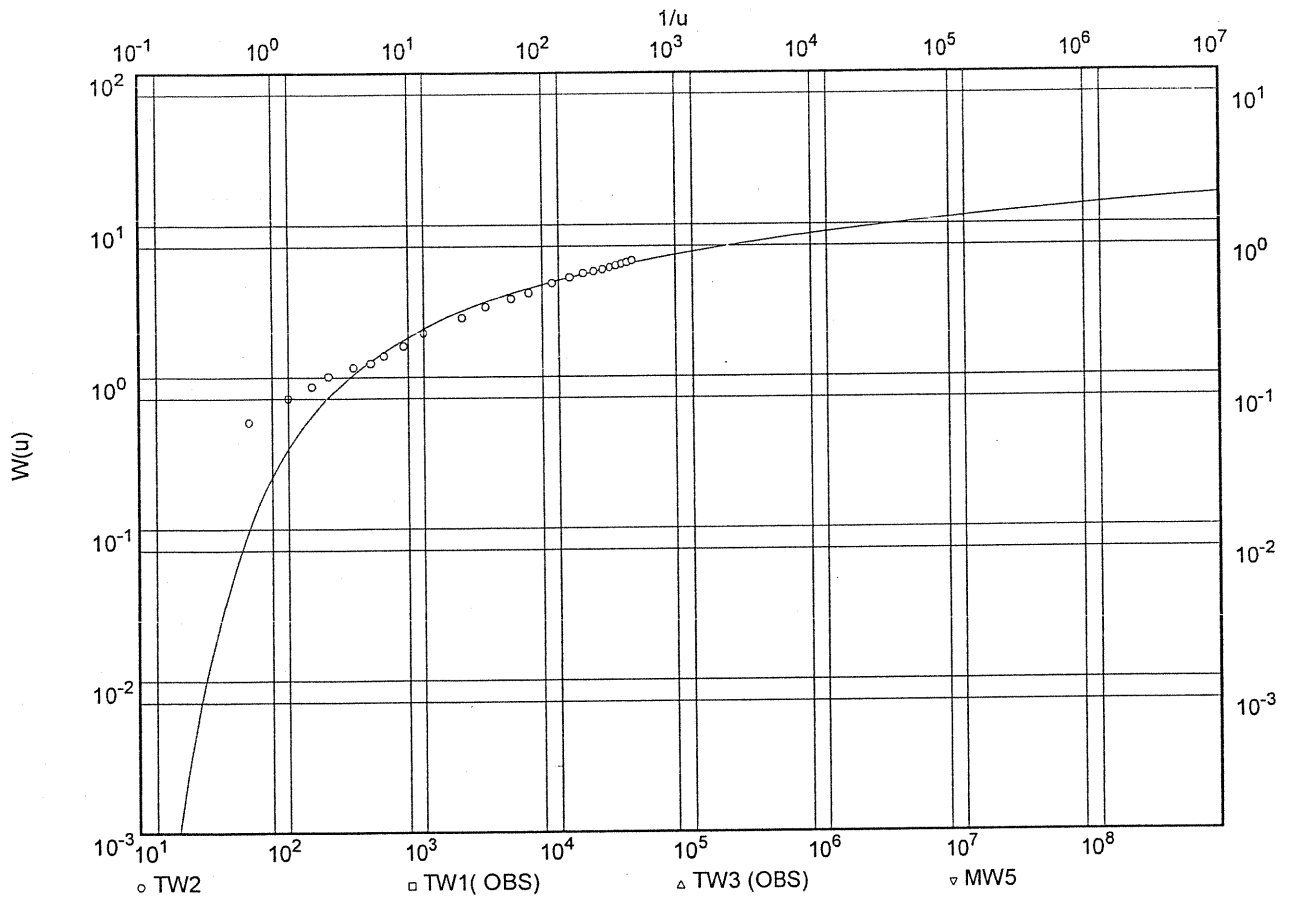


Pumping Test No. 2

Test conducted on: June 27, 2005

TW2

Discharge 1.40 l/s



Transmissivity [ $m^2/min$ ]:  $4.83 \times 10^{-2}$

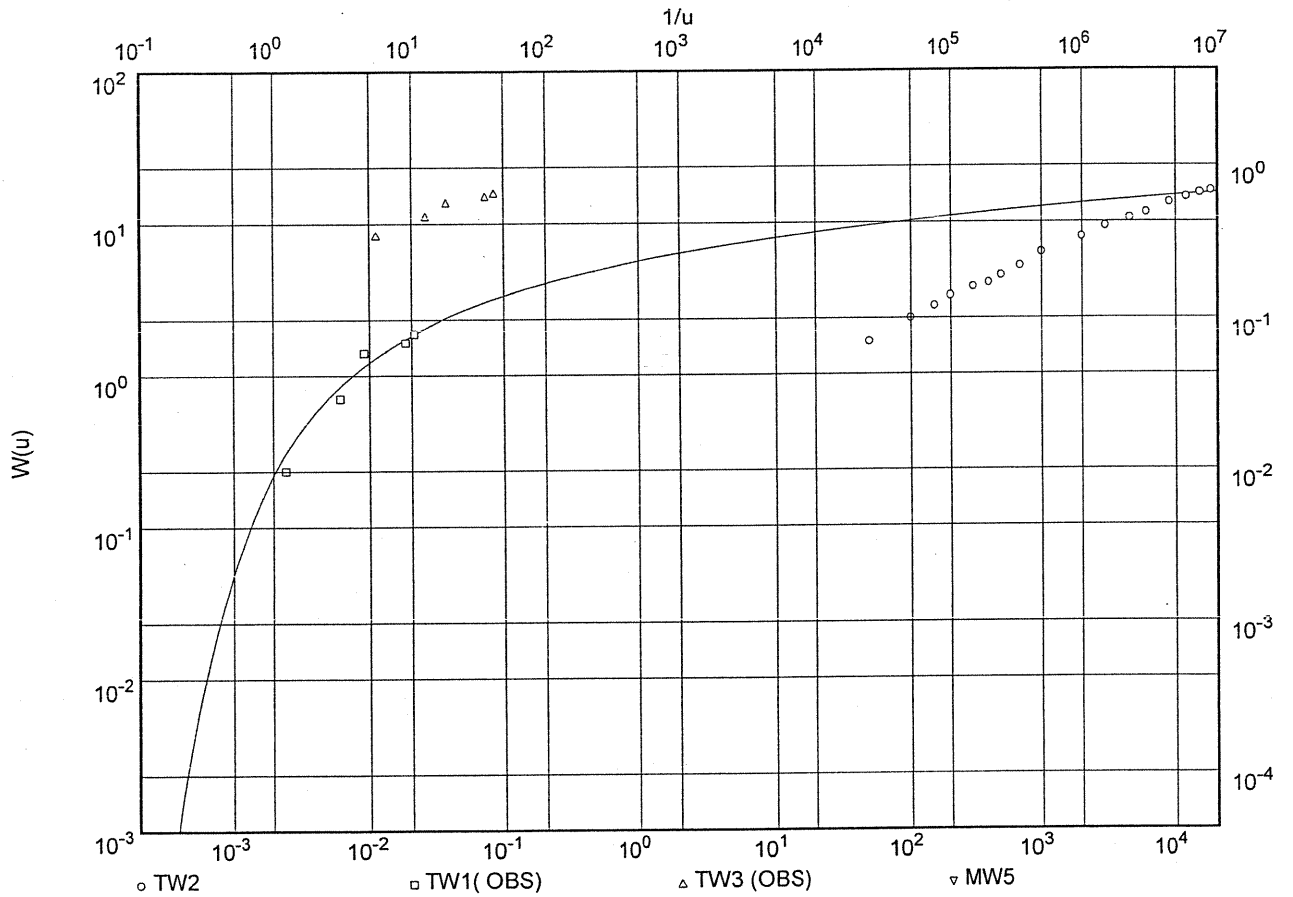
Storativity:  $1.45 \times 10^1$

Pumping Test No. 2

Test conducted on: June 27, 2005

TW2

Discharge 1.40 l/s



Transmissivity [ $m^2/min$ ]:  $1.56 \times 10^{-1}$

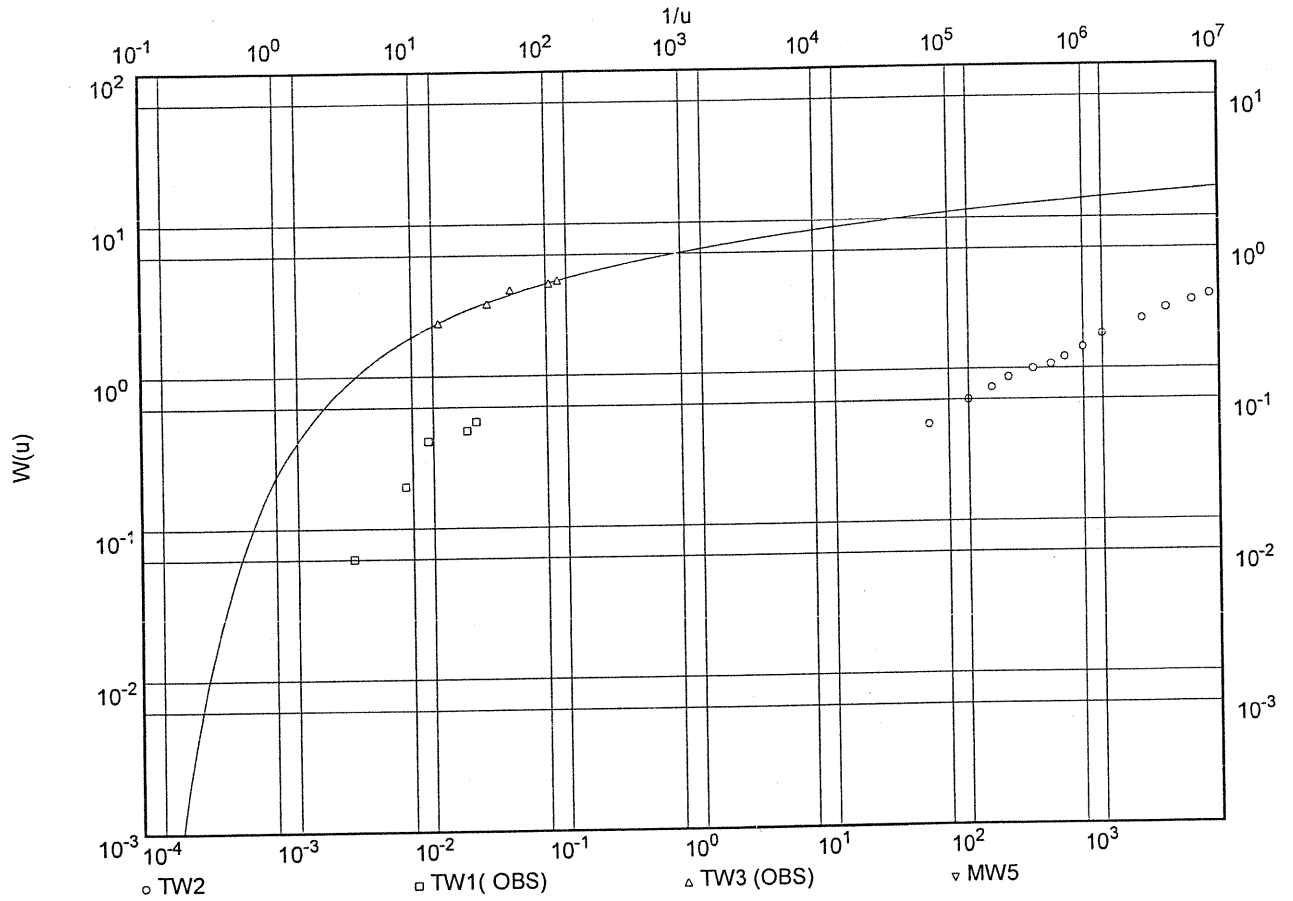
Storativity:  $1.25 \times 10^{-3}$

Pumping Test No. 2

Test conducted on: June 27, 2005

TW2

Discharge 1.40 l/s



Transmissivity [ $m^2/min$ ]:  $4.16 \times 10^{-2}$

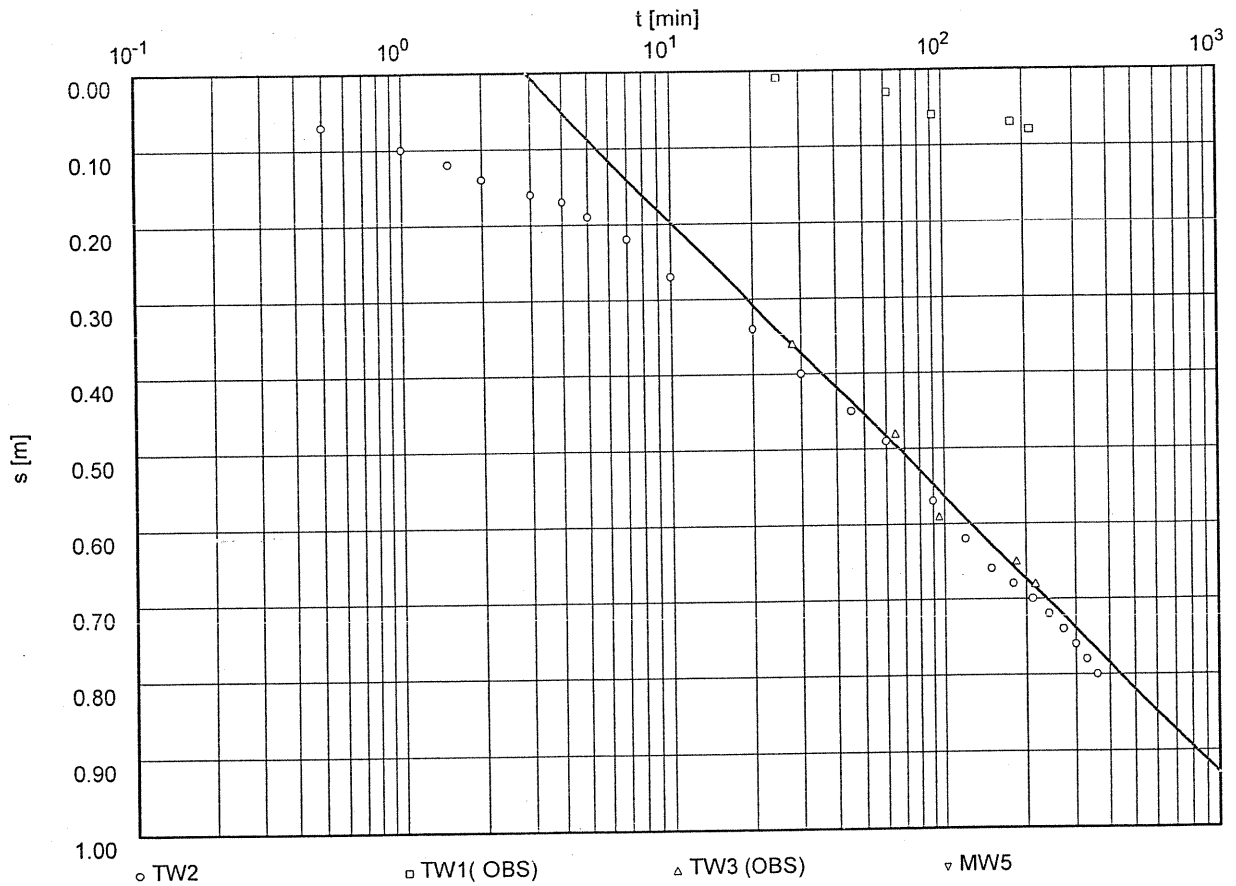
Storativity:  $1.16 \times 10^{-4}$

Pumping Test No. 2

Test conducted on: June 27, 2005

TW2

Discharge 1.40 l/s



Transmissivity [ $m^2/min$ ]:  $4.19 \times 10^{-2}$

Storativity:  $1.09 \times 10^{-4}$

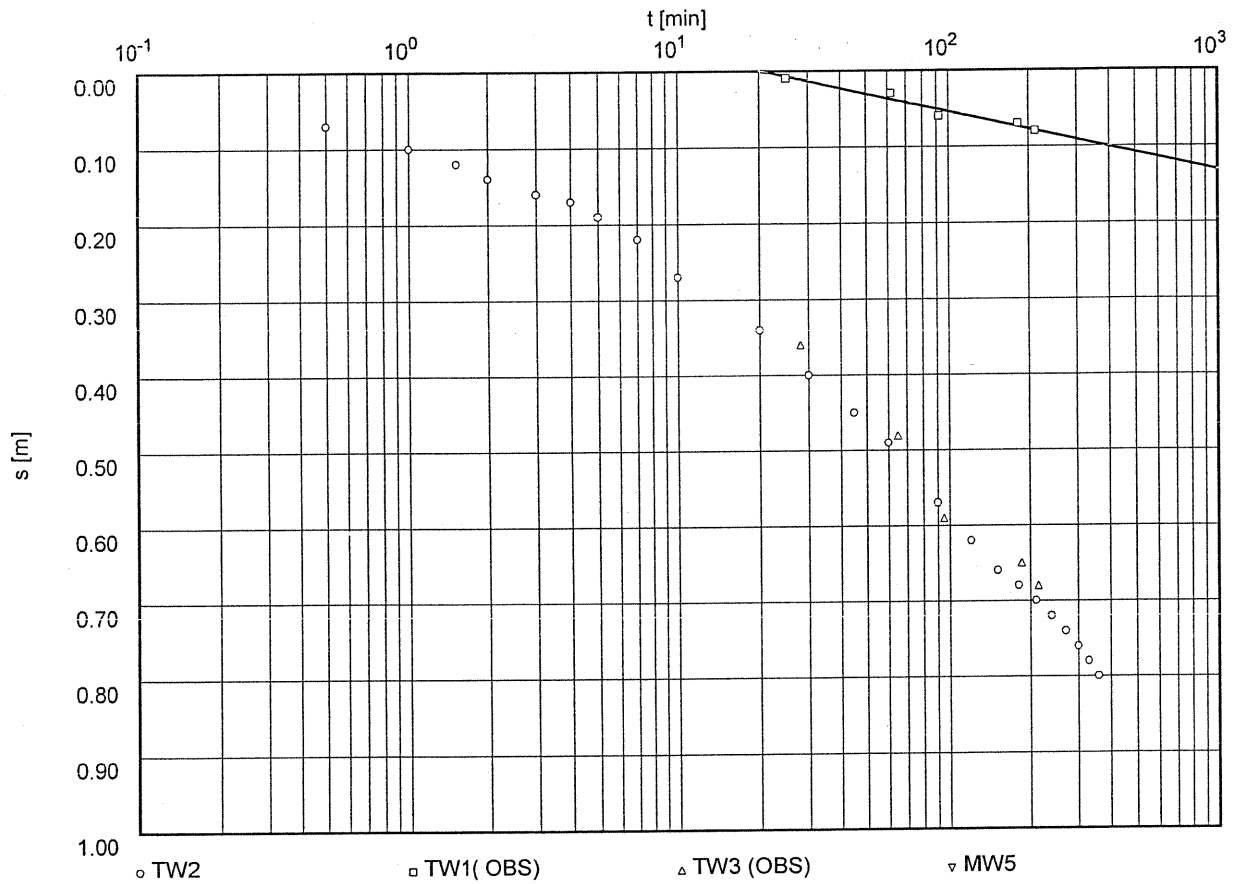


Pumping Test No. 2

Test conducted on: June 27, 2005

TW2

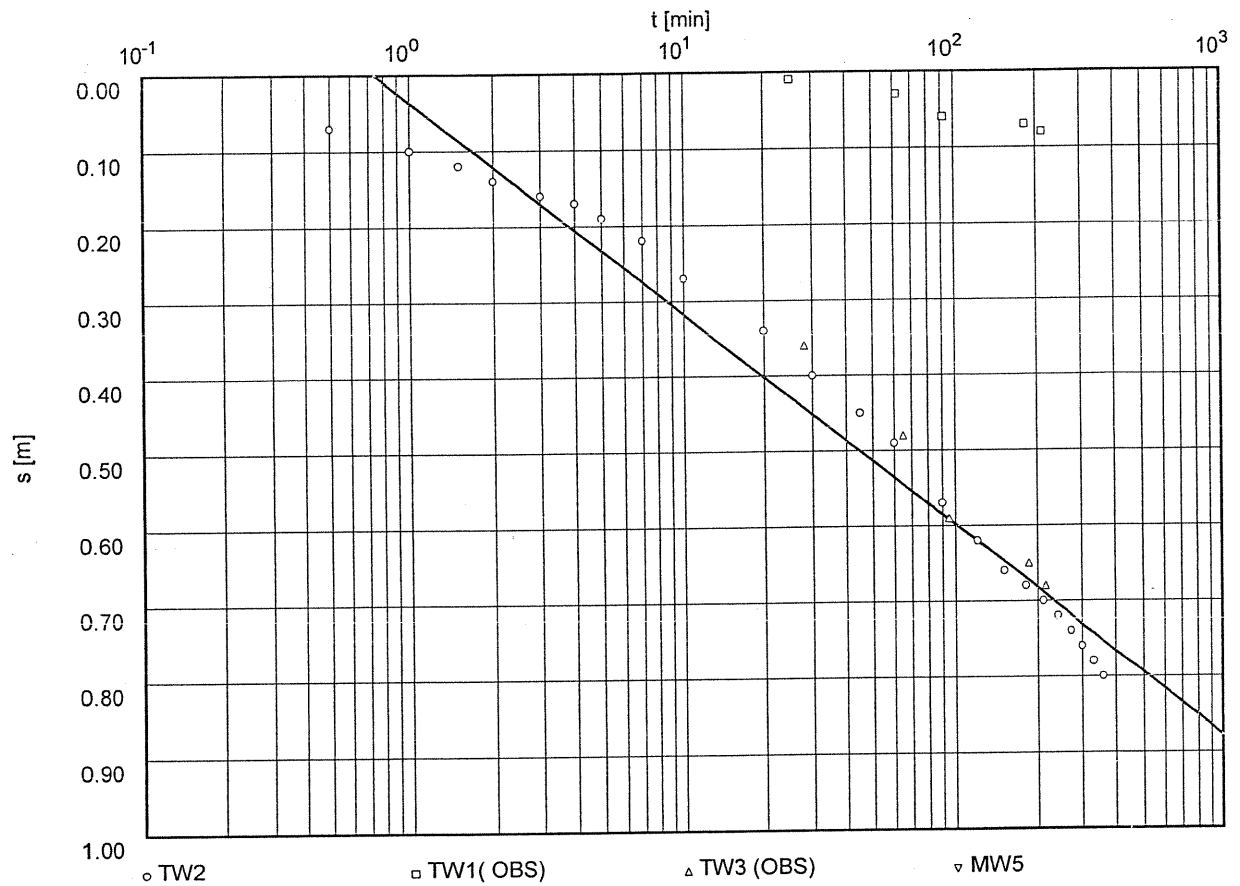
Discharge 1.40 l/s



Transmissivity [ $m^2/min$ ]:  $1.98 \times 10^{-1}$

Storativity:  $8.96 \times 10^{-4}$

<b>Paterson Group Ltd.</b> 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown-method after <b>COOPER &amp; JACOB</b> Confined aquifer	Date: 25.07.2005	none, Page 1
		Project: Sunset Lakes	
		Evaluated by: RAP	
Pumping Test No. 2		Test conducted on: June 27, 2005	
TW2			
Discharge 1.40 l/s			



Transmissivity [m<sup>2</sup>/min]:  $5.47 \times 10^{-2}$

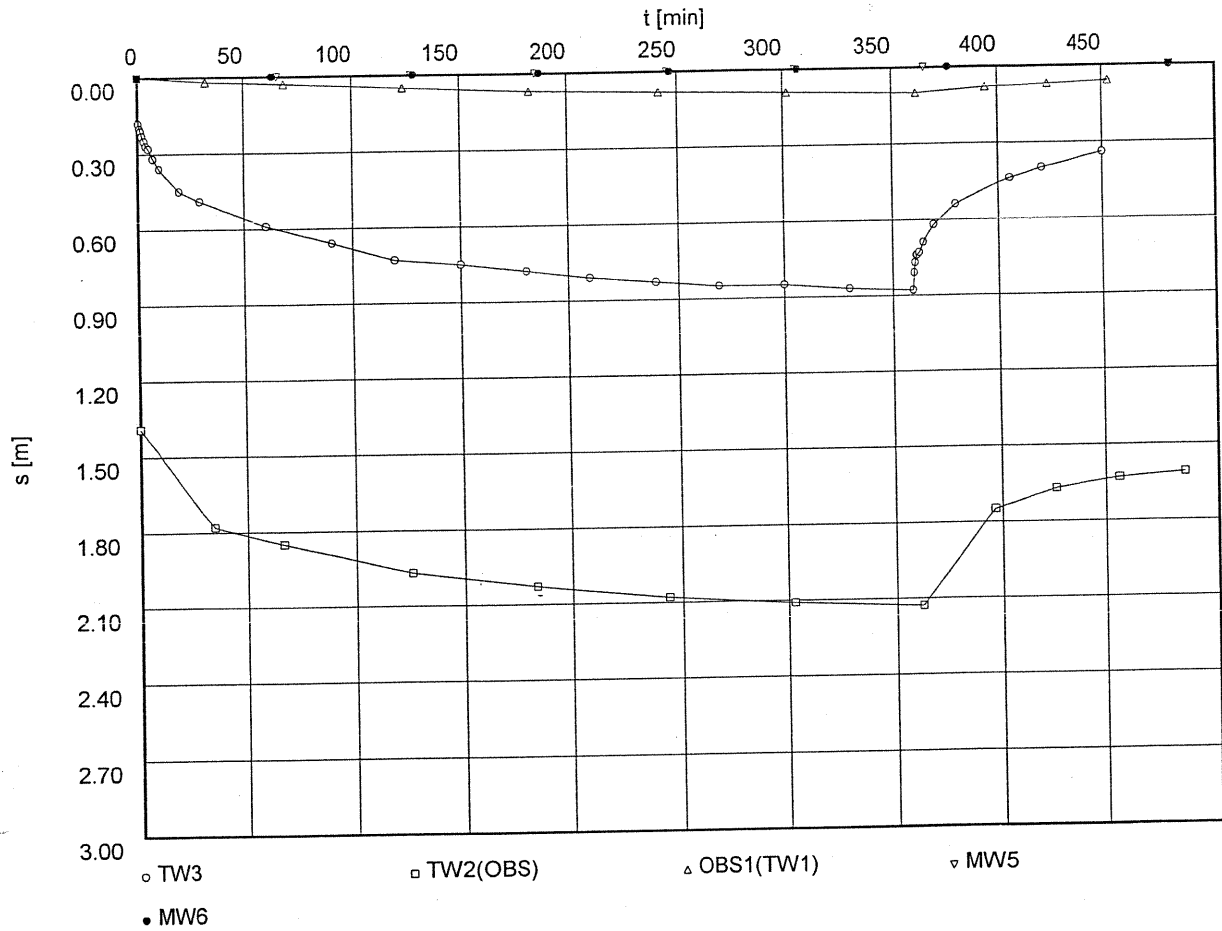
Storativity:  $9.11 \times 10^0$

Pumping Test No. 3

Test conducted on: June 28, 2005

TW 3

Discharge 1.68 l/s















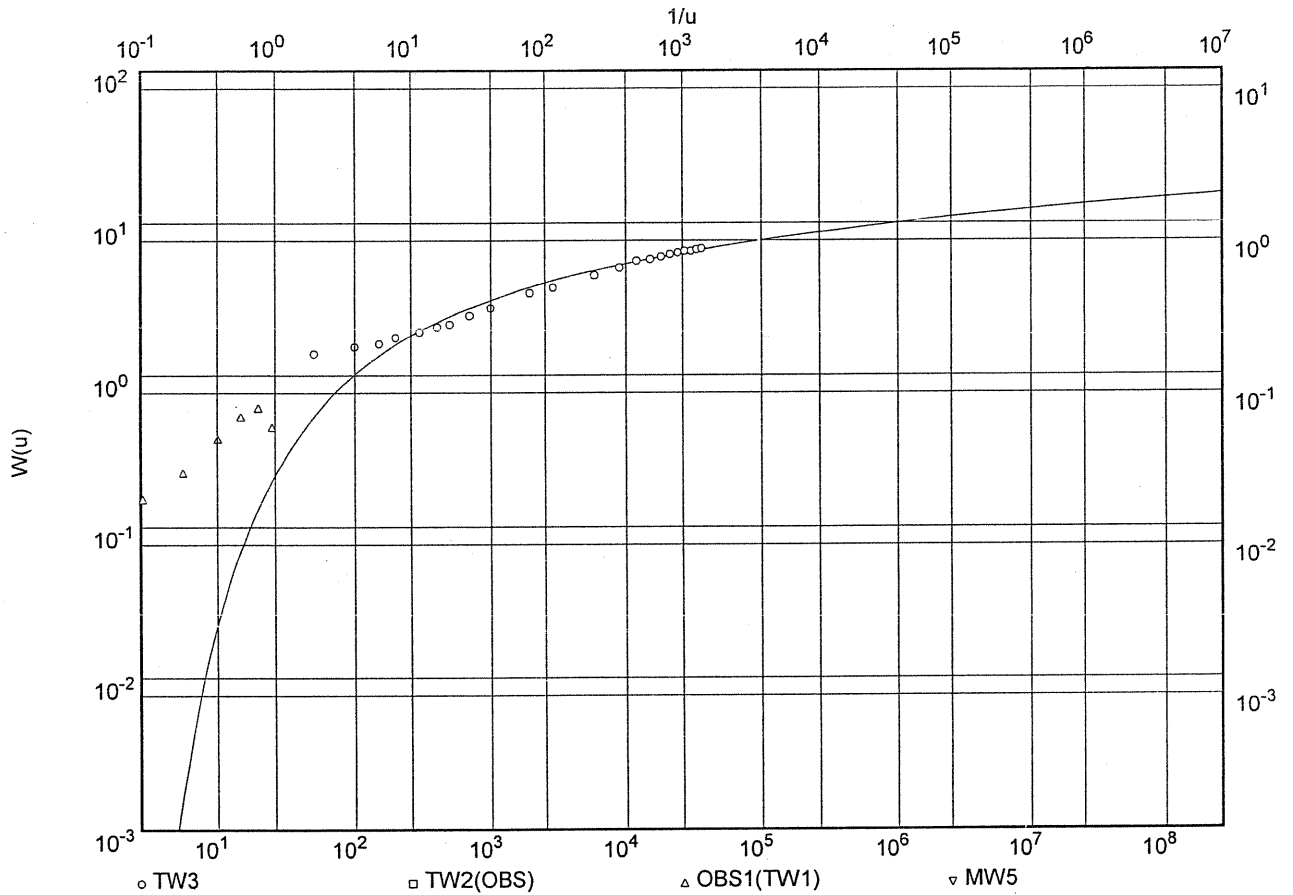


Pumping Test No. 3

Test conducted on: June 28, 2005

TW 3

Discharge 1.68 l/s



Transmissivity [ $m^2/min$ ]:  $6.13 \times 10^{-2}$

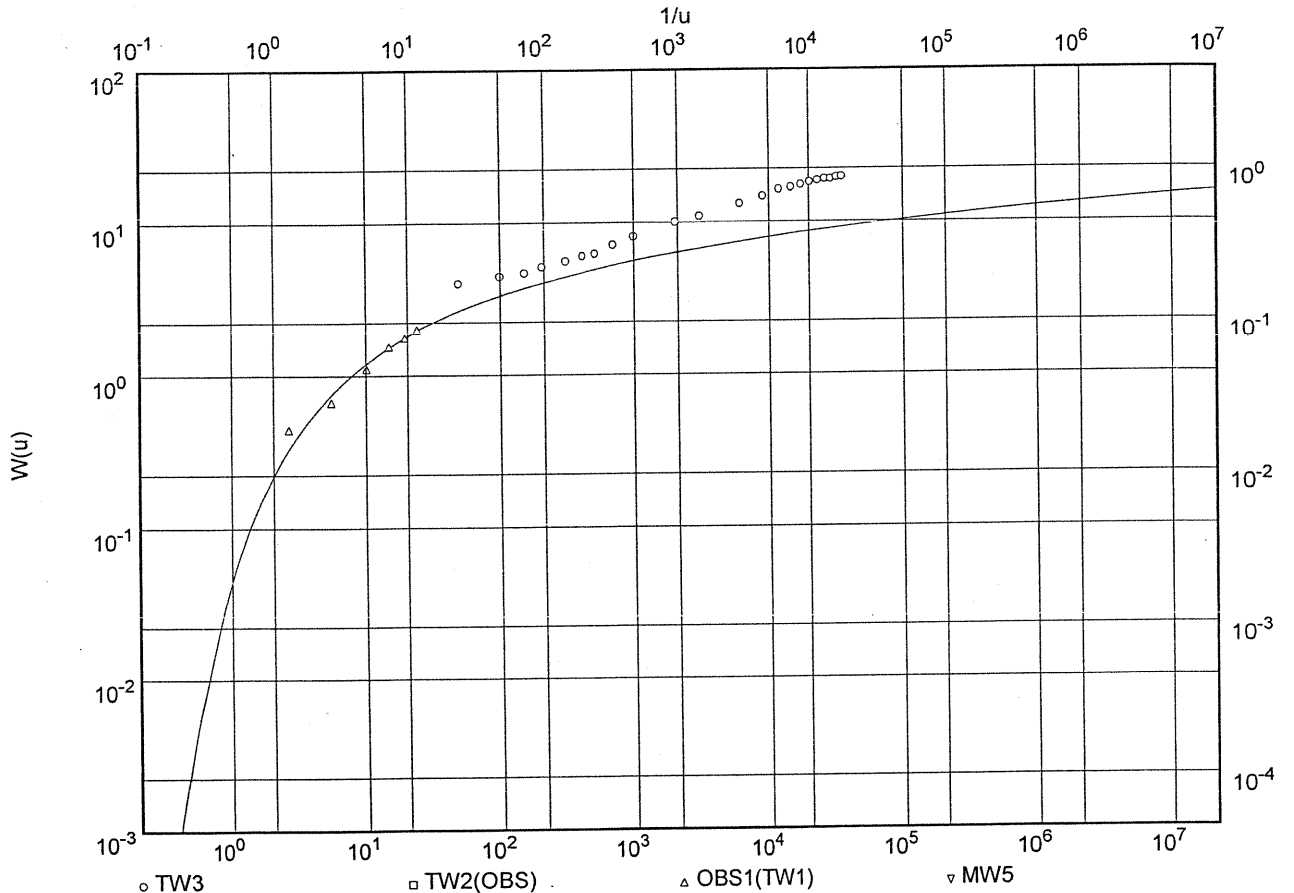
Storativity:  $6.35 \times 10^0$

Pumping Test No. 3

Test conducted on: June 28, 2005

TW 3

Discharge 1.68 l/s



Transmissivity [ $m^2/min$ ]:  $1.78 \times 10^{-1}$

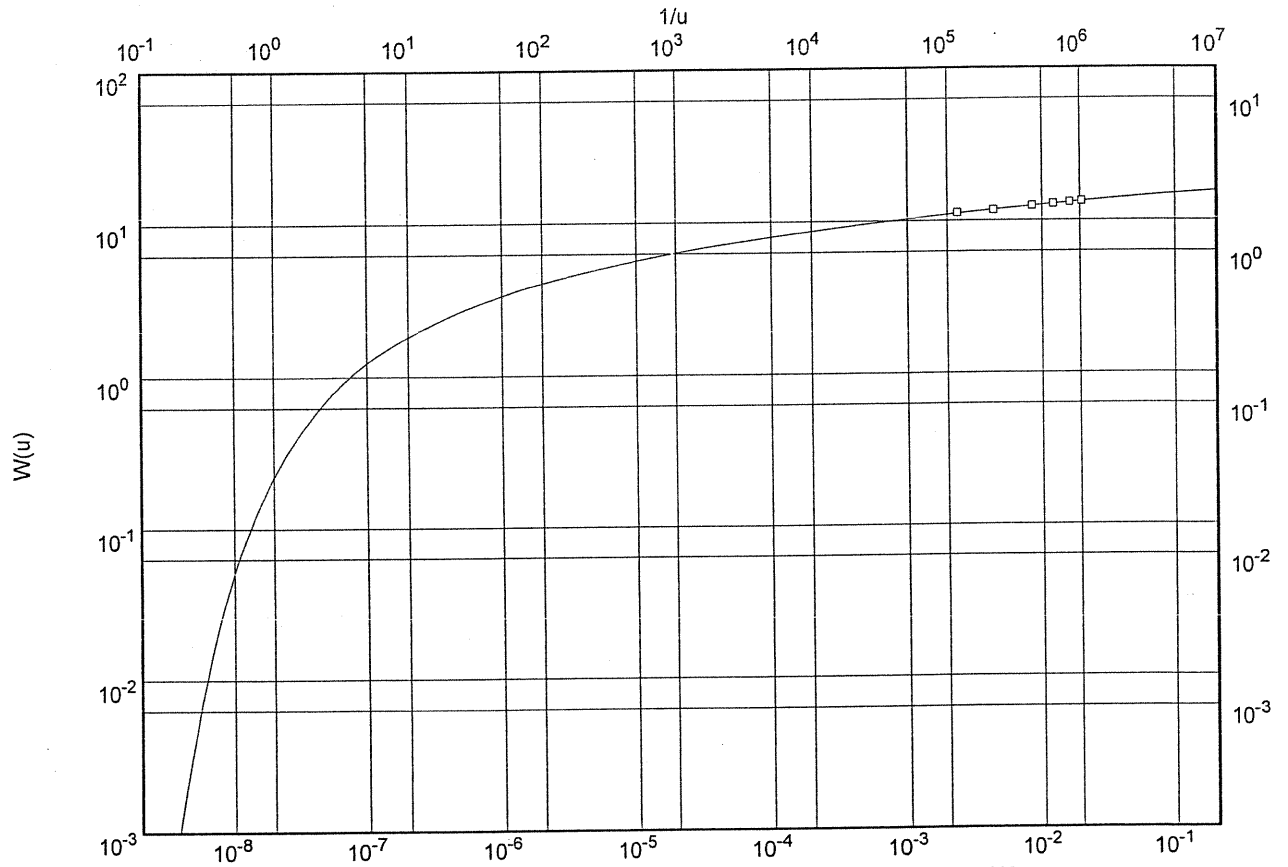
Storativity:  $1.47 \times 10^0$

Pumping Test No. 3

Test conducted on: June 28, 2005

TW 3

Discharge 1.68 l/s



○ TW3                      □ TW2(OBS)                      △ OBS1(TW1)                      ▽ MW5

● MW6

Transmissivity [m<sup>2</sup>/min]:  $5.04 \times 10^{-2}$

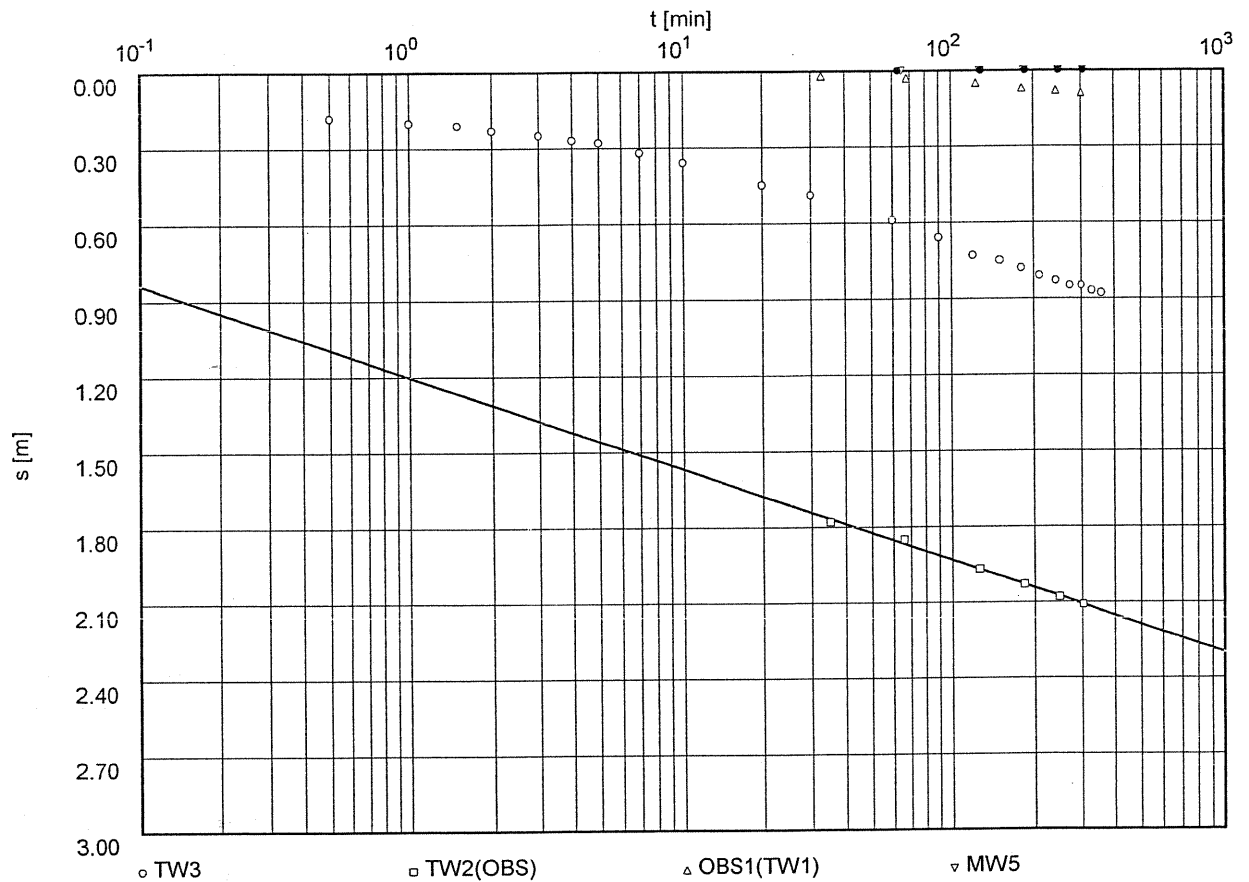
Storativity:  $3.98 \times 10^{-9}$

Pumping Test No. 3

Test conducted on: June 28, 2005

TW 3

Discharge 1.68 l/s



○ TW3

□ TW2(OBS)

△ OBS1(TW1)

▽ MW5

● MW6

Transmissivity [ $m^2/min$ ]:  $5.04 \times 10^{-2}$

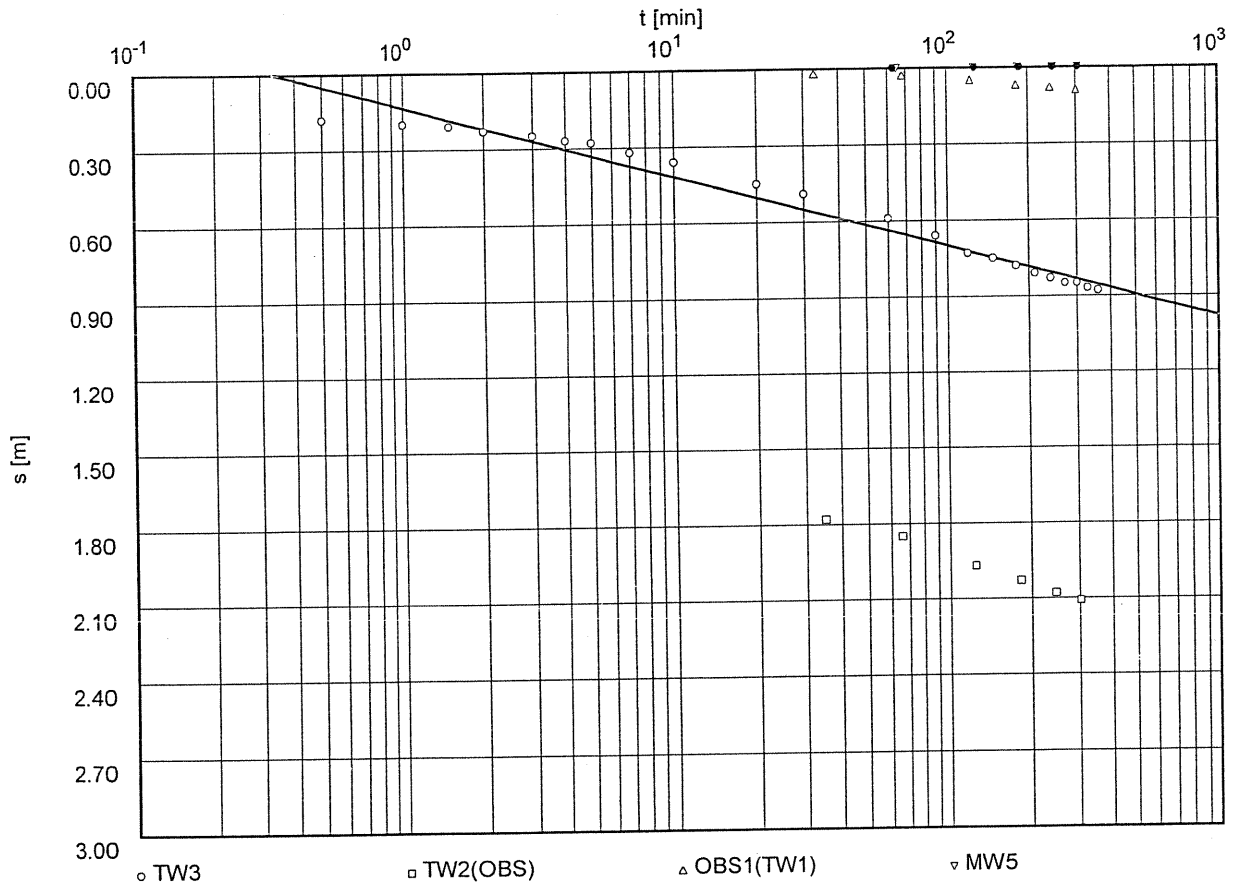
Storativity:  $3.90 \times 10^{-9}$

Pumping Test No. 3

Test conducted on: June 28, 2005

TW 3

Discharge 1.68 l/s



○ TW3      □ TW2(OBS)      △ OBS1(TW1)      ▽ MW5

● MW6

Transmissivity [ $m^2/min$ ]:  $6.55 \times 10^{-2}$

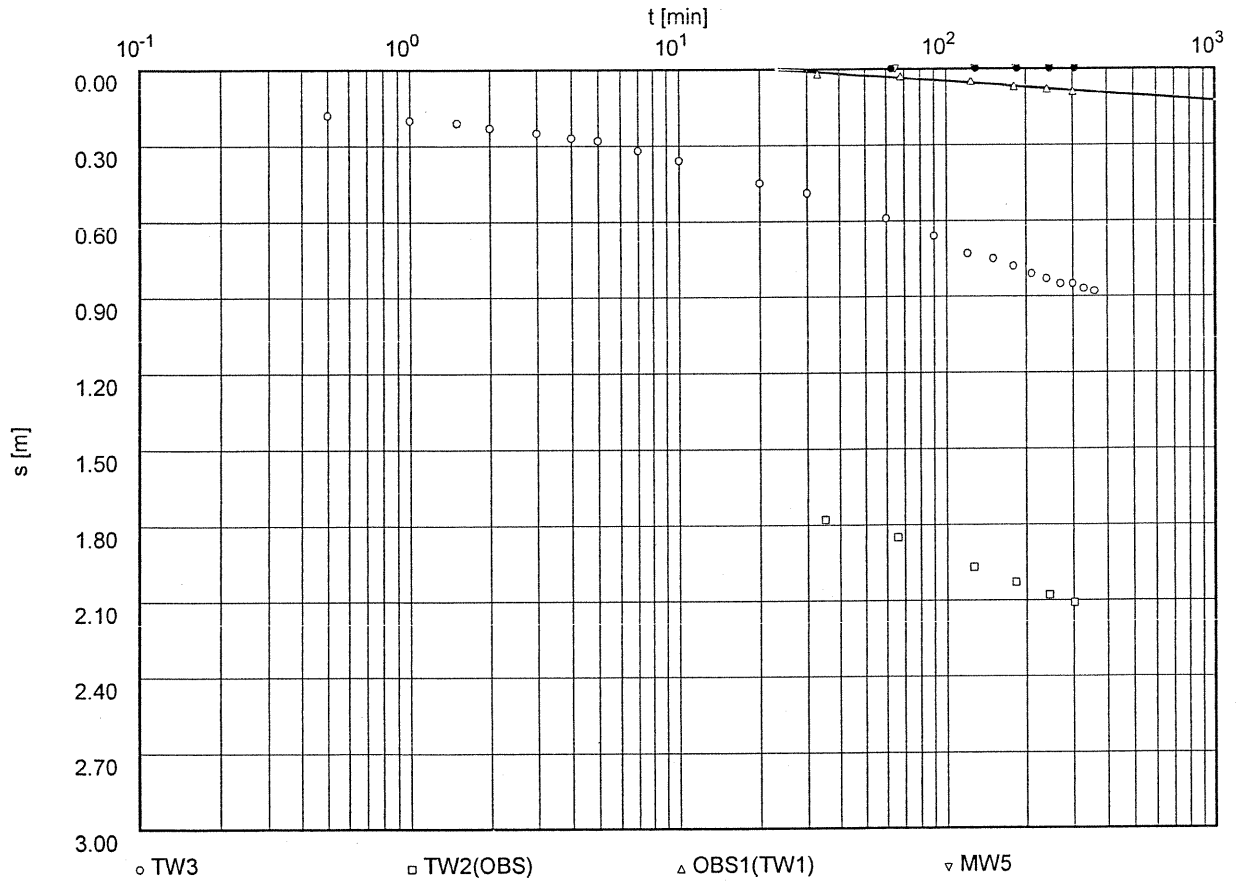
Storativity:  $4.88 \times 10^0$

Pumping Test No. 3

Test conducted on: June 28, 2005

TW 3

Discharge 1.68 l/s



○ TW3      □ TW2(OBS)      △ OBS1(TW1)      ▽ MW5  
 ● MW6

Transmissivity [m<sup>2</sup>/min]: 2.39 x 10<sup>-1</sup>

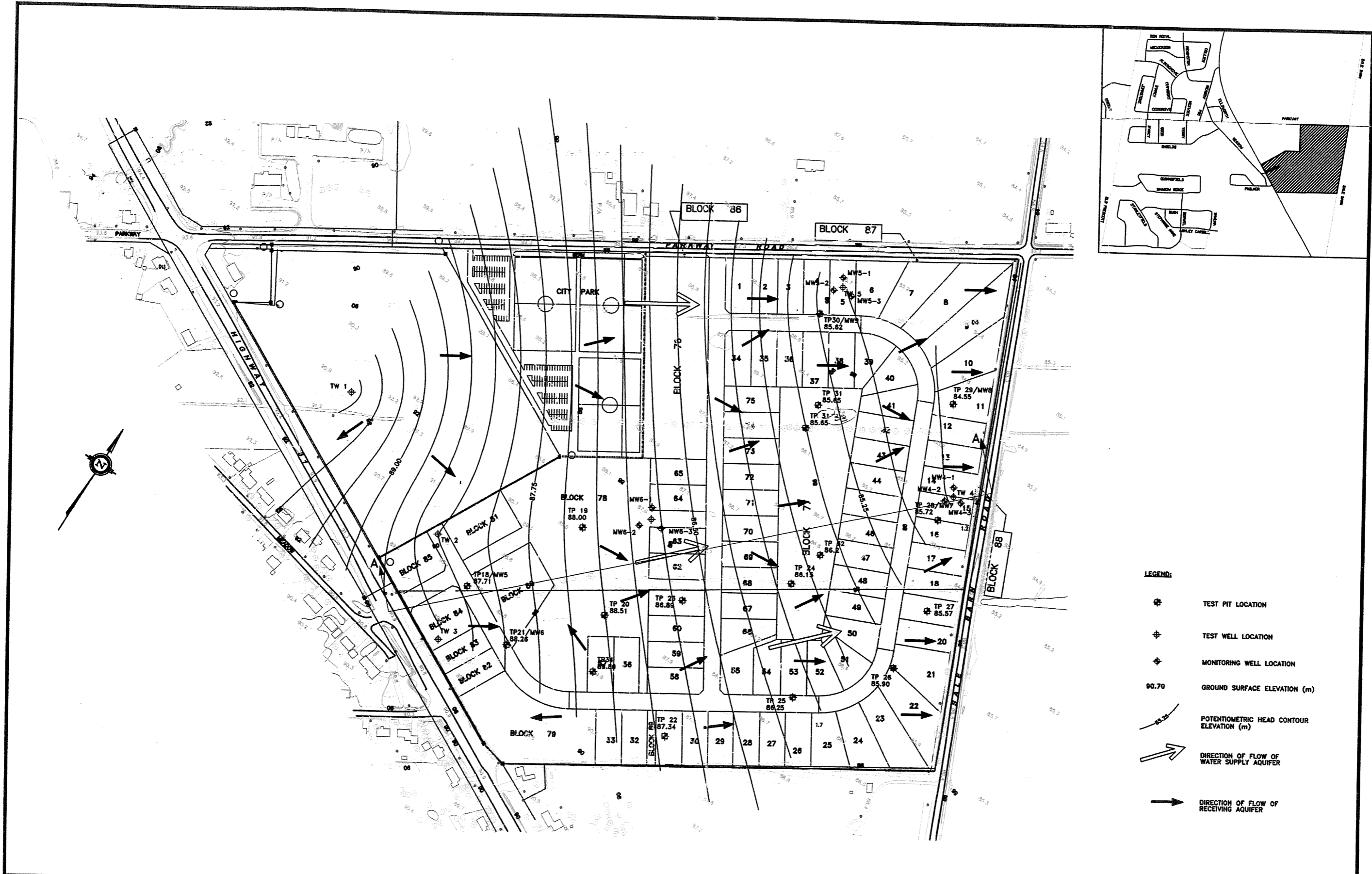
Storativity: 1.00 x 10<sup>0</sup>

## **APPENDIX 5**

### **SUPPORTING DOCUMENTATION REVISED DRAWINGS & SPECIFICATIONS**

1. PH0145-1: TEST HOLE LOCATION PLAN
2. PH0145-2: LOT DEVELOPMENT PLAN
3. PH0145-3: PIEZOMETRIC HEAD DELINATION
4. PH0145-4: STRATIGRAPHIC CROSS SECTION A-A
5. FIGURE 1: LOCATION PLAN OF NEIGHBOURING  
SAMPLING
6. FIGURE 2: GRAPHICAL ANALYSIS OF  
MONITORING WELL DATA





- LEGEND:**
- TEST PIT LOCATION
  - TEST WELL LOCATION
  - MONITORING WELL LOCATION
  - GROUND SURFACE ELEVATION (m)
  - POTENTIOMETRIC HEAD CONTOUR ELEVATION (m)
  - DIRECTION OF FLOW OF WATER SUPPLY AQUIFER
  - DIRECTION OF FLOW OF RECEIVING AQUIFER

NOTE: REFER TO DRAWING NO. PH0145-4 FOR SECTION DETAIL OF CUT LINE A-A

NO.	REVISIONS	DATE	INITIAL
1	OVERBURDEN FLOW DIRECTIONS ADDED	18/06/06	RAP

**patersongroup**  
consulting engineers  
28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

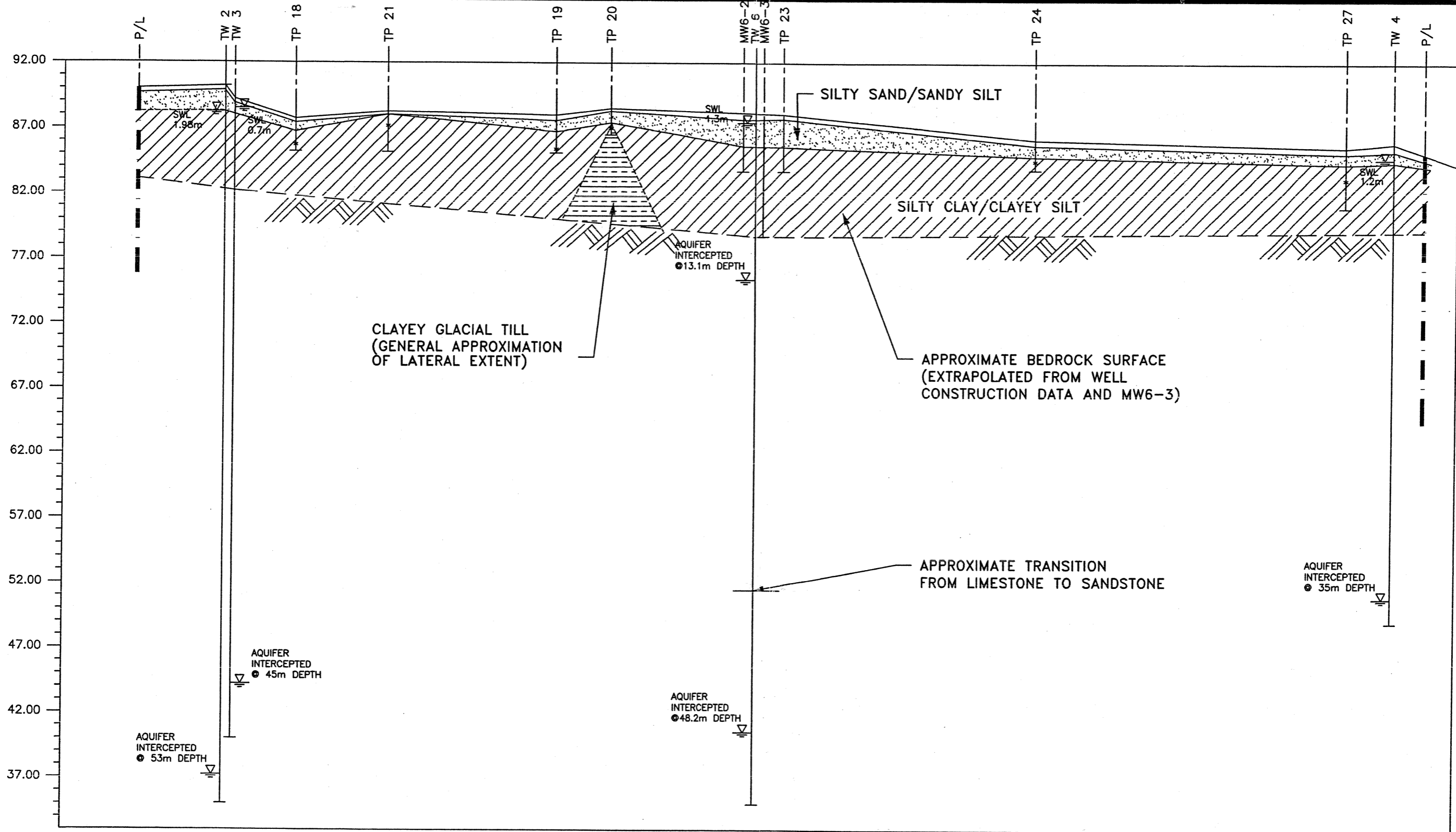
SCALE: 1:2000  
DESIGN: RAP  
DRAWN: MPG  
CHECKED: RAP  
DATE: 09/2005

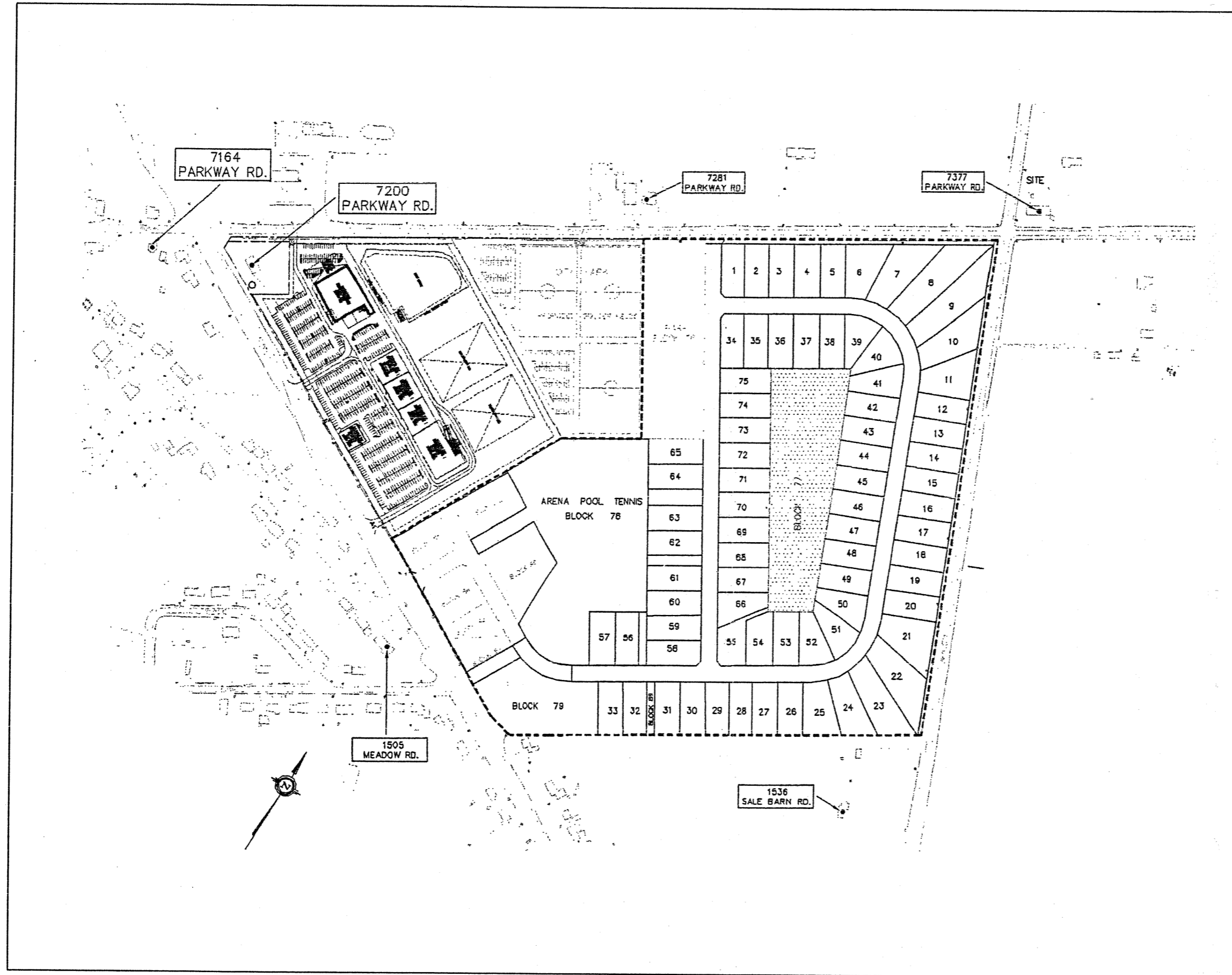
PROPOSED VILLAGE CENTRE SUBDIVISION  
SALE BARN ROAD  
OTTAWA, ONTARIO

DWG. NO. PH0145-3

**SUNSET LAKES DEVELOPMENT CORP.**

**POTENTIOMETRIC HEAD DELINEATION**





**paterson group**  
 consulting engineers  
 28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

Scale: NTS  
 Des.: RAP  
 Dwn: MPG  
 Chkd: RAP

SUNSET LAKES DEVELOPMENT CORP.  
 PROPOSED VILLAGE CENTRE SUBDIVISION  
 SALES BARN ROAD  
 OTTAWA, ONTARIO

LOCATION OF NEIGHBOURING  
 WATER SAMPLE COLLECTION

Dwg. No. **FIGURE 1**  
 Report No.: PH0145-02  
 Date: 06/2006



# patersongroup

September 28, 2006  
Report No. PH0145-03.Let

**South Nation River Conservation Authority**  
15 Union Street  
Berwick, Ontario  
K0C 1G0

Attention: **Ms. Jennifer L. Boyer**  
**Environmental Planner**

Subject: **Response to Conservation Partners Comments of August 3<sup>rd</sup>, 2006**  
**Greely Centre Subdivision**  
**Sunset Lakes Development Corporation**

## Consulting Engineers

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Geological Engineering  
Materials Testing  
Building Science

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Dear Sir:

In response to the comments provided to by the Conservation Partners, we offer the following comments. It is understood by your response that the previous comments have been addressed, and the more recent comments are as a result of the subsequent addendum submitted by this firm.

The Conservation Partners identify the water as not being potable, which in itself states that the water is unsafe for consumption. This is not scientifically valid, in that this comment is being made on the basis of an exceedance of an aesthetic parameter. By definition, **potable is defined as water that is safe for human consumption**. Our studies indicate that the water is safe in this regard, and that the chemical parameters are within the Ontario Drinking Water Objectives for health related parameters. Also, by definition, **aesthetic objectives apply to the characteristics of drinking water that can affect consumer acceptance (i.e. - appearance and palatability), and can vary from person to person**. For instance, some people find the City of Ottawa municipal water supply to be offensive, and provide treatment of the water, yet that does not mean that the municipal water supply is unsafe. Furthermore, the aesthetic objective for sodium in Saskatchewan is 300 mg/L compared to 200 mg/L in Ontario, which in itself would suggest that there is no hard and fast limit at which sodium is unacceptable.. It is simply a matter of personal choice, and the sodium exceedences for this development are simply aesthetic and do not pose a health risk. It is important that the Conservation Partners separate a Maximum Allowable Concentration (MAC) from an Aesthetic Objective (AO), which is the intent of the standards.

### **Section 2.2.1**

With respect to the issue of watercourses or wetlands on the site, accept this as confirmation that the site is free of these features. However, there is a ditch immediately adjacent to, and downgradient of the site along Sale Barn Road, and whether or not this is indeed considered a watercourse is debatable, in that it only serves to control stormwater, and does not contain water year round. This is typical of the rural environment where ditches always exist along significant roadways. We do not believe that it is the intent of the guidelines to consider a ditch to be a watercourse.

In any event, all septic systems in this development are located at least 30 metres from this ditch, which provides a more than adequate buffer for in-ground treatment of effluent, and ensures that effluent does not discharge directly into the ditch. In that there is no discharge of effluent into the ditch, there is no need for phosphorus impact modeling.

Based on our review of available MOE Water Well Records, we are not aware of any shallow overburden wells within 500 metres downgradient of the site. Comments regarding the ditch being a hydraulic barrier are based on the fact that the base of the ditch terminates in clay soils, and any subsurface drainage within the strata above the clay is perched, and would be intercepted by the Sale Barn Road ditch. This situation is quite common throughout the Greely area, where typically coarser grained soils overly silt/clay soils that serve as an aquitard. Given the above, even if shallow overburden wells did exist downgradient, the deep ditch along Sale Barn Road provides the necessary protection.

### **Section 2.2.4**

The designation of off-site groundwater recharge studies can only be determined through large scale regional groundwater studies, which would involve extensive field investigations on private lands that are not owned by the proponent. In the studies produced by the City of Ottawa to date, we are not aware of these studies identifying significant recharge areas that would specifically impact the proposed development. Also, we are not aware of any Permit to Take Water Permits that would impact the proposed development. If indeed there is information to suggest otherwise, it would be a little more pro-active on the part of the Conservation Partners to identify the specific risks so that the specifics can be constructively dealt with.

### **Section 2.2.5**

The purpose of the hydrogeological study is not to conduct research into the variability and precision of various test methods, but rather to use accepted procedures for analysis, and to take that data to arrive at a professional opinion. In your comments, you provide an "opinion that grain size analyses and hydraulic conductive (?) should have been supplemented by in-situ permeability tests." What is the rationale for this? This is a new concept being thrown out by the Conservation Partners, and we would caution that the new draft City of Ottawa guidelines have not been adopted, and the Conservation Partners should not be conducting the review based on the proposed guidelines.

In a recent Ontario Municipal Board Decision for the South Village / Woodstream subdivisions in Greely, the City's expert testified that isolation could be proven by laboratory grain size testing or pump testing of the water supply wells with overburden monitoring (but not both), and was accepted by all of the experts. For this project, we have done both, and it is our opinion that in situ hydraulic testing is not required, nor would it change the conclusions, based on the testing that has been completed to date. With respect to the estimate of time for the effluent to reach the top of the bedrock layer, the entire overburden soil layer was considered, so that no additional analyses are required.

### **Section 2.2.6**

To date, the Conservation Partners have never defined the acceptable criteria for thicknesses of an overburden isolating layer. As part of this study, a series of test holes was put down to delineate the stratigraphy, and a clay layer was delineated. In situ testing confirmed that isolation existed. As a rule of thumb, from an engineering perspective, for surficial structures that could impact the groundwater aquifer, (i.e. stormwater ponds, sewage lagoons, etc.), the use of a clay liner is the most common means of providing the necessary protection. Typically, 450 to 600 mm of clay is specified in this regard (where there is a significant potential for contamination), and that would be more than acceptable in the natural environment. In addition, the RVCA Ottawa Septics Approvals Office typically recommends 100 mm of clay seal over fractured bedrock be used immediately below septic systems to prevent sewage migration directly into fractured bedrock. Based on my review of all the test pit logs, laboratory analyses, site data and knowledge of the area, it is my opinion that a more than adequate thickness of low permeability exists across the site to protect the drinking water supply.

The clarification of the Sale Barn Road ditch acting as a hydraulic barrier is provided in 2.2.1 above.

### **Section 2.2.7**

To provide clarification with respect to the numbering of the figures, we hereby confirm that Figure 2 is indeed the item pertaining the reference of Figure A-1-1 in the report. This matter was previously clarified in response to Mr. Rizvi's email request for clarification of July 18, 2006. The purpose of that graph was to demonstrate that natural fluctuations exist prior to and during the pumping process. To assist you in your interpretation, Table 2.1.10.1 is a summary of observations during pumping. The maximum fluctuation of 4 cm occurred in MW6-2 during the pumping of where the water level rose 4 cm. (For clarification, a -0.04m drawdown indicates a rise in the water level). The observed maximum drawdown at any single point was no greater than 1 cm, which is well within the natural variations that occurred when no pumping was taking place. The fact that increases in the water level occurred (as opposed to drawdown) is a clear indication that there is no interconnection of the two aquifers.

### **Section 2.2.13**

We acknowledge your acceptance that the site has not been impacted by the use of herbicides.

With respect to the JWEL comments, it could be surmised that they saw fit that a single sample would suffice for the entire village of Greely as part of their study, in that no further testing was conducted.

### **Section 2.2.15**

The Conservation Partners are quite familiar with the nature of the content for performance reports, that are submitted prior to the releasing of additional phases. The RVCA has been very inconsistent over the last couple of years in what the requirements are, and for the record there are no established criteria in this regard, other than previous guidelines being provided by the MOE for development in the Greely area, which we have referred to in the Addendum report, which recommends a 20% buildout. If the RVCA has technical evidence to support any defined number, we would request that we be copied with these studies. We are reluctant to rely solely upon RVCA's opinion.



We will point out that both Mr. Rizvi and myself gave evidence under oath on phased buildouts in December of 2005, before an arbitration panel of three lawyers, including a retired judge. In the written decision, Mr. Rizvi's evidence was not accepted, and the evidence of Mr. Walker was unanimously accepted in this regard. I believe that you can derive some comfort from a professional perspective and now one that has been judicially accepted that the professional opinion on what is required for a phased release is acceptable. The recommendations made by this firm under similar hydrogeological conditions are consistent with what is normally considered acceptable in the Ottawa area.

### **Summary**

The Conservation Partners comments go on to discuss the City of Ottawa Official Plan, and the Provincial Policy Statement. From our studies, it is evident that the water in the residential portion of the site meets both the aesthetic and health related objectives, and in the business park portion, the health related objectives are met. As discussed earlier, the definition of an aesthetic objective(AO) can vary from person to person, and based on further investigation, the provincial objectives for aesthetics can also significantly vary. For example, the AO in Ontario for sodium is 200 mg/L, and in Saskatchewan, the AO is 300 mg/L, which is 50% higher. This is a clear indication that aesthetic objectives represent nothing more than a threshold at which an individual may find the water unpleasing. It is not suggested that people in Saskatchewan may have a higher tolerance, rather that these aesthetic guidelines are subjective. It should also be noted that throughout the City of Ottawa, people may find the municipal water supply to be offensive, and choose to treat the water with in-house water treatment systems. This is in no way an indication that the water is unsafe to drink. This is emphasized on the City of Ottawa web site where it speaks to problems that could occur with appearance, taste and odour, and assures residents that this is not a health concern. It also goes on to recommend the use of treatment (carbon filters) for dealing with offensive taste and odour issues. The concept of treatment for sodium (or any other parameter) on the Greely Village site would be merely a personal choice.

Please find attached information on portable (and inexpensive) reverse osmosis systems that are readily available, along with the applicable contamination rejection rates for the same equipment. In addition, we have attached the Saskatchewan aesthetic objectives for water quality.

**Ms. Jennifer L. Boyer**  
**September 28, 2006**  
**Page 6**

It should also be noted that we do not see the relevance of your comments regarding Small Water and Wastewater Works, in that such systems have not been proposed for this project.

We trust this addresses the comments contained in your letter of August 3, 2006. If you have any questions, please call.

Sincerely,  
Paterson Group Inc.

A handwritten signature in black ink, appearing to read "Stephen J. Walker". The signature is fluid and cursive, written over a light background.

Stephen J. Walker, P.Eng.

cc: City of Ottawa (Charles Warnock)  
Rideau Valley Conservation Authority (Asher Rizvi)  
Sunset Lakes Development Corporation (Dan Anderson)

Geotechnical  
Engineering

Environmental  
Engineering

Hydrogeology

Geological  
Engineering

Materials Testing

Building Science

## Supplemental Hydrogeological Assessment

Greely Village Centre Subdivision  
Part of Lot 73 and Part of Lot 74,  
Registrar's Compiled Plan 902  
Ottawa (Osgoode), Ontario

Prepared For

Sunset Lakes  
Development Corporation

February 28, 2007

Report No. PH0145-REP.05

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## APPENDICES

- Appendix 1 Ontario Ministry of the Environment Water Well Records for Test Wells
- Appendix 2 Laboratory Test Data for Water Quality Analysis
- Appendix 3 Aquifer Analysis Data for Additional Test Wells
- Appendix 4 Revised Lot Development Plan

## **1.0 INTRODUCTION**

This report summarizes the supplemental hydrogeological assessment undertaken by this firm for the proposed development, referred to hereafter as Greely Village Centre, and located on the property forming Part of Lot 73 and Part of Lot 74, Concession 5, former Township of Osgoode, now in the City of Ottawa, Ontario (subject property).

Specifically, the purpose of these works is to present, to the Ontario Municipal Board Chair, water quantity and quality data obtained from a deeper bedrock aquifer present beneath the subject property in order to demonstrate the aquifer is a viable water supply aquifer for the proposed Greely Village Centre development.

### **1.1 Background**

Paterson Group Inc. (Paterson) produced a Terrain Analysis and Hydrogeological Study (Report No. PH0145-REP.01) in September 2005. Two additional addendum reports, entitled Addendum No. 1 and Addendum No.2 were prepared by Paterson in June 2006 and December 2006, respectively. Both addendum reports addressed relevant outstanding issues related to the technical review of the original report.

During the execution of a portion of the additional fieldwork in preparation of Addendum No.2, carried out to address issues related to the investigation of the presence of a deeper potential water supply aquifer located beneath the subject site, a deep well (TW7) was constructed at the site. This well encountered an aquifer located in the Nepean Sandstone formation, several metres below the base of the overlying limestone. Analysis of the pumping test and water quality data for TW7 concluded that the sandstone aquifer has excellent water quality and quantity characteristics making it a potential water supply aquifer for the development.

As part of this Supplemental Hydrogeological Assessment, Paterson undertook additional fieldwork, under the authorization of Sunset Lakes Development Corporation (Sunset Lakes), in order to assess the certainty of intercepting the sandstone aquifer at all points throughout the subject site.

### **1.2 Methodology**

In order to demonstrate that future wells can adequately intercept and utilize the sandstone aquifer, an additional four (4) wells were constructed at locations such that the five (5) wells into the sandstone layer would be distributed throughout the site. The locations of these additional

test wells, denoted hereafter as TW8, TW9, TW10 and TW11, are shown on Drawing No. PH0145-1, REV. 3.

Each well was developed for a period of one (1) hour after completion of construction of the well and in advance of the pumping tests. Each well was pumping tested for a period of at least six (6) hours at a constant rate and raw water samples were recovered at three (3) hour and six (6) hour milestones. In addition, field measurements of temperature, pH, Total Dissolved Solids (TDS), turbidity and free chlorine residual were recorded for each test well during the pumping test.

Aquifer analysis was performed on the pumping test data obtained from the pumping of each test well using Aquifer Test for Windows v. 2.57, by Waterloo Hydrogeologic Inc. Transmissivity and storativity values for the aquifer were obtained using the Theis and Cooper-Jacobs methods for aquifer analysis.

## **2.0 ADDITIONAL TEST WELL CONSTRUCTION**

### **2.1 General Discussion of Test Well Construction**

The general construction of TW8, TW9, TW10 and TW11 was closely modelled after the construction of TW7. The construction of the additional test wells took place between February 1, 2007 and February 7, 2007 and the locations of the wells are shown on the appended Test Hole Location Plan, Drawing No. PH0145-1, REV.3. The Ministry of the Environment (MOE) Water Well Records are provided in Appendix 2.

The following are the relevant observations of the general construction of each test well:

1. A 300 mm diameter tricone bit was used to advance a working casing hole approximately 600 mm into the surface of the limestone bedrock. The depth of the overburden varied at the well locations from between 4.9 m and 8.78m.
2. A 250 mm diameter steel working casing was installed into the casing hole to stabilize the overburden.
3. A 220 mm diameter casing hole was advanced through the base of the limestone layer and through a transitional layer consisting of interbedded layers of limestone and sandstone. The sandstone in the transitional layer was noted to be relatively soft and fractured. The casing hole was advanced through the transitional layer and terminated approximately 4 m into hard to very hard white sandstone. Casing hole depths varied somewhat between the test wells with hole depths varying between 56.4 m and 61.7 m below ground surface (bgs).
4. A casing, consisting of 150 mm diameter new steel, was installed in the casing hole. The casing was fitted with a drive shoe and each 6 m length of casing was welded together in a satisfactory manner creating a single watertight casing column.
5. Grouting of the annular space was conducted using a tremie pipe placed down the inside of the 150 mm diameter casing, and pumped through the annulus to the surface using a reverse-pressure grouting method. The grout was visually verified by Paterson to consist of approximately 20% bentonite solids slurry, consistent with the mixing ratio specified by Bariod Industrial Drilling Products. Prior to termination of grouting, a batch of high early cement grout was prepared and delivered to the annulus at the bottom of the grout



column. Pumping of the grout to the ground surface was visually verified by Paterson.

6. The casing was lightly hammered against the bedrock face, in order to seat the drive shoe prior to initiating a standby period of at least 18 hours while the cement grout set up.
7. A 150 mm diameter open borehole was advanced from the bottom of the casing to the point of interception of a water supply aquifer within the Nepean sandstone formation. The sandstone aquifer was intercepted at between 10 m and 13 m below the underside of casing, which corresponds to depths of between 64 m and 73 m bgs.

### 3.0 AQUIFER ANALYSIS

#### 3.1 Test Well 8

##### 3.1.1 Water Quantity

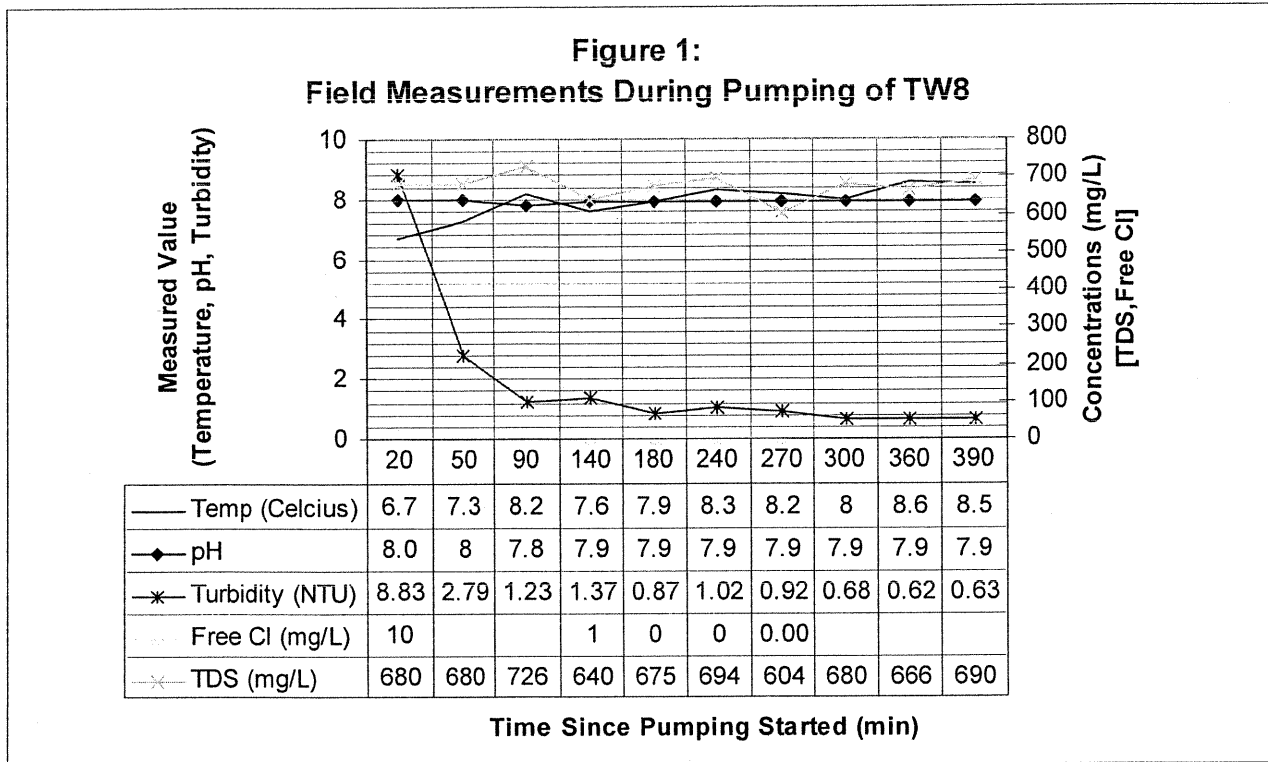
The aquifer characteristics for TW8 are summarized, below, in Table 1.

<b>Table 1: Summary of Sandstone Aquifer Characteristics Resulting from Analysis of Pumping Test Data for TW 8</b>	
<b>Aquifer Parameter</b>	<b>Result of Analysis</b>
Storativity	$1.20 \times 10^{-1}$
Transmissivity ( $m^2/min$ )	$9.42 \times 10^{-3}$
Transmissivity (T) ( $m^2/day$ )	13.56
Available Drawdown (s) (m)	60
Specific Capacity (L/min/m drawdown)	15.9
20 year safe yield ( $m^3/day$ )	553

##### 3.1.2 Water Quality

###### 3.1.2.1 Field Water Quality Analysis

Figure 1, below summarizes the field measurements taken during the pumping test for TW8.



A review of the field water quality data recorded during the pumping test indicates that the temperature, pH and Total Dissolved Solids (TDS) stabilized after approximately 300 minutes of pumping. This corresponds to a reduction of turbidity to below 1 NTU. Free chlorine residual was also recorded to be non-detectable after 180 minutes of pumping.

### 3.1.2.2 Laboratory Water Quality Analysis

The water quality data for TW8 is summarized in Tables 2 and 3 below.

Table 2: Summary of Health and Aesthetic/Operation Objective Parameters for TW8					
Parameter	Units	TW No. 8		Ontario Drinking Water Standards <sup>1</sup>	
		3 Hour	6 Hour	Type	Limit
<b>Microbiological Parameters<sup>2</sup></b>					
<i>Escherichia Coli</i>	ct/100 mL	0	0	MAC	0
Faecal Coliforms	ct/100 mL	0	0	-	-
Faecal Streptococcus	ct/100 mL	0	0	-	-
Heterotrophic Plate Count	ct/1 mL	0	0	-	-
Total Coliforms	ct/100 mL	0	0	MAC	0
<b>Chemical Parameters (Health Related)</b>					
Fluoride	mg/L	0.25	0.25	MAC	2.4
Nitrite	mg/L	<0.10	<0.10	MAC	1
Nitrate	mg/L	<0.10	<0.10	MAC	10
<b>Chemical Parameters with Aesthetic Objectives/ Operational Guidelines</b>					
Alkalinity	mg/L	210	207	OG	500
Chloride	mg/L	205	204	AO	250
Colour	TCU	<2	2	AO	5
DOC	mg/L	~0.9	0.9	AO	5
Hydrogen Sulfide	mg/L	<0.01	<0.01	AO	0.05
pH		8.04	8.06	AO	6.5-8.5
Sulphate	mg/L	55	53	AO	500
Hardness	mg/L	404	381	OG	100
Sodium	mg/L	54	53	AO	20(200)
Iron	mg/L	0.22	0.23	AO	0.30
Manganese	mg/L	0.04	0.04	AO	0.05
Total Dissolved Solids	mg/L	748	728	AO	500
Turbidity (Laboratory)	NTU	2.5	0.2	AO	1
Turbidity (Field)	NTU	0.68	0.63	AO	1

- Ontario Drinking Water Standards identifies the following types of parameters: MAC= Maximum Allowable Concentration; AO=Aesthetic Objective; OG=Operational Guideline.
- Free chlorine residuals verified to be non-detectable prior to collection of water samples.

Table 3: Summary of General Chemical Parameters for TW8			
Parameter	Units	TW No. 8	
		3 Hour	6 Hour
<b>General Chemical Parameters</b>			
Conductivity	uS/cm	1150	1120
N-NH <sub>3</sub> (Ammonia)	mg/L	0.09	0.09
Phenols	mg/L	<0.001	<0.001
Tannin & Lignin	mg/L	<0.1	<0.1
Total Kjeldahl Nitrogen	mg/L	0.16	0.09
Ion Balance	Unitless	0.95	0.92
Calcium	mg/L	96	90
Magnesium	mg/L	40	38
Potassium	mg/L	7	6

A review of the water quality analysis data for TW8 indicates that the raw water meets all health related parameters of the Ontario Drinking Water Standards (ODWS). With respect to aesthetic objectives and operational guidelines, the water contains modestly elevated concentrations of hardness and total dissolved solids. Observations made during the construction of TW8 note that the source of water in TW8 originates from a layer of limestone sandwiched between sandstone layers. It is believed that the casing for TW8 was not advanced past the base of the transition layer and is not indicative of the water quality of the sandstone aquifer.

Although acceptable quality of water was available from TW8, it was observed in subsequent drilling that improved water quality could be obtained with consistent penetration to the sandstone aquifer.

Hardness, an operational guideline, does not appear in the ODWS. Rather it appears in the Technical Support Documents for Drinking Water Standards, Objectives and Guidelines (Technical Support Documents) as a parameter with an operational guideline of 100 mg/L. At the measured concentrations, the water is considered to be very hard, however it is below the reasonable treatable limit of 500 mg/L specified in Table 3 of the guidance document, entitled, "Procedure D-5-5: Technical Guideline for Private Wells: Water Supply Assessment", published by the MOE in 1995.

With respect to Total Dissolved Solids (TDS), the Technical Support Documents state an aesthetic objective of 500 mg/L. Based on the fundamentals of groundwater chemistry, it is typical that ions of calcium, chloride, magnesium, sodium and sulphate, and hardness account for more than 90% of the TDS concentration measured in groundwater. TDS is a gross measurement of dissolved material and the aesthetic objective set out in the Technical Support Documents reflects both the tendency to have balanced water and the minimization of ionic concentrations that could affect the palatability of the water.

Although the aquifer that TW8 intercepts contains a TDS concentration of 728 mg/L, the water does not have any individual concentrations of ions that result in an adverse impact on the palatability of the water. In fact, the water appears to be generally balanced between chloride and hardness resulting in aesthetically pleasing water.

In accordance with Procedure D-5-5, Table 3 does not reflect a maximum concentration considered reasonably treatable. Rather, Procedure D-5-5 requires written rationale that corrosion, encrustation, or taste problems will not occur. The Langelier Saturation Index (LSI) indicates the corrosivity of water. The LSI is explained in the Table 4 below:

<b>Table 4: Summary of Explanation of Langelier Saturation Index Values</b>	
<b>LSI Value</b>	<b>Explanation</b>
less than -0.5	Water is corrosive
between -0.5 and +0.5	Water is in equilibrium
higher than +0.5	Water has high scale potential

The LSI value for the water in the aquifer intercepted by TW8 is **+0.27** based on the field measured pH and temperature, and the laboratory analyses for calcium, alkalinity and TDS. Based on the calculated LSI, the water is in equilibrium with minimal potential for creation of scale and is non-corrosive. The taste of the water, as such, is anticipated to be balanced and aesthetically pleasing and palatable.

### 3.2 Test Well 9

#### 3.2.1 Water Quantity

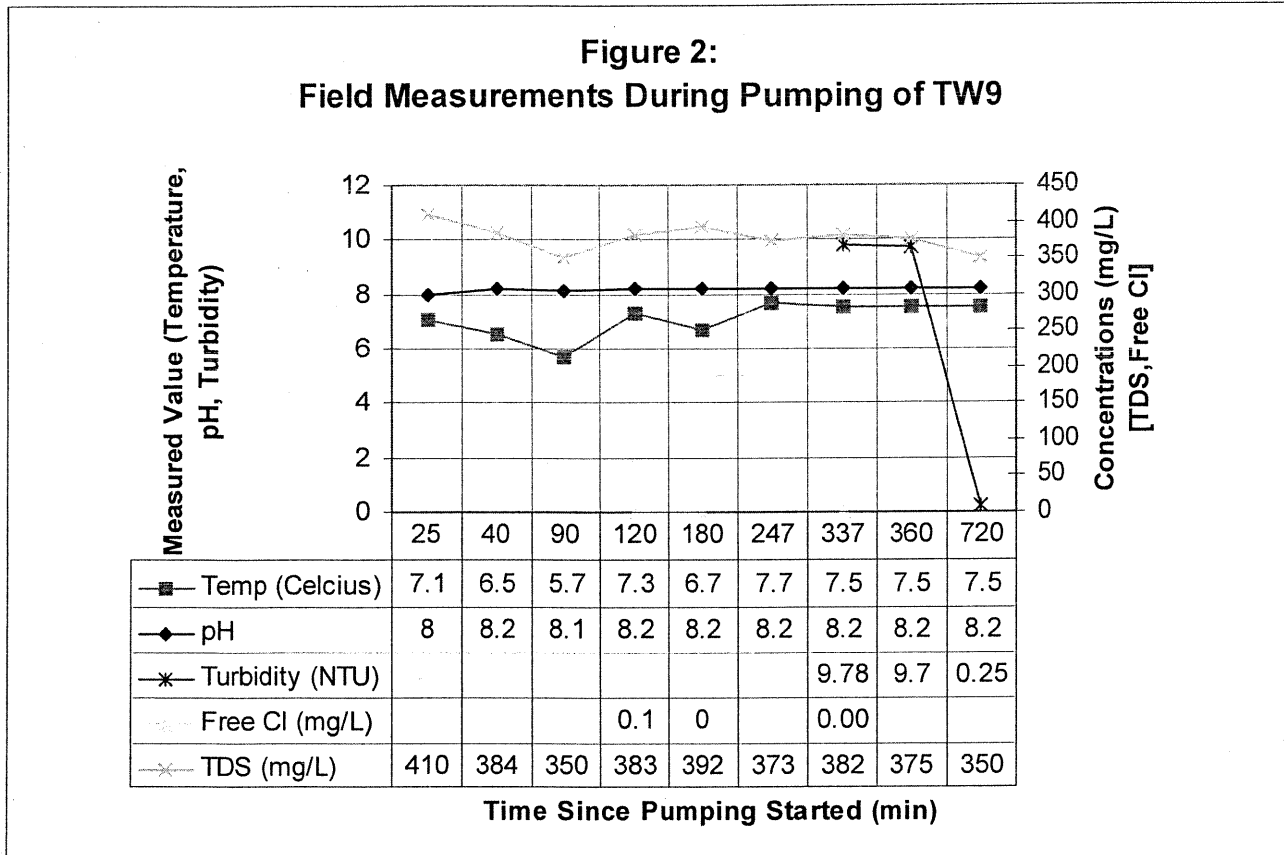
The aquifer characteristics for TW9 are summarized, below, in Table 5.

<b>Table 5: Summary of Sandstone Aquifer Characteristics Resulting from Analysis of Pumping Test Data for TW 9</b>	
<b>Aquifer Parameter</b>	<b>Result of Analysis</b>
Storativity	$1.19 \times 10^{-1}$
Transmissivity ( $m^2/min$ )	$1.12 \times 10^{-3}$
Transmissivity (T) ( $m^2/day$ )	1.61
Available Drawdown (s) (m)	73.2
Specific Capacity (L/min/m drawdown)	2.44
20 year safe yield ( $m^3/day$ )	78.5

#### 3.2.2 Water Quality

##### 3.2.2.1 Field Water Quality Analysis

Figure 2, below summarizes the field measurements taken during the pumping test for TW9.



A review of the field measurements for TW9 indicates that the measured values for temperature, pH, and TDS appeared to stabilize within the six hour pumping period. Field turbidity remained high during the pumping test period as excess rust on the casing was observed to be present throughout testing. TW9 was pumped for an extended period in order to clean the casing of any residual rust. The field turbidity measurement after six hours of extended pumping was recorded to be 0.25 NTU. A sample of the water from TW9, obtained at the end of the extended pumping, was submitted for analysis for parameters comprise the “subdivision” package from Accutest Laboratories. The data appears in Table 6 in Section 3.2.2.2. and the laboratory analysis report is provided in Appendix 3.

### 3.2.2.2 Laboratory Water Quality Analysis

The water quality data for TW9 is summarized in Tables 6 and 7 below.



Table 6: Summary of Health and Aesthetic/Operation Objective Parameters for TW9					
Parameter	Units	TW No. 9		Ontario Drinking Water Standards <sup>1</sup>	
		3 Hour	6 hour <sup>3</sup>	Type	Limit
<b>Microbiological Parameters<sup>2</sup></b>					
<i>Escherichia Coli</i>	ct/100 mL	0	0	MAC	0
Faecal Coliforms	ct/100 mL	0	0	-	-
Faecal Streptococcus	ct/100 mL	0	0	-	-
Heterotrophic Plate Count	ct/1 mL	1	0	-	-
Total Coliforms	ct/100 mL	0	0	MAC	0
<b>Chemical Parameters (Health Related)</b>					
Fluoride	mg/L	0.42	0.36	MAC	2.4
Nitrite	mg/L	<0.10	<0.10	MAC	1
Nitrate	mg/L	<0.10	<0.10	MAC	10
<b>Chemical Parameters with Aesthetic Objectives/ Operational Guidelines</b>					
Alkalinity	mg/L	207	207	OG	500
Chloride	mg/L	61	60	AO	250
Colour	TCU	<2	<2	AO	5
DOC	mg/L	1.0	1.3	AO	5
Hydrogen Sulfide	mg/L	<0.01	<0.01	AO	0.05
pH		8.23	7.96	AO	6.5-8.5
Sulphate	mg/L	45	41	AO	500
Hardness	mg/L	217	226	OG	100
Sodium	mg/L	44	45	AO	20(200)
Iron	mg/L	2.25	0.15	AO	0.30
Manganese	mg/L	0.05	0.03	AO	0.05
Total Dissolved Solids	mg/L	435	435	AO	500
Turbidity (Laboratory)	NTU	16.5	1.1	AO	1
Turbidity (Field)	NTU	9.7	0.25	AO	1

1. Ontario Drinking Water Standards identifies the following types of parameters: MAC= Maximum Allowable Concentration; AO=Aesthetic Objective; OG=Operational Guideline.
2. Free chlorine residuals verified to be non-detectable prior to collection of water samples.
3. Water quality analysis of water collected after an additional six hours of extended pumping.

Table 7: Summary of General Chemical Parameters for TW9			
Parameter	Units	TW No. 9	
		3 Hour	6 Hour <sup>1</sup>
<b>General Chemical Parameters</b>			
Conductivity	uS/cm	670	677
N-NH <sub>3</sub> (Ammonia)	mg/L	0.10	0.09
Phenols	mg/L	<0.001	<0.001
Tannin & Lignin	mg/L	0.1	0.2
Total Kjeldahl Nitrogen	mg/L	0.16	0.18
Ion Balance	Unitless	0.94	0.92
Calcium	mg/L	49	48
Magnesium	mg/L	23	22
Potassium	mg/L	6	6

1. Water quality analysis of water collected after an additional six hours of extended pumping.

Analysis of the water quality data obtained from TW9, after the additional six hours of pumping, reveals water meeting all of the ODWS health parameters and all aesthetic parameters with the exception of turbidity and hardness.

Laboratory turbidity was reported to be 1.1 NTU, however field turbidity readings noted consistent turbidity data below 1 NTU during the extended pumping period. It is likely that oxidation of the iron within the sample, during collection, is likely the reason for the difference. Oxidation of iron and manganese are common during sample collection as air is often introduced to the water during sample recovery.

Hardness was reported at a concentration of 226 mg/L after six hours of pumping. The operational guideline for hardness, in the ODWS is 100 mg/L. At the reported concentration, the water is considered to be hard, however it is considered reasonably treatable based on Table 3 of Procedure D-5-5.

### 3.3 Test Well 10

#### 3.3.1 Water Quantity

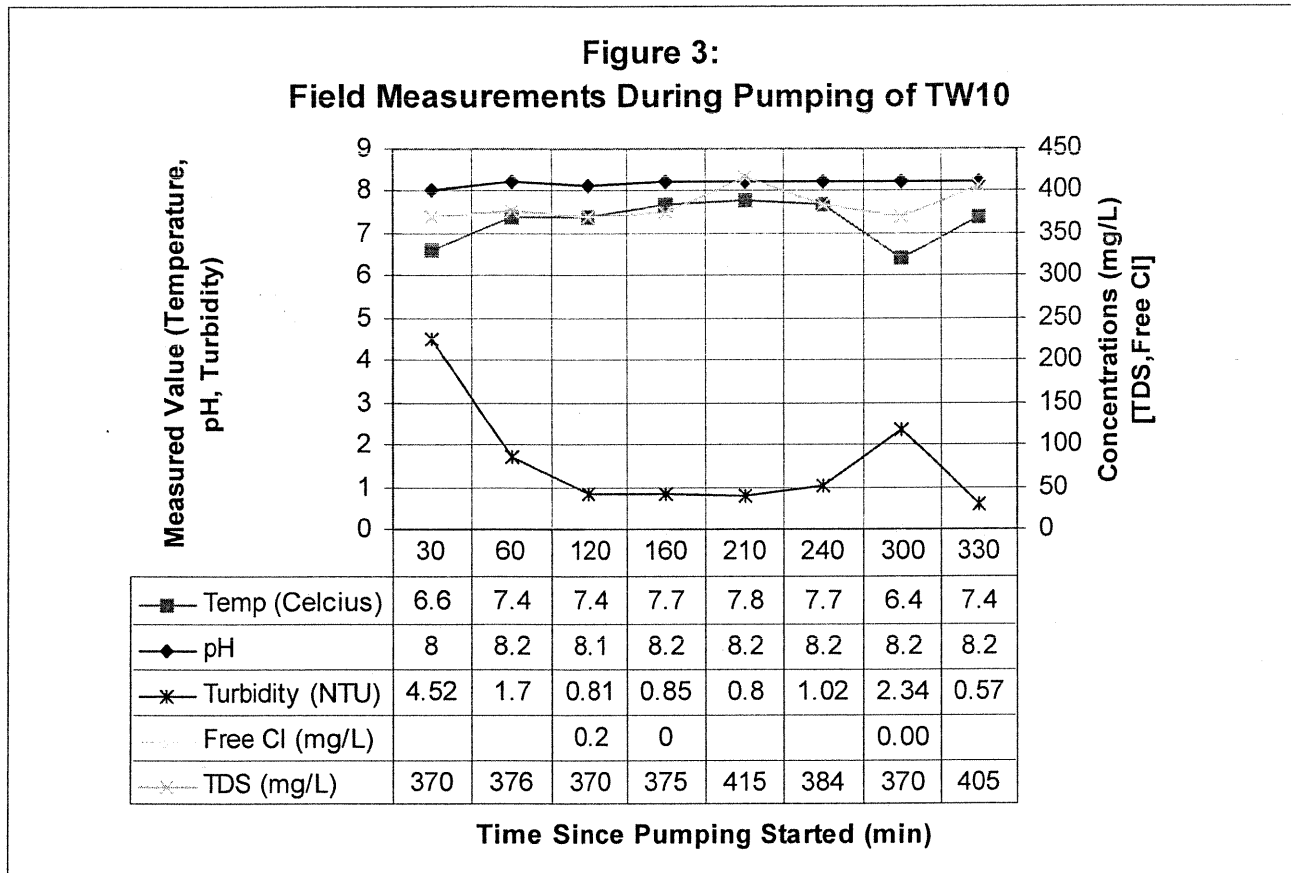
The aquifer characteristics for TW10 are summarized, below, in Table 8.

<b>Table 8: Summary of Sandstone Aquifer Characteristics Resulting from Analysis of Pumping Test Data for TW 10</b>	
<b>Aquifer Parameter</b>	<b>Result of Analysis</b>
Storativity	$7.24 \times 10^{-2}$
Transmissivity (m <sup>2</sup> /min)	$1.77 \times 10^{-3}$
Transmissivity (T) (m <sup>2</sup> /day)	2.55
Available Drawdown (s) (m)	70
Specific Capacity (L/min/m drawdown)	3.7
20 year safe yield (m <sup>3</sup> /day)	121

#### 3.3.2 Water Quality

##### 3.3.2.1 Field Water Quality Analysis

Figure 3, below summarizes the field measurements taken during the pumping test for TW10.



A review of the field water quality data recorded during the pumping test suggests that the water from the aquifer intercepted by TW10 was stable at the completion of the six hour pumping test period. Free chlorine residual was recorded to be non detectable after 160 minutes of pumping.

### 3.3.2.2 Laboratory Water Quality Analysis

The water quality data for TW10 is summarized in Tables 9 and 10 below.

Table 9: Summary of Health and Aesthetic/Operation Objective Parameters for TW10					
Parameter	Units	TW No. 10		Ontario Drinking Water Standards <sup>1</sup>	
		3 Hour	6 Hour	Type	Limit
<b>Microbiological Parameters<sup>2</sup></b>					
<i>Escherichia Coli</i>	ct/100 mL	0	0	MAC	0
Faecal Coliforms	ct/100 mL	0	0	-	-
Faecal Streptococcus	ct/100 mL	0	0	-	-
Heterotrophic Plate Count	ct/1 mL	0	0	-	-
Total Coliforms	ct/100 mL	0	0	MAC	0
<b>Chemical Parameters (Health Related)</b>					
Fluoride	mg/L	0.36	0.38	MAC	2.4
Nitrite	mg/L	<0.10	<0.10	MAC	1
Nitrate	mg/L	<0.10	<0.10	MAC	10
<b>Chemical Parameters with Aesthetic Objectives/ Operational Guidelines</b>					
Alkalinity	mg/L	208	207	OG	500
Chloride	mg/L	65	65	AO	250
Colour	TCU	3	2	AO	5
DOC	mg/L	1.1	1.1	AO	5
Hydrogen Sulfide	mg/L	<0.01	<0.01	AO	0.05
pH		8.14	8.09	AO	6.5-8.5
Sulphate	mg/L	48	48	AO	500
Hardness	mg/L	231	252	OG	100
Sodium	mg/L	36	37	AO	20(200)
Iron	mg/L	0.09	0.09	AO	0.30
Manganese	mg/L	0.03	0.03	AO	0.05
Total Dissolved Solids	mg/L	439	442	AO	500
Turbidity (Laboratory)	NTU	1.0	0.7	AO	1
Turbidity (Field)	NTU	0.85	0.57	AO	1

1. Ontario Drinking Water Standards identifies the following types of parameters: MAC= Maximum Allowable Concentration; AO=Aesthetic Objective; OG=Operational Guideline.
2. Free chlorine residuals verified to be non-detectable prior to collection of water samples.

Table 10: Summary of General Chemical Parameters for TW10			
Parameter	Units	TW No. 10	
		3 Hour	6 Hour
<b>General Chemical Parameters</b>			
Conductivity	uS/cm	676	680
N-NH <sub>3</sub> (Ammonia)	mg/L	0.09	0.09
Phenols	mg/L	<0.001	<0.001
Tannin & Lignin	mg/L	0.2	0.2
Total Kjeldahl Nitrogen	mg/L	0.13	0.12
Ion Balance	Unitless	0.90	0.97
Calcium	mg/L	54	58
Magnesium	mg/L	25	26
Potassium	mg/L	5	6

TW10 was noted to be a free flowing artesian well. As such, the water chemistry is very much stable, as noted in the water quality analysis, due to the natural development process resulting from the constant flow of water.

The water from TW10 is noted to meet all health and aesthetic related parameters of the ODWS with the exception of hardness. The hardness, reported to be between 231 and 252 mg/L, is consistent with the values noted from pumping of TW9 and is considered to be reasonably treatable according to Table 3 of Procedure D-5-5.

### 3.4 Test Well 11

#### 3.4.1 Water Quantity

The aquifer characteristics for TW11 are summarized, below, in Table 11.

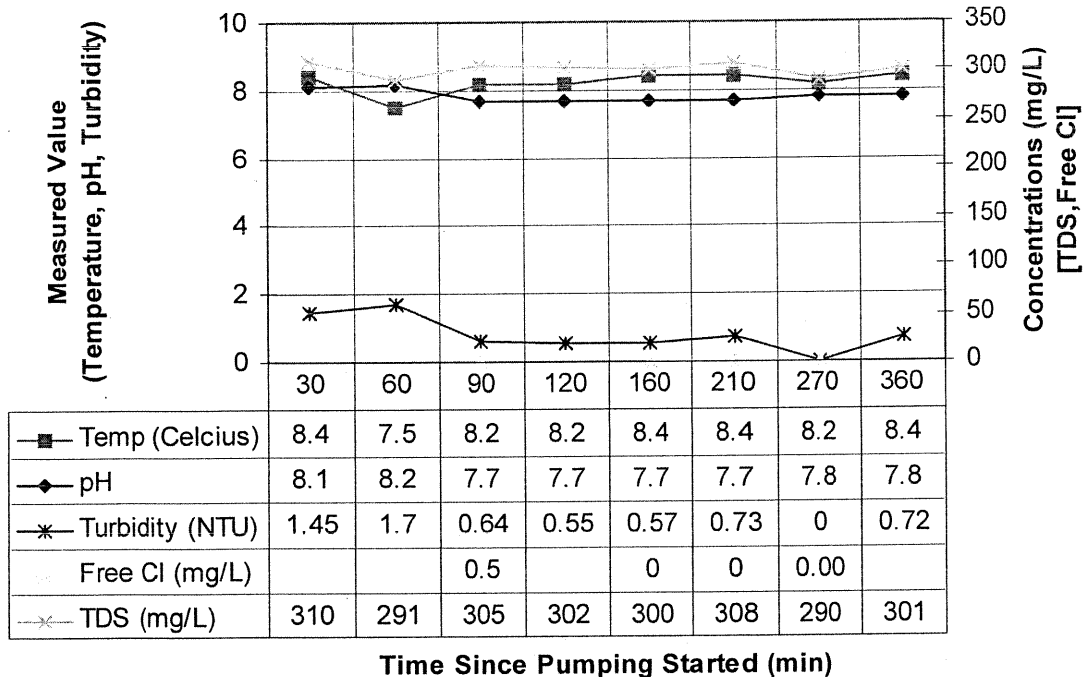
<b>Table 11: Summary of Sandstone Aquifer Characteristics Resulting from Analysis of Pumping Test Data for TW 11</b>	
<b>Aquifer Parameter</b>	<b>Result of Analysis</b>
Storativity	$7.15 \times 10^{-4}$
Transmissivity (m <sup>2</sup> /min)	$2.32 \times 10^{-1}$
Transmissivity (T) (m <sup>2</sup> /day)	33.4
Available Drawdown (s) (m)	57
Specific Capacity (L/min/m drawdown)	181.1
20 year safe yield (m <sup>3</sup> /day)	1295

#### 3.4.2 Water Quality

##### 3.4.2.1 Field Water Quality Analysis

Figure 4, below summarizes the field measurements taken during the pumping test for TW8.

**Figure 4:  
 Field Measurements During Pumping of TW11**



A review of the field water quality data recorded during the pumping test indicates that the water chemistry stabilized after approximately 160 minutes of pumping. Free residual was measured to be non detectable at this point in the pumping test also.

**3.4.2.2 Laboratory Water Quality Analysis**

The water quality data for TW11 is summarized in Tables 12 and 13 below.



Table 12: Summary of Health and Aesthetic/Operation Objective Parameters for TW11					
Parameter	Units	TW No. 11		Ontario Drinking Water Standards <sup>1</sup>	
		3 Hour	6 Hour	Type	Limit
<b>Microbiological Parameters<sup>2</sup></b>					
<i>Escherichia Coli</i>	ct/100 mL	0	0	MAC	0
Faecal Coliforms	ct/100 mL	0	0	-	-
Faecal Streptococcus	ct/100 mL	0	0	-	-
Heterotrophic Plate Count	ct/1 mL	0	1	-	-
Total Coliforms	ct/100 mL	0	0	MAC	0
<b>Chemical Parameters (Health Related)</b>					
Fluoride	mg/L	0.4	0.4	MAC	2.4
Nitrite	mg/L	<0.10	<0.10	MAC	1
Nitrate	mg/L	<0.10	<0.10	MAC	10
<b>Chemical Parameters with Aesthetic Objectives/ Operational Guidelines</b>					
Alkalinity	mg/L	203	205	OG	500
Chloride	mg/L	43	42	AO	250
Colour	TCU	<2	<2	AO	5
DOC	mg/L	1.0	0.9	AO	5
Hydrogen Sulfide	mg/L	<0.01	<0.01	AO	0.05
pH		8.09	8.13	AO	6.5-8.5
Sulphate	mg/L	39	39	AO	500
Hardness	mg/L	203	203	OG	100
Sodium	mg/L	37	37	AO	20(200)
Iron	mg/L	0.23	0.4	AO	0.30
Manganese	mg/L	0.03	0.03	AO	0.05
Total Dissolved Solids	mg/L	384	384	AO	500
Turbidity (Laboratory)	NTU	1.9	4.2	AO	1
Turbidity (Field)	NTU	0.57	0.72	AO	1

1. Ontario Drinking Water Standards identifies the following types of parameters: MAC= Maximum Allowable Concentration; AO=Aesthetic Objective; OG=Operational Guideline.
2. Free chlorine residuals verified to be non-detectable prior to collection of water samples.

<b>Table 14: Summary of General Chemical Parameters for TW11</b>			
<b>Parameter</b>	<b>Units</b>	<b>TW No. 11</b>	
		<b>3 Hour</b>	<b>6 Hour</b>
<b>General Chemical Parameters</b>			
Conductivity	uS/cm	590	591
N-NH <sub>3</sub> (Ammonia)	mg/L	0.09	0.09
Phenols	mg/L	<0.001	<0.001
Tannin & Lignin	mg/L	<0.1	0.1
Total Kjeldahl Nitrogen	mg/L	0.12	0.13
Ion Balance	Unitless	0.95	0.95
Calcium	mg/L	45	45
Magnesium	mg/L	22	22
Potassium	mg/L	6	6

Water quality analysis of the water recovered from TW11 reveals that the water meets all health related parameters of the ODWS. Furthermore, the water meets all aesthetic related parameters with the exception of hardness, laboratory turbidity, and iron.

The concentration of hardness in the water from TW11 is noted to be 203 mg/L. This concentration is consistent with the values reported in both TW9 and TW10. Like the hardness reported in TW9 and TW10, the reported hardness is considered reasonably treatable according to Procedure D-5-5.

The laboratory turbidity and concentration of iron are above ODWS values. The field turbidity data indicates consistent turbidity levels of less than 1 NTU. As previously detailed on Section 3.2.2.2 of this report, oxidation of iron during sample recover is likely responsible for the difference between turbidity readings. Given that the concentration of iron was reported to be 0.4 mg/L after six hours of pumping, there is ample iron present to form iron oxide precipitate in the sample bottle. Although the concentration of iron is above the ODWS aesthetic objective of 0.3 mg/L, the water is considered reasonably treatable according to Table 3 of Procedure D-5-5.

### **3.5 Well Interference Calculations**

The original well interference calculations have been updated to reflect the utilization of the sandstone aquifer. Figure 5, below, summarizes the anticipated cumulative drawdown within the centre of the site resulting from continuous pumping of residential and commercial wells.

Based on an analysis of the revised well interference calculations, it is evident that there is an ample supply of water available to the proposed developments from the sandstone aquifer.

#### 4.0 DISCUSSION

With respect to the water quality analysis for TW9, TW10, and TW11, these test wells are noted to have intercepted the same water supply aquifer located within the sandstone of the Nepean formation. The quantity of water is considered to be more than adequate for residential and commercial uses. Moreover, this water supply aquifer is of excellent water quality with only minor elevations in hardness, and iron reported. These aesthetic parameters are reported at concentrations that are considered reasonably treatable as per Table 3 of Procedure D-5-5.

It must be noted that the sodium concentration in the sandstone aquifer is quite low at values between 36 and 53 mg/L. Although the ODWS aesthetic objective is 200 mg/L, any concentrations of sodium above 20 mg/L requires that the water quality data be made available to the local Medical Officer of Health. This is in order to allow for the dissemination of this information to local physicians for treatment of persons with sodium restricted dietary needs.

Based on the locations of the additional test wells, the site has comprehensive coverage of deep test wells with TW7, TW9, TW10 and TW11 easily intercepting the sandstone aquifer at approximately 61 to 73 m bgs within the residential areas. The sandstone aquifer can be easily intercepted by advancing the casing an additional 6 to 10 m into the sandstone formation in the commercial areas.

Static water levels reported in the additional test wells reveal a significant upwards gradient exists within the sandstone aquifer. The updated well interference calculations confirm acceptable anticipated drawdown values within the site and also confirm that the upwards gradient will be maintained even during the worst case scenario of maximum water taking from the aquifer for the proposed development. As such, the sandstone aquifer, considered to be hydraulically isolated, is an excellent water supply for this site.

## 5.0 CONCLUSIONS

Based on the information presented in the body of this supplemental hydrogeological assessment, the following conclusions can be drawn:

1. A suitable water supply aquifer exists within the sandstone formation underlying the limestone formation at the subject site.
2. The sandstone water supply aquifer has an aeral extent such that all portions of the site can access it.
3. The sandstone water supply aquifer has ample quantities of water available for utilization by both the proposed residential and commercial portions of the site and has excellent water quality.
4. The sandstone water supply aquifer possesses a significant upwards gradient that remains largely unaffected by maximum water taking estimates at the site and, as agreed to by experts at the Ontario Municipal Board Hearing, is hydrogeologically isolated from surface activity.
5. The sandstone aquifer is considered to be an excellent aquifer for this development.

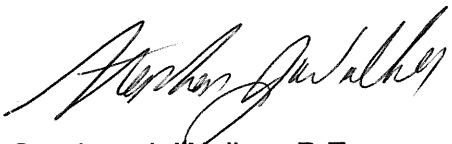
## 6.0 RECOMMENDATIONS

The following recommendations are presented, based on the information contained within the body of this report:

1. Wells intended to utilize the sandstone aquifer in the residential portion of the site should be cased and properly grouted, in accordance with Ontario Regulation 903, through the limestone formation, and transition zone, and should extend to a depth of not less than 60 m bgs or at least a minimum of 4 m into the sandstone layer.
2. Wells intended to utilize the sandstone aquifer in the commercial portion of the site, should be cased and properly grouted, in accordance with Ontario Regulation 903, through the limestone formation and transition zone, and should extend to a depth of not less than 70 m bgs or at least a minimum of 10 m into the sandstone layer.
3. The sodium concentrations require the usual warning clause in the subdivision agreement for persons with sodium restricted dietary needs.

### Paterson Group Inc.

Robert A. Passmore, B.Eng.



Stephen J. Walker, P.Eng.

### Report Distribution:

- Sunset Lakes Development Corporation (3 copies)
- Paterson Group (1 copy)

**APPENDIX 1**

**Ontario Ministry of the Environment Water Well Records  
for Additional Test Wells**







Ministry of the Environment

Well No A 052445 (see below) A052445

Well Record

Regulation 903 Ontario Water Resources Act

page \_\_\_ of \_\_\_

Instructions for Completing Form

- For use in the Province of Ontario only. This document is a permanent legal document. Please retain for future reference. All Sections must be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form. Questions regarding completing this application can be directed to the Water Well Help Desk (Toll Free) at 1-888-396-9355. All metro measurements shall be reported to 1/10th of a metre. Please print clearly in blue or black ink only.

Well Owner's Information and Location of Well Information. Includes fields for Well Name (Sunset Lakes Farm Inc), Mailing Address (6576 Apple Orchard Road), County (Greeley), Township (Osgoode), and various identification numbers.

Log of Overburden and Bedrock Materials (see instructions). Table with columns: General Colour, Most common material, Other Materials, General Description, Depth From, Metres To. Includes entries for Sandy Clay, Sand Gravel, lime stone, and Grey Sandstone.

Construction Record and Test of Well Yield. Construction Record includes Hole Diameter, Casing, Screen, and Plugging/Sealing Record. Test of Well Yield includes Pumping test method (Subs pump), Draw Down, and Recovery data.

Method of Construction, Water Use, Final Status of Well, Well Contractor/Technician information, and Location of Well. Includes details on construction methods, intended water use, contractor info (AIR ROCK DRILLING CO LTD), and a location diagram showing the well's position relative to Bank Street and Parkway Road.



Ministry of the Environment

Well ID: **A 052446**  
 (number below)  
**A052446**

Well Record  
Regulation 903 Ontario Water Resources Act

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- All Sections must be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Help Desk (Toll Free) at 1-888-396-9355.
- All metro measurements shall be reported to 1/10<sup>th</sup> of a metre.
- Please print clearly in blue or black ink only.

Well Owner's Information and Location of Well Information

First Name: **Sunset Lakes Farm Inc** Last Name: **Grealy Family** Mailing Address: **96576 Apple Orchard Rd**  
 County/District/Municipality: **Grealy** Township/City/Town/Village: **Grealy** Province: **Ontario** Postal Code: **K4P 1E5** Telephone Number: **902 811 7374**  
 Address of Well Location: **Osgoode** Township: **Osgoode** Lot: **6** Concession: **3**  
 RR#/Street Number/Name: **#1268 Parkway** City/Town/Village: **Grealy** Site/Compartment/Block/Fracture: **Plan 902 P/L 73-74**  
 GPS Reading: NAD 83 Zone: **18** Easting: **457115** Northing: **542089** UTM: **18QGL001** Mode of Operation:  Undifferentiated  Averaged  Differentiated, specific

Log of Overburden and Bedrock Materials (see instructions)

General Colour	Most common material	Other Materials	General Description	Depth From (Metres)	To (Metres)
	Sand, gravel	Barreness w/ Blue Clay		0	7.62
	Limestone			7.62	42.97
	Sandstone			42.97	73.15

**Hole Diameter**  
 Depth From: 0 To: 73.15 Metres  
 Diameter Centimetres: 15.23

**Water Record**  
 Water found at depth of: **15.83** m  
 Kind of Water: **None**  
 Gas  Fresh  Sulphur  Other: **None**  
 Gaseous  Salty  Minerals  Other: **None**  
 m  Fresh  Sulphur  Gas  Salty  Minerals  Other: **None**  
 After test of well yield, water was  **not**  **tested**  
 Chlorinated  **None**  **None**

**Construction Record**

Inside diam (centimetres)	Material	Wall thickness (centimetres)	Depth From (Metres)	To (Metres)
15.83	<input checked="" type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized <input type="checkbox"/> Enamel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized <input type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized	1.48	0	61.57
<b>Screen</b>				
Outside diam	<input type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized	Slot No.		
<b>No Casing or Screen</b>				
<input checked="" type="checkbox"/> Open hole				

**Test of Well Yield**

Pumping test method	Draw Down		Recovery	
	Time min	Water Level Metres	Time min	Water Level Metres
<b>Sub Pump</b>				
Pump intake depth (metres)	60.76	Flow		16.80
Pumping rate (litres/min)	66.78	1	1	13.10
Duration of pumping	1.0 min	2	2	11.20
Final water level and of pumping	15.80 metres	3	3	9.40
Recommended pump type	<input checked="" type="checkbox"/> Shallow <input type="checkbox"/> Deep	4	4	7.30
Recommended pump depth (metres)	60.76	5	5	6.40
Recommended pump rate (litres/min)	66.78	10	10	1.70
If flowing give rate	66.78	15	15	0.12
		20	20	
		25	25	
If pumping discontinued, give reason:		30	30	
		40	40	
		50	50	
		60	60	

**Plugging and Sealing Record**

Depth seal - Metres From	To	Material and type (benzoite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
60.76	57.71	Neat Cement Slurry	1.316
57.71	0	benzoite slurry	2.21

**Location of Well**

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

**Method of Construction**  
 Cable Tool  Rotary (oil)  Diamond  Digging  
 Rotary (conventional)  Air percussion  Intilling  Other  
 Rotary (reverse)  Boring  Driving

**Water Use**  
 Domestic  Industrial  Public Supply  Other  
 Stock  Commercial  Not used  
 Irrigation  Municipal  Cooling & air conditioning

**Final Status of Well**  
 Water Supply  Recharge well  Unfinished  Abandoned, (Other)  
 Observation well  Abandoned, insufficient supply  Dewatering  
 Test Hole  Abandoned, poor quality  Replacement well

**Well Contractor/Technician Information**  
 Name of Well Contractor: **AIR ROCK DRILLING** Well Contractor's Licence No.: **1119**  
 Business Address (street name, number, city etc.): **2221 KATHLEEN CREST ROAD**  
 Name of Well Technician (last name, first name): **MURCELL STANANEN** Well Technician's Licence No.: **12122**  
 Signature of Technician/Contractor: *[Signature]* Date Submitted: **02/20/07**

**Ministry Use Only**  
 Data Source: **Contractor**  
 Date Received: **02/20/07** Date of Inspection: **02/20/07**  
 Remarks: **Test Well #10**  
 Audit No.: **Z 64735** Data Well Completed: **02/20/07**  
 Was the well owner's information package delivered?  Yes  No Data Unlogged: **02/20/07**



Ministry of the Environment

Well Tag A 052506 or below A 052506

Well Record Regulation 903 Ontario Water Resources Act

page 01 of 01

Instructions for Completing Form

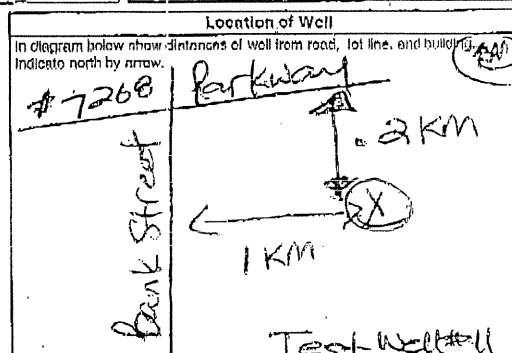
- For use in the Province of Ontario only. This document is a permanent legal document. Please retain for future reference. All Sections must be completed in full to avoid delays in processing. Questions regarding completing this application can be directed to the Water Well Help Desk (Toll Free) at 1-888-396-9355. All metre measurements shall be reported to 1/10th of a metre. Please print clearly in blue or black ink only.

Well Owner's Information and Location of Well Information. Includes fields for Well Owner Name (Greedy family), Mailing Address (6576 Apple Orchard Road), County (Creeley), Township (Osborne), and GPS Reading (NAD 83, Zone 18, Easting 451084, Northing 501352).

Log of Overburden and Bedrock Materials (see Instructions). Table with columns: General Colour, Most common material, Other Materials, General Description, Depth From (Metres), Depth To (Metres). Includes entries for Clay gravel, boulders, Limestone, Limestone & Sandstone, and Sandstone.

Construction Record and Test of Well Yield. Construction Record includes Hole Diameter (0.6096m), Inside diam (15.38cm), Material (Steel), Wall thickness (4.8cm), Depth (0.5486m). Test of Well Yield includes Pumping test method (Subplump), Draw Down (Time, Water Level), and Recovery (Time, Water Level).

Plugging and Scaling Record, Method of Construction, Water Use, Final Status of Well, and Well Contractor/Technician Information. Includes details on slurry types (Neat Cement Slurry, Bestonite Slurry), construction methods (Rotary), water use (Domestic), and contractor details (AIR ROCK DRILLING CO LTD).



Audit No. 2 64736, Date Well Completed 2007 03 09, Was the well owner's information package delivered? Yes

Ministry Use Only. Fields for Date Received, Date of Inspection, Remarks, and Well Record Number.

**APPENDIX 2**

**Laboratory Test Data Reports of Water Quality Analyses**

Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6  
 Attention: Robert Passmore

Report Number: 2702286  
 Date: 2007-02-05  
 Date Submitted: 2007-02-02  
 Project: PH0145

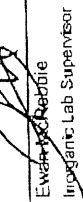
P.O. Number:  
 Matrix: Water

Chain of Custody Number: 53647

PARAMETER	UNITS	MDL	LAB ID:			TYPE	LIMIT	UNITS
			Sample Date:	Sample ID:	GUIDELINE			
Chloride Conductivity TDS (COND - CALC) Sodium	mg/L	1	522033		AO	250	mg/L	
	uS/cm	5	2007-02-02		AO	500	mg/L	
	mg/L	5	TW8 WS01		AO	20	mg/L	
	mg/L	2						

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

Comment:

APPROVAL:   
 Ewert K. Rebbire  
 Inorganic Lab Supervisor

Client: Paterson Group  
 28 Concourse Gate, Unit 1  
 Nepean, ON  
 K2E 7T7

Report Number: 2702746  
 Date: 2007-02-12  
 Date Submitted: 2007-02-09  
 Project: PH0145

Attention: Mr. Robert Passmore  
 INVOICE: Paterson Group Inc.  
 Chain of Custody Number: 53219

P.O. Number:  
 Matrix: Water

PARAMETER	UNITS	MDL	LAB ID:		GUIDELINE
			Sample Date:	Sample ID:	
Total Coliforms	cf/100mL		523363	523364	ODWSOG
Escherichia Coli	cf/100mL		2007-02-08	2007-02-09	
Heterotrophic Plate Count	cf/1mL		TW 8 WS 2	TW 8 WS 3	
Faecal Coliforms	cf/100mL				
Faecal Streptococcus	cf/100mL				
					UNITS
					LIMIT
					TYPE
					MAC
					MAC
					0
					0
					cf/100mL
					cf/100mL

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration  
 Comment:

APPROVAL: *Kristia Quantill*  
 Kristia Quantill  
 Microbiology Analyst

Client: Paterson Group  
 28 Concourse Gate, Unit 1  
 Nepean, ON  
 K2E 7T7

Attention: Mr. Robert Passmore

INVOICE: Paterson Group Inc.  
 Chain of Custody Number: 53219

Report Number: 2702749  
 Date: 2007-02-14  
 Date Submitted: 2007-02-09

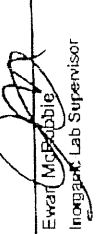
Project: PHO 145

P.O. Number:  
 Matrix: Water

PARAMETER	LAB ID:		UNITS	MDL	Sample Date:	Sample ID:	523367 2007-02-09 TW 8 WS2	523368 2007-02-09 TW 8 WS3	TYPE	LIMIT	UNITS	GUIDELINE
	523367	523368										
Alkalinity as CaCO3	mg/L	5	210	207	OG	500	mg/L					
Chloride	mg/L	1	205	204	AO	250	mg/L					
Colour	TCU	2	<2	2	AO	5	TCU					
Conductivity	uS/cm	5	1150	1120	AO	5	mg/L					
Dissolved Organic Carbon	mg/L	0.5	0.9	0.9	MAC	1.5	mg/L					
Fluoride	mg/L	0.10	0.25	0.25	AO	0.05	mg/L					
Hydrogen Sulphide	mg/L	0.01	<0.01	<0.01	AO	0.05	mg/L					
N-NH3 (Ammonia)	mg/L	0.02	0.09	0.09	MAC	1.0	mg/L					
N-NO2 (Nitrite)	mg/L	0.10	<0.10	<0.10	MAC	10.0	mg/L					
N-NO3 (Nitrate)	mg/L	0.10	<0.10	<0.10	AO	6.5-8.5	mg/L					
pH			8.04	8.06	AO	500	mg/L					
Phenols	mg/L	0.001	<0.001	<0.001	AO	500	mg/L					
Sulphate	mg/L	1	55	53	AO	500	mg/L					
Tannin & Lignin	mg/L	0.1	<0.1	<0.1	AO	500	mg/L					
TDS (COND - CALC)	mg/L	5	748	728	AO	500	mg/L					
Total Kjeldahl Nitrogen	mg/L	0.05	0.16	0.09	AO	1.0	NTU					
Turbidity	NTU	0.1	2.5	0.2	OG	100	mg/L					
Hardness as CaCO3	mg/L	1	404	381	OG	100	mg/L					
Ion Balance		0.01	0.95	0.92								
Calcium	mg/L	1	96	90	AO	20	mg/L					
Magnesium	mg/L	1	40	38	AO	0.3	mg/L					
Potassium	mg/L	1	7	6	AO	0.05	mg/L					
Sodium	mg/L	2	54	53	AO	0.05	mg/L					
Iron	mg/L	0.03	0.22	0.23	AO							
Manganese	mg/L	0.01	0.04	0.04	AO							

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

Comment:

APPROVAL:   
 Ewan MacRae  
 Inorganic Lab Supervisor

R.L. JR. J.F.A. ....YS

ACCUTEST LABORATORIES LTD

Client: Paterson Group  
 28 Concourse Gate, Unit 1  
 Nepean, ON  
 K2E 7T7  
 Attention: Mr. Robert Passmore

Report Number: 2702685  
 Date: 2007-02-12  
 Date Submitted: 2007-02-08  
 Project: PH0145

INVOICE: Paterson Group Inc.  
 Chain of Custody Number: 53590

P.O. Number:  
 Matrix:

Water

PARAMETER	UNITS	MDL	LAB ID:		Sample Date:		Sample ID:		TYPE	LIMIT	UNITS	GUIDELINE
			523230	523231	2007-02-08	2007-02-08	TW9 WS2	TW9 WS3				
Total Coliforms	cf/100mL		0	0					MAC	0	cf/100mL	ODWSOG
Escherichia Coli	cf/100mL		0	0					MAC	0	cf/100mL	
Heterotrophic Plate Count	cf/1 mL		1	0								
Faecal Coliforms	cf/100mL		0	0								
Faecal Streptococcus	cf/100mL		0	0								

MDL = Method Detection Limit INC = Incomplete AD = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL: *Krista Quantrell*  
 Krista Quantrell  
 Microbiology Analyst



REPORT OF ANALYSIS

Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6

Attention: Robert Passmore

Report Number: 2702502  
 Date: 2007-02-07  
 Date Submitted: 2007-02-06


Project: PH0145

Chain of Custody Number: 53938

P.O. Number:  
 Matrix:

PARAMETER	UNITS	MDL	LAB ID: Sample Date: Sample ID:	522629 2007-02-06 TW9 WS1	Water		
					TYPE	LIMIT	GUIDELINE
Hardness as CaCO3	mg/L	1					
Calcium	mg/L	1		208			
Magnesium	mg/L	1		47			
Sodium	mg/L	2		22			
				43			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration  
 Comment:

APPROVAL:   
 Ewal MacPherson  
 Inorganic Lab Supervisor

STANDARD OPERATING PROCEDURES

Client: Paterson Group  
1-28 Concourse Gate  
Ottawa, Ont.  
K1V 1T6  
Attention: Robert Passmore


Report Number: 2702503  
Date: 2007-02-13  
Date Submitted: 2007-02-06  
Project: PH0145

Chain of Custody Number: 53938

P.O. Number:  
Matrix: Water

PARAMETER	UNITS	MDL	LAB ID: 522630			TYPE	LIMIT	UNITS
			Sample Date: 2007-02-06	Sample ID: TW9 WS1				
Chloride	mg/L	1						
Conductivity	uS/cm	5	60					
TDS (COND - CALC)	mg/L	5	657					
			427					

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration  
Comment:

APPROVAL:   
Ewan Macdonald  
Inorganic Lab Supervisor

Client: Paterson Group  
28 Concourse Gate, Unit 1  
Nepean, ON  
K2E 7T7

Attention: Mr. Robert Passmore

Report Number: 2702686  
Date: 2007-02-14  
Date Submitted: 2007-02-08

Project: PH0145

INVOICE: Paterson Group Inc.  
Chain of Custody Number: 53980

P.O. Number:  
Matrix: Water

PARAMETER	LAB ID:		MDL	UNITS	GUIDELINE		
	Sample Date:	Sample ID:			TYPE	LIMIT	UNITS
Alkalinity as CaCO3	523232	523233	5	mg/L	OG	500	mg/L
Chloride	2007-02-08	2007-02-08	1	mg/L	AO	250	mg/L
Colour	TW9 WS2	TW9 WS3	2	TCU	AO	5	TCU
Conductivity			5	uS/cm			
Dissolved Organic Carbon			0.5	mg/L	AO	5	mg/L
Fluoride			0.10	mg/L	MAC	1.5	mg/L
Hydrogen Sulphide			0.01	mg/L	AO	0.05	mg/L
N-NH3 (Ammonia)			0.02	mg/L	MAC	1.0	mg/L
N-NO2 (Nitrite)			0.10	mg/L	MAC	10.0	mg/L
N-NO3 (Nitrate)			0.10	mg/L	AO	6.5-8.5	
pH							
Phenols			0.001	mg/L	AO	500	mg/L
Sulphate			1	mg/L	AO	500	mg/L
Tannin & Lignin			0.1	mg/L	AO		
TDS (COND - CALC)			5	mg/L	AO		
Total Kjeldahl Nitrogen			0.05	mg/L	AO		
Turbidity			0.1	NTU	AO	1.0	NTU
Hardness as CaCO3			1	mg/L	OG	100	mg/L
Iron			0.01	mg/L			
Calcium			1	mg/L			
Magnesium			1	mg/L			
Potassium			1	mg/L			
Sodium			2	mg/L			
Iron			0.03	mg/L	AO	20	mg/L
Manganese			0.01	mg/L	AO	0.3	mg/L
					AO	0.05	mg/L

MDL = Method Detection Limit INO = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

*[Signature]*  
Eward McPherson  
Inorganic Lab Supervisor

Client: Paterson Group  
 28 Concourse Gate, Unit 1  
 Nepean, ON  
 K2E 7T7  
 Attention: Mr. Robert Passmore

Report Number: 2703210  
 Date: 2007-02-19  
 Date Submitted: 2007-02-15

Project: PH0145

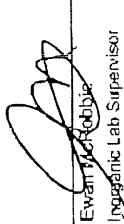
INVOICE: Paterson Group Inc.  
 Chain of Custody Number: 53221

P.O. Number:  
 Matrix: Water

PARAMETER	LAB ID:		UNITS	MDL	Sample Date:	Sample ID:	TYPE	LIMIT	UNITS
	524762	2007-02-15							
Alkalinity as CaCO3	mg/L	5	207				OG	500	mg/L
Chloride	mg/L	1	60				AO	250	mg/L
Colour	TCU	2	<2				AO	5	TCU
Conductivity	uS/cm	5	670				AO	5	mg/L
Dissolved Organic Carbon	mg/L	0.5	1.3				MAC	1.5	mg/L
Fluoride	mg/L	0.10	0.35				AO	0.05	mg/L
Hydrogen Sulphide	mg/L	0.01	<0.01				AO	1.0	mg/L
N-NH3 (Ammonia)	mg/L	0.02	0.09				MAC	10.0	mg/L
N-NO2 (Nitrite)	mg/L	0.10	<0.10				AO	6.5-8.5	mg/L
N-NO3 (Nitrate)	mg/L	0.10	<0.10				AO	500	mg/L
pH			7.96						
Phenols	mg/L	0.001	<0.001				AO	500	mg/L
Sulphate	mg/L	1	41				AO	500	mg/L
Tannin & Lignin	mg/L	0.1	0.1				AO		
TDS (COND - CALC)	mg/L	5	435				AO		
Total Kjeldahl Nitrogen	mg/L	0.05	0.11				AO	1.0	NTU
Turbidity	NTU	0.1	1.1				OG	100	mg/L
Hardness as CaCO3	mg/L	1	226						
Ion Balance		0.01	0.99						
Calcium	mg/L	1	51						
Magnesium	mg/L	1	24						
Potassium	mg/L	1	6						
Sodium	mg/L	2	45						
Iron	mg/L	0.03	0.15				AO	20	mg/L
Manganese	mg/L	0.01	0.03				AO	0.3	mg/L
							AO	0.05	mg/L

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

Comment:

APPROVAL:   
 Ewan MacKinnon  
 Inorganic Lab Supervisor

CC ST OR/...IES... REPORT OF ANALYSIS

Client: Paterson Group  
 28 Concourse Gate, Unit 1  
 Nepean, ON  
 K2E 7T7

Report Number: 2702802  
 Date: 2007-02-14  
 Date Submitted: 2007-02-12

Attention: Mr. Robert Passmore

Project:

INVOICE: Paterson Group Inc.  
 Chain of Custody Number: 58471

P.O. Number:  
 Matrix:

PARAMETER	UNITS	MDL	LAB ID:		TYPE	LIMIT	UNITS	GUIDELINE
			Sample Date:	Sample ID:				
Total Coliforms	cf/100mL		523515		MAC	0	cf/100mL	Water ODWSOG
Escherichia Coli	cf/100mL		2007-02-12		MAC	0	cf/100mL	
Heterotrophic Plate Count	cf/1mL		TW10 WS1					
Faecal Coliforms	cf/100mL							
Faecal Streptococcus	cf/100mL							

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

Comment:

APPROVAL: *Krista Quantill*  
 Krista Quantill  
 Microbiology Analyst

**ACCUTEST LABORATORIES LTD**

**KLORIN OF ANALYSIS**

**Client:** Paterson Group  
28 Concourse Gate, Unit 1  
Nepean, ON  
K2E 7T7

**Report Number:** 2702834  
**Date:** 2007-02-14  
**Date Submitted:** 2007-02-12

**Attention:** Mr. Robert Passmore

**Project:** PH 0145

**INVOICE:** Paterson Group Inc.  
**Chain of Custody Number:** 58356

**P.O. Number:**  
**Matrix:**

Water

PARAMETER	UNITS	MDL	LAB ID: 523572		GUIDELINE
			Sample Date: 2007-02-12	Sample ID: TW 10WS2	
			TYPE	LIMIT	UNITS
Total Coliforms	cf/100mL		MAC	0	cf/100mL
Escherichia Coli	cf/100mL		MAC	0	cf/100mL
Heterotrophic Plate Count	cf/1mL				
Faecal Coliforms	cf/100mL				
Faecal Streptococcus	cf/100mL				

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration  
 Comment:

**APPROVAL:**   
Krista Cluentill  
Microbiology Analyst

Client: Paterson Group  
 1-28 Concourse Gate  
 Ottawa, Ont.  
 K1V 1T6  
 Attention: Robert Passmore

Report Number: 2702812  
 Date: 2007-02-16  
 Date Submitted: 2007-02-12  
 Project:

Chain of Custody Number: 58471

P.O. Number:  
 Matrix:

PARAMETER	LAB ID:		UNITS	MDL	523535 2007-02-12 TW10 WS1	Water	GUIDELINE		
	Sample Date:	Sample ID:					TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5	208	OG	500	mg/L			
Chloride	mg/L	1	65	AO	250	mg/L			
Colour	TCU	2	3	AO	5	TCU			
Conductivity	uS/cm	5	676	AO	5	mg/L			
Dissolved Organic Carbon	mg/L	0.5	1.1	MAC	1.5	mg/L			
Fluoride	mg/L	0.10	0.36	AO	0.05	mg/L			
Hydrogen Sulphide	mg/L	0.01	<0.01	MAC	1.0	mg/L			
N-NH3 (Ammonia)	mg/L	0.02	0.09	MAC	10.0	mg/L			
N-NO2 (Nitrite)	mg/L	0.10	<0.10	AO	6.5-8.5	mg/L			
N-NO3 (Nitrate)	mg/L	0.10	<0.10	AO					
pH			8.14						
Phenols	mg/L	0.001	<0.001	AO	500	mg/L			
Sulphate	mg/L	1	48	AO	500	mg/L			
Tannin & Iginin	mg/L	0.1	0.2						
TDS (COND - CALC)	mg/L	5	439						
Total Kjeldahl Nitrogen	mg/L	0.05	0.13						
Turbidity	NTU	0.1	1.0	AO	1.0	NTU			
Hardness as CaCO3	mg/L	1	231	OG	100	mg/L			
Ion Balance		0.01	0.90						
Calcium	mg/L	1	54						
Magnesium	mg/L	1	25						
Potassium	mg/L	1	5						
Sodium	mg/L	2	36						
Iron	mg/L	0.03	0.09	AO	20	mg/L			
Manganese	mg/L	0.01	0.03	AO	0.3	mg/L			
				AO	0.05	mg/L			

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

APPROVAL:

*Elvyn McRobbie*  
 Inorganic Lab Supervisor

**Client:** Paterson Group  
28 Concourse Gate, Unit 1  
Nepean, ON  
K2E 7T7

**Attention:** Mr. Robert Passmore

**INVOICE:** Paterson Group Inc.  
**Chain of Custody Number:** 58356

**Report Number:** 2702831  
**Date:** 2007-02-16  
**Date Submitted:** 2007-02-12

**Project:** PH 0145

**P.O. Number:**  
**Matrix:** Water

PARAMETER	LAB ID: 523566		UNITS	MDL	CONCENTRATION	TYPE	LIMIT	UNITS
	Sample Date: 2007-02-12	Sample ID: TW 10WS2						
Alkalinity as CaCO3	mg/L	5	207		OG	500	mg/L	
Chloride	mg/L	1	65		AO	250	mg/L	
Colour	TCU	2	2		AO	5	TCU	
Conductivity	uS/cm	5	680		AO	5	mg/L	
Dissolved Organic Carbon	mg/L	0.5	1.1		MAC	1.5	mg/L	
Fluoride	mg/L	0.10	0.38		AC	0.05	mg/L	
Hydrogen Sulphide	mg/L	0.01	<0.01		MAC	1.0	mg/L	
N-NH3 (Ammonia)	mg/L	0.02	0.09		MAC	10.0	mg/L	
N-NO2 (Nitrite)	mg/L	0.10	<0.10		AO	6.5-8.5	mg/L	
N-NO3 (Nitrate)	mg/L	0.10	<0.10		AO	500	mg/L	
pH			8.09					
Phenols	mg/L	0.001	<0.001		AO	500	mg/L	
Sulphate	mg/L	1	48		AO	500	mg/L	
Tannin & Lignin	mg/L	0.1	0.2		AO	500	mg/L	
TDS (COND - CALC)	mg/L	5	442		AO	500	mg/L	
Total Kjeldahl Nitrogen	mg/L	0.05	0.12		AO	1.0	NTU	
Turbidity	NTU	0.1	0.7		OG	100	mg/L	
Hardness as CaCO3	mg/L	1	252					
Ion Balance			0.97					
Calcium	mg/L	1	58		AO	20	mg/L	
Magnesium	mg/L	1	26		AO	0.3	mg/L	
Potassium	mg/L	1	6		AO	0.05	mg/L	
Sodium	mg/L	2	37					
Iron	mg/L	0.03	0.09					
Manganese	mg/L	0.01	0.03					

MDL = Method Detection Limit INC = Incomplete AD = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration  
Comment:

APPROVAL:

*[Signature]*  
Evan M. Kobler  
Inorganic Lab Supervisor





**Client:** Paterson Group  
28 Concourse Gate, Unit 1  
Nepean, ON  
K2E 7T7

**Report Number:** 2702988  
**Date:** 2007-02-16  
**Date Submitted:** 2007-02-13

**Attention:** Mr. Robert Passmore

**Project:** PHO145

**INVOICE:** Paterson Group Inc.  
**Chain of Custody Number:** 49794

**P.O. Number:**  
**Matrix:**

PARAMETER	UNITS	MDL	LAB ID:		GUIDELINE	TYPE	LIMIT	UNITS
			Sample Date:	Sample ID:				
Alkalinity as CaCO3	mg/L	5	524059	524060	Water	OG	500	mg/L
Chloride	mg/L	1	2007-02-13	2007-02-13	Water	AC	250	mg/L
Colour	TCU	2	TW11 WS1	TW11 WS2	Water	AO	5	TCU
Conductivity	uS/cm	5						
Dissolved Organic Carbon	mg/L	0.5						
Fluoride	mg/L	0.10						
Hydrogen Sulphide	mg/L	0.01						
N-NH3 (Ammonia)	mg/L	0.02						
N-NO2 (Nitrite)	mg/L	0.10						
N-NO3 (Nitrate)	mg/L	0.10						
pH								
Phenols	mg/L	0.001						
Sulphate	mg/L	1						
Tannin & Lignin	mg/L	0.1						
TDS (COND - CALC)	mg/L	5						
Total Kjeldahl Nitrogen	mg/L	0.05						
Turbidity	NTU	0.1						
Hardness as CaCO3	mg/L	1						
Iron Balance								
Calcium	mg/L	1						
Magnesium	mg/L	1						
Potassium	mg/L	1						
Sodium	mg/L	2						
Iron	mg/L	0.03						
Manganese	mg/L	0.01						

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

Comment:

APPROVAL:

*[Signature]*  
Ewa M. Korduba  
Regional Lab Supervisor

**APPENDIX 3**

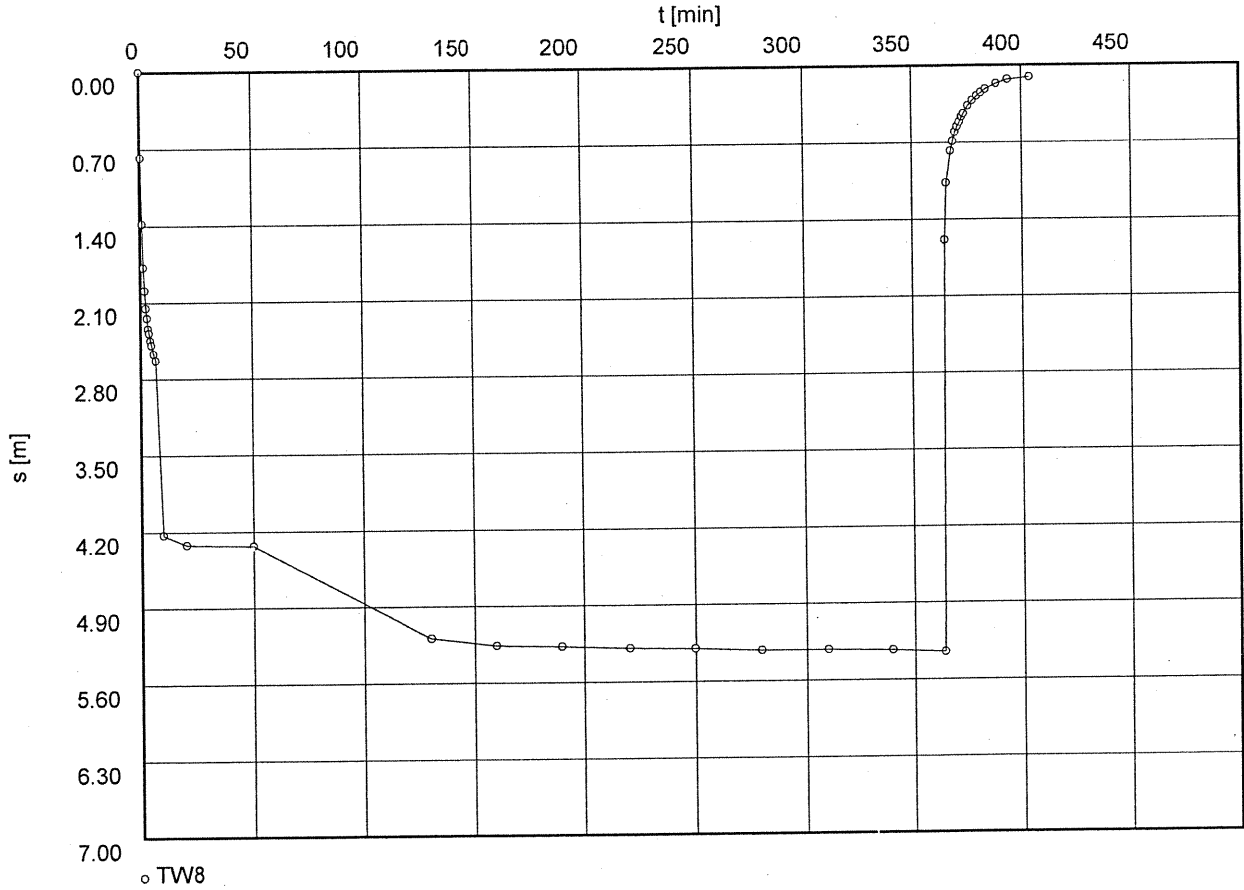
**Aquifer Analysis Data for Additional Test Wells**

Pumping Test No. 2

Test conducted on: Feb. 9, 2007

TW8

Discharge 1.42 l/s



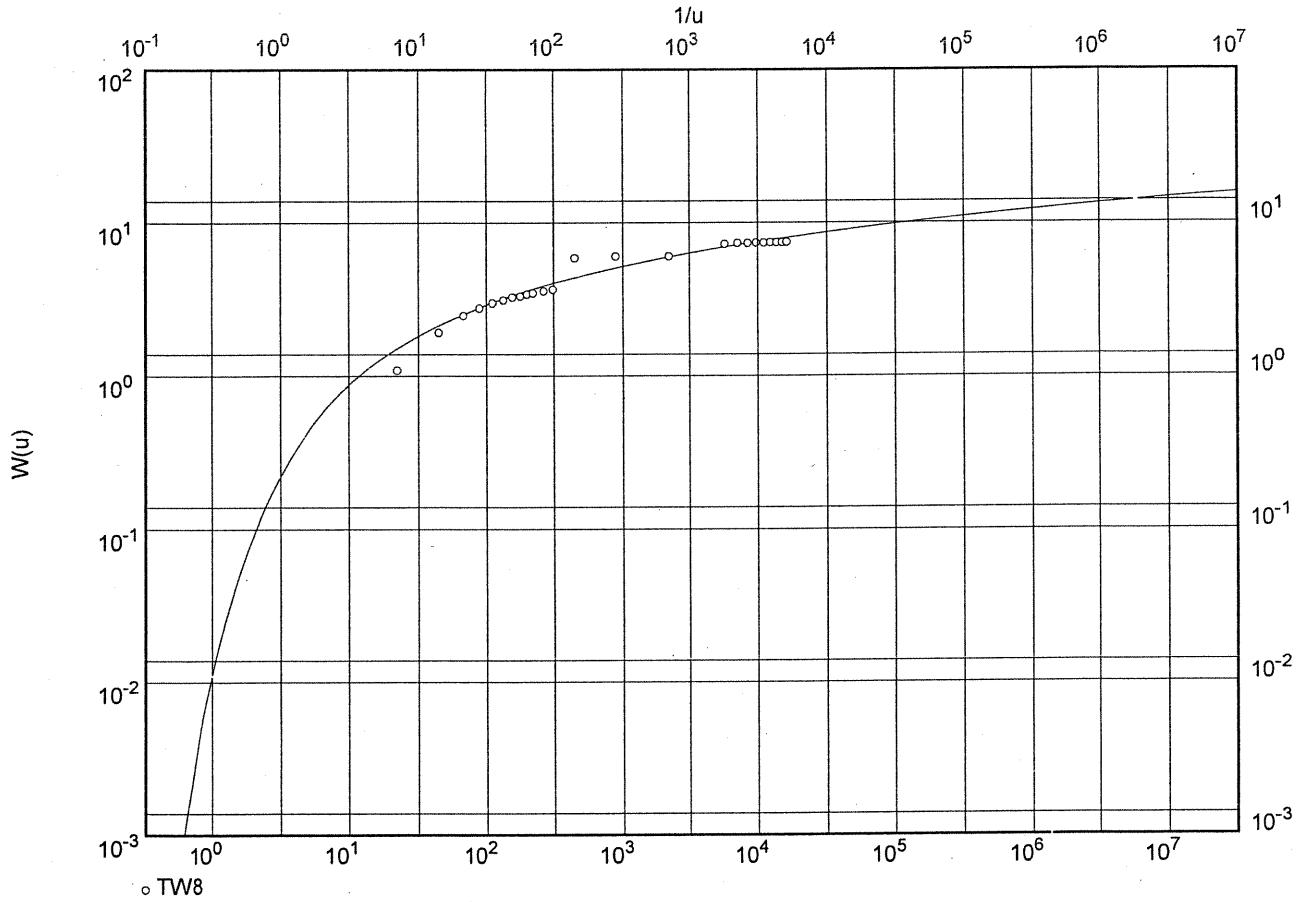


Pumping Test No. 2

Test conducted on: Feb. 9, 2007

TW8

Discharge 1.42 l/s



Transmissivity [m<sup>2</sup>/min]:  $9.41 \times 10^{-3}$

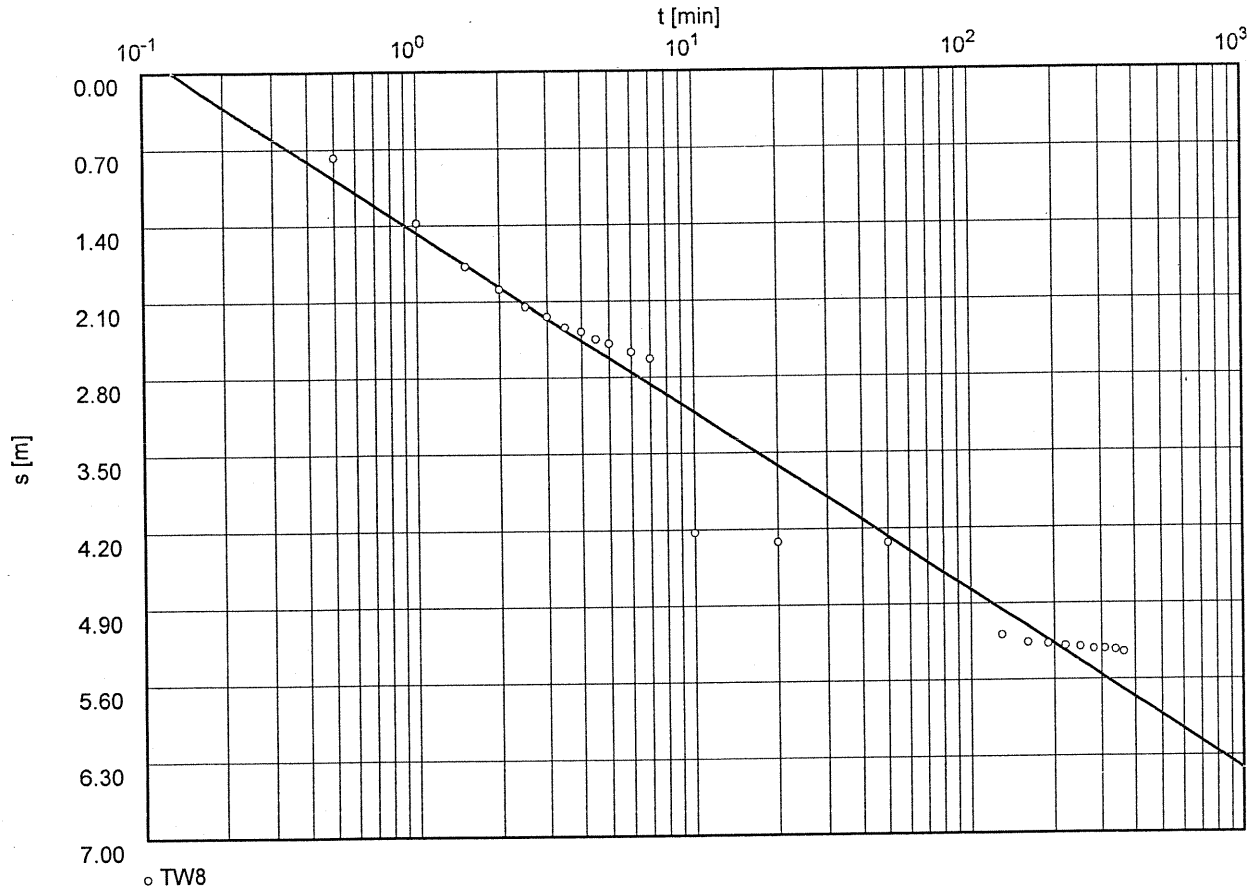
Storativity:  $1.18 \times 10^{-1}$

Pumping Test No. 2

Test conducted on: Feb. 9, 2007

TW8

Discharge 1.42 l/s



Transmissivity [m<sup>2</sup>/min]:  $9.44 \times 10^{-3}$

Storativity:  $1.21 \times 10^{-1}$

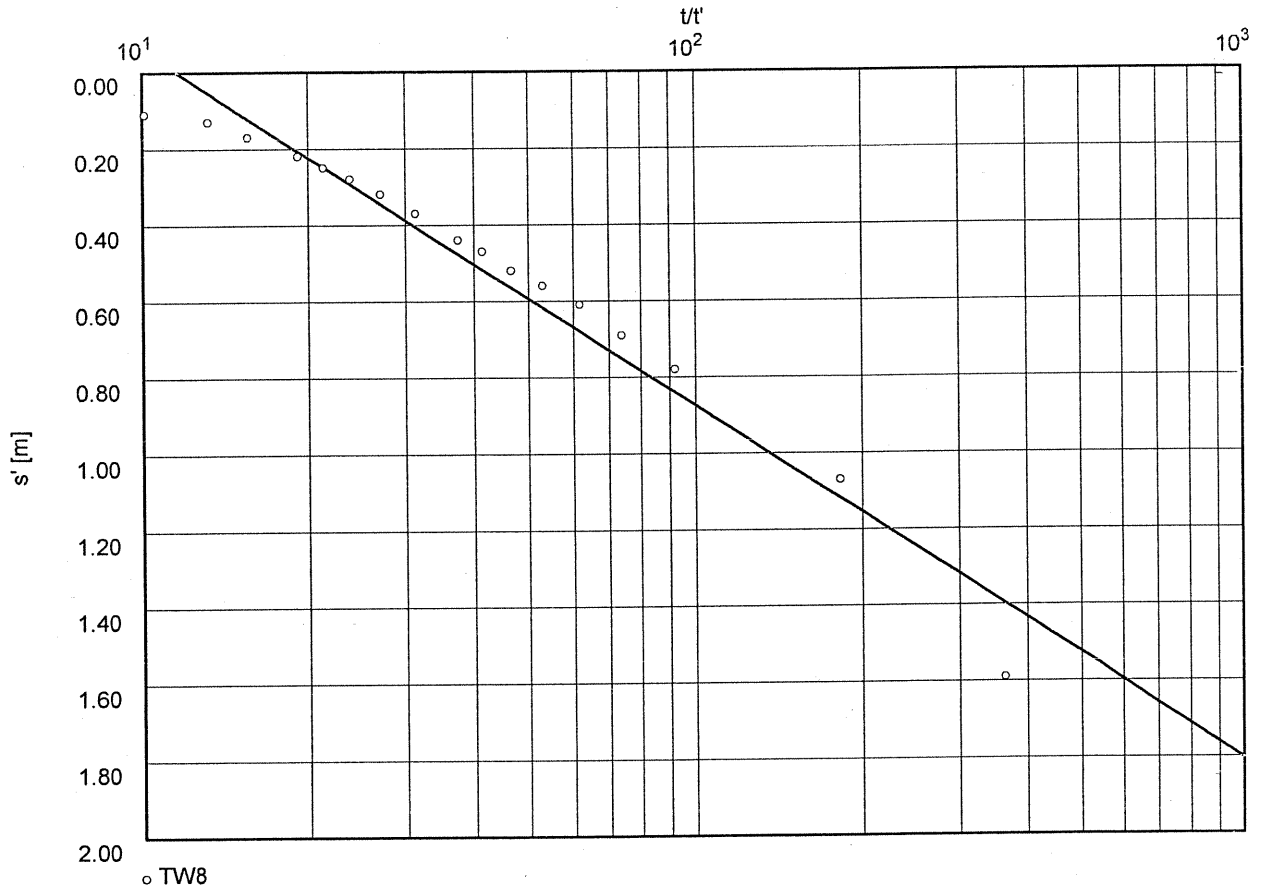
Pumping Test No. 2

Test conducted on: Feb. 9, 2007

TW8

Discharge 1.42 l/s

Pumping test duration: 364.00 min



Transmissivity [m<sup>2</sup>/min]:  $1.67 \times 10^{-2}$

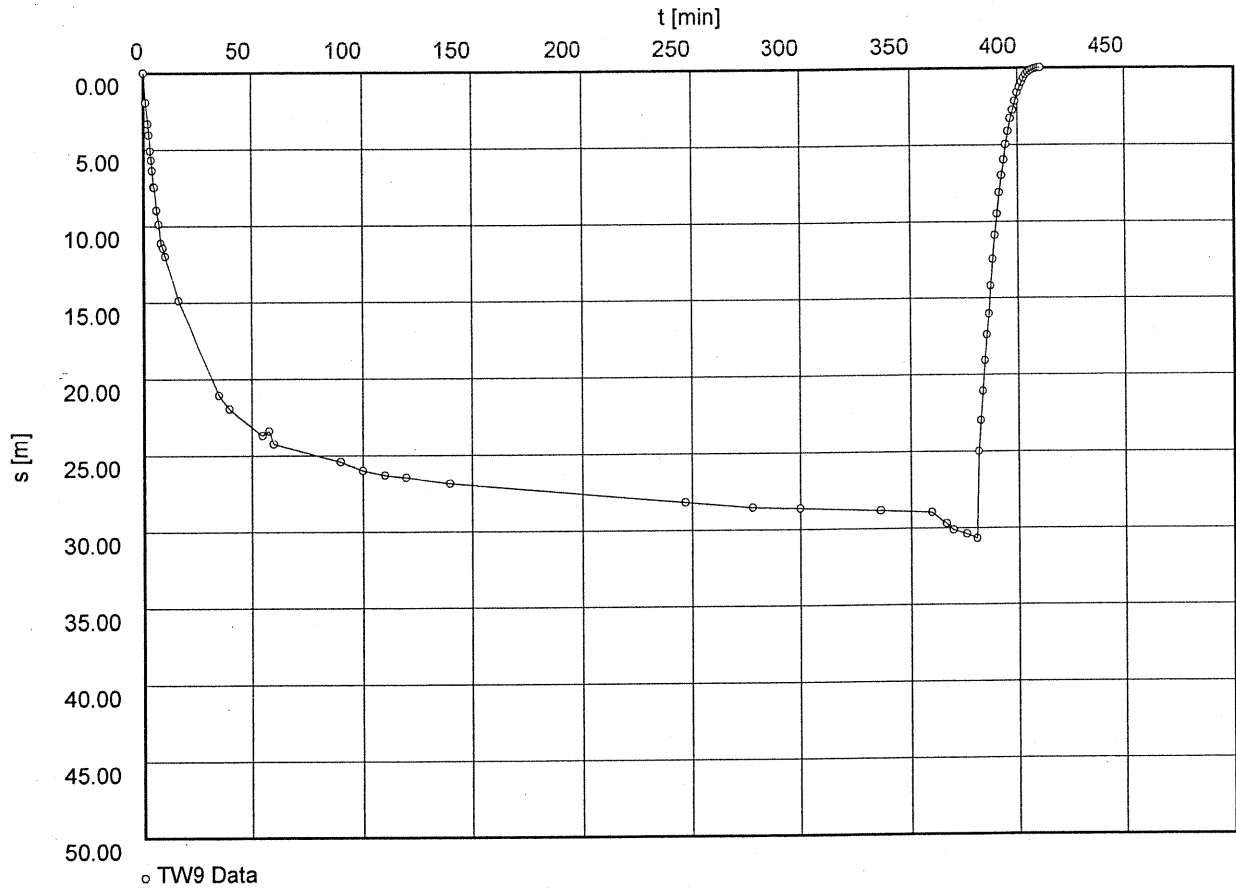


Pumping Test No. 1

Test conducted on: February 8, 2007

TW9

Discharge 1.50 l/s



Pumping Test No. 1

Test conducted on: February 8, 2007

TW9

TW9 Data

Discharge 1.50 l/s

Distance from the pumping well 0.150 m

Static water level: 0.970 m below datum

	Pumping test duration	Water level	Drawdown	
	[min]	[m]	[m]	
1	0.00	0.970	0.000	
2	1.00	2.880	1.910	
3	2.00	4.280	3.310	
4	2.50	5.020	4.050	
5	3.00	6.050	5.080	
6	3.50	6.650	5.680	
7	4.00	7.340	6.370	
8	4.50	8.400	7.430	
9	5.00	8.440	7.470	
10	6.00	9.920	8.950	
11	7.00	10.840	9.870	
12	8.00	12.100	11.130	
13	9.00	12.400	11.430	
14	10.00	12.950	11.980	
15	16.00	15.850	14.880	
16	35.00	22.030	21.060	
17	40.00	22.930	21.960	
18	55.00	24.660	23.690	
19	58.00	24.370	23.400	
20	60.00	25.200	24.230	
21	90.00	26.380	25.410	
22	100.00	26.960	25.990	
23	110.00	27.280	26.310	
24	120.00	27.420	26.450	
25	140.00	27.830	26.860	
26	247.00	29.160	28.190	
27	278.00	29.540	28.570	
28	300.00	29.620	28.650	
29	337.00	29.810	28.840	
30	360.00	29.950	28.980	
31	367.00	30.670	29.700	
32	370.00	31.100	30.130	
33	376.00	31.360	30.390	
34	381.00	31.660	30.690	
35	382.00	25.960	24.990	
36	383.00	23.940	22.970	
37	384.00	22.060	21.090	
38	385.00	20.050	19.080	
39	386.00	18.360	17.390	
40	387.00	17.000	16.030	
41	388.00	15.170	14.200	
42	389.00	13.420	12.450	
43	390.00	11.870	10.900	
44	391.00	10.460	9.490	
45	392.00	9.090	8.120	
46	393.00	7.960	6.990	
47	394.00	6.950	5.980	
48	395.00	5.950	4.980	
49	396.00	5.100	4.130	
50	397.00	4.270	3.300	

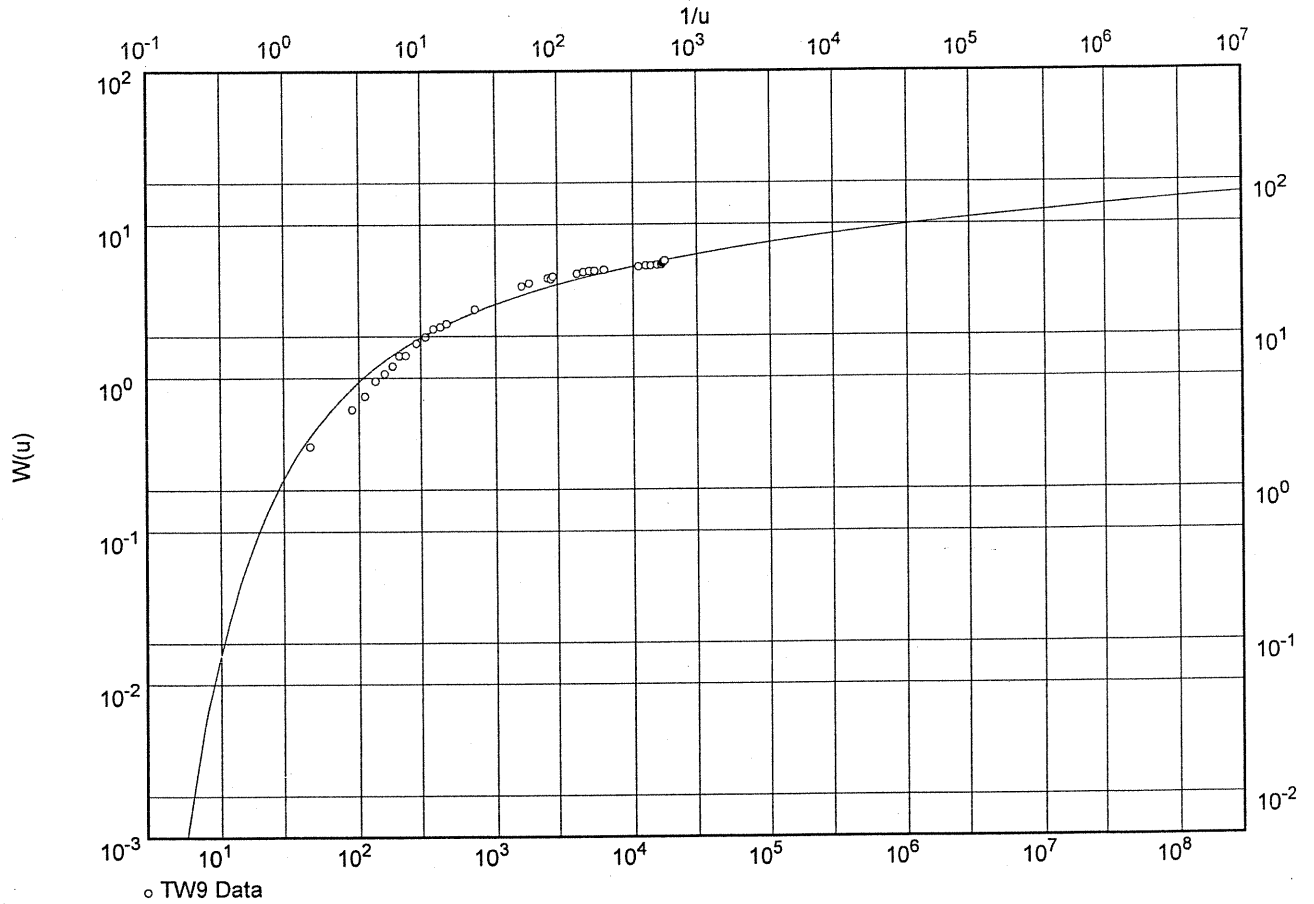


Pumping Test No. 1

Test conducted on: February 8, 2007

TW9

Discharge 1.50 l/s



Transmissivity [m<sup>2</sup>/min]:  $1.33 \times 10^{-3}$

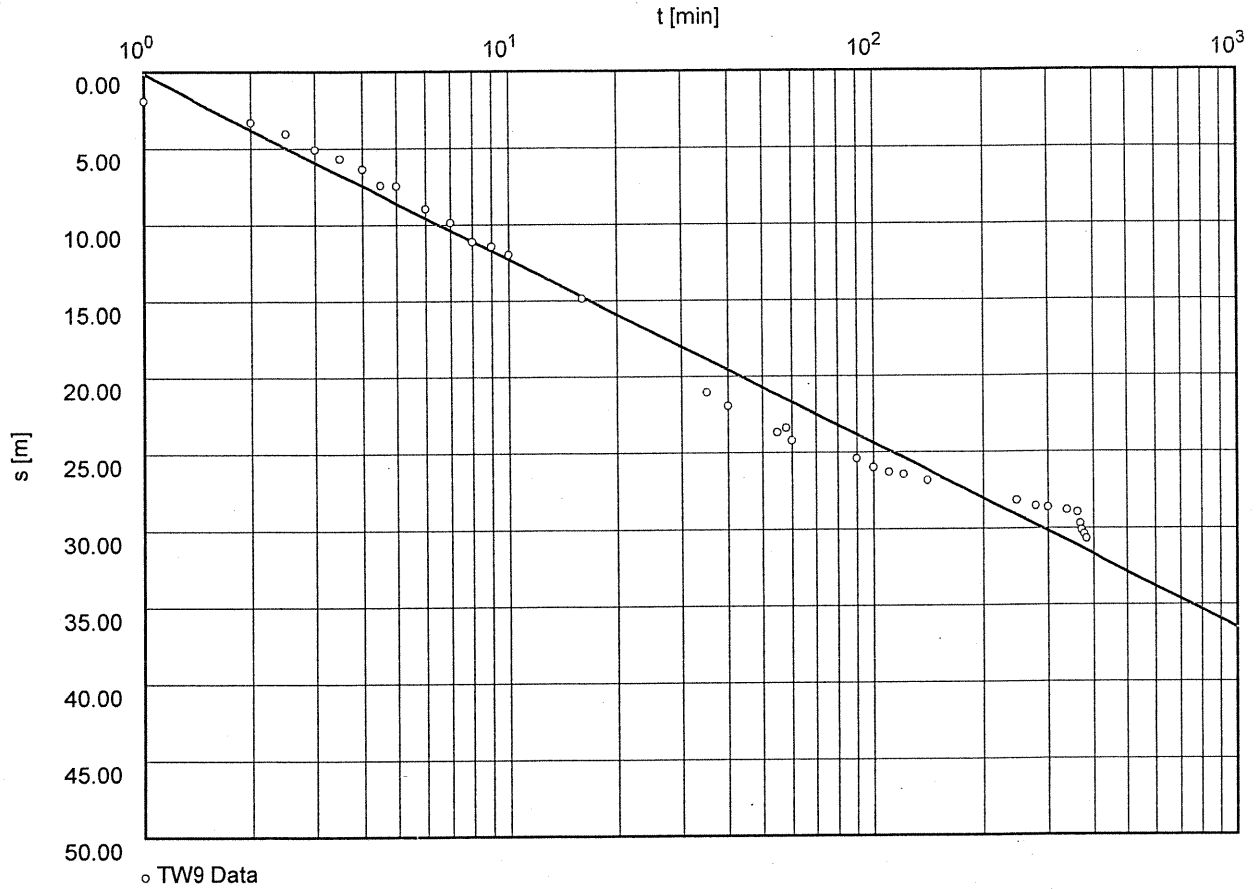
Storativity:  $1.52 \times 10^{-1}$

Pumping Test No. 1

Test conducted on: February 8, 2007

TW9

Discharge 1.50 l/s



Transmissivity [ $m^2/min$ ]:  $1.35 \times 10^{-3}$

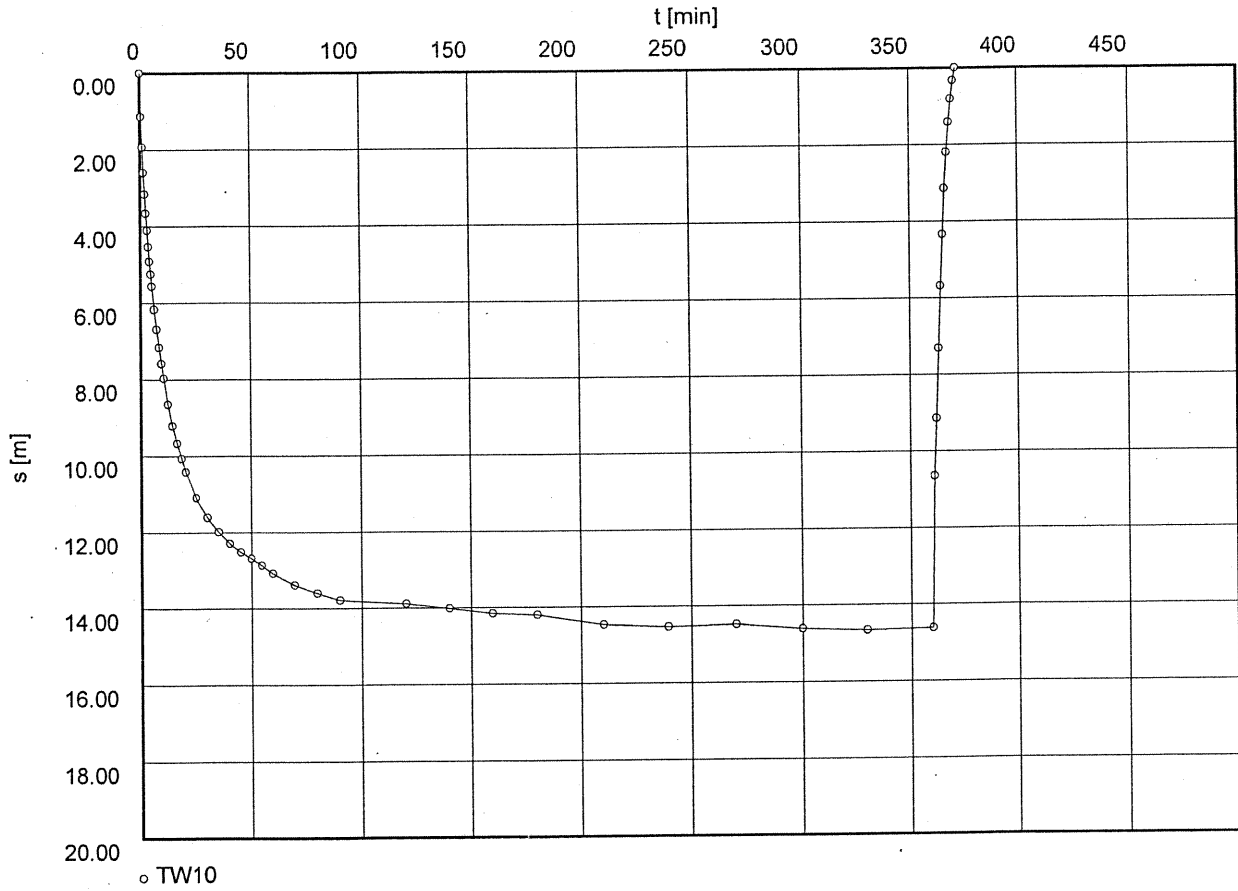
Storativity:  $1.32 \times 10^{-1}$

Pumping Test No. 3

Test conducted on: Feb. 12, 2007

TW10

Discharge 0.90 l/s



Pumping Test No. 3

Test conducted on: Feb. 12, 2007

TW10

TW10

Discharge 0.90 l/s

Distance from the pumping well 0.150 m

Static water level: 0.000 m below datum

	Pumping test duration	Water level	Drawdown	
	[min]	[m]	[m]	
1	0.00	0.000	0.000	
2	0.50	1.130	1.130	
3	1.00	1.930	1.930	
4	1.50	2.600	2.600	
5	2.00	3.170	3.170	
6	2.50	3.660	3.660	
7	3.00	4.110	4.110	
8	3.50	4.530	4.530	
9	4.00	4.920	4.920	
10	4.50	5.250	5.250	
11	5.00	5.570	5.570	
12	6.00	6.170	6.170	
13	7.00	6.680	6.680	
14	8.00	7.160	7.160	
15	9.00	7.580	7.580	
16	10.00	7.970	7.970	
17	12.00	8.650	8.650	
18	14.00	9.210	9.210	
19	16.00	9.670	9.670	
20	18.00	10.070	10.070	
21	20.00	10.420	10.420	
22	25.00	11.090	11.090	
23	30.00	11.610	11.610	
24	35.00	11.980	11.980	
25	40.00	12.290	12.290	
26	45.00	12.520	12.520	
27	50.00	12.680	12.680	
28	55.00	12.870	12.870	
29	60.00	13.080	13.080	
30	70.00	13.390	13.390	
31	80.00	13.610	13.610	
32	90.00	13.790	13.790	
33	120.00	13.890	13.890	
34	140.00	14.020	14.020	
35	160.00	14.160	14.160	
36	180.00	14.200	14.200	
37	210.00	14.470	14.470	
38	240.00	14.530	14.530	
39	270.00	14.480	14.480	
40	300.00	14.610	14.610	
41	330.00	14.660	14.660	
42	360.00	14.620	14.620	
43	361.00	10.650	10.650	
44	362.00	9.140	9.140	
45	363.00	7.310	7.310	
46	364.00	5.680	5.680	
47	365.00	4.340	4.340	
48	366.00	3.150	3.150	
49	367.00	2.200	2.200	
50	368.00	1.420	1.420	



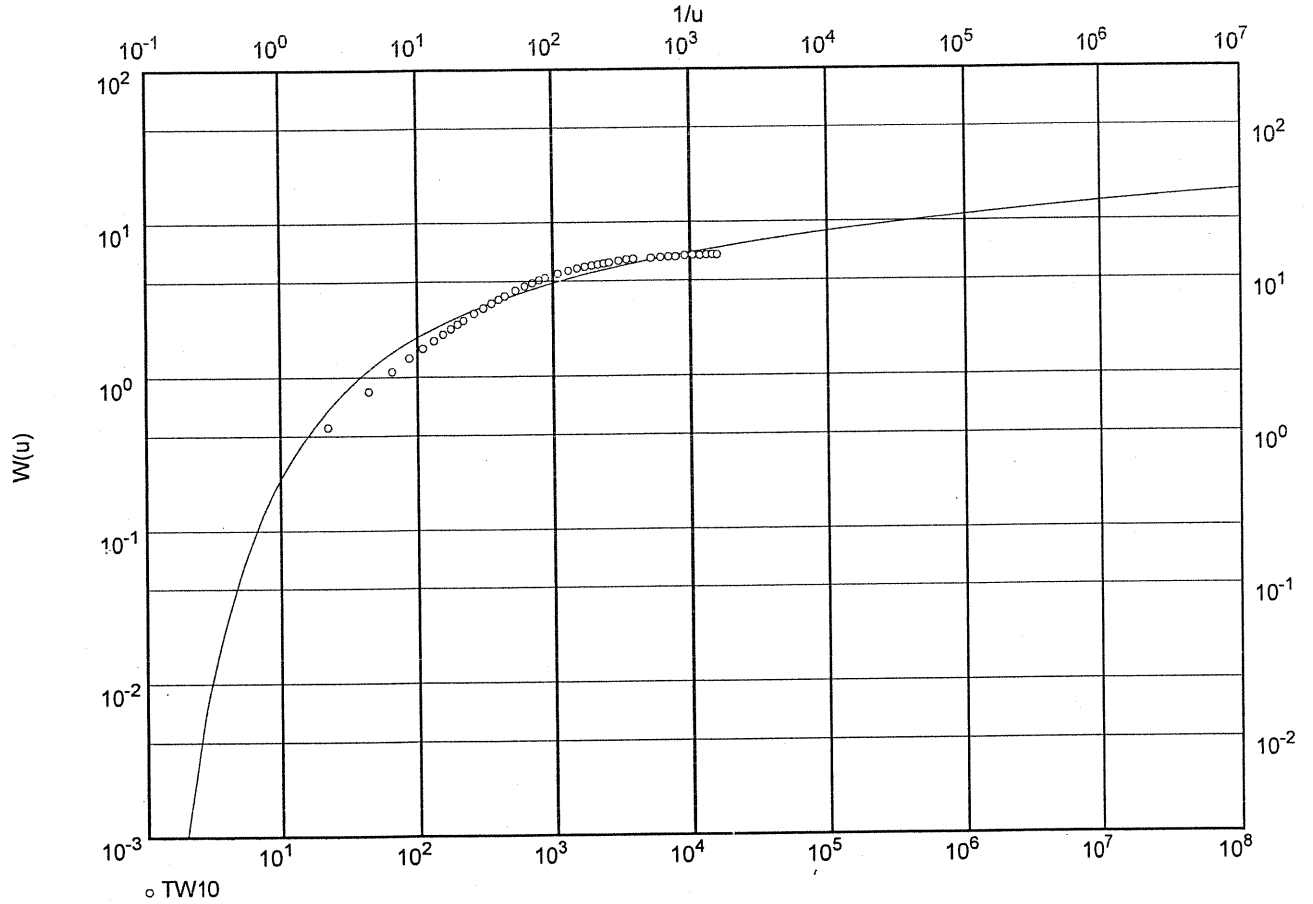


Pumping Test No. 3

Test conducted on: Feb. 12, 2007

TW10

Discharge 0.90 l/s



Transmissivity [ $m^2/min$ ]:  $1.78 \times 10^{-3}$

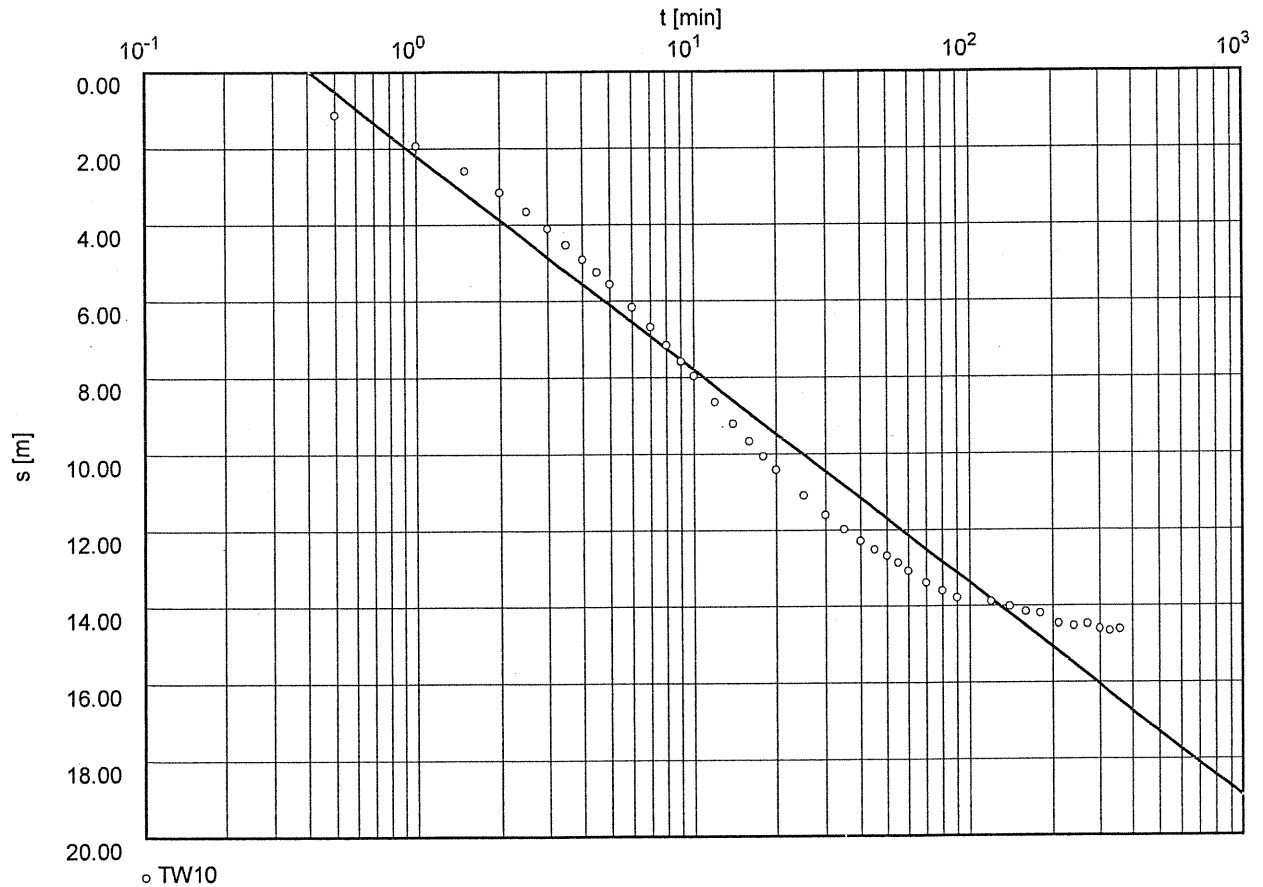
Storativity:  $7.31 \times 10^{-2}$

Pumping Test No. 3

Test conducted on: Feb. 12, 2007

TW10

Discharge 0.90 l/s



Transmissivity [ $m^2/min$ ]:  $1.76 \times 10^{-3}$

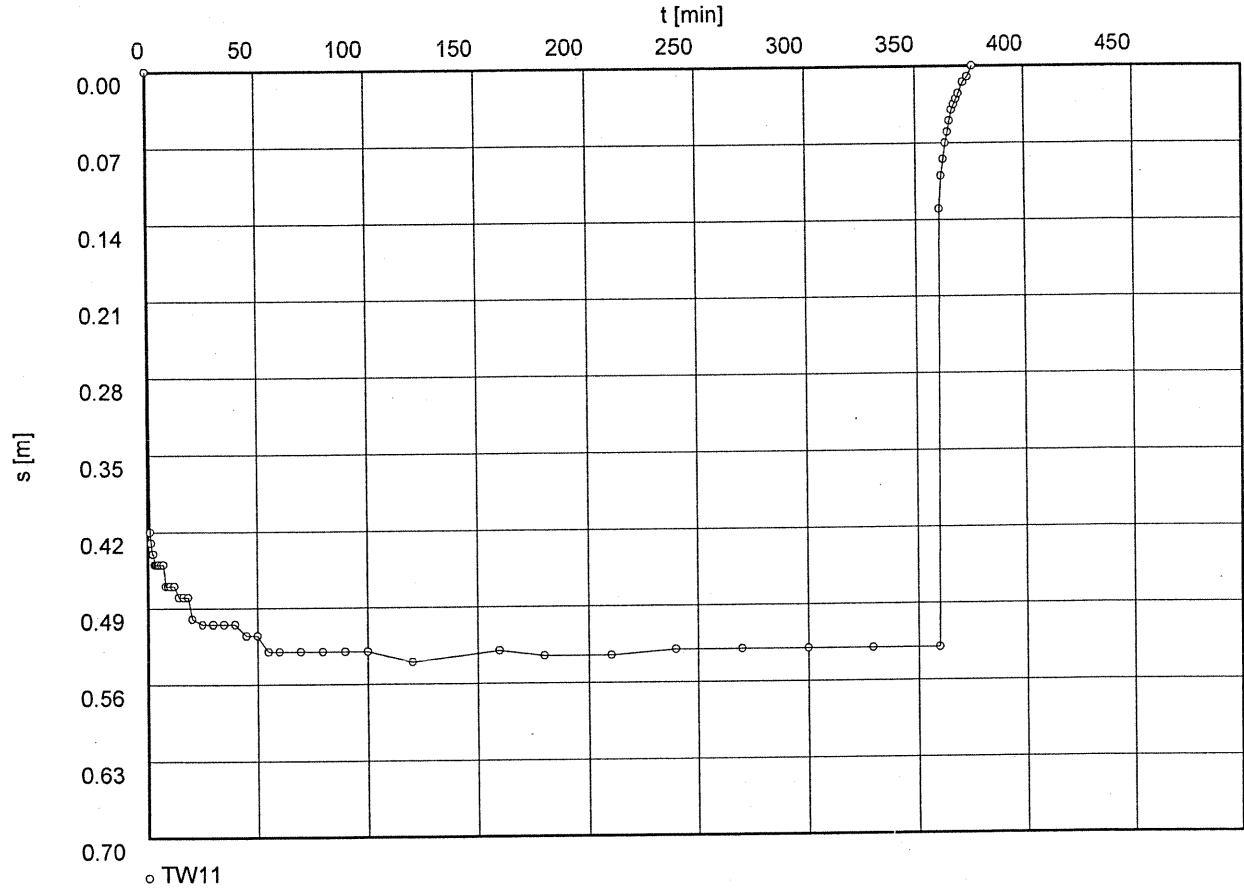
Storativity:  $7.16 \times 10^{-2}$

Pumping Test No. 4

Test conducted on: Feb. 13, 2007

TW11

Discharge 1.60 l/s



Pumping Test No. 4

Test conducted on: Feb.13, 2007

TW11

TW11

Discharge 1.60 l/s

Distance from the pumping well 0.150 m

Static water level: 0.800 m below datum

	Pumping test duration	Water level	Drawdown	
	[min]	[m]	[m]	
1	0.00	0.800	0.000	
2	1.00	1.220	0.420	
3	1.50	1.230	0.430	
4	2.00	1.240	0.440	
5	2.50	1.240	0.440	
6	3.00	1.250	0.450	
7	3.50	1.250	0.450	
8	4.00	1.250	0.450	
9	4.50	1.250	0.450	
10	5.00	1.250	0.450	
11	6.00	1.250	0.450	
12	7.00	1.250	0.450	
13	8.00	1.270	0.470	
14	9.00	1.270	0.470	
15	10.00	1.270	0.470	
16	12.00	1.270	0.470	
17	14.00	1.280	0.480	
18	16.00	1.280	0.480	
19	18.00	1.280	0.480	
20	20.00	1.300	0.500	
21	25.00	1.305	0.505	
22	30.00	1.305	0.505	
23	35.00	1.305	0.505	
24	40.00	1.305	0.505	
25	45.00	1.315	0.515	
26	50.00	1.315	0.515	
27	55.00	1.330	0.530	
28	60.00	1.330	0.530	
29	70.00	1.330	0.530	
30	80.00	1.330	0.530	
31	90.00	1.330	0.530	
32	100.00	1.330	0.530	
33	120.00	1.340	0.540	
34	160.00	1.330	0.530	
35	180.00	1.335	0.535	
36	210.00	1.335	0.535	
37	240.00	1.330	0.530	
38	270.00	1.330	0.530	
39	300.00	1.330	0.530	
40	330.00	1.330	0.530	
41	360.00	1.330	0.530	
42	361.00	0.930	0.130	
43	362.00	0.900	0.100	
44	363.00	0.885	0.085	
45	364.00	0.870	0.070	
46	365.00	0.860	0.060	
47	366.00	0.850	0.050	
48	367.00	0.840	0.040	
49	368.00	0.835	0.035	
50	369.00	0.830	0.030	

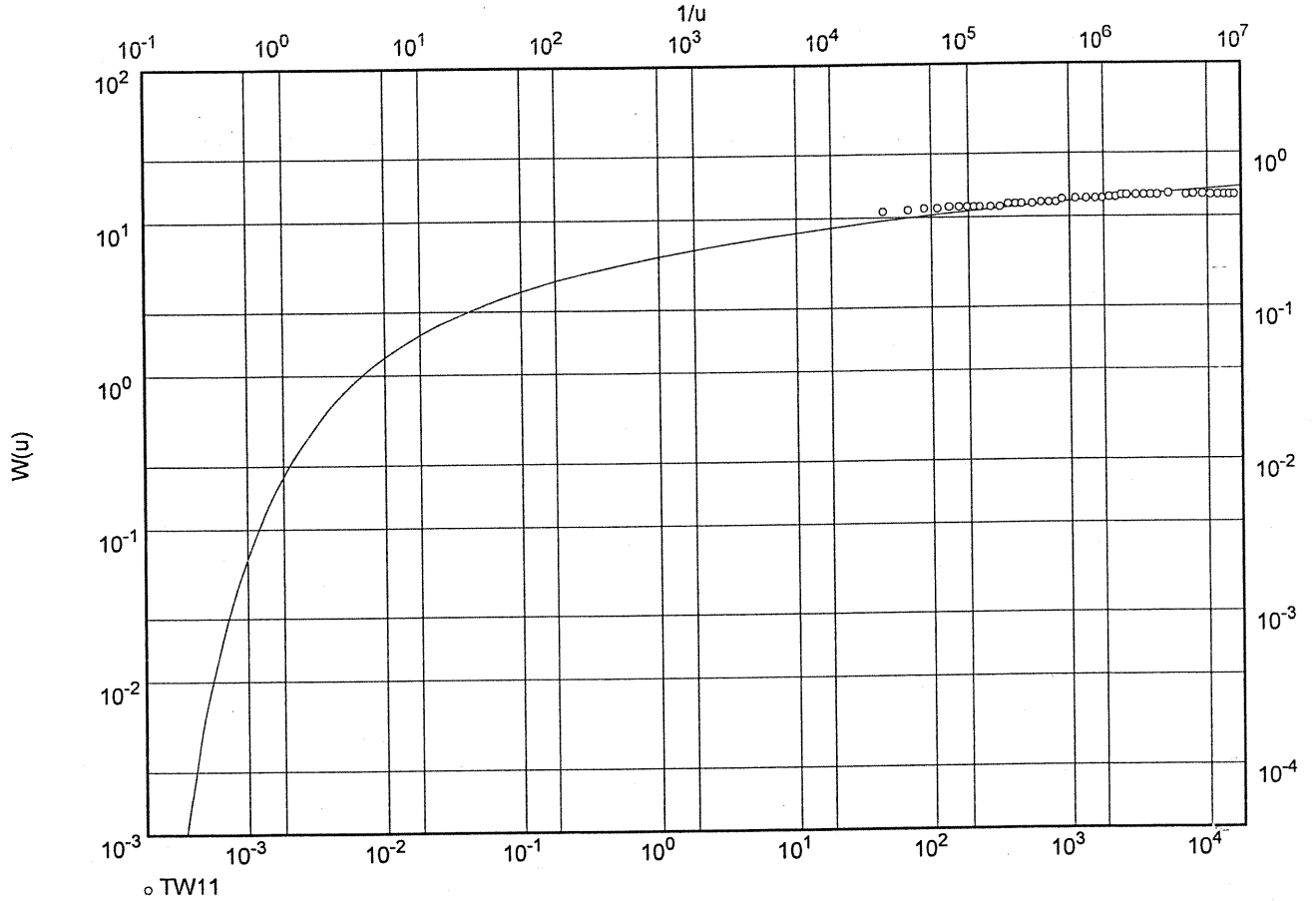


Pumping Test No. 4

Test conducted on: Feb.13, 2007

TW11

Discharge 1.60 l/s



Transmissivity [ $m^2/min$ ]:  $1.97 \times 10^{-1}$

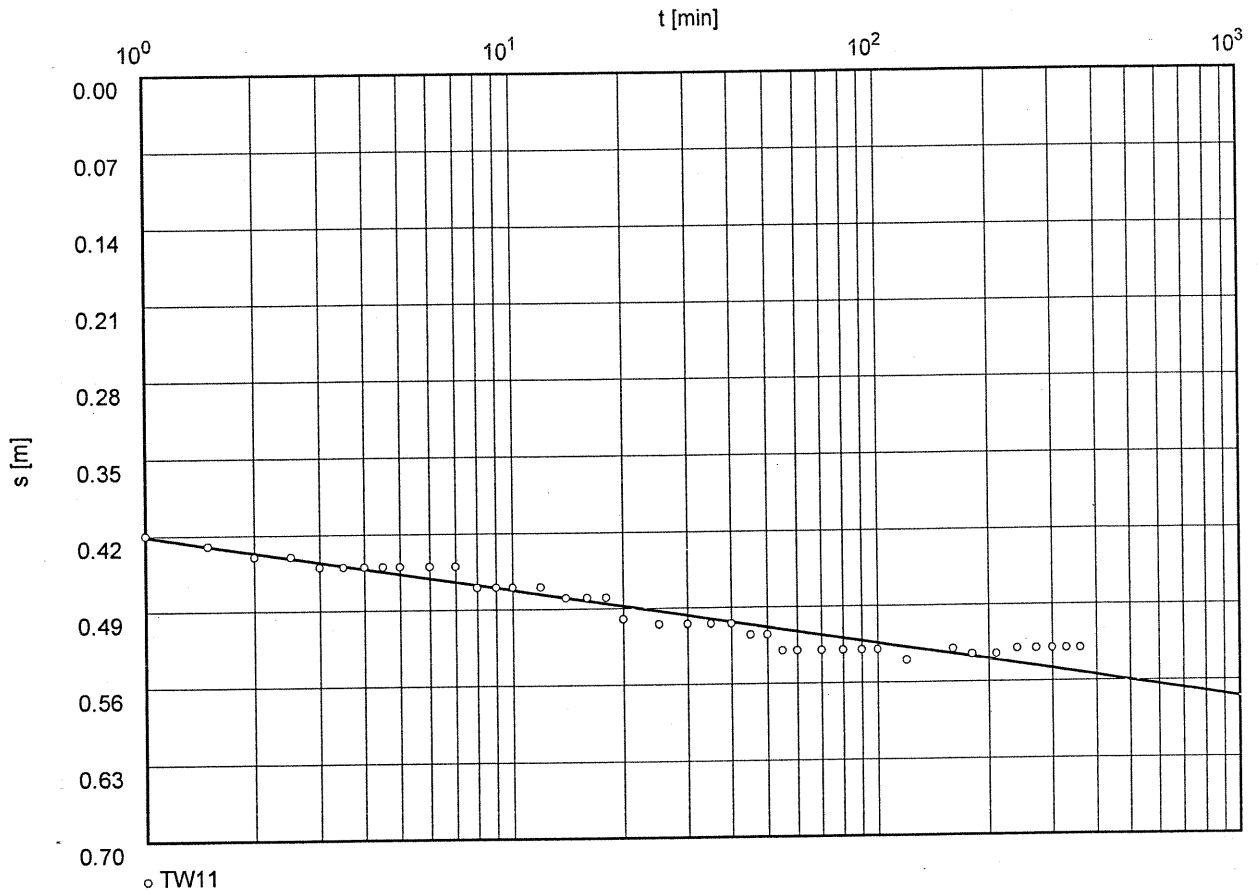
Storativity:  $1.43 \times 10^{-3}$

Pumping Test No. 4

Test conducted on: Feb.13, 2007

TW11

Discharge 1.60 l/s



Transmissivity [ $m^2/min$ ]:  $3.41 \times 10^{-1}$   
Storativity:  $2.20 \times 10^{-7}$

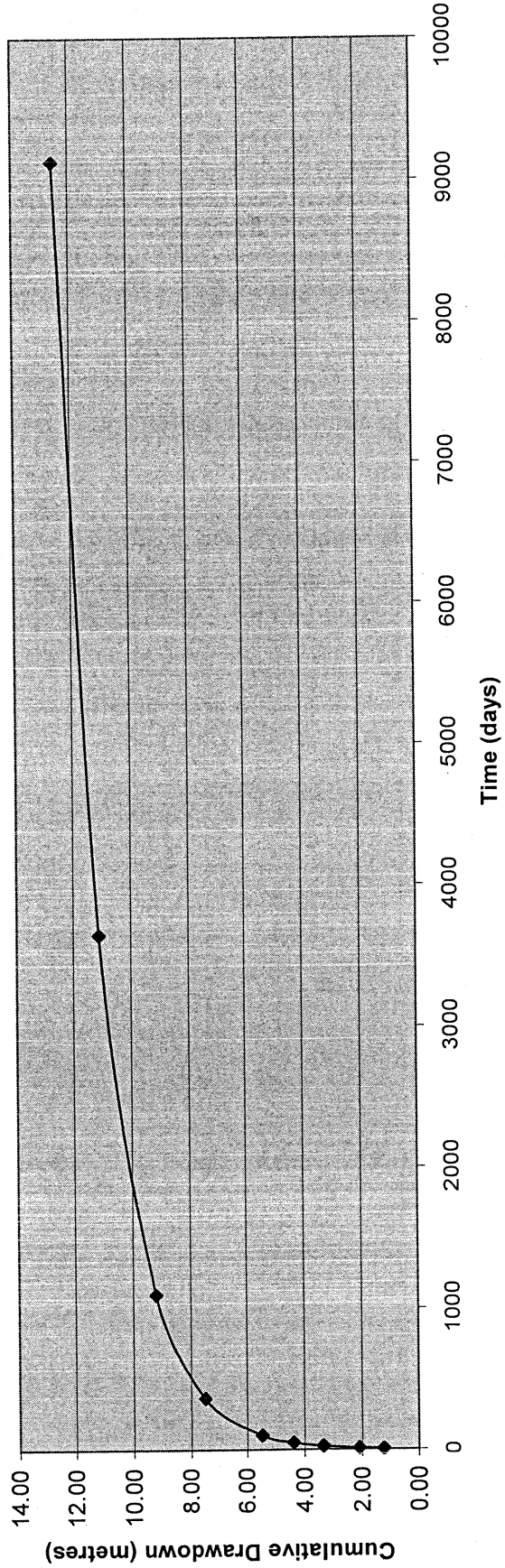
# Determination of Potential Well Interference

Pumping Rate (Q) m<sup>3</sup>/day 2  
 Transmissivity (T) m<sup>2</sup>/day 12.52  
 Average Well Spacing (m) 25  
 Coefficient of Storage S 0.0423

Notes: Analysis Assumes Continuous Pumping of 252 Wells

Time (days)	1st Well Grouping u	W(u)	2nd Well Grouping u	W(u)	3rd Well Grouping u	W(u)	4th Well Grouping u	W(u)	5th Well Grouping u	W(u)	Drawdown m
5	5.3E-02	2.4126	1.6E-01	1.4092	2.6E-01	1.0139	3.7E-01	0.7554	4.8E-01	0.5848	1.26
10	2.6E-02	3.0983	7.9E-02	2.0386	1.3E-01	1.5889	1.8E-01	1.3098	2.4E-01	1.0762	2.10
25	1.1E-02	3.9436	3.2E-02	2.8965	5.3E-02	2.4126	7.4E-02	2.0991	9.5E-02	1.8695	3.36
50	5.3E-03	4.6681	1.6E-02	3.5739	2.6E-02	3.0983	3.7E-02	2.7563	4.8E-02	2.5068	4.39
100	2.6E-03	5.3776	7.9E-03	4.2716	1.3E-02	3.7785	1.8E-02	3.4581	2.4E-02	3.1763	5.47
365	7.2E-04	6.6598	2.2E-03	5.5443	3.6E-03	5.0532	5.1E-03	4.7064	6.5E-03	4.4652	7.48
1100	2.4E-04	7.7579	7.2E-04	6.6598	1.2E-03	6.1494	1.7E-03	5.8016	2.2E-03	5.5443	9.19
3650	7.2E-05	8.9617	2.2E-04	7.8449	3.6E-04	7.3526	5.1E-04	7.0044	6.5E-04	6.7620	11.10
9125	2.9E-05	9.8710	8.7E-05	8.7725	1.4E-04	8.2968	2.0E-04	7.9402	2.6E-04	7.6779	12.56

Graph of Drawdown vs. Time





**APPENDIX 4**

**Revised Lot Development Plan**

# patersongroup

July 4, 2008  
File No. PH0145-05.Let

**Sunset Lakes Development Corporation**  
6576 Apple Orchard Road  
Greely, ON  
K4P 1E5

Attention: **Mr. Dan Anderson**

Subject: **Nitrate Impact Calculations**  
**Greely Village, Ottawa, ON**

## Consulting Engineers

28 Concourse Gate, Unit 1  
Ottawa, Ontario  
Canada K2E 7T7  
Tel: (613) 226-7381  
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Geotechnical Engineering  
Environmental Engineering  
Hydrogeology  
Geological Engineering  
Materials Testing  
Building Science

[www.patersongroup.ca](http://www.patersongroup.ca)

Dear Sir:

As requested, please find below our revised nitrate impact calculations for the above referenced site. It is our understanding that the most recent development proposal calls for 71 residential lots and 6 office blocks.

### Design Flows

The design flows used for sizing residential leaching beds are typically in the range of 3000 to 3500 L/day, depending on the size of house. As per MOE Guideline D-5-4, a corresponding figure of 1000 L/day per residential unit is used as representing the portion of flows containing nitrates at a concentration of 40 mg/L. The design flows for office buildings are covered under the Ontario Building Code, with a specified design flow of 75 L / 9.3 m<sup>2</sup> of office space. Based on our understanding that the typical office building will be of the order of 186 m<sup>2</sup>, this would equate to a design flow of 1500 L/day, which would be approximately half that of a typical house. As such, for purposes of nitrate impact assessment, it would be taken that 2 office blocks would be equivalent to one house, and as such a total site loading of 74,000 L/day would be used in the analysis for the site (71 houses x 1000 l/day plus 6 offices x 0.5x1000 l/day).

### Site Topography Factor

The sewage loadings will be reduced through dilution using precipitation. The amount of infiltration is reduced by factors such as evapotranspiration, and runoff, with the remaining portion being identified as surplus moisture. This portion is available for dilution.

It is important to note that dilution modelling must consider the post development condition, to provide a reasonable assessment of how the subdivision will perform in the long term. As would be expected, site grading, stormwater management, and an understanding of how hard surfaces contribute to the overall groundwater recharge to the site are important in predictive assessments.

In arriving at a reasonable value for a site topography factor, it is important to base it on the actual conditions that will exist when development takes place. Regrading of the site is required as part of the overall stormwater management, to ensure that stormwater is directed to the ponds on the interior of the site. On Page 4.55 of the MOEE Hydrogeological Technical Information Requirements for Land Development Applications it states that:

*"Another crucial consideration is the potential to a site's soil cover which can occur from grading and regrading activities which are part of the site's development."*

This provides a clear indication that the actual post development condition should be considered.

On the same page of the above referenced document, it states that:

*"Stormwater management facilities may also contribute to infiltration. However, they may also detract from infiltration by directing water away from the tile bed area. These facilities should be considered as part of determination of available infiltration."*

This is a further indication that the predictive assessment should consider the post development conditions. It is our opinion that the proposed ponds will contribute to infiltration in that they are dug to intercept the overburden aquifer, and are not lined with an impervious material to prevent infiltration.

In conducting our analysis, the following assumptions are made:

#### Infiltration Factors

As part of the overall site development, significant regrading will occur as part of the stormwater management design. It is assumed that 75 % of the stormwater runoff will be contained within the site boundaries by directing the runoff to stormwater management ponds. It is also recognized that although the available infiltration area is reduced by the presence of hard or impervious surfaces, a portion of the runoff from these surfaces is available for infiltration. This can be ensured by connecting roof down-spouts into the subsurface soils. In our analysis, this available water is reduced by a factor of 20% to provide for losses.

Topography	Flat Land (controlled through stormwater management)	0.30
Soil Type	Open Sandy Loam (weighted for anomolous areas)	0.35
Cover	Cultivated Lands (Grass Covered)	0.1
Total		0.75

What this implies is that 25% of the surplus water leaves the site. In actuality, approximately 75% of this runoff water (for calculation purposes) is retained on site and available for dilution. The approach of using retained runoff in the analysis has been used in numerous subdivisions throughout the Greely area, and has been accepted by the authorities, including MOE, as part of the review process. Specifically, this approach was accepted by the MOE for the original Sunset Lakes Subdivision (which is of the order of 15+/- years old), and the recent Jacques Whitford studies show that no nitrate impacts have been detected in this area.

We have conducted our predictions using the following:

Site Area	32 hectares
Total Site Sewage Flow	74,000 L/day
Surplus Water	372.2 mm / year

Mr. Dan Anderson

July 4, 2008

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With the above parameters, the cumulative nitrate impact has been calculated to be 8.1 mg/L, which is considered to be acceptable.

Accepting that retained stormwater runoff on site is a contributor, the selection of infiltration factors is not a major contributing factor. By way of example, if we assume steeper average slopes for the site, more runoff occurs which is available for dilution, and results in only a slight change in the predicted cumulative nitrate concentration. As such, we have repeated the calculation using a topography factor of 0.2 and a soil cover factor of 0.3, and the resulting cumulative nitrate impact has been calculated to be 8.5 mg/L., which is only a 5% increase over the originally predicted value of 8.1 mg/L.

The other contributing factor to be considered is the availability of additional lands for dilution. Approximately 4.14 hectares of land has been conveyed to the City for use as sports fields. If these lands are included in the dilution area, the nitrate impact is reduced to 7.3 mg/L.

Our experience throughout the recent development of the Greely area is that as a general rule of thumb, development can safely occur at a density of one lot / 0.4 hectares. This site is proposing a density of 77 lots (74 equivalent lots based on sewage flow considerations) on 32 hectares, which is a reduced density from this general guideline. Studies by Jacques Whitford Limited (JWL), on behalf of the City of Ottawa, indicate that nitrate impacts throughout Greely are significantly below what these simplistic models would predict, and the Jacques Whitford study indicates that at full buildout of Greely, acceptable impacts will exist. It should also be noted that in the early stages of this development proposal, the City of Ottawa had retained Jacques Whitford Limited to update their study, with particular emphasis on this development. In their analysis of this specific site, they predict average nitrate concentrations of 2 mg/L and peak concentrations of 4.5 mg/L.

As an additional comfort level, the existing development across Highway 31 has been in place for what we believe to be over 30 years, and lot sizes appear to be smaller, or at least comparable to the proposed development. The proposed development is downgradient from this existing development, and in all of our test wells, we have not detected any nitrates, which is an indication of satisfactory performance. Also, in all six off-site wells that were tested, two of which are in the older development, the nitrates were also non-detectable. This provides a further reassurance that the risks associated with development in the area are acceptable.

In summary, it is our opinion that the proposed development comprising 71 residential lots and 6 office blocks will have an acceptable impact on the underlying groundwater aquifer.

We trust this is to your satisfaction. If we can be of further assistance in this matter, please call.

Yours truly,  
Paterson Group Inc.



Stephen J. Walker, P.Eng.

# Nitrate Impact Assessment

**Project:** Greely Village Centre  
**File:** PH0145  
**Condition:** 71 Village Lots with 6 Office Blocks - 75 % of Runoff retained on site

### Groundwater Flow Calculation

Background Nitrate Concentration ( $C_b$ ) = 0 mg/L  
 Hydraulic Conductivity ( $k$ ) = 0 m/s  
 Horizontal Gradient ( $i$ ) = 0  
 Length ( $L$ ) = 0 m  
 Aquifer Thickness ( $t$ ) = 0 m  
 Groundwater Flow ( $Q_b$ ) = 0 m<sup>3</sup>/day

### Infiltration Calculation

Nitrate Concentration in Precipitation ( $C_i$ ) = 0 mg/L  
 Surplus Water (Environment Canada)  
 Factored Water Surplus = 372.2 mm/yr  
 Additional Surplus from Landscape Runoff = 279.15 mm/yr  
 Infiltration Flow Entering the System ( $Q_i$ ) = 69.79 mm/yr  
 Infiltration Flow Entering the System ( $Q_i$ ) = 291.50 m<sup>3</sup>/day

### Mass Balance Model (MOEE 1995)

$$C_T = (Q_b C_b + Q_e C_e + Q_i C_i) / (Q_b + Q_e + Q_i) = \text{Cumulative Nitrate Concentration}$$

where:  
 $Q_b$  = flow entering the system across the upgradient area = 0 m<sup>3</sup>/day  
 $C_b$  = background nitrate concentration = 0 mg/L  
 $Q_e$  = flow entering the system from the septic drainfield = 74 m<sup>3</sup>/day  
 $C_e$  = concentration of nitrates in the septic effluent = 40 mg/L  
 $Q_i$  = flow entering the system from infiltration = 291.50 m<sup>3</sup>/day  
 $C_i$  = Concentration of nitrates in the infiltrate = 0 mg/L

Therefore:  $C_T$  = 8.1 mg/L

### Weighted Infiltration Factors

Topography 0.3  
 Soil 0.35  
 Cover 0.1  
 Total 0.75

### Septic Effluent

Concentration of Effluent ( $C_s$ ) = 40 mg/L  
 Number of Lots: 74  
 Daily Sewage Flow ( $Q_s$ ) = 74 m<sup>3</sup>

### Site Characteristics

Area of Site : 320000 m<sup>2</sup>  
 Roof Areas: 15400 m<sup>2</sup>  
 Length of Roadways: 1850 m  
 Driveways: 15400 m<sup>2</sup>  
 Impervious Area 41900 m<sup>2</sup>  
 Percent Impervious Area = 13.09 %  
 Infiltration Area = 278100 m<sup>2</sup>

# Nitrate Impact Assessment

**Project:** Greely Village Centre  
**File:** PH0145  
**Condition:** 71 Village Lots with 6 Office Blocks - 75 % of Runoff retained on site

## Groundwater Flow Calculation

Background Nitrate Concentration ( $C_b$ ) =	0 mg/L	Weighted Infiltration Factors	
Hydraulic Conductivity (k) =	0 m/s	Topography	0.2
Horizontal Gradient (i) =	0	Soil	0.3
Length (L) =	0 m	Cover	0.1
Aquifer Thickness (t) =	0 m	Total	0.6
Groundwater Flow ( $Q_b$ ) =	0 m <sup>3</sup> /day	Septic Effluent	

## Infiltration Calculation

Nitrate Concentration in Precipitation ( $C_i$ ) =	0 mg/L	Concentration of Effluent ( $C_s$ ) =	40 mg/L
Surplus Water (Environment Canada)	372.2 mm/yr	Number of Lots:	74
Factored Water Surplus =	223.32 mm/yr	Daily Sewage Flow ( $Q_s$ ) =	74 m <sup>3</sup>
Additional Surplus from Landscape Runoff =	111.66 mm/yr		
Infiltration Flow Entering the System ( $Q_i$ ) =	275.74 m <sup>3</sup> /day		

## Mass Balance Model (MOEE 1995)

$$C_T = (Q_b C_b + Q_e C_e + Q_i C_i) / (Q_b + Q_e + Q_i) = \text{Cumulative Nitrate Concentration}$$

where:  
 $Q_b$  = flow entering the system across the upgradient area = 0 m<sup>3</sup>/day  
 $C_b$  = background nitrate concentration = 0 mg/L  
 $Q_e$  = flow entering the system from the septic drainfield = 74 m<sup>3</sup>/day  
 $C_e$  = concentration of nitrates in the septic effluent = 40 mg/L  
 $Q_i$  = flow entering the system from infiltration = 275.74 m<sup>3</sup>/day  
 $C_i$  = Concentration of nitrates in the infiltrate = 0 mg/L

Therefore:  $C_T = 8.5$  mg/L

## Site Characteristics

Area of Site :	320000 m <sup>2</sup>
Roof Areas:	15400 m <sup>2</sup>
Length of Roadways:	1850 m
Driveways:	15400 m <sup>2</sup>
Impervious Area	41900 m <sup>2</sup>
Percent Impervious Area =	13.09 %
Infiltration Area =	278100 m <sup>2</sup>

# Nitrate Impact Assessment

**Project:** Greely Village Centre  
**File:** PH0145

**Condition:** 71 Village Lots with 6 Office Blocks - 75 % of Runoff retained on site and using sports fields

## Groundwater Flow Calculation

Background Nitrate Concentration ( $C_b$ ) = 0 mg/L  
 Hydraulic Conductivity ( $k$ ) = 0 m/s  
 Horizontal Gradient ( $i$ ) = 0  
 Length ( $L$ ) = 0 m  
 Aquifer Thickness ( $t$ ) = 0 m  
 Groundwater Flow ( $Q_b$ ) = 0 m<sup>3</sup>/day

## Weighted Infiltration Factors

Topography 0.3  
 Soil 0.35  
 Cover 0.1  
 Total 0.75

## Septic Effluent

Concentration of Effluent ( $C_s$ ) = 40 mg/L  
 Number of Lots: 74  
 Daily Sewage Flow ( $Q_s$ ) = 74 m<sup>3</sup>

## Infiltration Calculation

Nitrate Concentration in Precipitation ( $C_i$ ) = 0 mg/L  
 Surplus Water (Environment Canada)  
 Factored Water Surplus = 372.2 mm/yr  
 Additional Surplus from Landscape Runoff = 279.15 mm/yr  
 Infiltration Flow Entering the System ( $Q_i$ ) = 69.79 mm/yr  
 331.08 m<sup>3</sup>/day

## Site Characteristics

Area of Site: 361400 m<sup>2</sup>  
 Roof Areas: 15400 m<sup>2</sup>  
 Length of Roadways: 1850 m  
 Driveways: 15400 m<sup>2</sup>  
 Impervious Area: 41900 m<sup>2</sup>  
 Percent Impervious Area = 11.59 %  
 Infiltration Area = 319500 m<sup>2</sup>

## Mass Balance Model (MOEE 1995)

$$C_T = (Q_b C_b + Q_e C_e + Q_i C_i) / (Q_b + Q_e + Q_i) = \text{Cumulative Nitrate Concentration}$$

where:  
 $Q_b$  = flow entering the system across the upgradient area = 0 m<sup>3</sup>/day  
 $C_b$  = background nitrate concentration = 0 mg/L  
 $Q_e$  = flow entering the system from the septic drainfield = 74 m<sup>3</sup>/day  
 $C_e$  = concentration of nitrates in the septic effluent = 40 mg/L  
 $Q_i$  = flow entering the system from infiltration = 331.08 m<sup>3</sup>/day  
 $C_i$  = Concentration of nitrates in the infiltrate = 0 mg/L

Therefore:  $C_T = 7.3$  mg/L