Geotechnical Engineering

Environmental Engineering

Hydrogeology

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**Materials Testing** 

**Building Science** 

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## Consolidated Terrain Analysis and Hydrogeological Study Reports

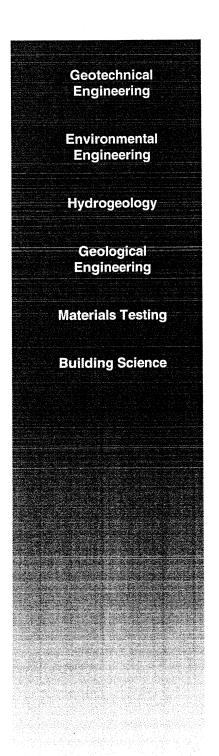
Greely Village Centre Subdivision Part of Lot 73 and Part of Lot 74, Registrar's Compiled Plan 902 Ottawa (Osgoode), Ontario

## Prepared For

Sunset Lakes Development Corporation

October 8, 2008

Report No. PH0145-07



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

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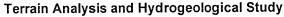
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1.0 INTRODUCTION

#### 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 <u>Terrain Analysis</u>

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.

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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 <u>Laboratory Testing</u>

#### 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 in 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:



SUMMARY OF	UNIQUE STRATIC	TABLE 1 RAPHIC UNITS ENC PROPERTY	OUNTERE	O ON SUBJECT
Stratigraphic Unit	General Description (USCS Classification)	Composition <sup>1</sup> (%sand, silt, clay)	and the same of th	Estimated Hydraulic Conductivity <sup>2</sup> (cm/s)
1	SM - Silty sand - inorganic silt with fine sand composite	Not Available	0.3 to more than 1.2	10 <sup>-3</sup> to 10 <sup>-5</sup>
2	GM- gravel, sand silt mixture (glacial till)	Not Available	1.2 to more than 1.5	10 <sup>-2</sup> to 10 <sup>-4</sup>
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 <sup>-5</sup> to less than 10 <sup>-7</sup>
4	CH–CL- inorganic clay of high plasticity to silty clay	1 703-79770500	2.7 to more than 6	10 <sup>-7</sup> to less than 10 <sup>-9</sup>

1. Composition for CH, CL, ML and MHdetermined 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.

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#### 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

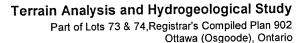
As stated previously, a total of five (5) test wells were constructed throughout the site (refer to Dwg. No. PH0145-1 in Appendix 5). Construction details for each test well, based on MOE Water Well Records and site notes, are summarized below in Table 2. The geodetic elevations of the top of casing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

	SUMM	ARY OF GI DURING T	TABLE EOLOGIC C EST WELL		S OBSERVED CTION
Test Well No.			ELEVATIOI Mean Sea I		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 definintion, "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.

AQUIFER TES	T RESUL	TABL TS FROM F		ING OF FIV	E WELLS
ITEM	TW 1	TW 2	TW 3	TW 4	TW 5
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	3.01x10 <sup>-4</sup>	1.16x10 <sup>-4</sup>	5.5x10 <sup>-1</sup>	3.73 x10 <sup>-6</sup>	5.33x10 <sup>-6</sup>
Transmissivity <sup>1</sup> (m <sup>2</sup> /min)	1.60x10 <sup>-1</sup>	2.1x10 <sup>-1</sup>	1.65x10 <sup>-1</sup>	2.0x10 <sup>-1</sup>	1.31x10 <sup>-1</sup>

<sup>1.</sup>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,

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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.

# Terrain Analysis and Hydrogeological Study Part of Lot 73 and Part of Lot 74, Registrar's Compiled Plan 902 Ottawa (Osgoode), Ontario



		S	JMMARY	OF HEA	TABLE 4	TABLE 4: UMMARY OF HEALTH RELATED PARAMETERS	ARAMET	ERS			
TW1 TW1 WS6 WS6 WS6 (3.Hr) (6.Hr)	A SACRET SECTION AND ADDRESS OF THE PERSON	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
QN	100 m	0.15	0.13	96.0	0.18	0.17	0.33	0.50	0.16	0.15	1.5
0.20		0.03	0.10	90.0	0.10	0.10	0.09	0.10	0.02	0.02	1
9		Q	Q.	Q.	QN	9	ND	ND	ND	QN	_
ΩN		S.	Q.	Q	Q.	QN	ND	ND	ND	N N	10
1.8	<b>科·维罗斯瓦罗斯</b>	1.6		9.6	2.5	74.5	17.75	62.3	27.6	28.5	<del>-</del>
		0.89		0.40		0.62		N/A		0.11	7
0	ļ	0	0	0	0	0	0	0	0	0	0
0		0	0	0	0	0	0	0	0	0	0
0		0	0	0	0	0	0	0	0	0	0
0		0	0	0	0	0	0	0	0	0	0
0		-	4	~	0	~	0	2	0	~	500
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1. Total Coliform concentrations reported in this table are compiled from retesting after further well development

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		SU	MMARY	OF AES	SUMMARY OF AESTHETIC RELATED PARAMETERS	E 5A RELATI	ED PAR	AMETER			
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	1
Colour (TCU)	2	2	S	က	2	2	2	N N	2	ND	5
Hardness	583	.578	529	524	- 219	519	532	354	- 603	. 598	80 - 100
Alkalinity	313	312	289	287	274	268	271	220	307	307	200
Total Dissolved Solids	1630	1640	1630	1630	1790	1740	761	-670	1.787	787	500
Hd	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	280	869	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	1
Magnesium	50	50	49	49	49	49	43	43	47	47	1
Sodium	292	281	383	301	336	333	- 26	- 26	40	39	20

		SUMMARY		AESTHE	OF AESTHETIC RELATED PARAMETERS (CONT'D)	TABLE 5B	ARAME	TERS (C	SONT'D)		
PARAMETER	TW1 WS5 (3 Hr)	TW1 TW3 WS6 WS: (6 Hr) (3 H	2 7 Ir)	TW2 WS8 (6 Hr)	TW3 WS9 (3 Hr)	TW3 TW4 WS10 (6 Hr) (3 Hr)	water the state of	TW4 WS2 (6 Hr)	TW5 WS3 (3 Hr)	TW5 WS4 (6 Hr)	Ontario Drinking Water Quality Objective <sup>1</sup>
Potassium	4	4	5	5	7	7	4	4	2	2	•
TKN	0.21	0.25	0.14	0.15	0.15	0.13	0.21	0.21	0.33	0.28	
Dissolved	<0.5	6.0	1.1	1.2	1.1	1.8	1.2	1.1	0.5	1.4	5
Organic Carbon				A CONTRACTOR OF THE CONTRACTOR							
Iron	0.68	0.68 0.69 0.74		0.72	0.65	7.0.64	Accepted to	1.71	2.31	2.46	0.3
Manganese	0.10	0.10 0.06	0.06	90.0	90'0	90:0	0.22	0.22	0.35	0.35	0.05
Hydrogen Sulphide	ND	QN	ΩN	QN	QN	QN	71.0	0.15	ND	ND	0.05
Phenois	ND	QN	QN	ND	QN	QN	QN	ND	ND	ND	-
Tannin & Lignin	QN	QN	QN	ND	ND	ND	QN	ΩN	QN	ΩN	ı



#### 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 <u>Site Development</u>

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 m², assuming a two-storey 240 m² (2600 ft²) home, with a garage of 50 m², 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

#### **Hydrogeolocial 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.

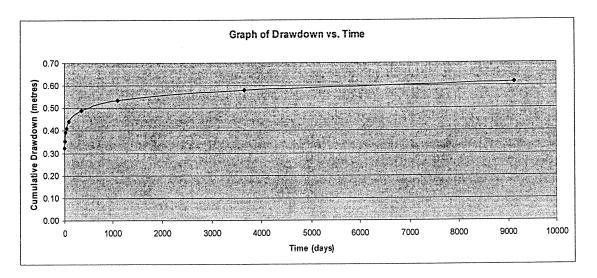


#### 8.4 Potential Well Interference

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 m³/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 <u>Sewage System Design</u>

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 m². 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 m² 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 how 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.
- 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:

- 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.
- 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.

10157 P.

# **APPENDIX 1**

# TERRAIN ANALYSIS DOCUMENTS

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

# patersongroup

Consulting Engineers

# **SOIL PROFILE & TEST DATA**

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

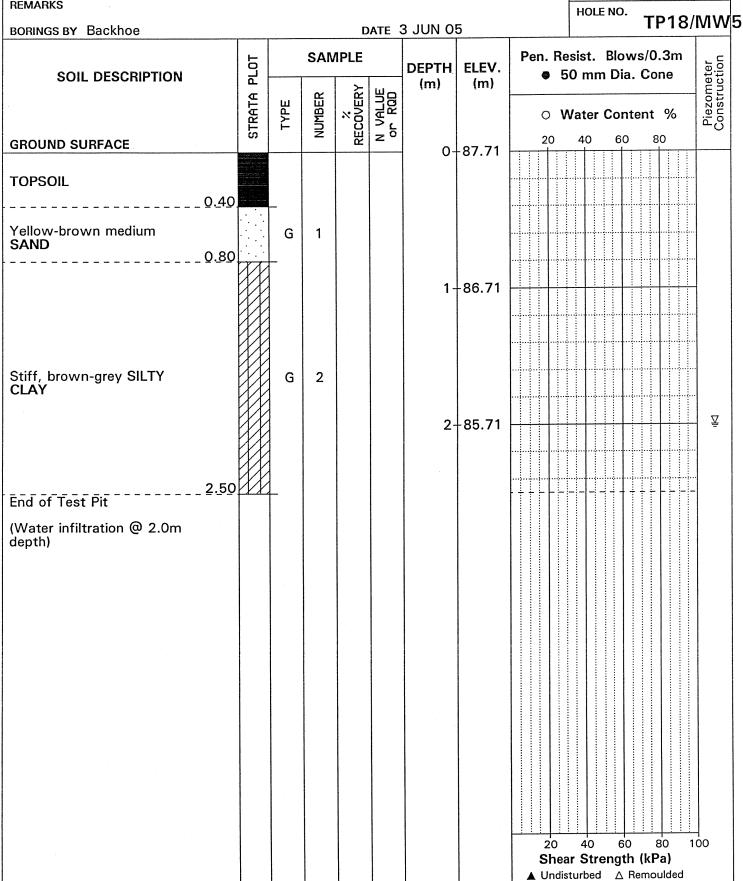
**DATUM** 

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

**REMARKS** 

FILE NO.

PH0145

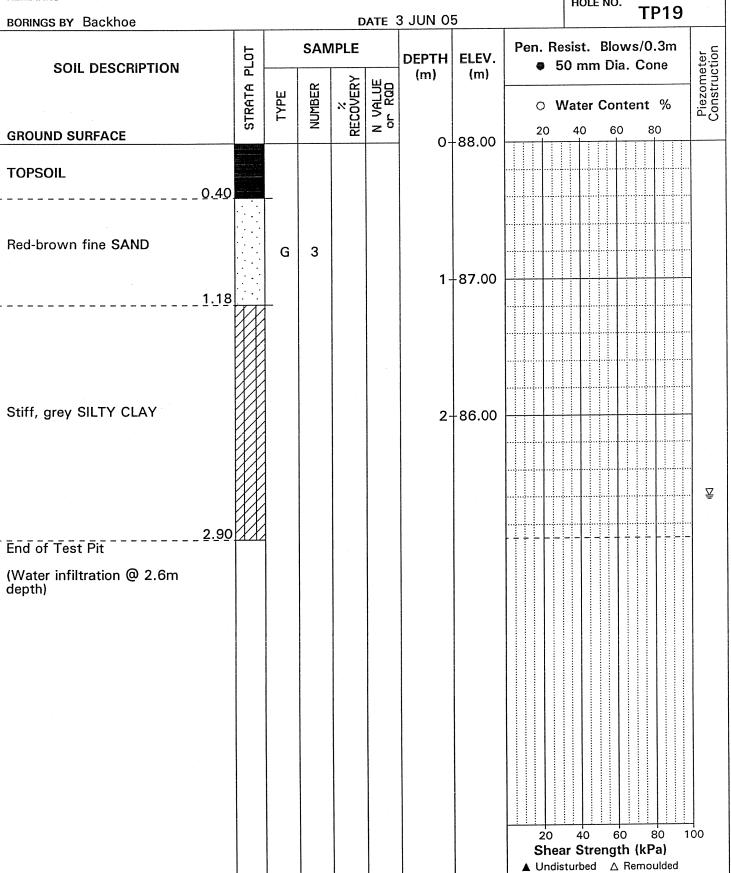


28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

**SOIL PROFILE & TEST DATA** 

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

FILE NO. Approximate geodetic **DATUM** PH0145 **REMARKS** HOLE NO.



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

# **SOIL PROFILE & TEST DATA**

▲ Undisturbed △ Remoulded

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

FILE NO. Approximate geodetic **DATUM** PH0145 **REMARKS** HOLE NO.

**TP20** DATE 3 JUN 05 BORINGS BY Backhoe Pen. Resist. Blows/0.3m **SAMPLE** PLOT DEPTH ELEV. • 50 mm Dia. Cone SOIL DESCRIPTION (m) (m) % RECOVERY N VALUE or RQD STRATA NUMBER TYPE O Water Content % 60 40 **GROUND SURFACE** 0 + 88.51**TOPSOIL** \_ 0.30 Red-brown fine SAND G 4 1 + 87.515 G **GLACIAL TILL:** Compact to 立 dense, grey silty sand with gravel, cobbles and boulders G 6 2.00 2+86.51 End of Test Pit (Water infiltration @ 1.5m depth) 40 80 100 Shear Strength (kPa)

# **SOIL PROFILE & TEST DATA**

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

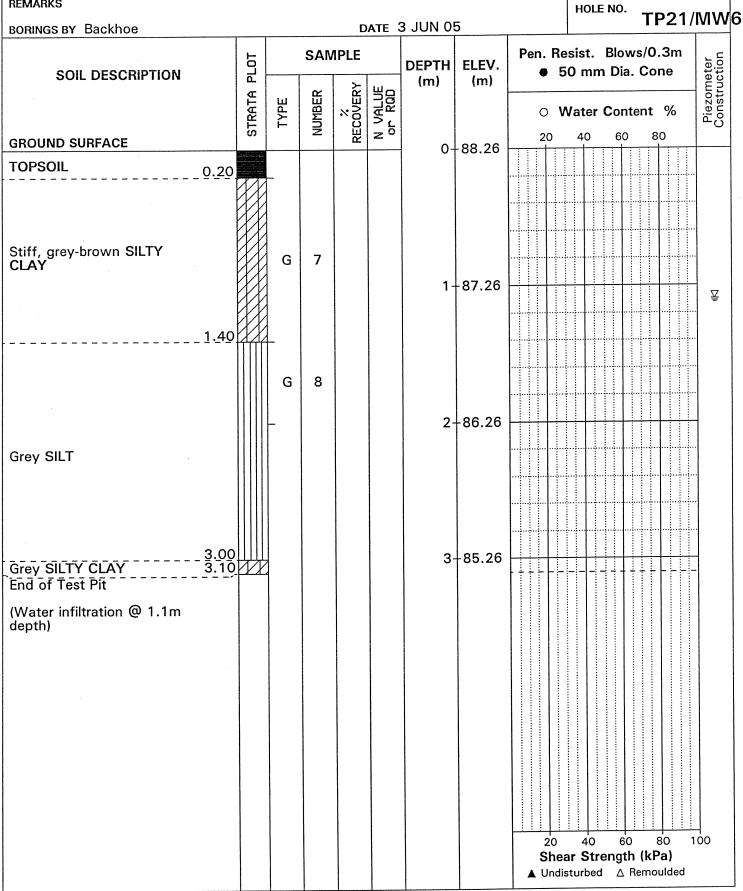
**DATUM** 

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

FILE NO.

PH0145

REMARKS

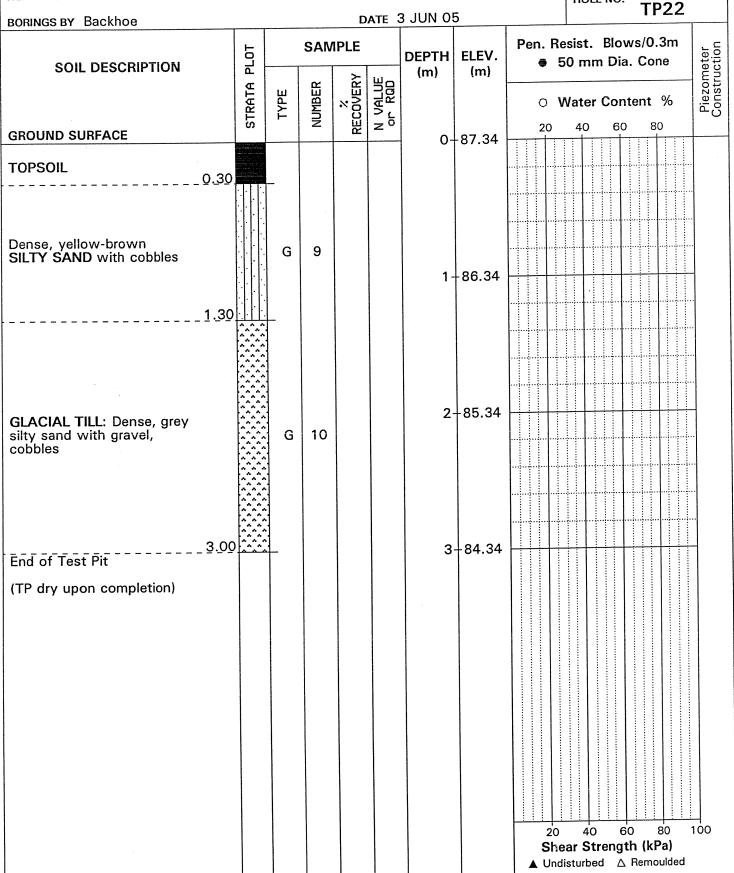


28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

**SOIL PROFILE & TEST DATA** 

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

FILE NO. Approximate geodetic **DATUM** PH0145 **REMARKS** HOLE NO. **TP22** DATE 3 JUN 05 BORINGS BY Backhoe Pen. Resist. Blows/0.3m **SAMPLE** ELEV. DEPTH



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

**SOIL PROFILE & TEST DATA** 

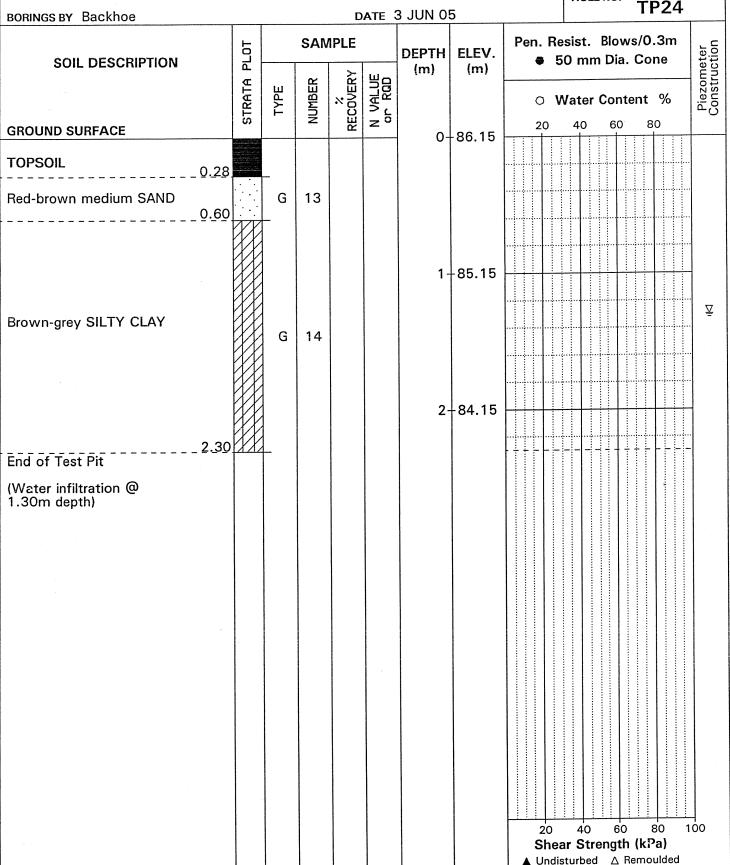
Hydrogeological Study and Terrain Analysis Greely Village Centre, Parkway Road Ottawa (Greely), Ontario

FILE NO. Approximate geodetic **DATUM** PH0145 **REMARKS** HOLE NO. **TP23** DATE 3 JUN 05 BORINGS BY Backhoe **SAMPLE** Pen. Resist. Blows/0.3m PLOT DEPTH ELEV. 50 mm Dia. Cone SOIL DESCRIPTION (m) (m) 2 RECOVERY N VALUE or RaD STRATA NUMBER O Water Content % 40 60 80 20 **GROUND SURFACE** 0 + 86.89**TOPSOIL** Yellow-brown medium to coarse SAND G 11 1 + 85.89 $\underline{\nabla}$ 1.40 2+84.89 Dense, grey SILT 3 + 83.89 3.20 End of Test Pit (Water infiltration @ 1.3m depth) 100 60 80 Shear Strength (kPa) ▲ Undisturbed △ Remoulded

### SOIL PROFILE & TEST DATA

Hydrogeological Study and Terrain Analysis Greely Village Centre, Parkway Road

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7 Ottawa (Greely), Ontario FILE NO. **DATUM** Approximate geodetic PH0145 REMARKS HOLE NO. **TP24** DATE 3 JUN 05 BORINGS BY Backhoe Pen. Resist. Blows/0.3m **SAMPLE** DEPTH ELEV. 50 mm Dia. Cone SOIL DESCRIPTION



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

FILE NO. **DATUM** Approximate geodetic PH0145 REMARKS

REMARKS BORINGS BY Backhoe				<b>D</b>	ATE '	3 JUN 0	5		HOL	E NO	. Т	P25	
SOIL DESCRIPTION	PLOT		SAN		AIE	DEPTH	ELEV.	Pen. Re			ws/0 a. Co		eter stion
GOIL DEGOIN HON	STRATA P	TYPE	NUMBER	% RECOVERY	N VALUE or RaD	(m)	(m)				ntent		Piezometer Construction
GROUND SURFACE	.S		Ž	RE	Z 0	0-	-86.25	20	40	60 : : 1	) {	во <del>1 : : : :</del>	
TOPSOIL0.30													
						1-	-85.25						
Brown SILTY CLAY													   <u>\\</u>
- grey by 1.8m depth						2-	-84.25						
End of Test Pit  (Water infiltration @ 1.7m depth)													
								20 Shea			th (kF		100

### **SOIL PROFILE & TEST DATA** patersongroup Consulting Engineers Hydrogeological Study and Terrain Analysis Greely Village Centre, Parkway Road 28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7 Ottawa (Greely), Ontario FILE NO. **DATUM** Approximate geodetic PH0145 **REMARKS** HOLE NO. **TP26** DATE 3 JUN 05 BORINGS BY Backhoe **SAMPLE** Pen. Resist. Blows/0.3m STRATA PLOT ELEV. DEPTH • 50 mm Dia. Cone SOIL DESCRIPTION (m) (m) % RECOVERY VALUE r Rab NUMBER TYPE Water Content % 2 o 80 20 40 60 **GROUND SURFACE** 0 + 85.90**TOPSOIL** 1 + 84.90Brown SILT 2+83.90 $\underline{\nabla}$ - grey by 2.9m depth 3 + 82.90 15 G 3.20 **GLACIAL TILL**: Grey clayey sandy silt with gravel, G 16 cobbles and boulders 3.80 End of Test Pit (Water infiltration @ 2.8m depth) 40 60 80 Shear Strength (kPa) ▲ Undisturbed △ Remoulded

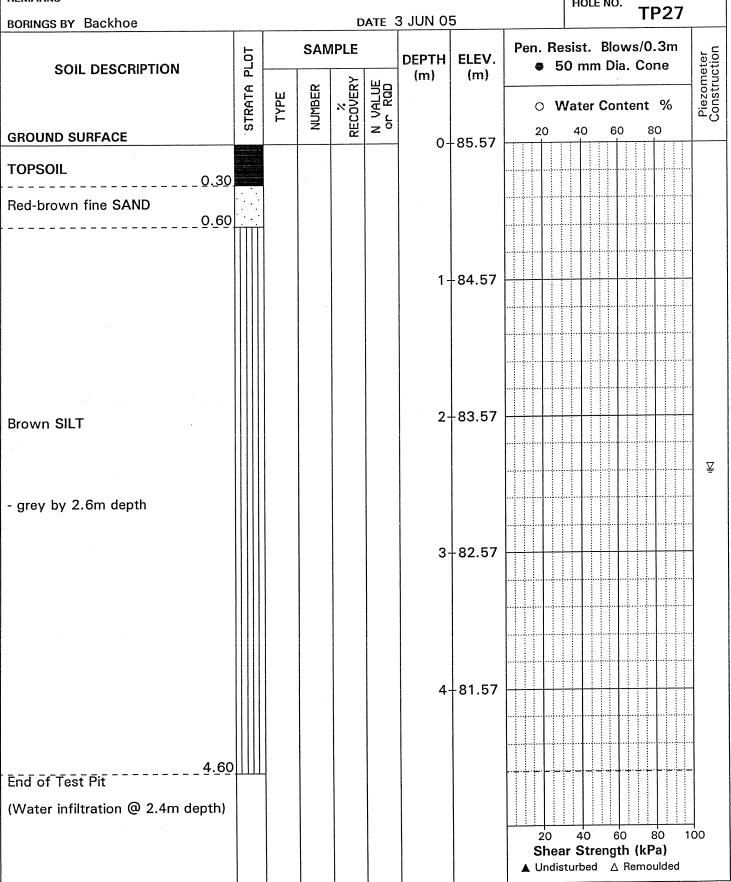
28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

### **SOIL PROFILE & TEST DATA**

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

FILE NO. Approximate geodetic **DATUM** PH0145

**REMARKS** HOLE NO. **TP27** DATE 3 JUN 05 BORINGS BY Backhoe



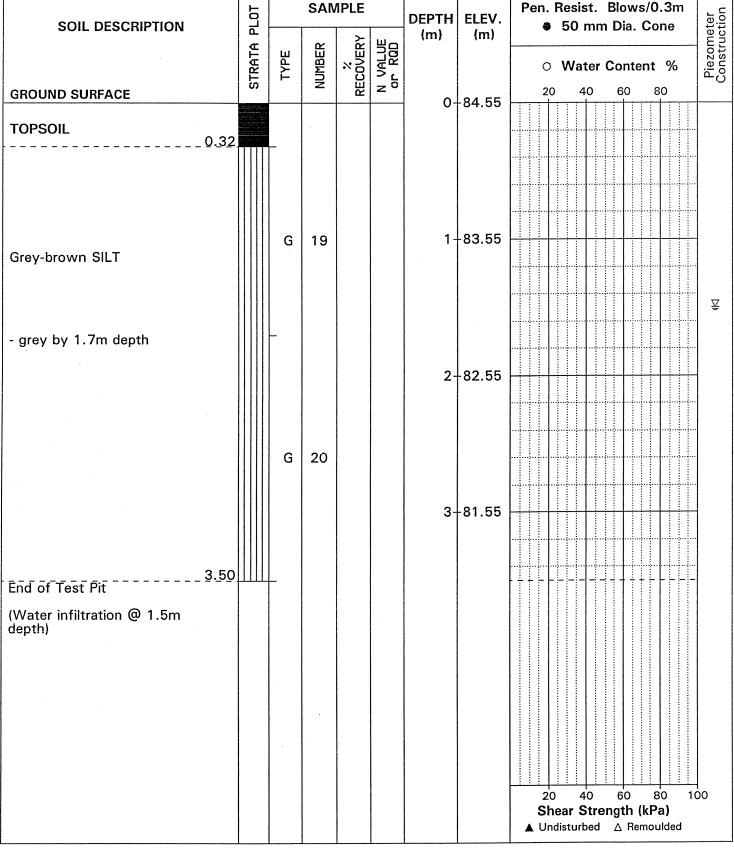
## patersongroup Consulting Engineers 28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

**SOIL PROFILE & TEST DATA** 

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

FILE NO. Approximate geodetic **DATUM** PH0145 **REMARKS** HOLE NO. **TP28/MW**7 DATE 3 JUN 05 BORINGS BY Backhoe Pen. Resist. Blows/0.3m **SAMPLE** STRATA PLOT ELEV. DEPTH 50 mm Dia. Cone SOIL DESCRIPTION (m) (m) % RECOVERY N VALUE or RGD NUMBER O Water Content % 40 80 20 **GROUND SURFACE** 0 + 85.72 **TOPSOIL** Red-brown medium SAND G 17 1 + 84.72 豆 1.20 G 18 Grey-brown SILT - grey by 1.8m depth 2+83.72 3+82.72 3.60 **Grey SILTY CLAY** 3.80 End of Test Pit (Water infiltration @ 1.2m depth) 100 80 40 60 Shear Strength (kPa) ▲ Undisturbed △ Remoulded

### **SOIL PROFILE & TEST DATA** patersongroup Consulting Engineers Hydrogeological Study and Terrain Analysis Greely Village Centre, Parkway Road 28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7 Ottawa (Greely), Ontario DATUM Approximate geodetic FILE NO. PH0145 **REMARKS** HOLE NO. **TP29/MW8** DATE 3 JUN 05 BORINGS BY Backhoe **SAMPLE** Pen. Resist. Blows/0.3m PLOT **DEPTH** ELEV. SOIL DESCRIPTION • 50 mm Dia. Cone (m) (m) 2. RECOVERY N VALUE or RQD STRATA NUMBER TYPE O Water Content % 40 20 60 **GROUND SURFACE** 0 + 84.55 **TOPSOIL** 1 + 83.55G 19 Grey-brown SILT - grey by 1.7m depth 2+82.55



### **SOIL PROFILE & TEST DATA**

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

**DATUM** 

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

REMARKS

FILE NO. PH0145

REMARKS									HOLE	NO.	TDOO	/N/INA/
BORINGS BY Backhoe	DATE 3 JUN 05							<u> </u>			TP30	
SOIL DESCRIPTION	PLOT		SAN	Τ	I	DEPTH (m)	ELEV. (m)	Pen. Re	sist. 0 mm			neter
·	STRATA	TYPE	NUMBER	RECOVERY	N VALUE or RQD	(,	,,	0 V	Vater (	Conte	nt %	Piezometer Construction
GROUND SURFACE	လ		Ž	RE	z ō	0-	85.62	20	40 :   : :	60 <del>:   : :</del>	80	
TOPSOIL 0.2	0											
Red-brown SILTY SAND												
<u>0.6</u>												
Grey-brown SILT						1-	84.62					
Grey-brown Sill												
- grey by 1.4m depth												
						2-	83.62					1
												포
					-	3-	82.62					1 1
End of Test Pit	оШШ											-
(Water infiltration @ 2.4m												
depth)												
								20	40	60	80	100
									r Stre	ngth (	kPa)	
					<u></u>			_ Olidis	Luibou	<u></u> 1101		

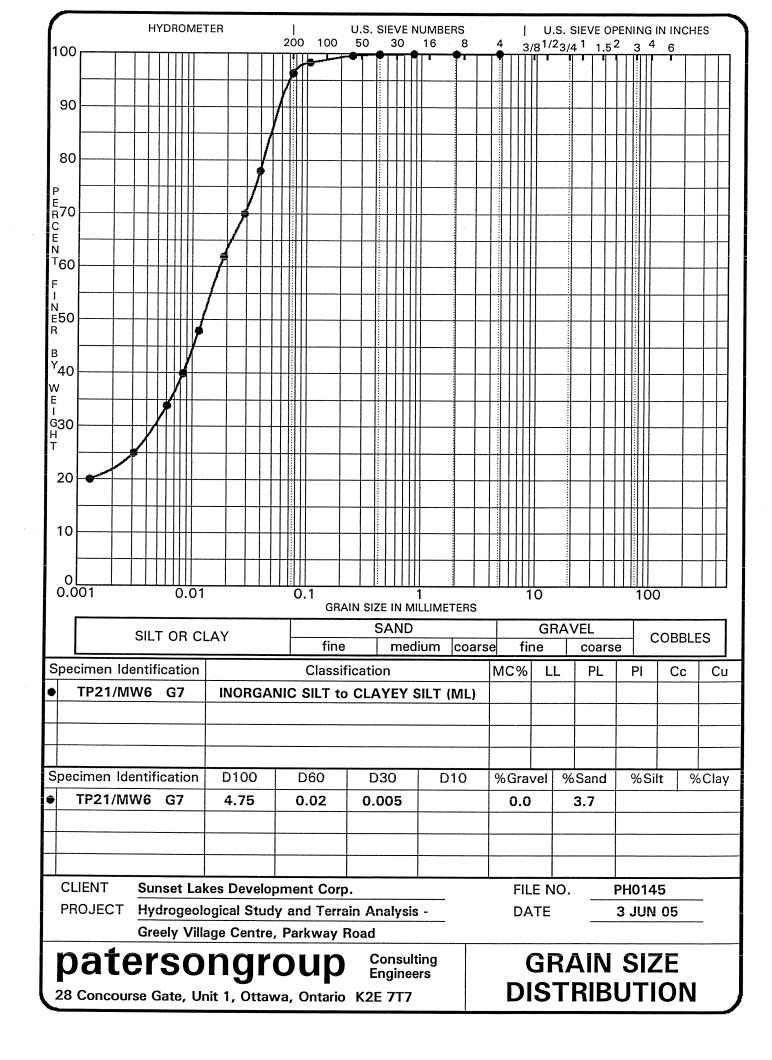
28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

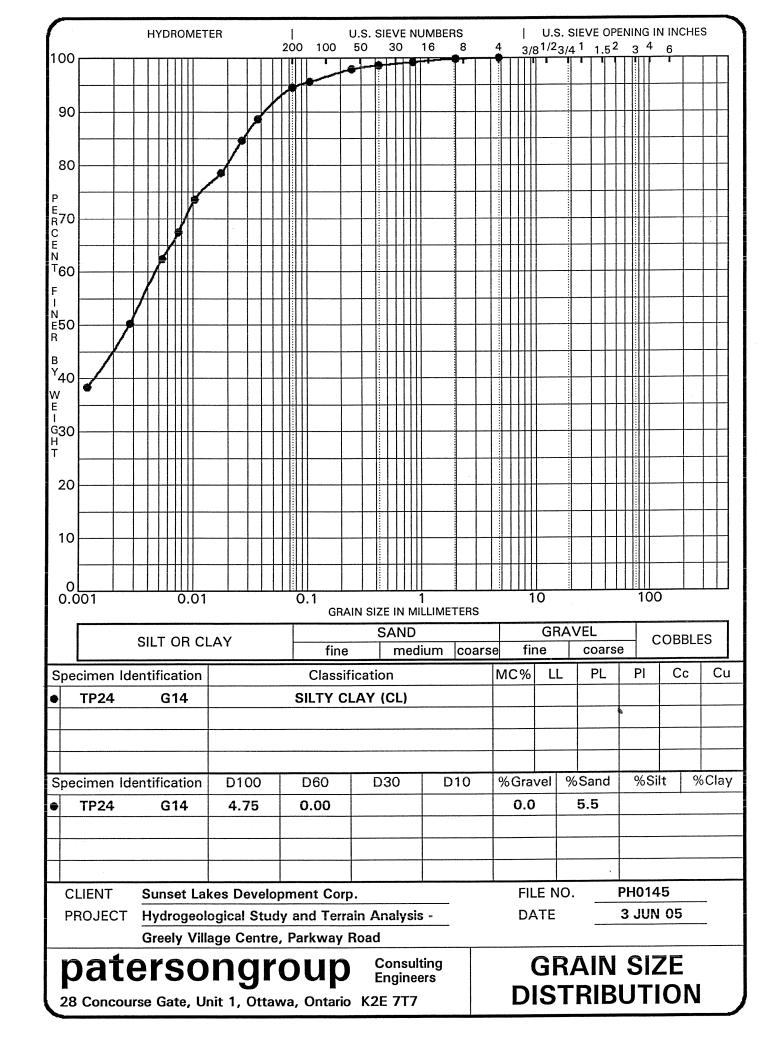
### **SOIL PROFILE & TEST DATA**

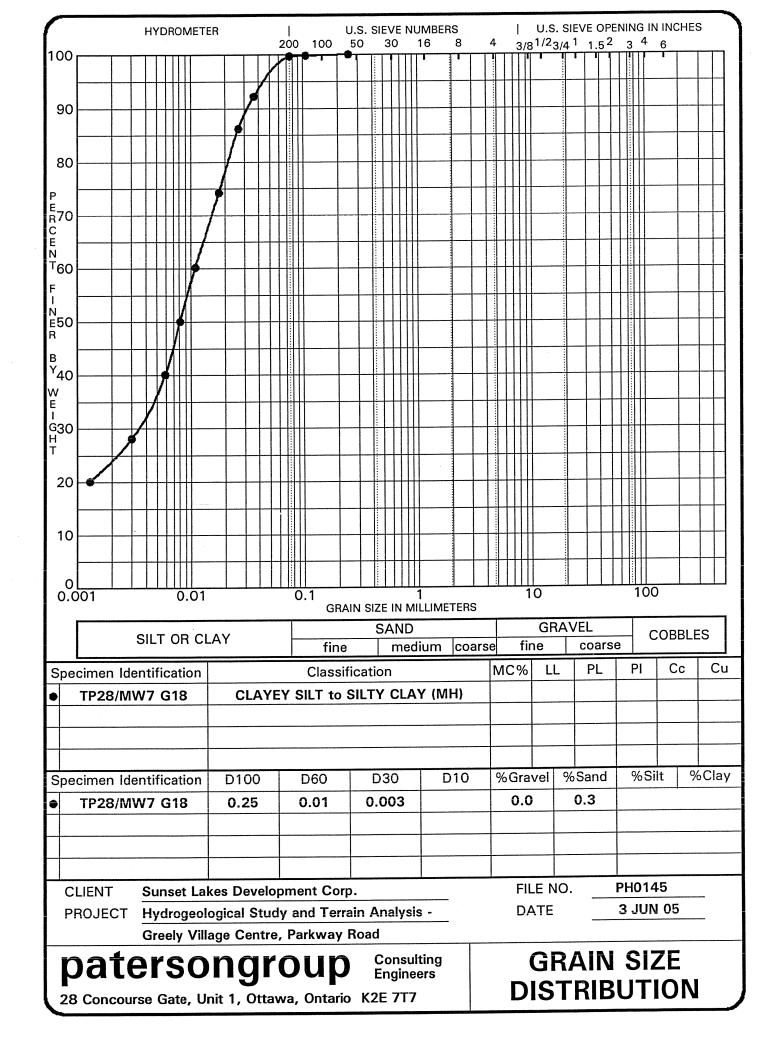
Hydrogeological Study and Terrain Analysis Greely Village Centre, Parkway Road Ottawa (Greely), Ontario

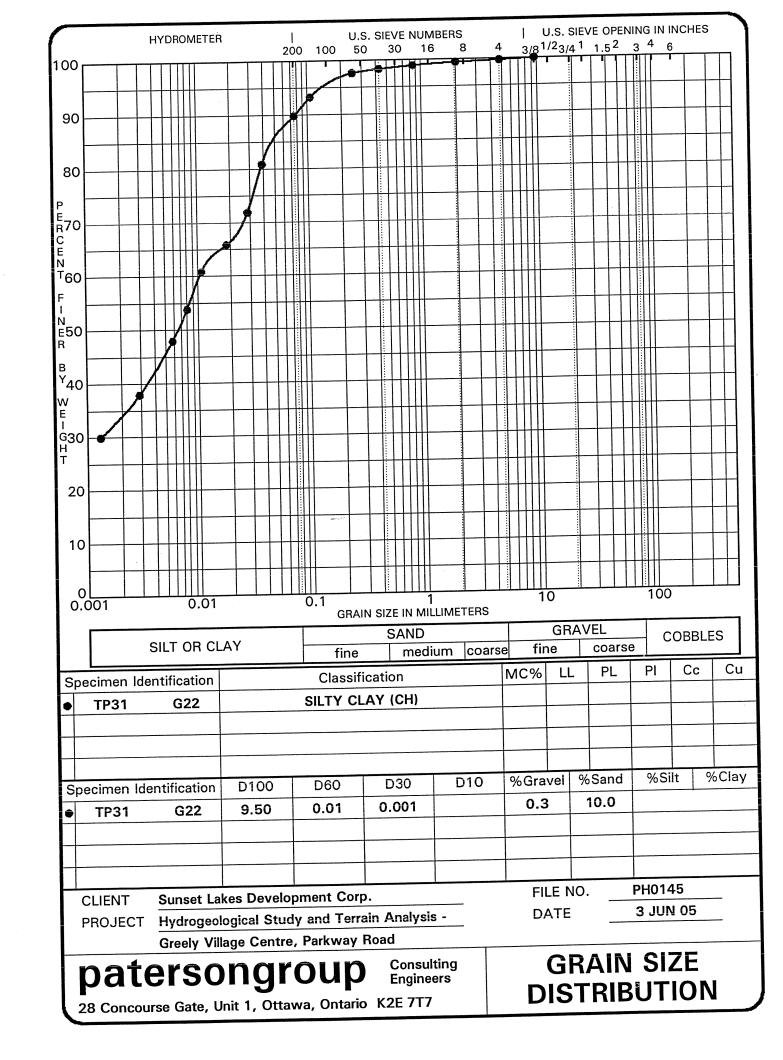
FILE NO. **DATUM** Approximate geodetic PH0145 **REMARKS** HOLENO

REMARKS     BORINGS BY Backhoe				г	ATF :	3 JUN 0	5		HOL	E NO	. Т	г <b>Р</b> 31	
SOIL DESCRIPTION	PLOT		SAN	/IPLE		DEPTH	ELEV.	Pen. Re	sist. 0 mr				eter stion
	STRATA F	TYPE	NUMBER	% RECOVERY	N VALUE or RaD	(m)	(m)	0 <b>V</b>	Vater	Cor	nten	t %	Piezometer Construction
GROUND SURFACE	်		Ž	RE	zō	0-	85.65	20	40	60	0	80	
TOPSOIL	30												
Red-brown fine SAND		G	21										
9.3													
						1-	84.65						
													<u>T</u>
Brown-grey SILTY CLAY		G	22			2-	83.65						
							·						
			-										
						3-	82.65						
3.3	30												
End of Test Pit													
(Water infiltration @ 1.8m depth)													
									40 or Str	engt	o th (k	80 ( <b>Pa)</b>	100
								▲ Undis	turbe	Δb	Rem	oulded	









### **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

Contractor's Copy Ministry's Copy Well Owner's Copy

Dewatering
Replacement Test Hole Abandoned, poor quality Well Contractor/Technician Information Ministry Use Only Data Source Date Received ww ММ 00 Date of Inspection YYYY Well Record Numbe 05 10p 128 Contractor's Copy Ministry's Copy Well Owner's Copy Cette formule est disponible en français

05 105 100

Contractor's Copy Ministry's Copy Well Owner's Copy

Well Record Numbe

Cette formule est disponible en français

Date Received

Remarks

03 184130

Contractor's Copy Minicitry's Copy Well Owner's Copy

MM DO

Date of Inspection

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Cette formule est disponible en français

00

		aging and acquiry record		
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				1
			<i>V</i>	
		Method of Cons	struction	
_ Cable T	'oal	Rotary (air)	☐ Diamond	☐ Digging
Rotary (	(convention:	al) Air percussion	Jetting	Other
Rotary (	(reverse)	Boring	Driving	
		Water Us	9	
Domest	ic	[] Industrial	Public Supply	Other
Stock		Commercial	☐ Not used	
Irrigation	n	Municipal	Cooling & air con	ditioning
		Final Status o	of Well	
Water S	Supply	Recharge well	Unfinished	Abandoned, (Other)
	ation well	Abandoned, insufficient supply		
Test H	ole	Abandoned, poor quality	Replacement well	
		Well Contractor/Technic		
Name of W	ell Contract		Well Co	ntractor's Licence No.
411	<u>/e S</u>	BOUR a low	15	19
5	T /	set name, number city etc.)		
Verne of W	ell Tachnici	lag (lest name, first name)	Well Te	thnician's Licence No.
	نبكب	The	Q	-193
Signature	rechnida	or/Sonicaclor	Date Sub	ן מס אא יייירי
X	تكمرار	to prouge	<b>√</b>	05 05 05
09/0	)3) '	Contract	or's Copy Minietr	y's Copy Well Ow
		,		

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#10t 15 /4	ometer of Bank
Audit No. Z 21761	Date Wall Completed
Was the well owner's information package delivered? Yes 7 No	Date Delivered YYYY MM DO

		Min	Istry	Use Only			
Data Source				Contractor			
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WATER WELL DATA SYSTEM Oct 29 1999

GROUND WATER BULLETIN REPORT

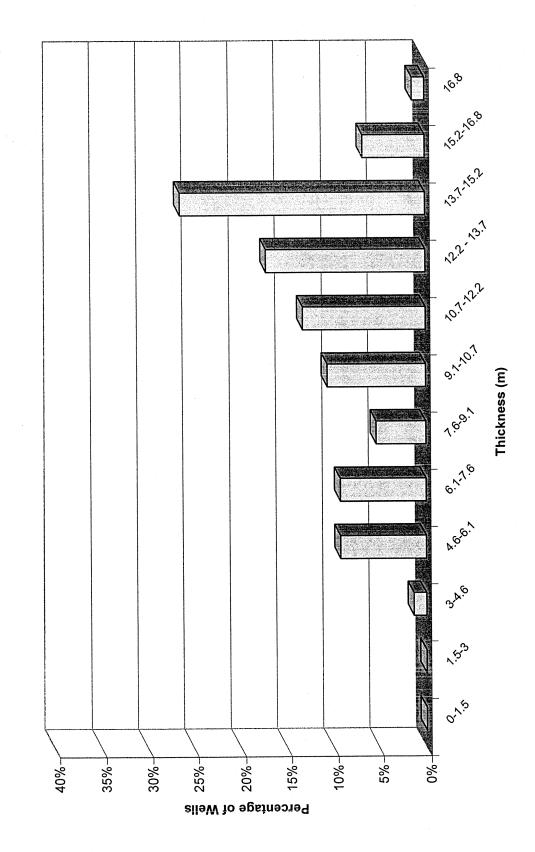
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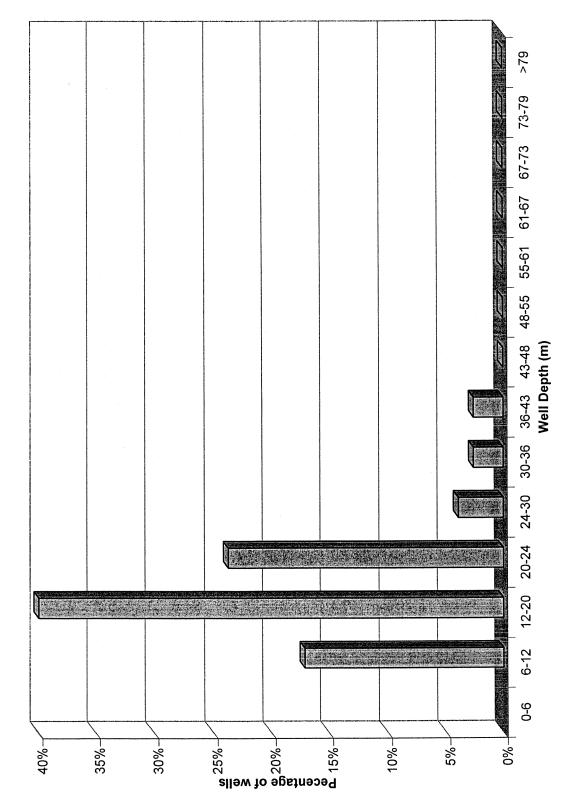
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PAGE: 1079 COUNTY: OTTAWA-CARLETON	CSG KIND WATER STAT PUMP TEST TEST DIA OF FOUND LVL LVL RATE TIME DRILLER INS WATER FEET FEET FEET GPM HR:MN
ATER WELL DATA SYSTEM OCT 29 1999	LTY UTW UTW  N WELL EASTING ELEV  LOT NO NORTHING FEET DATE
WATER WEL	MUNICIPAL: CONCESSION ETC

	MORROW G CLAY MSND 0020 HPAN BLDR 0034 LMSN 0057	HERBERT C GRVL MSND 0024 LMSN 0035	SKRABS A CLAY 0016 LMSN 0025	WOUTERS A MSND 0021 LMSN 0027	MCEVOY P LOAM MSND 0012 QSND 0015 MSND GRVL 0017 GREY LMSN	١.	NAMELER S LOAM MSND 0020 QSND 0030 MSND 0038 LMSN 0042	MCEVOY P HPAN 0031 GREY LMSN 0036	SHIELD A HPAN 0031 LMSN 0042	0020	Ment 0003 BLIE	NY PHILIP MEND 0003 OSND 0021 BLCK	LANDRIGAN  CANADA COSC CERV IMEN DOCK 0045	0026 GREI LMSN ROCK	GREY MSND 0080 GREY	LMSN 0087	SAND	Ξ.	BRWN LOAM 0003 GREY OSND 0016 UNKN 0026 SHIELD R	BRWN HPAN BLDR 0043	DIFKANCESCO VAN BRWN HPAN BLDR 0025 GREY LMSN 0035	SAND FILL	0049 GREY LMSN 0207 KAUFERT, HARRY	PRDG 0032	DONWEL, CONSTROLLEY BRWW CLAY FILL 0003 GREY SAND FGRD 0042 GREY SAND FGYL 0049 GREY LMSN SHLE HARD 0179	LL, CONSTRUCTIC SAND 0010 GREY	A, MR WELDC SAND 0015	SHLE 0215 GREY SNDS 0245
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Summary of Overburden Thickness Reported in Surrounding Water Wells



Summary of Well Depths Reported in Surrounding Water Wells



>43 37-43 31-37 12-18 18-24 --- --- Aquifer Depth (m below ground surface) 9-0 -%09 -%09 Percentage of Wells

Summary of Reported Aquifer Depths In Surrounding Water Wells

5 to 10 33% Summary of Well Yields Reported for Surrounding Water Wells (Range of Well Yields in Imperial Gallons per Minute) 3 to 5 \_070 \_0% 0-3 0% 10 to 20 33% >50 5% 11% 30-40 20-30\_ 16%\_

### **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

2512050 2005-06-27 2005-06-23

PH0145

Project:

## ACCUTES I LABURATURIES LID

Client: Paterson Group

Attention: Robert Passmore

Ottawa, Ont. K1V 1T6

Paterson Group	Report Number:
1-28 Concourse Gate	Date:
Ottawa, Ont.	Date Submitted:
X4X 4T6	

			P.O. Number:	PO# 2552
f Custody Number: 29556			Matrix:	Water
LAB ID:	394207	394208		GUIDELINE

Chain of Custody Number: 29556						 r.o. Number. Matrix:		Water	
		LAB ID:	394207	394208				GUIDELINE	
	Samp	le Date:	2005-06-23	2005-06-23					
	Sar	Sample ID:	TW1, WS5	TW1, WS6			W V	MOE REG. 170/03	)3
							·		
PARAMETER	UNITS	MDL					TYPE	LIMIT	UNITS
Total Coliforms	ct/100mL		0	1			MAC	0	ct/100mL
Escherichia Coli	ct/100mL		0	0			MAC	0	ct/100mL
Heterofronhic Plate Count	ct/1mL		0	-			MAC	200	ct/1mL
Faecal Coliforms	ct/100mL		0	0			MAC	0	ct/100mL
Faecal Streptococcus	ct/100mL		0	0					ct/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 McCooeye

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

2512053 2005-07-06

2005-06-23

PH0145

## ACCUTES I LABORATORIES LID

Report Number: Date Submitted: Project: Attention: Robert Passmore 1-28 Concourse Gate Client: Paterson Group Ottawa, Ont. K1V 1T6

PO# 2552 Water P.O. Number: Matrix: Chain of Custody Number: 29556

Chain of Custody Number: 29330		- CI 04	304243	304214			אומנו ואי		GIIDEI INE	
	Sampl	Sample Date:	2005-06-23	2005-06-23						
	San	Sample ID:	TW1, WS5	TW1, WS6				MO	MOE REG. 170/03	33
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5	313	312				90	200	mg/L
Chloride	mg/L	-	543	538				AO	250	mg/L
Colour	T01	7	2	7				AO	2	TCU
Conductivity	mS/cm	2	2500	2530						TCU
Dissolved Organic Carbon	mg/L	0.5	<0.5	6.0				AO	2	mg/L
Fluoride	mg/L	0.10	<0.10	0.15				MAC	<del>1</del> .5	mg/L
Hydrogen Sulphide	mg/L	0.01	<0.01	<0.01		-		AO AO	0.05	mg/L
N-NH3 (Ammonia)	mg/L	0.02	0.20	0.03						mg/L
N-NO2 (Nitrite)	mg/L	0.10	<0.10	<0.10				MAC	1.0	mg/L
N-NO3 (Nitrate)	mg/L	0.10	<0.10	<0.10				MAC	10.0	mg/L
Ho			7.58	7.63				AO	6.5-8.5	
Phenols	mg/L	0.001	<0.001	<0.001						
Sulphate	mg/L	-	134	133	-			AO	200	mg/L
Tannin & Lignin	mg/L	0.1	×0.1	<0.1						mg/L
TDS (COND - CALC)	mg/L	2	1630	1640				AO	200	mg/L
Total Kjeldahl Nitrogen	mg/L	0.05	0.21	0.25		-				mg/L
Turbidity	D_LN	0.1	1.8	1.6				AO	1.0	DLN N
Hardness as CaCO3	mg/L	-	583	578				90	100	mg/L
Ion Balance		0.01	1.00	0.99						mg/L
Calcium	mg/L	·-	151	149						mg/L
Magnesium	mg/L	τ-	20	20						mg/L
Potassium	mg/L	·	4	4						mg/L
Sodium	mg/L	2	292	281				AO	50	mg/L
lion	mg/L	0.03	0.68	69.0				AO	0.3	mg/L
Manganese	mg/L	0.01	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 Comment:



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

## ACCUTES [ LABORATORIES LID

Report Number: 2512305	Date: 2005-06-30		Project: PG0145
Client: Paterson Group	1-28 Concourse Gate	Ottawa, Ont. K1V 1T6	Attention: Robert Passmore

P.O. Number: PO# 2348 Matrix: Water		2005-06-27 2005-06-27	Sample ID:         TW2, WS7         TW2, WS8         MOE REG. 170/03	UNITS MD.	C C C C C C C C C C C C C C C C C C C	- O	MAC 500	0 0 0 MAC 0									
Chain of Custody Number: 29934	restruction of the contract of			PARAMETER	Total Colifornia	rotal Comornis Escherichia Coli	Heterotrophic Plate Count	Faecal Coliforms	Faecal Streptococcus								

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

## ACCUTES I LABORATORIES LID

Client: Paterson Group
1-28 Concourse Gate

Attention: Robert Passmore Ottawa, Ont. K1V 1T6

Date Submitted: Date:

Report Number:

2512307 2005-07-14 2005-06-27

PG0145

Project:

P.O. Number:

PO# 2348

Chain of Custody Number: 29934						Matrix:	-	Water	
		LAB ID:	394850	394851				GUIDELINE	
	Samp	Sample Date:	2005-06-27	2005-06-27			~~~		
	Sar	Sample ID:	TW2, WS7	TW2, WS8	-		W	MOE REG. 170/03	33
PARAMETER	UNITS	MDL					TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5	289	287			90	200	mg/L
Chloride	mg/L	_	591	280	-		AO	250	mg/L
Colour	, 57	7	42	ю			AO	2	70 10
Conductivity	m2/cm	2	2500	2510				1	한
Dissolved Organic Carbon	mg/L	0.5	-	1.2			YO :	ა ,	mg/L
Fluoride	mg/L	0.10	0.13	0.13			MAC	1.5	mg/L
Hydrogen Sulphide	mg/L	0.01	40.04 4.04	<0.01			Q O	60.0	mg/L
N-NH3 (Ammonia)	mg/L	0.02	0.10	0.12 0.12			MAC	1.0	mg/L
N-NOZ (Nitrite)	1 /6 E		, 0. 10 10 10	\$ 0.10 \$ 10			MAC	10.0	mg/L
N-NO3 (Nitrate)	j J	2	7.93	7.96			AO	6.5-8.5	•
Phenois	mg/L	0.001	<0.001	<0.001					
Sulphate	mg/L	-	114	113			AO	200	mg/L
Tannin & Lignin	mg/L	0.1	<0.1	<0.1			,	1	mg/L
TDS (COND - CALC)	mg/L	2	1630	1630			ΑO	200	mg/L
Total Kjeldahl Nitrogen	mg/L	0.05	0.14	0.15				,	mg/L
Turbidity	NTO	0.7	9.3	9.6			AO	1.0	) : Z
Hardness as CaCO3	mg/L	-	529	524			90	100	mg/L
Ion Balance		0.01	1.10	0.97					mg/L
Calcium	mg/L	-	131	129					mg/L
Magnesium	mg/L	-	49	49					mg/L
Potassium	mg/L	<del>-</del>	2	2					mg/L
Sodium	mg/L	7	383	301			AO	20	mg/L
Iron	mg/L	0.03	0.74	0.72			AO	0.3	mg/L
Manganese	mg/L	0.01	90.0	90.0			Q W	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:

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

num Allowable Concentration

	Date: 2005-07-08			Project: PH0145	
Client: Paterson Group	1-28 Concourse Gate	Ottawa, Ont.	K1V 1T6	Attention: Robert Passmore	

				s	Γ.																										 	-
			03	UNITS	mg/L	mg/L	TCU	TCU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	-		mg/L	mg/L	mg/L	mg/L	DTO	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	4.1411/20, 202	 	
PO# 2554 Water	GUIDELINE		MOE REG. 170/03	LIMIT	500	250	2		5	1.5	0.05		1.0	10.0	6.5-8.5		200		200		1.0	100					20	0.3	0.05			
			W	TYPE	90	AO	AO		AO	MAC	AO		MAC	MAC	AO		AO		AO		AO	90					AO	AO	AO			
P.O. Number: Matrix:																				-												
ш 2						****	-																								 	-
													-																			
	395160	2005-06-28	TW3, WS10		268	689	2	2680	1.8	0.17	<0.01	0.12	<0.10	<0.10	8.05	<0.001	104	<0.1	1740	0.13	4.5	519	0.93	127	49	7	333	0.64	90.0			
	395159	2005-06-28	TW3, WS9		274	869	7	2750		0.18	<0.01	0.10	<0.10	<0.10	8.03	<0.001	103	<0.1	1790	0.15	2.5	519	0.92	127	49	7	336	0.65	90.0		,	
	LAB ID:	Sample Date:	Sample ID:	MDL	2	-	7	2	0.5	0.10	0.01	0.02	0.10	0.10		0.001	_	0.1	2	0.05	0.1	_	0.01	<del>-</del>	-	_	2	0.03	0.01			
		Samp	Sar	UNITS	mg/L	mg/L	TCU	m2/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	D_LN	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L			
Chain of Custody Number: 29935				PARAMETER	Alkalinity as CaCO3	Chloride	Colour	Conductivity	Dissolved Organic Carbon	Fluoride	Hydrogen Sulphide	N-NH3 (Ammonia)	N-NO2 (Nitrite)	N-NO3 (Nitrate)	Ha	Phenois	Sulphate	Tannin & Lignin	TDS (COND - CALC)	Total Kjeldahl Nitrogen	Turbidity	Hardness as CaCO3	lon Balance	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese			

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

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

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

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

Attention: Robert Passmore

Report Number: Date Submitted: Date:

2512441 2005-07-04 2005-06-28

PH0145

Project:

			P.O. Number:	PO# 2554
Jy Number: 29935			Matrix:	Water
LAB ID:	395162	395163		GUIDELINE
Sample Date:	ample Date: 2005-06-28 2005-06-28	2005-06-28		
!	Or Class Charter Court Charter	0,000		

Chain of Custody Number: 29935						Matrix:		Water	
	LAB ID:	ID: 395162	395163					GUIDELINE	
	Sample Date:		3 2005-06-28	28					
	Sample ID:	L	<del> </del>	10			M	MOE REG. 170/03	
PARAMETER	UNITS MDL	7					TYPE	LIMIT	UNITS
Total Coliforms	ct/100mL		0				MAC	0	ct/100mL
Escherichia Coli	ct/100mL	0	0				MAC	0	ct/100mL
Heterotrophic Plate Count	ct/1mL	0	_				MAC	200	ct/1mL
Faecal Coliforms	ct/100mL	0	0				MAC	0	ct/100mL
Faecal Streptococcus	ct/100mL	0	0						ct/100mL
			-						
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MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration Comment:

608 Norris Court, Kingston, ON, K7P 2R9

8-146 Colonnade Road, Ottawa, ON, K2E 7Y1

## ACCUT LOT LABORATORIES LID

Cont.	Client: Paterson Group 1-28 Concourse Gate						Report Number: Date:		2511732 2005-06-24		
Project   Proj	Ottawa, Ont. K1V 1T6						Date Submitted:	ö	2005-06-21		
Poit 2850   Poit	Attention: Robert Passmore						Project:		PH0145		
Sample Date:   2005-06-21	000000000000000000000000000000000000000						P.O. Number:		PO# 2550		
Sample Date: 2005-06-21 2005-06-21   PARAMETER   TW4, WS2   TW4,	Chain of Custody Number: 29346		-CII av	303561	303562		Mati IX.		Vale GIIDEI INE		_
PARAMETER   UNITS   MDL		Sample	Date:	2005-06-21	2005-06-21				COLDE		
PARAMETER   UNITS   MDL		Samı	ple ID:	TW4, WS1	TW4, WS2			¥	DE REG. 170	03	
te Count ct/100mL 0 9 MAC 0 0 MAC 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	PARAMETER	UNITS	MDL					TYPE	LIMIT	UNITS	
te Count c'1700mL 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		ct/100mL		0	6			MAC	0	ct/100mL	
te Count	Escherichia Coli	ct/100mL		0	0			MAC	0	ct/100mL	
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Heterotrophic Plate Count	ct/1mL		0	7			MAC	200	ct/1mL	
	Faecal Coliforms	ct/100mL		0 (	0 "			MAC	0	ct/100mL	
	Faecal Streptococcus	ct/100mL		0	0					ct/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

# ACCUT EST LABORATORIES LID

PO# 2550 Water GUIDELINE 2511735 2005-06-28 2005-06-21 PH0145 Report Number: Date: Date Submitted: P.O. Number: Matrix: Project: Chain of Custody Number: 29548 Client: Paterson Group 1-28 Concourse Gate Ottawa, Ont. K1V 1T6 Attention: Robert Passmore

Chain of Custody Number: 29548			10000	202568					GUIDELINE	
	Same	Cample Date:	2005-06-21	2005-06-21						
	Sa	Sample ID:	TW4, WS1	TW4, WS2				MO	MOE REG. 170/03	3
			*:							
								TYPE	LIMIT	UNITS
PARAMETER	UNITS	MDL	710	CCC				90	200	mg/L
Alkalinity as CaCO3	mg/L	ۍ .	27.1	220	<u> </u>			AO	250	mg/L
Chloride	mg/L	-	193	= {				AO	2	TCU
Colour	TCU	7 -	7,720	1030						TCU
Conductivity	ms/cm	2	0/11	1030				AO	2	mg/L
Dissolved Organic Carbon	mg/L	0.5	1.2	- 6				MAC	1.5	mg/L
Fluoride	mg/L	0.10	0.33	0.50	***************************************			AO	0.05	mg/L
Hydrogen Sulphide	mg/L	0.0	7.0	5.5						mg/L
N-NH3 (Ammonia)	mg/L	0.02	0.09	5 5				MAC	1.0	mg/L
N-NO2 (Nitrite)	mg/L	0.10	V 0.10	0.00				MAC	10.0	mg/L
N-NO3 (Nitrate)	mg/L	0.10	40.10 7.60	7 80		-		АО	6.5-8.5	
Ha	:		7.00	2000						
Phenois	mg/L	0.00	7.00.00	45				AO	200	mg/L
Sulphate	mg/L	- 3	7 (7	5 0						mg/L
Tannin & Lignin	mg/L	<u>.</u>	76.1	670				AO	200	mg/L
TDS (COND - CALC)	mg/L	0 0	20.0	0.20						mg/L
Total Kjeldahl Nitrogen	mg/L	5. 5	17.7	62.3				AO	1.0	) ; K
Turbidity	0 7	; <b>-</b>	532	354	-			90	100	mg/L
Hardness as CaCO3		- 6	106	0.93						mg/L
Ion Balance	1/500		142	71						mg/L
Calcium	mo/L	_	43	43			-			mg/L
Magnesium	) pm		. 4	4						mg/L
Potassium	mo/l	. 2	26	26				YO !	50	mg/L
Sodium	mg/L	0.03	1.65	1.71				YO :	0.3	mg/L
Iron	- I/O#	0:00	0.22	0.22				AO	0.05	mg/L
Manganese			<u> </u>							
					INAC		- Maximim Allowable Concentration	ncentration		

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

Inorganic Lab Supervisor APPROVAL:

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

Client: Paterson Group 1-28 Concourse Gate

Ottawa, Ont. K1V 1T6

Attention: Robert Passmore

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

Date Submitted:

Project:

PH0145

P.O. Number:

Chain of Custody Number: 28540							Matrix:		Water	
		LAB ID:	393928	393929					GUIDELINE	
	Samp	Sample Date:	2005-06-22	2005-06-22						
	Sal	Sample ID:	TW5, WS3	TW5, WS4				W W	MOE REG. 170/03	33
·										
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Total Coliforms	ct/100mL		24	7				MAC	0	ct/100mL
Escherichia Coli	ct/100mL		0	0				MAC	0	ct/100mL
Heterotrophic Plate Count	ct/1mL		0	_				MAC	200	ct/1mL
Faecal Coliforms	ct/100mL		0	0				MAC	0	ct/100mL
Faecal Streptococcus	ct/100mL		0	0						ct/100mL
					·					
							,			
			•							
							Acces 100 Acces			
						,				-

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

Tim McCooeye QC Manager APPROVAL:

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

## ACCUI EST LABORATORIES LTD

Client: Paterson Group 1-28 Concourse Gate

Ottawa, Ont.

K1V 1T6

Attention: Robert Passmore

Report Number: Date Submitted:

2511889 2005-06-29 2005-06-22

PH0145

Project:

P.O. Number:

Chain of Custody Number: 28548						P.O. Number: Matrix:		Water	
		LAB ID:	393937	393938				GUIDELINE	
	Samp	Sample Date:	2005-06-22	2005-06-22					
-	Sai	Sample ID:	TW5, WS3	TW5, WS4			M	MOE REG. 170/03	
PARAMETER	UNITS	MDL					TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5	307	307			90	200	mg/L
Chloride	mg/L	-	191	194			AO	250	mg/L
Colour	TCU	2	2	<2			AO	S.	TCU
Conductivity	uS/cm	5	1210	1210					TCU
Dissolved Organic Carbon	mg/L	0.5	0.5	4.1			AO	5	mg/L
Fluoride	mg/L	0.10	0.16	0.15			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	0.02	0.02			-		mg/L
N-NO2 (Nitrite)	mg/L	0.10	<0.10	<0.10			MAC	1.0	mg/L
N-NO3 (Nitrate)	mg/L	0.10	<0.10	<0.10			MAC	10.0	mg/L
Ha			7.76	7.77			AO	6.5-8.5	
Phenols	mg/L	0.001	<0.001	<0.001					
Sulphate	mg/L	-	65	63		-	AO	200	mg/L
Tannin & Lignin	mg/L	0.1	<0.1	<b>√</b> 0.1					mg/L
TDS (COND - CALC)	mg/L	2	787	787			AO	200	mg/L
Total Kjeldahl Nitrogen	mg/L	0.05	0.33	0.28					mg/L
Turbidity	NTC	0.1	27.6	28.5			AO	1.0	NTO
Hardness as CaCO3	mg/L	_	603	298			90	100	mg/L
Ion Balance		0.01	1.07	1.06					mg/L
Calcium	mg/L	-	164	162					mg/L
Magnesium	mg/L	<del>-</del>	47	47					mg/L
Potassium	mg/L	-	7	7					mg/L
Sodium	mg/L	2	40	39			AO	20	mg/L
Iron	mg/L	0.03	2.31	2.46			AO	0.3	mg/L
Manganese	mg/L	0.01	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:

Inorganic Lat Supervisor Ewan McRobbie APPROVAL:

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

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

Attention: Robert Passmore

Report Number: Date: Date Submitted:

2517679 2005-09-06 2005-09-02

PH0145

Project:

of Custody Number: 23283		,			P.O. Number: Matrix:	PO# 2587 Water
LAB ID:	409025	409026	409027	409028		GUIDELINE
Sample Date:	2005-09-02	2005-09-02	2005-09-02	2005-09-02		
					֡	

Chain of Custody Number: 23283							Matrix:		Water	
		LAB ID:	409025	409026	409027	409028			GUIDELINE	
-	Samp	Sample Date:	2005-09-02	2005-09-02	2005-09-02	2				
	Sai	Sample ID:	TW1, WS R1			TW5, WS R1		MO	MOE REG. 170/03	)3
							-			
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Total Coliforms	ct/100mL		~	82	7	0		MAC	0	ct/100mL
Escherichia Coli	ct/100mL		0	0	0	0		MAC	0	ct/100mL
Heterotrophic Plate Count	ct/1mL		-	က	က	0		MAC	200	ct/1mL
Faecal Coliforms	ct/100mL		0	0	0	0		MAC	0	ct/100mL
Faecal Streptococcus	ct/100mL		0	0	0	0				
				-						
								***************************************		
	-					-				-
					451		-			
-										
-										
					-					
					·					
										-

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

Group	4.0
Paterson Gr	400 00000000000000000000000000000000000
Client: P	•

1-28 Concourse Gate Ottawa, Ont.

Attention: Robert Passmore K1V 1T6

Report Number: Date: Date Submitted:

2518550 2005-09-16 2005-09-14

PH0145

Project:

						P.O. Number:		PO# 2591	
Chain of Custody Number: 21891						Matrix:		Water	
		LAB ID:	411404	411405	411406			GUIDELINE	
	Samp	sample Date:	2005-09-14	2005-09-14	2005-09-14				
	Sar	Sample ID:	TW4 W5R2	TW4 W5R2 TW2 W5R2	TW1 W5R2		W	MOE REG. 170/03	03
PARAMETER	UNITS	MDL					TYPE	LIMIT	UNITS
Total Coliforms	ct/100mL		0	0	0		MAC	0	ct/100mL
Escherichia Coli	ct/100mL		0	0	0		MAC	0	ct/100mL
Heterotrophic Plate Count	ct/1mL		4	0	36		MAC	200	ct/1mL
Faecal Coliforms	ct/100mL		0	0	0		MAC	0	ct/100mL

		LAB ID:	411404	411405	411406			GUIDELIN
	Samp	Sample Date:	2005-09-14	2005-09-14	2005-09-14			
	Sa	Sample ID:	TW4 W5R2	TW2 W5R2	TW1 W5R2		M	MOE REG. 17
PARAMETER	UNITS	MDL					TYPE	LIMIT
Total Coliforms	ct/100mL		0	0	0		MAC	0
Escherichia Coli	ct/100mL		0	0	0		MAC	0
Heterotrophic Plate Count	ct/1mL		4	0	36		MAC	200
Faecal Coliforms	ct/100mL		0	0	0		MAC	0
Faecal Streptococcus	ct/100mL		0	0	0	 -		
							- 1	
						*********		

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

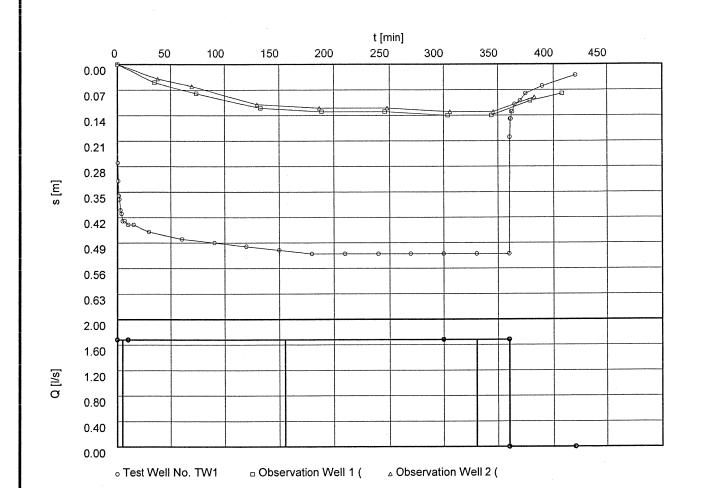
Microbiology Analyst APPROVAL:
Krista Quantrill

## **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

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysi Time-Drawdown plot with discharge		Project: Sunset Lal	
			Evaluated by: RAP	
Pumping Test No. 1		Test conducted on:	June 23, 2005	
TW1		·		
Discharge 1.44 l/s				



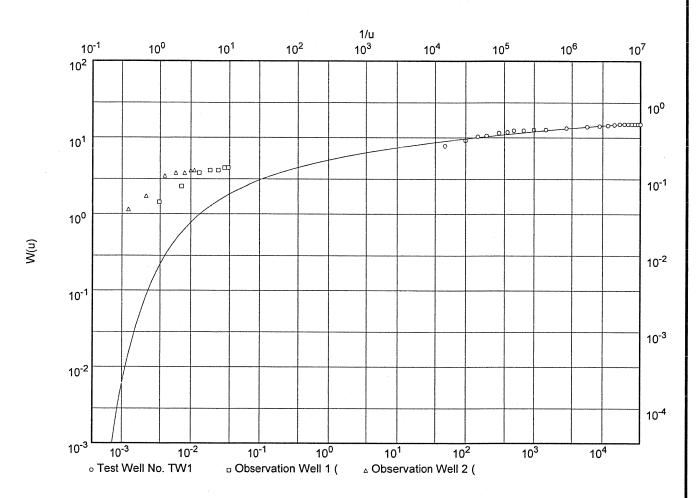
Pater	son Group Ltd.	Pumping test analysis	3	Date: 25.07.2005	none, Page 2
	Concourse Gate , ON K2E 7T7	Time-Drawdown plot with discharge		Project: Sunset Lak	Kes
Hopodii	, 0			Evaluated by: RAP	
Pumpi	ing Test No. 1		Test conducted on:	June 23, 2005	
TW1			Test Well No. TW1		
Discha	arge 1.44 l/s		Distance from the pu	umping well 0.100 m	
Static	water level: 1.650 m below datum				
	Pumping test duration	Water level	Drawdov	wn	
	[min]	[m]	[m]		
1	0.00	1.650		0.000	
2	0.50	1.920		0.270	
3	1.00	1.970		0.320	
4	1.50	2.010		0.360	
5	2.00	2.020		0.370	
6	3.00	2.050		0.400	
7	4.00	2.060		0.410	
8	5.00	2.080		0.430	
9	7.00	2.080		0.430	
10	10.00	2.090		0.440	
11	15.00	2.090		0.440	
12	30.00	2.110		0.460	
13	60.00	2.130		0.480	
14	90.00	2.140		0.490	
15	120.00	2.150		0.500	
16	150.00	2.160		0.510	
17	180.00	2.170		0.520	
18	210.00	2.170		0.520	
19	240.00	2.170		0.520	1
20	270.00	2.170		0.520	
21	300.00	2.170		0.520	
22	330.00	2.170		0.520	
23	360.00	2.170		0.520	
24	360.50	1.850		0.200	
25	361.00	1.800		0.150	
26	361.50	1.800		0.150	
27	362.00	1.780		0.130	
28	363.00	1.780		0.130	
29	365.00	1.760		0.110	
30	370.00	1.750		0.100	
31	375.00	1.730		0.080 0.060	
32	390.00	1.710		0.080	
33	420.00	1.680	'	0.030	

Paterso	on Group Ltd.	Pumping test analysis	S .	Date: 25.07.2005	none, Page 3
1-28 Cor Nepean, O		Time-Drawdown plot with discharge		Project: Sunset La	akes
rrepean, e	111022717			Evaluated by: RAF	
Pumping	Test No. 1		Test conducted on:	June 23, 2005	
TW1			Constant rate pump	o test	
Discharg	ge 1.44 l/s				
	Pumping test duration	Discharge			
	[min]	[l/s]			
1	0.00	1.68			
2	10.00	1.68			
3	300.00	1.68			
4	360.00	1.68			
5 6	360.10 420.00	0.00 0.00			
0	420.00	0.00			
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Paterson	Group Ltd.	Pumping test analysi	s	Date: 25.07.200	none, Page 4
1-28 Conco		Time-Drawdown plot with discharge		Project: Sunset	Lakes
				Evaluated by: F	RAP
Pumping Te	est No. 1		Test conducted or	n: June 23, 2005	
TW1			Observation Well	1 (TW2)	
Discharge 1	1.44 l/s		Distance from the	pumping well 100.0	000 m
Static water	level: 1.650 m below datum		1904-Paper Alle Balletin III. January Sangar Balletin Balletin Balletin Balletin Balletin Balletin Balletin Ba		
Р	umping test duration	Water level	Draw	down	
	[min]	[m]	[n	กไ	
1	0.00	1.650		0.000	
2	35.00	1.700		0.050	
3	73.00	1.730		0.080	
4	133.00	1.770		0.120	
5	189.00	1.780	<b>I</b>	0.130	
6 7	246.00 304.00	1.780		0.130	
8	344.00	1.790 1.790		0.140 0.140	
9	379.00	1.750		0.100	
10	408.00	1.730		0.080	
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Pate	rson Group Ltd.	Pumping test analysis	S	Date: 25.07.2005	none, Page 5	
	rson Group Ltd. Concourse Gate n, ON K2E 7T7	Time-Drawdown plot with discharge		Project: Sunset L	akes	-
Nepea	I, ON IZE / I/	man disonal ge		Evaluated by: RA	P	•
Pump	ping Test No. 1		Test conducted on:	June 23, 2005		
TW1			Observation Well 2 (	(TW3)		_
Disch	arge 1.44 l/s		Distance from the pu	umping well 175.00	0 m	-
Statio	water level: 0.360 m below datum					-
	Pumping test duration	Water level	Drawdo	wn		-
	[min]	[m]	[m]			
1	[min] 0.00	[m] 0.360		0.000		-
2	38.00	0.400		0.040		_
3	69.00	0.420		0.060		
4	130.00	0.470		0.110 0.120		_
5 6	187.00 248.00	0.480 0.480		0.120		_
7	306.00	0.490		0.130		-
8	346.00	0.490		0.130		_
9	383.00	0.450		0.090		_
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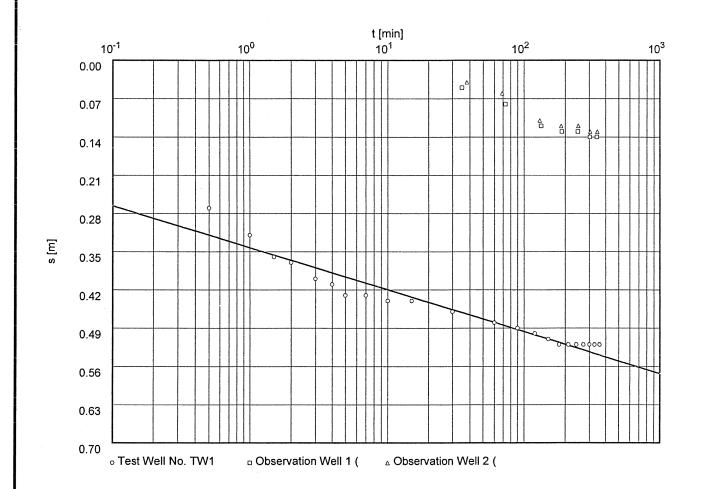
Paterson Group Ltd.	Pumping test analysi		Date: 25.07.2005	none, Page 6
1-28 Concourse Gate Nepean, ON K2E 7T7	Theis analysis methor Confined aquifer	od	Project: Sunset La	(es
	·		Evaluated by: RAP	
Pumping Test No. 1		Test conducted on:	June 23, 2005	
TW1				
Discharge 1.44 l/s				
				***************************************



Transmissivity [m²/min]: 1.96 x 10<sup>-1</sup>

Storativity: 2.82 x 10<sup>-3</sup>

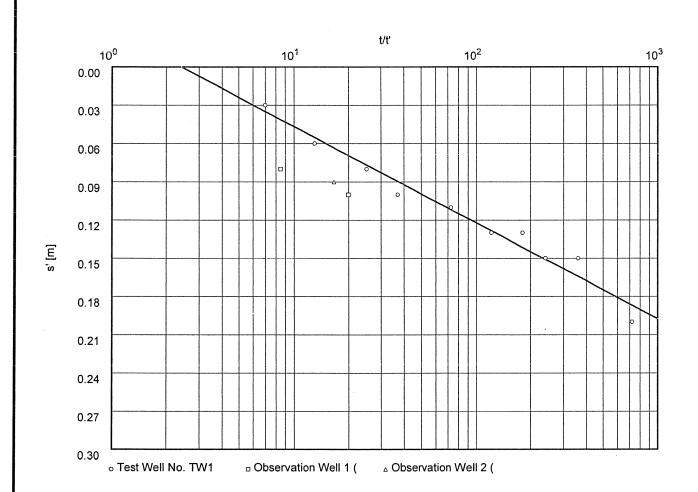
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Time-Drawdown-me COOPER & JACOB	Pumping test analysis Time-Drawdown-method after COOPER & JACOB		Date: 25.07.2005   none, Page 7  Project: Sunset Lakes		
	Confined aquifer		Evaluated by: RAP			
Pumping Test No. 1		Test conducted on	: June 23, 2005			
TW1						
Discharge 1.44 l/s						
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Transmissivity [m²/min]: 2.05 x 10<sup>-1</sup>

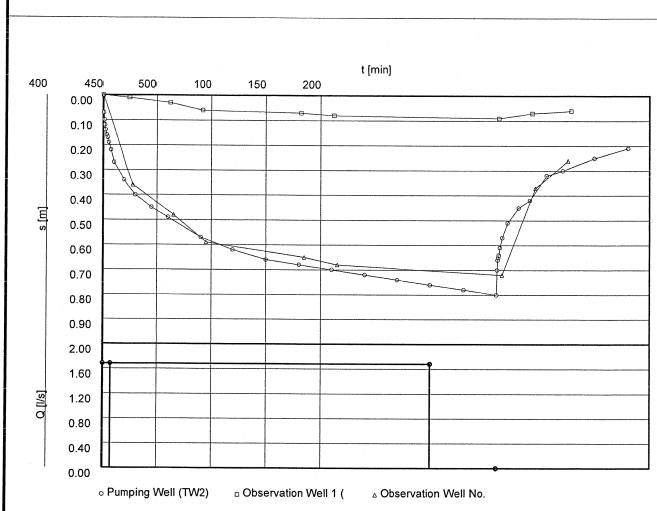
Storativity:  $1.61 \times 10^{-3}$ 

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Recovery method after THEIS & JACOB Confined aquifer		Date: 25.07.2005 none, Page 8  Project: Sunset Lakes  Evaluated by: RAP		
Pumping Test No. 1		Test conducted on:	June 23, 2005		
TW1					
Discharge 1.44 l/s					
		Pumping test duration	on: 360.00 min		



Transmissivity [m²/min]: 2.09 x 10<sup>-1</sup>

Paterson Group Ltd. 1-28 Concourse Gate	Pumping test analysi		Date: 25.07.2005	none, Page 9
Nepean, ON K2E 7T7	Time-Drawdown plot with discharge		Project: Sunset Lal	(es
			Evaluated by: RAP	
Pumping Test No. 2		Test conducted on:	June 27, 2005	
TW2				
Discharge 1.40 l/s				



Paters	on Group Ltd. ncourse Gate	Pumping test analysis	3	Date: 25.07.2005	none, Page 10
	ncourse Gate N K2E 7T7	Time-Drawdown plot with discharge		Project: Sunset Lake	s
,			Evaluated by: RAP		
Pumping	Test No. 2		Test conducted	i on: June 27, 2005	
TW2			Constant Rate	Pump Test	
Discharg	ge 1.40 l/s		<del></del>		
	Pumping test duration	Discharge			
	[min]	[l/s]			
1	0.00	1.68			
2	7.00	1.68			
3 4	300.00 360.00	1.68			
	360.00	0.00			
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Paterson Group Ltd.
1-28 Concourse Gate
Nepean, ON K2E 7T7

Pumping test analysis Time-Drawdown plot with discharge

Date: 25.07.2005	none, Page 11
Project: Sunset Lak	es

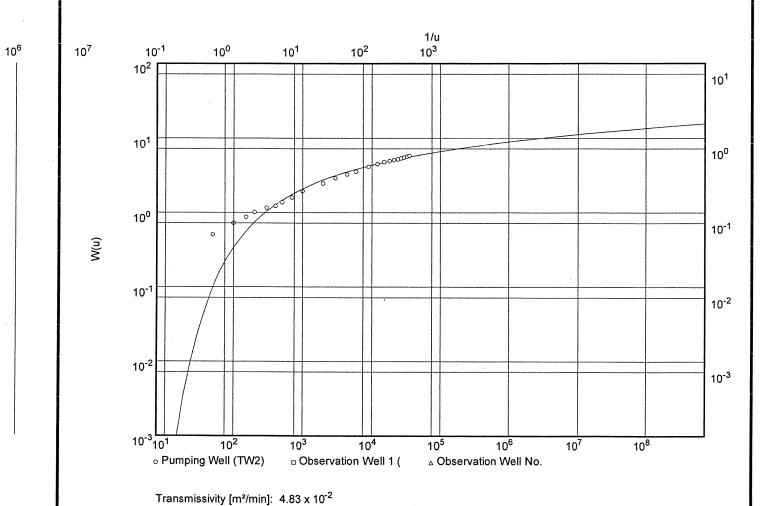
		Evaluated by: RAP
Pumping Test No. 2	Test conducted on: J	une 27, 2005
TW2	Pumping Well (TW2)	
Discharge 1.40 l/s	Distance from the pur	mping well 0.100 m

Static v	water level: 1.980 m below datum			
	Pumping test duration	Water level	Drawdown	
	[min]	[m]	[m]	
1	0.00	1.980	0.000	
2	0.50	2.050	0.070	
3	1.00	2.080	0.100	
4	1.50	2.100	0.120	
5	2.00	2.120	0.140	
6	. 3.00	2.140	0.160	
7	4.00	2.150	0.170	
8	5.00	2.170	0.190	
9	7.00	2.200	0.220	
10	10.00	2.250	0.270	
11	20.00	2.320	0.340	
12	30.00	2.380	0.400	
13	45.00	2.430	0.450	
14	60.00	2.470	0.490	
15	90.00	2.550	0.570	
16	120.00	2.600	0.620	
17	150.00	2.640	0.660	
18	180.00	2.660	0.680	
19	210.00	2.680	0.700	
20	240.00	2.700	0.720	
21	270.00	2.720	0.740	
22	300.00	2.740	0.760	
23	330.00	2.760	0.780	
24	360.00	2.780	0.800	
25	360.50	2.680	0.700	
26	361.00	2.640	0.660	
27	361.50	2.630	0.650	-
28	362.00	2.620	0.640	
29	363.00	2.590	0.610	
30	365.00	2.550	0.570	
31	370.00	2.490	0.510	
32	380.00	2.430	0.450	
33	390.00	2.400	0.420	
34	405.00	2.300	0.320	
35 36	420.00	2.280	0.300	
37	450.00 480.00	2.230	0.250	
31	480.00	2.190	0.210	

Paterson	Group Ltd. ourse Gate	Pumping test analysis		Date: 25.07.2005	none, Page 1		
1-28 Conco		Time-Drawdown plot with discharge		Project: Sunset La	kes		
•			Evaluated by: RAP		)		
Pumping Te	est No. 2		Test conducted on: June 27, 2005  Observation Well 1 (TW1)				
TW2							
Discharge 1	1.40 l/s		Distance from the pumping well 100.000 m				
Static water	r level: 1.810 m below datum						
P	Pumping test duration	Water level	Drawdo	wn			
	[min]	[m]	[m]				
1	0.00	1.810	[iii]	0.000			
2	25.00	1.820		0.010			
3	62.00	1.840		0.030			
4	92.00	1.870		0.060			
5	182.00	1.880		0.070			
6	212.00	1.890		0.080			
7	362.00	1.900		0.090			
8	392.00	1.880		0.070			
9	428.00	1.870		0.060			
		1.070		0.000			
					· · · · · · · · · · · · · · · · · · ·		

Paterson Group Ltd. 1-28 Concourse Gate		Pumping test analysis		Date: 25.07.	2005 none, Page 1
	oncourse Gate ON K2E 7T7	Time-Drawdown plot with discharge		Project: Sunset Lakes Evaluated by: RAP	
Pumpir	ng Test No. 2		Test conducted on: June 27, 2005		
TW2			Observation Well No	o. 2 (TW3)	· · · · · · · · · · · · · · · · · · ·
Discha	rge 1.40 l/s		Distance from the pr	umping well 50	.000 m
Static v	vater level: 0.690 m below datum	· · · · · · · · · · · · · · · · · · ·			
	Pumping test duration	Water level	Drawdo	wn	
	[min]	[m]	[m]		
1	0.00	0.690		0.000	43 6 2 2
2	28.00	1.050		0.360	
3	65.00	1.170		0.480	
4	95.00	1.280		0.590	
5	185.00	1.340		0.650	
6	215.00	1.370		0.680	
7	365.00	1.410		0.720	
8	395.00	1.060		0.370	
9	425.00	0.950		0.260	
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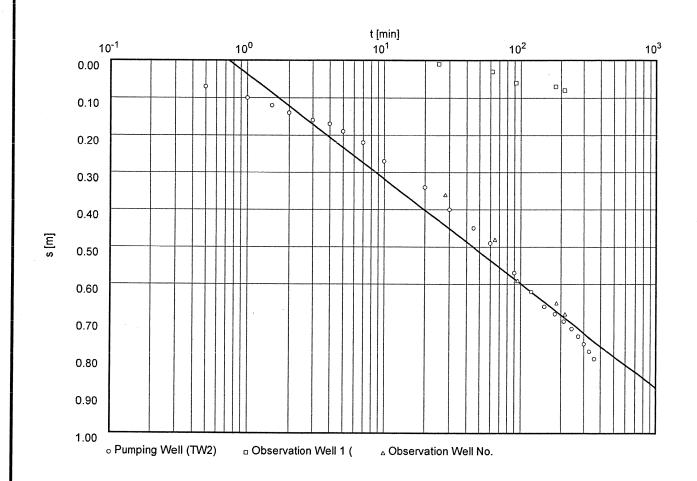
Paterson Group Ltd.		Pumping test analysis Theis analysis method Confined aquifer		none, Page 15	
1-28 Concourse Gate Nepean, ON K2E 7T7	1			kes	
Mopouli, Olynez Pri				)	
Pumping Test No. 2		Test conducted or	Test conducted on: June 27, 2005		
TW2					
Discharge 1.40 l/s					
,					



Storativity: 1.45 x 10<sup>1</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Confined aquifer		Date: 25.07.2005  Project: Sunset Lak  Evaluated by: RAP	none, Page 16
Pumping Test No. 2		Test conducted on: J	une 27, 2005	
TW2				
Discharge 1.40 l/s				

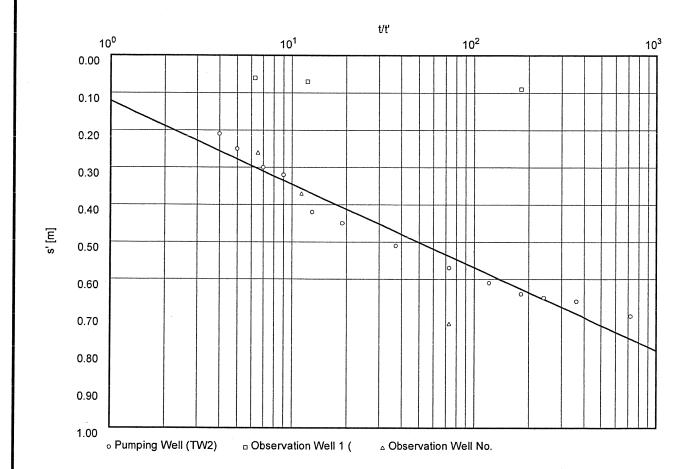
Date: 25.07.2005 none, Page 16



Transmissivity [m²/min]: 5.47 x 10<sup>-2</sup>

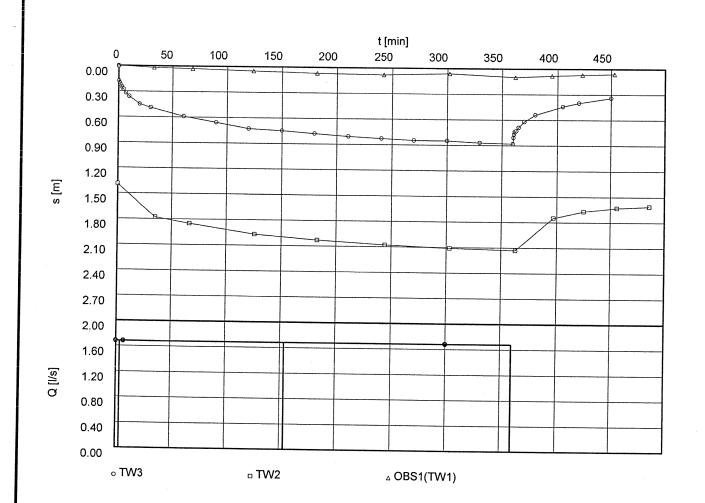
Storativity: 9.11 x 10<sup>0</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Recovery method after THEIS & JACOB		Date: 25.07.2005 none, Page 17  Project: Sunset Lakes	
	Confined aquifer	fined aquifer		
Pumping Test No. 2		Test conducted on: June 27, 2005		
TW2				
Discharge 1.40 l/s				
		Pumping test duratio	n: 360.00 min	



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

Paterson Group Ltd. 1-28 Concourse Gate	Time-Drawdown plot with discharge		Date: 27.07.2005	none, Page 18	
Nepean, ON K2E 7T7			I Drojoot: Cunaat Lakaa		es
			Evaluated by: RAp		
Pumping Test No. 3		Test conducted on: June 28, 2005			
TW 3					
Discharge 1.68 l/s					



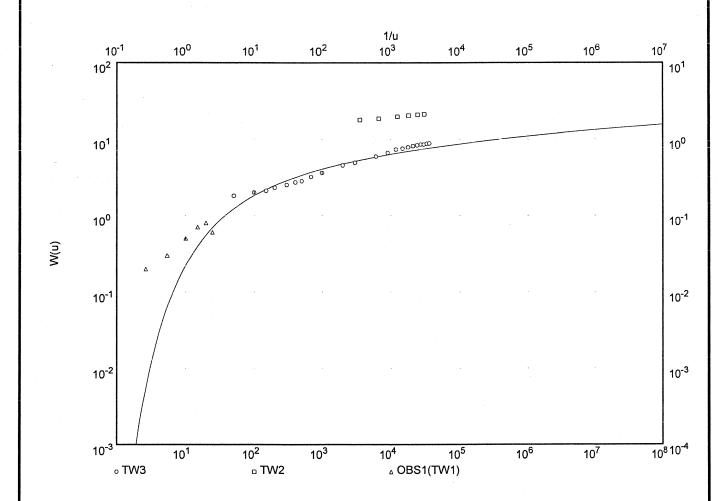
Paterson	Group Ltd. ourse Gate	Pumping test analysis		Date: 27.07.2005	none, Page 19	
Nepean, ON		Time-Drawdown plot with discharge		Project: Sunset La	kes	
				Evaluated by: RAp	aluated by: RAp	
Pumping T	est No. 3		Test conducted on:	June 28, 2005		
TW 3			TW3			
Discharge	1.68 l/s		Distance from the pu	ımping well 0.100 m		
Static water	er level: 0.700 m below datum					
	Pumping test duration	Water level	Drawdov	wn		
	[min]	[m]	[m]			
1	0.00	0.700		0.000		
2	0.50	0.880		0.180		
3	1.00	0.900		0.200		
4	1.50	0.910		0.210		
5	2.00	0.930		0.230		
6	3.00	0.950	****	0.250		
7	4.00	0.970		0.270		
8	5.00	0.980		0.280		
9 10	7.00	1.020		0.320		
11	10.00	1.060		0.360		
12	20.00 30.00	1.150		0.450		
13	60.00	1.190 1.290		0.490 0.590		
14	90.00	1.360		0.660		
15	120.00	1.430		0.730		
16	150.00	1.450		0.750		
17	180.00	1.480		0.780		
18	210.00	1.510		0.810		
19	240.00	1.530		0.830		
20	270.00	1.550		0.850		
21	300.00	1.550		0.850		
22	330.00	1.570		0.870		
23	360.00	1.580		0.880		
24	360.50	1.510		0.810		
25	361.00	1.470		0.770		
26	361.50	1.440		0.740		
27	362.00	1.440		0.740		
28	363.00	1.430		0.730		
29	365.00	1.390		0.690		
30	370.00	1.320		0.620		
31	380.00	1.240		0.540		
32	405.00	1.140		0.440		
33	420.00	1.100		0.400		
34	450.00	1.040		0.340		
- 1						

Paterson	Group Ltd.	Pumping test analysis	S	Date: 27.07.2005	none, Page 20
		Time-Drawdown plot with discharge		Project: Sunset Lakes	
Nepean, ON	K2E 717			Evaluated by: RAp	
Pumping 1	Feet No. 3		Toot conducted on:	<del></del>	
	est No. 5		Test conducted on:	June 28, 2005	
TW 3			Constant rate test		
Discharge	1.68 l/s				
	Pumping test duration	Discharge			
	[min]	[l/s]			
1 2	0.00 7.00	1.68 1.68			
3	300.00	1.68			
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Patersor	Paterson Group Ltd. Pumping test an			Date: 27.07.200	5 none, Page 21
1-28 Cond	course Gate	Time-Drawdown plot with discharge		Project: Sunset	Lakes
Nepean, ON	INZE / I /	With discharge	with discharge		Ap
Pumping	Test No. 3		Test conducte	ed on: June 28, 2005	
TW 3			TW2		
Discharge	e 1.68 l/s		Distance fron	the pumping well 0.100	m
Static wat	ter level: 0.700 m below datum	· ·			
	Pumping test duration	Water level		)rawdown	
	[min]	[m]		[m]	
1	0.00	2.090		1.390	
2	35.00	2.480		1.780	
3	66.00	2.550		1.850	
4	126.00	2.670		1.970	
5	183.00	2.730		2.030	
6	244.00	2.780		2.080	100
7	303.00	2.810		2.110 2.130	
8	363.00 397.00	2.830 2.450		1.750	
9 10	425.00	2.450		1.670	, , , , , , , , , , , , , , , , , , ,
11	425.00	2.370		1.630	
12	485.00	2.310		1.610	
12	403.00	2.010		1.0.0	
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1 aterson	Paterson Group Ltd. 1-28 Concourse Gate Pumping Time-Dr		S	Date: 27.07.2005	none, Page 22
Nepean, ON K2E 7T7		Time-Drawdown plot with discharge		Project: Sunset La	akes
				Evaluated by: RA	)
Pumping 7	est No. 3		Test conducted on	: June 28, 2005	
TW 3			OBS1(TW1)		
Discharge	1.68 l/s		Distance from the	pumping well 3.500 n	1
Static water	er level: 1.860 m below datum				
	Pumping test duration	Water level	Drawd	own	
	[min]	[m]	[m	]	
1	0.00	1.860		0.000	
2	33.00	1.880		0.020	
3 4	68.00 124.00	1.890 1.910		0.030 0.050	
5	182.00	1.930		0.070	
6	242.00	1.940		0.080	
7	302.00	1.920		0.060	
8	362.00	1.960		0.100	
9	395.00	1.940		0.080	
10	423.00	1.930		0.070	
11	453.00	1.920		0.060	
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					***************************************
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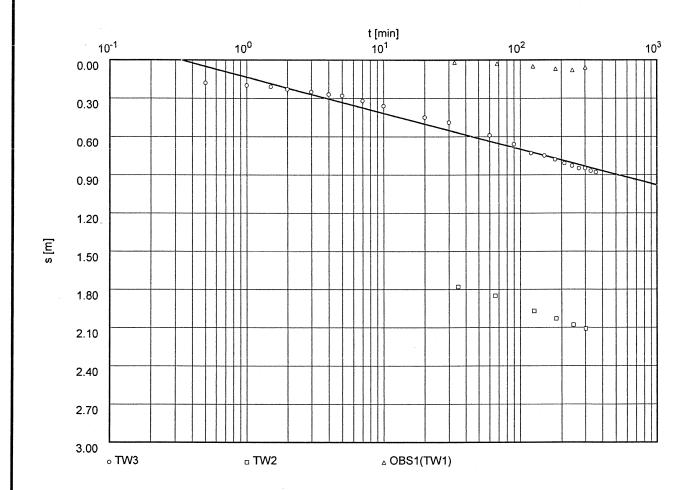
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Theis analysis method Confined aquifer		Date: 27.07.2005  Project: Sunset Lak  Evaluated by: RAp	none, Page 23
Pumping Test No. 3		Test conducted on: June 28, 2005		
TW 3				
Discharge 1.68 l/s				



Transmissivity [m $^2$ /min]: 8.02 x 10 $^{-2}$ 

Storativity: 3.20 x 10<sup>0</sup>

Pumping test analysis Time-Drawdown-method after COOPER & JACOB Confined aquifer				
Pumping Test No. 3		Test conducted on: June 28, 2005		
Discharge 1.68 l/s				
	Time-Drawdown-met	Time-Drawdown-method after COOPER & JACOB Confined aquifer	Time-Drawdown-method after COOPER & JACOB Confined aquifer  Project: Sunset Lak Evaluated by: RAp	

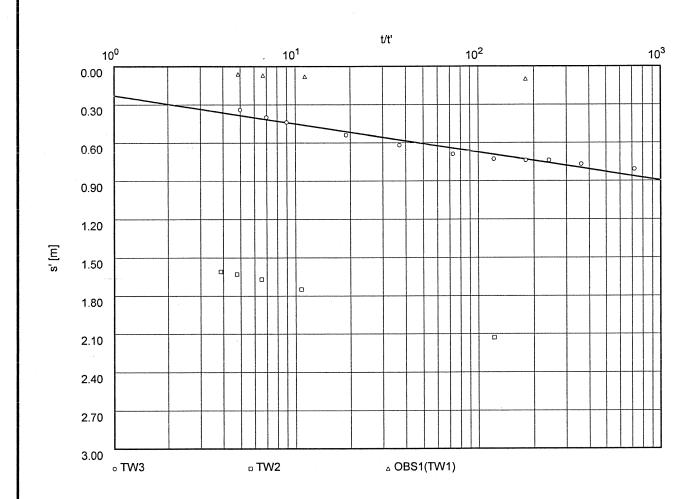


Transmissivity [m²/min]: 6.55 x 10<sup>-2</sup>

Storativity: 4.88 x 10<sup>0</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Recovery method after THEIS & JACOB Confined aquifer		Date: 27.07.2005  Project: Sunset Lak  Evaluated by: RAp	none, Page 25
Pumping Test No. 3	Т.	est conducted on: J	une 28, 2005	
TW 3				
Discharge 1.68 l/s				

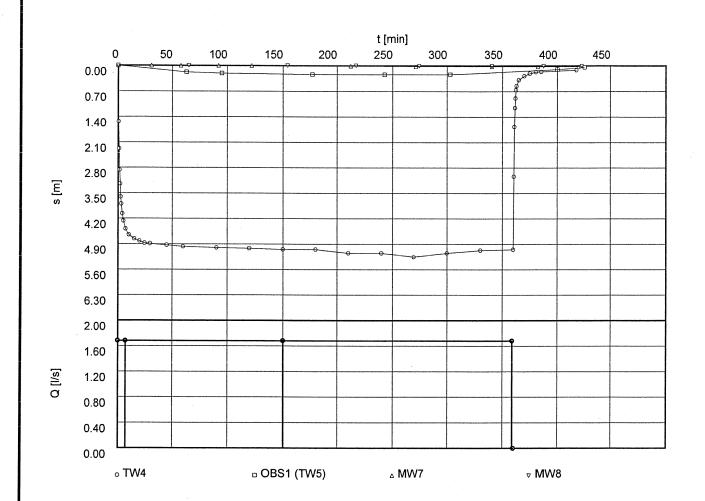




Transmissivity [m²/min]: 8.30 x 10<sup>-2</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown plot with discharge		Date: 09.08.2005 Project: Sunset Lal	none, Page 26
Hopour, Office 117			Evaluated by: RAP	
Pumping Test No. 1		Test conducted on: June 21, 2005		
TW4				
Discharge 1.68 l/s				

Date: 09.08.2005 none, Page 26



Paterson	Group Ltd. urse Gate	Pumping test analysis	3	Date: 09.08.2005	none, Page 27		
1-28 Conco Nepean, ON K		Time-Drawdown plot with discharge		Project: Sunset Lakes			
ropoun, ortro			Evaluated by: RAP				
Pumping Te	est No. 1		Test conducted on:	June 21, 2005			
ΓW4			Constant Rate Test				
Discharge 1	I.68 l/s						
	Pumping test duration	Discharge					
1	[min] 0.00	[l/s] 1.68					
2	7.00	1.68					
3	150.00	1.68					
4	359.00	1.68					
5	360.00	0.00					
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		Manager to the second s					

Paterson Group Ltd. 1-28 Concourse Gate
Nepean, ON K2E 7T7

Pumping test analysis Time-Drawdown plot with discharge

	Date: 09.08.2005						none, Page 28			
ĺ				_				_		_

Project: Sunset Lakes

Evaluated by: RAP

Pumping Test No. 1

Test conducted on: June 21, 2005

TW4

TW4

Discharge 1.68 l/s

Distance from the pumping well 0.100 m

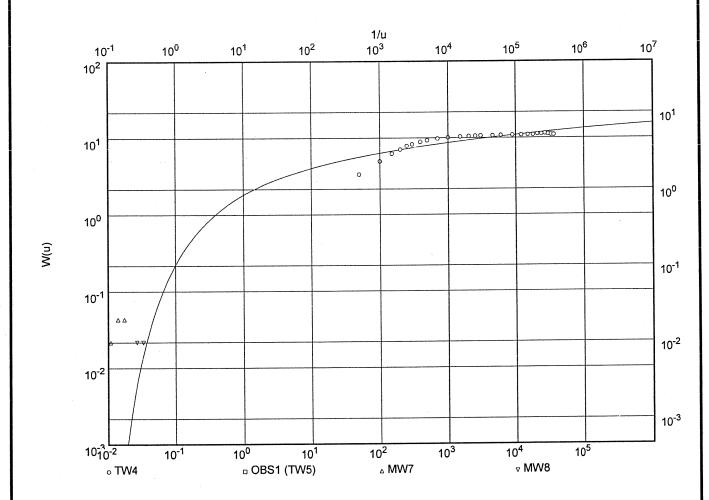
Static v	vater level: 1.200 m below datum			
	Pumping test duration	test duration Water level Drawdown		
	[min]	[m]	[m]	
1	0.00	1.200	0.000	
2	0.50	2.740	1.540	
3	1.00	3.480	2.280	
4	1.50	4.070	2.870	
5	2.00	4.450	3.250	
6	2.50	4.810	3.610	
7	3.00	5.000	3.800	
8	4.00	5.270	4.070	
9	5.00	5.470	4.270	
10	7.00	5.690	4.490	
11	10.00	5.850	4.650	
12	15.00	5.960	4.760	
13	20.00	6.020	4.820	
14	25.00	6.080	4.880	
15	30.00	6.090	4.890	
16	45.00	6.130	4.930	
17	60.00	6.170	4.970	
18	90.00	6.200	5.000	
19	120.00	6.220	5.020	
20	150.00	6.250	5.050	
21	180.00	6.250	5.050	
22	210.00	6.350	5.150	
23	240.00	6.350	5.150	
24	270.00	6.450	5.250	
25	300.00	6.350	5.150	
26	330.00	6.270	5.070	
27	360.00	6.250	5.050	
28	360.50	4.240	3.040	
29	361.00	2.870	1.670	
30	361.50	2.350	1.150	
31	362.00	2.090	0.890	
32	362.50	1.860	0.660	
33	363.00	1.750	0.550	
34	365.00	1.590	0.390	
35	370.00	1.480	0.280	
36	375.00	1.410	0.210	
37	380.00	1.370	0.170	
38	385.00	1.360	0.160	
39	417.00	1.320	0.120	
-33	417.00	1.020	3.125	
				20 1 2 4 4 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5
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Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7		Pumping test analysis Time-Drawdown plot	•	Date: 09.08.2005   none, Page 29		
		with discharge		Project: Sunset La		
				Evaluated by: RAP		
Pumping T	est No. 1		Test conducted on:	June 21, 2005 		
TW4			OBS1 (TW5)			
Discharge	1.68 l/s		Distance from the pu	imping well 273.000	m	
Static wate	r level: 0.750 m below datum					
F	Pumping test duration	Water level	Drawdo	wn		
	[min]	[m]	[m]			
1	0.00	0.750		0.000		
2	63.00	0.930		0.180		
3	95.00	0.960		0.210		
4	177.00	0.990		0.240		
5	243.00	0.990		0.240		
6	303.00	0.990		0.240		
7	400.00	0.850		0.100		
8	425.00	0.790		0.040		
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Paterso	on Group Ltd.	Pumping test analysi Time-Drawdown plot	s	Date: 09.08.2			
1-28 Concourse Gate Nepean, ON K2E 7T7		with discharge		Project: Sun			
			Evaluated by: RAP				
Pumping	g Test No. 1		Test condu	icted on: June 21, 2005			
TW4	-		MW7				
Discharç	ge 1.68 l/s		Distance fr	om the pumping well 14	0.000 m		
Static wa	ater level: 0.720 m below datum						
	Pumping test duration	Water level		Drawdown			
	[min]	[m]		[m]			
1	0.00	0.720		0.000			
2	31.00	0.720		0.000			
3 4	58.00 92.00	0.720 0.720		0.000 0.000			
5	122.00	0.720		0.000			
6	212.00	0.720		0.010			
7	272.00	0.740		0.020			
8	340.00	0.740		0.020			
9	382.00	0.740		0.020			
10	419.00	0.740		0.020			
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	*						
		***************************************			<u> </u>		
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Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7		Pumping test analysis	s	Date: 09.08.200	none, Page 31
		Time-Drawdown plot with discharge		Project: Sunset Lakes	
				Evaluated by: R	AP
Pumping 7	Test No. 1		Test conducted of	n: June 21, 2005	
TW4			MW8		
Discharge	1.68 l/s		Distance from the	e pumping well 100.0	00 m
Static water	er level: 0.140 m below datum				
	Pumping test duration	Water level	Drav	/down	
	[min]	[m]		m]	
1	0.00	0.140		0.000	
2	65.00	0.140		0.000	
3	154.00	0.140		0.000	
4	217.00	0.140		0.000	
5	275.00	0.150		0.010	
6	340.00	0.150		0.010	
7	387.00	0.150		0.010	
8	422.00	0.150		0.010	
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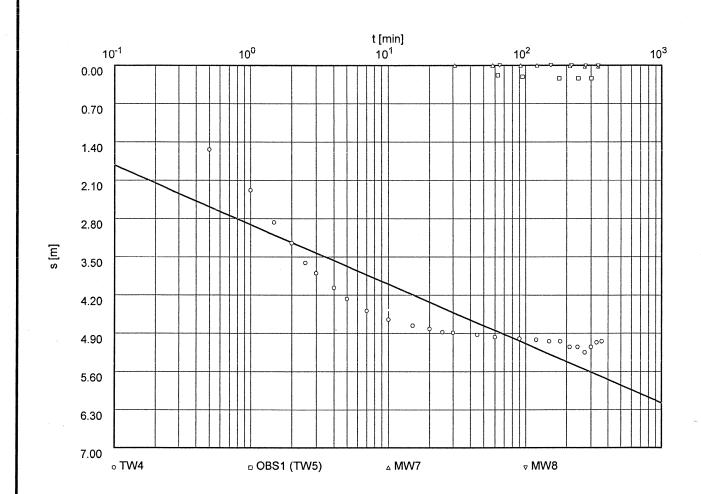
Paterson Group Ltd. 1-28 Concourse Gate	Pumping test analysis Theis analysis method Confined aquifer		Date: 09.08.2005 none, Page 31  Project: Sunset Lakes	
Nepean, ON K2E 7T7	Commed aquiler		Evaluated by: RAP	
Pumping Test No. 1	Test conducted on: June 21, 2005			
TW4				
Discharge 1.68 l/s				



Transmissivity [m²/min]: 1.73 x 10<sup>-2</sup>

Storativity: 6.86 x 10<sup>-3</sup>

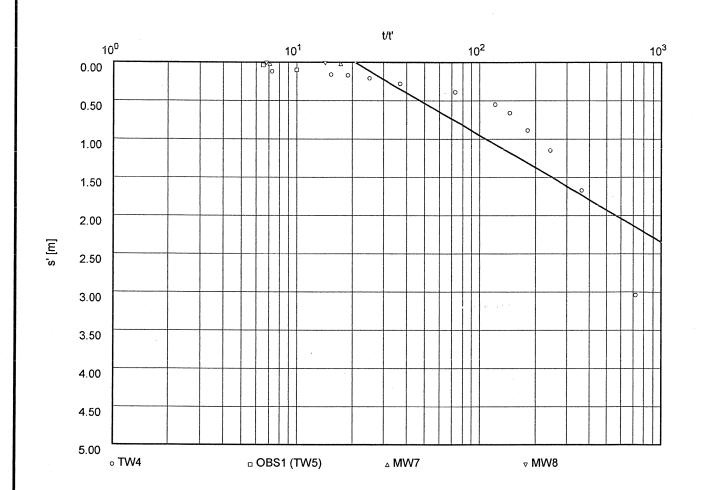
Pumping Test No. 1 Test conducted on: June 21, 2005	Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Confined aquifer		Project: Sunset Lak Evaluated by: RAP	Kes
	Pumping Test No. 1		Test conducted on: June 21, 2005		
TW4	TW4				
Discharge 1.68 l/s	Discharge 1.68 l/s				



Transmissivity [m²/min]: 1.68 x 10<sup>-2</sup>

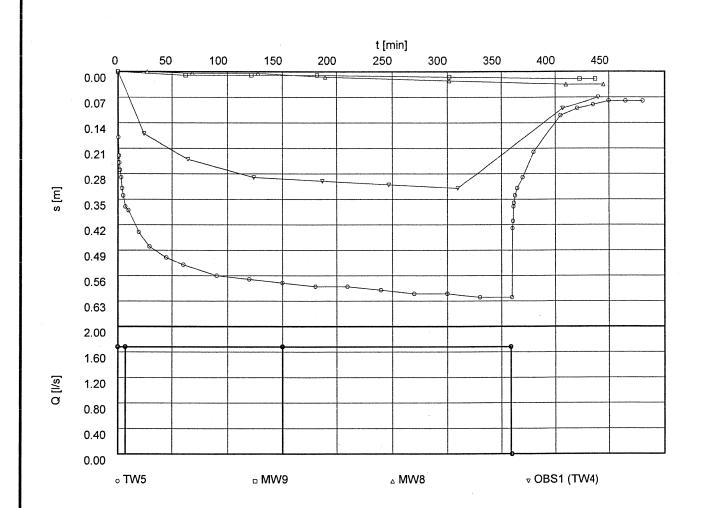
Storativity: 8.11 x 10<sup>-3</sup>

Paterson Group Ltd. 1-28 Concourse Gate	Pumping test analys		Date: 09.08.2005	none, Page 33	
Nepean, ON K2E 7T7	Recovery method after THEIS & JACOB		Project: Sunset Lakes		
	Confined aquifer		Evaluated by: RAP		
Pumping Test No. 1		Test conducted on:	June 21, 2005		
TW4					
Discharge 1.68 l/s					
		Pumping test duration	on: 360.00 min		



Transmissivity [m²/min]: 1.31 x 10<sup>-2</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	course Gate Time-Drawdown plot		
Hopour, ON IZE 111	dioonal go	Evaluated by: RAP	
Pumping Test No. 2	Test conduc	ted on: June 22, 2005	
TW5			
Discharge 1.68 l/s			



					_		
Paterso	n Group Ltd. course Gate	Pumping test analysis	3	Date: 09.08.2005	none, Page 35		
1-28 Con Nepean, ON		Time-Drawdown plot with discharge		Project: Sunset Lal	t: Sunset Lakes		
Nepean, Or	N NZE / 1 /	With discharge	Evaluated by: RAP				
Pumping	Test No. 2		Test conducted on:	l			
 ГW5			Constant Rate Test				
	e 1.68 l/s						
	Pumping test duration	Discharge					
	,, <u>,</u>	g					
	[min]	[l/s]					
1 2	0.00 7.00	1.68 1.68					
3	150.00	1.68					
4	359.00	1.68					
5	360.00	0.00					
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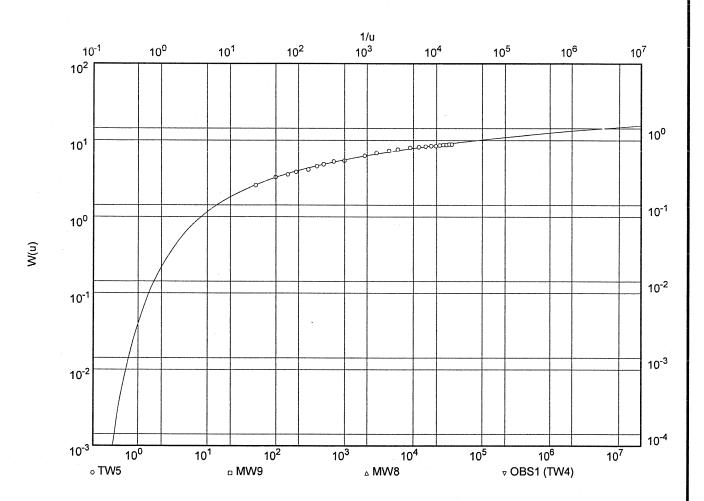
Paterson 1-28 Conco	Group Ltd.	Pumping test analysi Time-Drawdown plot	s	Date: 09.08.200	Date: 09.08.2005 none, Page 36		
Nepean, ON K		with discharge		Project: Sunset Lakes			
-			Evaluated by: RAP				
Pumping To	est No. 2		Test conducted	l on: June 22, 2005			
TW5			TW5		N 60 C C C C C C C C C C C C C C C C C C		
Discharge 1.68 l/s			Distance from t	he pumping well 0.100	m		
Static wate	r level: 0.710 m below datum	**************************************					
P	rumping test duration	Water level	Dra	awdown			
	[min]	[m]		[m]			
1	0.00	0.710		0.000			
2	0.50	0.890		0.180			
3	1.00	0.940		0.230			
4	1.50	0.960	7.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1	0.250			
5	2.00	0.980		0.270			
6	3.00	1.000		0.290			
7	4.00	1.030		0.320			
8	5.00	1.050		0.340			
9	7.00	1.080		0.370	***************************************		
10	10.00	1.090		0.380			
11	20.00	1.150		0.440			
12	30.00	1.190		0.480			
13	45.00	1.220		0.510			
14	60.00	1.240	I	0.530			
15	90.00	1.270		0.560			
16	120.00	1.280		0.570			
17	150.00	1.290		0.580			
18	180.00	1.300		0.590	95		
19	210.00	1.300		0.590			
20	240.00	1.310		0.600			
21	270.00	1.320		0.610			
22	300.00	1.320	1	0.610			
23	330.00	1.330		0.620			
24	360.00	1.330		0.620			
25	360.50	1.140	1	0.430			
26	361.00	1.120		0.410			
27	361.50	1.080		0.370			
28	362.00	1.070		0.360			
29	363.00	1.050		0.340			
30	365.00	1.030		0.320			
31	370.00	1.000		0.290			
32	380.00	0.930		0.220			
33	405.00	0.830		0.120			
34	420.00	0.810		0.100			
35	435.00	0.800		0.090			
36	450.00	0.790		0.080			
37	465.00	0.790		0.080			
38	480.00	0.790		0.080			
				·			
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Paterson G 1-28 Concou	Group Ltd.	Pumping test analys	S	Date: 09.08.2005 none, Pag		none, Page 37	
1-28 Concou Nepean, ON K2		Time-Drawdown plot with discharge			Project: Sun	set Lak	es
					Evaluated b		
Pumping Tes	st No. 2		Test conduct	ted on: J	une 22, 2005		
TW5			MW9				
Discharge 1.0	68 l/s	Distance from	n the pu	mping well 40	0.000 m		
Static water I	evel: 0.720 m below datum						
Pui	mping test duration	Water level		Drawdov	/n		
	[min]	[m]		[m]			
1 2	0.00 62.00	0.720			0.000		
3	122.00	0.730 0.730			0.010 0.010		
4	182.00	0.730			0.010		
5	302.00	0.735			0.015		
6	422.00	0.740			0.020		
7	437.00	0.740			0.020		
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Paterson Gro 1-28 Concourse	up Ltd.	Pumping test analysis	3	Date: 09.08.2005 none, Page		
1-28 Concourse Gate Nepean, ON K2E 7T7		Time-Drawdown plot with discharge		Project: Sunset Lakes		
				Evaluated by: RAP		
Pumping Test N	0. 2		Test conducted on	: June 22, 2005		
TW5			MW8			
Discharge 1.68	/s		Distance from the	pumping well 190.000 m		
Static water leve	el: 0.125 m below datum					
Pump	ng test duration	Water level	Drawd	lown		
	[min]	[m]	[m	]		
1	0.00	0.125		0.000		
2	28.00	0.125		0.000		
3	68.00	0.130		0.005		
4	128.00	0.130		0.005		
5	190.00	0.140		0.015		
6	302.00	0.150		0.025		
7	410.00	0.160		0.035		
8	445.00	0.160		0.035		
		·				
				·		
·		20				
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Datarea	on Group I td	Pumping test analysis		Date: 09.08.2005	none, Page 39	
Paterson Group Ltd. 1-28 Concourse Gate		oncourse Gate Time-Drawdown plot		Project: Sunset Lakes		
lepean, C	N K2E 7T7	with discharge		Evaluated by: RAF	)	
oumping	g Test No. 2		Test conducted on:	June 22, 2005		
TW5			OBS1 (TW4)			
Dischar	ge 1.68 l/s		Distance from the p	umping well 273.000	m	
Static w	ater level: 1.170 m below datum					
	Pumping test duration	Water level	Drawdown			
	[min]	[m]	[m]			
1	0.00	1.170		0.000		
2	25.00	1.340		0.170		
3	64.00	1.410		0.240		
4	124.00	1.460		0.290		
5	187.00	1.470		0.300 0.310		
6	247.00	1.480		0.310		
7	310.00	1.490		0.320		
8	407.00	1.270 1.240		0.070		
9	440.00	1.240	!	0.070		
			·			

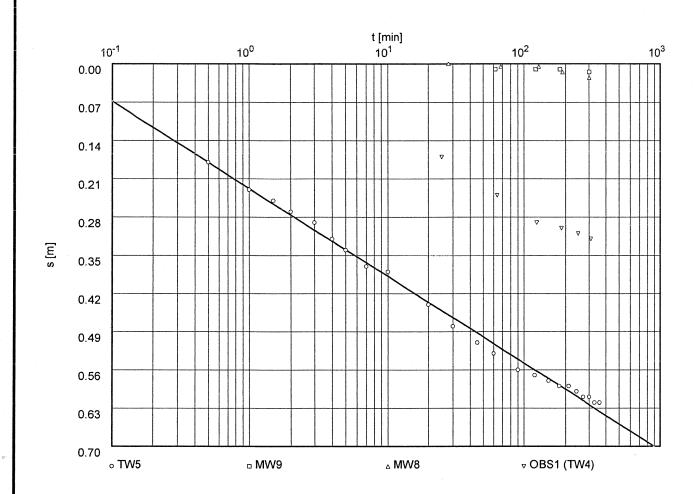
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Theis analysis method Confined aquifer		Date: 09.08.2005 none, Page 39  Project: Sunset Lakes		
			Evaluated by: RAP		
Pumping Test No. 2		Test conducted on: J	une 22, 2005		
TW5					
Discharge 1.68 l/s					



Transmissivity [m²/min]: 1.14 x 10<sup>-1</sup>

Storativity: 9.83 x 10<sup>-1</sup>

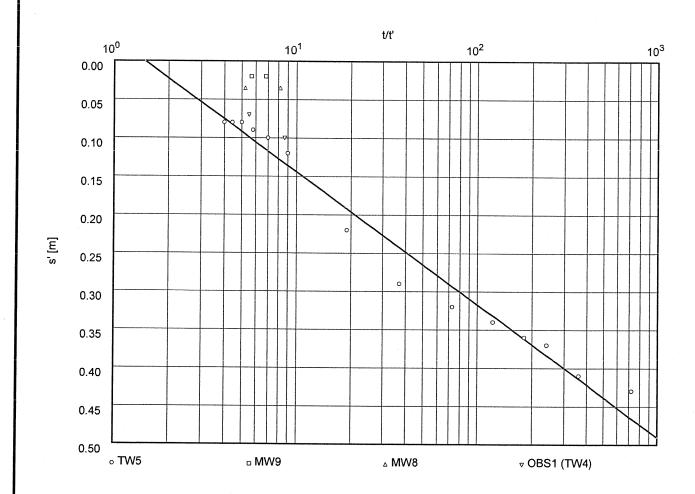
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Confined aquifer		Project: Sunset Lakes  Evaluated by: RAP		
Pumping Test No. 2		Test conducted on: J	lune 22, 2005		
TW5					
Discharge 1.68 l/s			,		



Transmissivity [m²/min]: 1.15 x 10<sup>-1</sup>

Storativity: 9.71 x 10<sup>-1</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Recovery method after THEIS & JACOB		28 Concourse Gate Recovery method after		Date: 09.08.2005 Project: Sunset Lal	none, Page 41
	Confined aquifer		Evaluated by: RAP			
Pumping Test No. 2		Test conducted on:	June 22, 2005			
TW5						
Discharge 1.68 l/s			,			
		Pumping test duration	on: 360.00 min			



Transmissivity [m²/min]: 1.06 x 10<sup>-1</sup>

	w etc.		Drawdown	0.32 0.35 0.39 0.41 0.49 0.53 0.58			10000
			<del>(</del>	7.94 8.86 9.84 10.24 11.55 13.60 14.85			0006
			4th Well Grouping u W(t	2E-04 8E-05 3E-05 2E-05 2E-06 7E-07 7E-07			8000
ence.			oing W(u)	8.63 9.14 10.24 10.94 11.45 12.55 13.93 14.85			7000
II Interfer			3rd Well Grouping u W(ι	1E-04 6E-05 2E-05 1E-05 1E-05 1-05 2E-06 5E-07 1-15 2E-07	1 2 1 2 4		0009
ation of Potential Well Interference			oing W(u)	8.99 9.84 10.94 11.29 12.14 13.34 15.65	Graph of Drawdown vs. Time	A STREET, STRE	5000 Time (days)
on of Pot		of 85 Wells	2nd Well Grouping u W(t	7E-05 3E-05 1E-05 7E-06 3E-06 1 9E-07 9E-08 1 4E-08	Sraph of Drav		4000 Ti
Determinati			/(u)	10.24 10.94 11.63 12.55 13.24 14.44 15.54 17.84	9		3000
De	2 249 15 0.001	Analysis Assumes Continuous Pumping	1st Well Grouping u W(u)	2E-05 1E-05 5E-06 1E-06 1E-06 1E-07 1E-07 1E-07			2000
		Analysis As	n T		1	And the second s	1000
	) m3/day ) m2/day acing (m) r age S		Time (days)	5 10 25 50 100 365 1100 9125			
	Pumping Rate (Q) m3/day Transmissivity (T) m2/day Average Well Spacing (m) r Coefficient of Storage S	Notes:	Time	1 3 7 7 7 7 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7	(sent) mwobwst		0



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#### Hourly Data Report for June 22, 2005

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

<u>WMO ID</u>: 71628

TC ID: YOW

		A	1 (100 to 100 to	Hourly	Data Report for J	une 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	<u>Hmdx</u>	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

Important Notices and Disclaimers

Created : 2002-06-21 Modified : 2004-01-21 Reviewed : 2004-01-21

 $Url\ of\ this\ page: http://www.climate.weather of fice.ec.gc.ca/climateData/hourly data\_e.html$ 



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## Hourly Data Report for June 21, 2005

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

				Hour	ly Data Report f	or June 21, 2005	i			
T i m e	Temp °C ⊮	<u>Dew Point Temp</u> °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
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
3:00	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
7:00	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
0:00	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
4:00	26.6	18.5	61	23	13	24.1	99.74	33		Cloudy
5:00	25.2	17.2	61	24	20	24.1	99.72	31		Cloudy
6:00	21.0	18.4	85	27	19	19.3	99,71			Rain Showers
7:00	20.6	19.0	91	23	19	19.3	99.67			Rain Showers
8:00	20.0	18.5	91	24	15	8.0	99.71			Rain Showers, Fo
9:00	19.5	18.6	95	23	13	8.0	99.71			Rain, Fog
0:00	19.5	18.6	95	24	13	9.7	99.71			Fog
1:00	19.2	18.1	93	25	11	12.9	99.75			Cloudy
2:00	19.0	18.0	94	26	9	16.1	99.78			Mostly Cloudy
3:00	18.8	17.9	95	26	4	12.9	99.82			Cloudy

Important Notices and Disclaimers

Created : 2002-06-21 Modified : 2004-01-21 Reviewed : 2004-01-21

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Environment Canada

Environnement Canada

[français] [Back]

## Hourly Data Report for June 28, 2005

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

<u>WMO ID</u>: 71628

TC ID: YOW

	** ** ******	1993 The second of the company of the control of th		Hourly	Data Report for J	une 28, 2005			to the second of	
T	Temp	Dew Point Temp	Rel Hum	Wind Dir	Wind Spd	Visibility	Stn Press	Hmdx	Wind Chill	Weather
m e	°C	°C ₩	% E	10's deg	km/h	km	kPa		***************************************	
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

Important Notices and Disclaimers

Created : 2002-06-21 Modified : 2004-01-21 Reviewed: 2004-01-21

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## **APPENDIX 5**

## **DRAWINGS & SPECIFICATIONS**

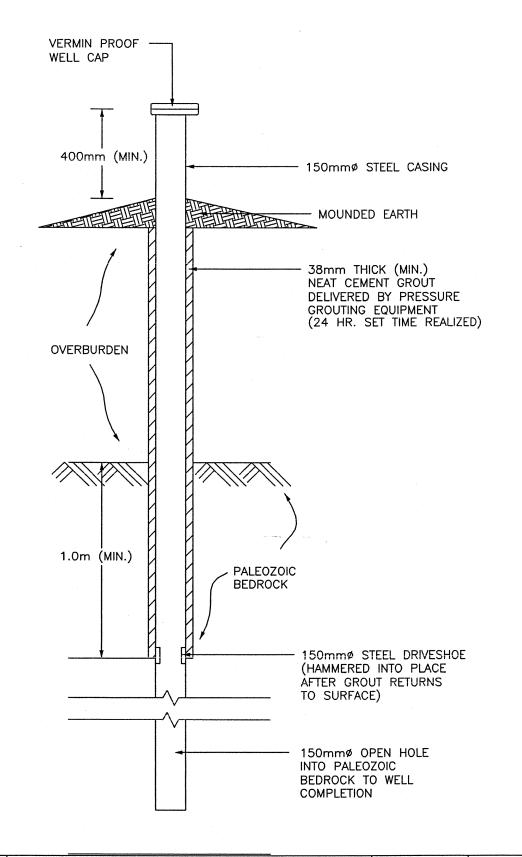
PH0145-1: TEST HOLE LOCATION PLAN
 PH0145-2: LOT DEVELOPMENT PLAN

3. PH0145-3: PIEZOMETRIC HEAD DELINATION

4. PH0145-4: STRATIGRAPHIC CROSS SECTION A-A

5. FIGURE 1: TYPICAL TEST WELL CONSTRUCTION

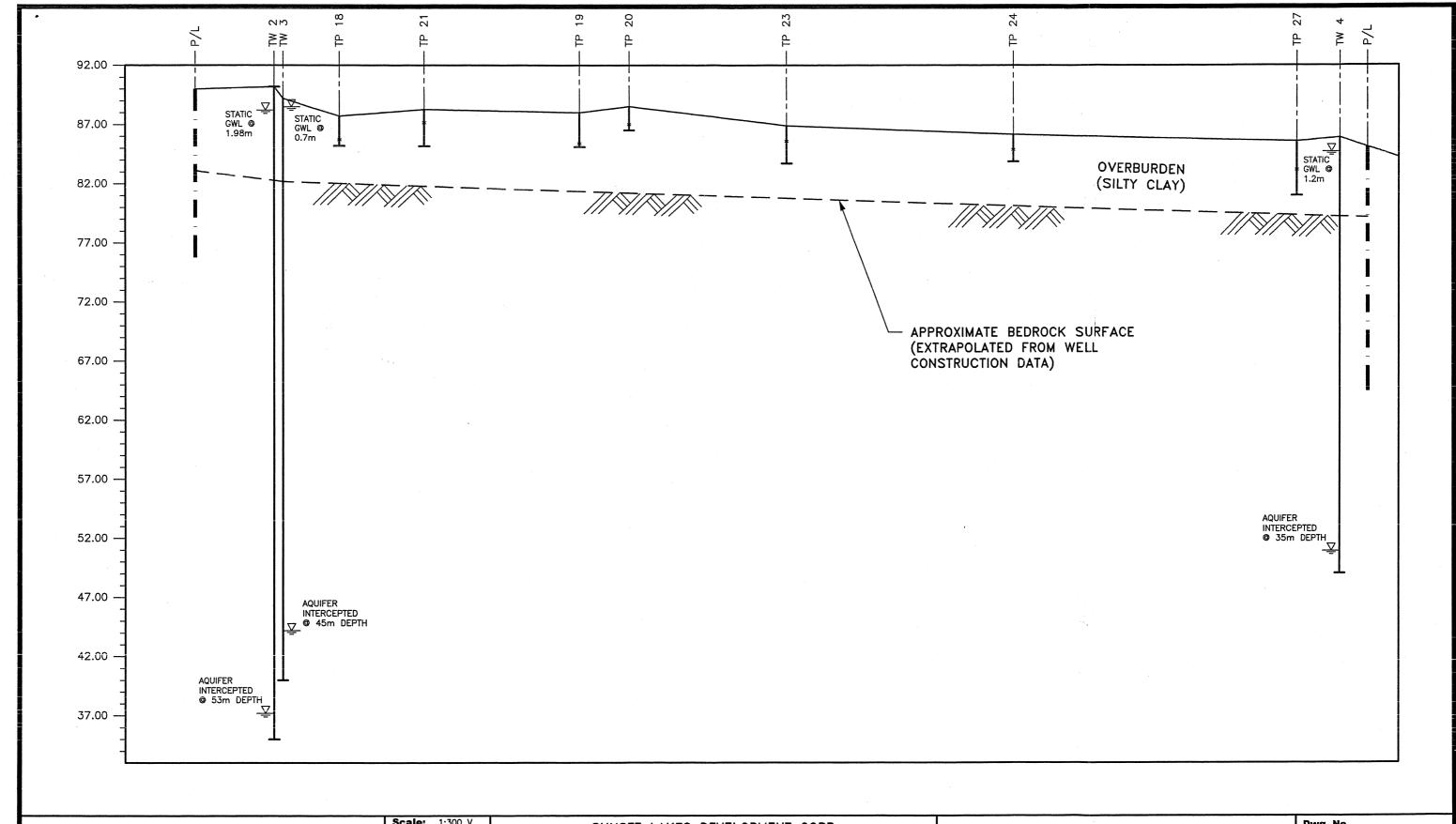
**DRAWING** 



patersongroup consulting engineers

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

Report No.:		Scale:	NITC
PH0145	-5		N.T.S.
Date:	Drawn:		Approved:
09/2005	R/	٩P	RAP



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)

PH0145-4

**Report No.:** PH0145-01

**Date:** 09/2005

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

**Materials Testing** 

**Building Science** 

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# patersongroup

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

June 19, 2006

Report No. PH0145-REP.02



## Terrain Analysis and Hydrogeological Study

Addendum No. 1
Part of Lot 73 and Part of Lot 74, Registrar's Compiled Plan 902
Ottawa (Osgoode), Ontario

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May 7, 2006

#### 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



Terrain Analysis and Hydrogeological Study

Addendum No. 1

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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



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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 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.

SUMMAR TE	Y OF MAXI CHNOLOGI	Table MUM TREATABLI ES FOR RELEVE	E LIMTS AND COM NT AESTHETIC P	MMON TREATMENT ARAMETERS
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 CaCO₃)	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

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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 aguifer. As such, the source of the chlorides is offsite and hydraulically

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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



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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.

SIIM	IMARY OF N		BLE 2.1.4		JALITY A	NALYSIS		
Parameter	Units	ODWS	1508	7164	7200	7281	7377	Sale Barn
Microbiological Par	rameters							
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 Streptocuccus	ct/100mL	0	0	0	0	0	0	0
Chemical Paramete	rs (Health F	Related)						
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				
Chemical Paramete	ers with Aes	thetic Ob	jectives/	Operation	nal Guid	elines	· · · · · · · · · · · · · · · · · · ·	
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



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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 m² 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 L/m²/day. Based on a flow of 3000 L/day, the minimum contact area of leaching bed fill required to meet the maximum loading rate of 4 L/m²/day is 750 m². The absorption trench leaching beds shown on Drawing No. PH0145-2 have a contact area of approximately 761 m² and a loading rate of 3.9 L/m²/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



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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.

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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



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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 x 10 <sup>-6</sup> 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.



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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.

## paterson OUP Ottawa North Bay

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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<sup>-6</sup> 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<sup>-6</sup> cm/s making the residence time somewhere from 75 to much more than 750 years.

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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



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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 then [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."

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#### 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

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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.

# patersongroup Ottawa North Bay

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

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

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

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

## 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."

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

#### 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

#### **SOIL PROFILE & TEST DATA** patersongroup Consulting Engineers Hydrogeological Study and Terrain Analysis Greely Village Centre, Parkway Road 28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7 Ottawa (Greely), Ontario DATUM Approximate geodetic FILE NO. PH0145 **REMARKS** HOLE NO. BORINGS BY Backhoe **TP32 DATE 26 APR 06 SAMPLE** PLOT Pen. Resist. Blows/0.3m DEPTH SOIL DESCRIPTION ELEV. ● 50 mm Dia. Cone (m) ≈ RECOVERY (m) N VALUE STRATA NUMBER TYPE O Water Content % **GROUND SURFACE** 20 40 60 80 0 + 86.15TOPSOIL 0.25 Brown medium SAND, trace silt 1 + 85.15\_\_\_\_1.60 2+84.15 SILTY CLAY $\underline{\nabla}$ 3 + 83.15 -82.15 End of Test Pit (Water infiltration @ 2.8m depth) 60 100 Shear Strength (kPa) ▲ Undisturbed △ Remoulded

patersongro	DL	lD	Con	sulting ineers	g				TEST DATA	
28 Concourse Gate, Unit 1, Ottawa, ON			Eng	meers	G	ydrogeol reely Vill ttawa (G	age Cer	itre, Parkv	Terrain Analysis vay Road	
DATUM Approximate geodetic			<del></del>						FILE NO.	ļ5
REMARKS BORINGS BY Backhoe						26 APR			HOLE NO. TP33	
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2.10			, -		. •	2-	-84.80			
SILTY CLAY to SILT						3-	-83.80			Ā
4 60						4-	-82.80			
End of Test Pit  (Water infiltration @ 2.6m depth)										
						,				
									40 60 80 100  Strength (kPa)  rbed Δ Remoulded	)

#### **SOIL PROFILE & TEST DATA** patersongroup Consulting Engineers Hydrogeological Study and Terrain Analysis 28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7 Greely Village Centre, Parkway Road Ottawa (Greely), Ontario DATUM Approximate geodetic FILE NO. PH0145 REMARKS HOLE NO. BORINGS BY Backhoe **TP34 DATE 26 APR 06 SAMPLE** PLOT Pen. Resist. Blows/0.3m DEPTH ELEV. SOIL DESCRIPTION ● 50 mm Dia. Cone (m) (m) % RECOVERY N VALUE STRATA NUMBER O Water Content % **GROUND SURFACE** 40 60 80 **TOPSOIL** 0+89.80 0.20 Brown SILTY SAND 1 + 88.80 Brown SAND, trace silt 2+87.80 2.50 3+86.80 $\underline{\underline{V}}$ **GLACIAL TILL** 4 + 85.804.20 ... End of Test Pit (Water infiltration @ 3.1m depth) 60 80 100 Shear Strength (kPa) ▲ Undisturbed △ Remoulded

### **SOIL PROFILE & TEST DATA** patersongroup Consulting Engineers Hydrogeological Study and Terrain Analysis Greely Village Centre, Parkway Road 28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7 Ottawa (Greely), Ontario **DATUM** Approximate geodetic FILE NO. PH0145 REMARKS HOLE NO. BORINGS BY Backhoe MW 4-1 **DATE 25 APR 06 SAMPLE** Pen. Resist. Blows/0.3m STRATA PLOT DEPTH ELEV. SOIL DESCRIPTION • 50 mm Dia, Cone (m) (m) % RECOVERY N VALUE or ROD NUMBER TYPE O Water Content % **GROUND SURFACE** 20 40 60 80 TOPSOIL 0 + 85.880.25 Brown medium SAND, 1 + 84.88 trace silt End of Monitoring Well Monitoring well terminated on silty clay @ 1.94m depth (GWL @ 1.55m-May 5/06)

60

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

80

100

#### patersongroup Consulting Engineers Hydrogeological Study and Terrain Analysis Greely Village Centre, Parkway Road 28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7 Ottawa (Greely), Ontario **DATUM** Approximate geodetic FILE NO. PH0145 **REMARKS** HOLE NO. BORINGS BY Backhoe MW 4-2 **DATE 25 APR 06** PLOT **SAMPLE** Pen. Resist. Blows/0.3m DEPTH ELEV. SOIL DESCRIPTION ● 50 mm Dia. Cone (m) % RECOVERY (m) N VALUE or RGD STRATA NUMBER TYPE O Water Content % **GROUND SURFACE** 20 40 80 0 + 85.91TOPSOIL 0.25 1 + 84.91 Brown medium SAND, trace silt 2+83.91 2.27 End of Monitoring Well Monitoring well terminated on silty clay @ 2.27m depth (GWL @ 1.25m-May 5/06) 40 60 80 100 Shear Strength (kPa) ▲ Undisturbed △ Remoulded

SUIL PRUFILE & TEST DATA

#### **SOIL PROFILE & TEST DATA** patersongroup Consulting Engineers Hydrogeological Study and Terrain Analysis Greely Village Centre, Parkway Road 28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7 Ottawa (Greely), Ontario **DATUM** Approximate geodetic FILE NO. PH0145 **REMARKS** HOLE NO. MW 4-3 BORINGS BY Backhoe **DATE 25 APR 06 SAMPLE** Pen. Resist. Blows/0.3m Piezometer Construction PLOT DEPTH ELEV. SOIL DESCRIPTION • 50 mm Dia. Cone (m) (m) N VALUE or ROD RECOVERY STRATA NUMBER Water Content % **GROUND SURFACE** 40 60 80 0 + 85.86**TOPSOIL** 0.22 1 + 84.86 Brown medium SAND, trace silt 2+83.86 2.28 End of Monitoring Well Monitoring well terminated on silty clay @ 2.28m depth (GWL @ 1.48m-May 5/06) 40 60 80 Shear Strength (kPa) ▲ Undisturbed △ Remoulded

#### **SOIL PROFILE & TEST DATA** patersongroup Consulting Engineers Hydrogeological Study and Terrain Analysis Greely Village Centre, Parkway Road 28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7 Ottawa (Greely), Ontario Approximate geodetic **DATUM** FILE NO. PH0145 **REMARKS** HOLE NO. MW 5-1 BORINGS BY Backhoe **DATE 26 APR 06 SAMPLE** PLOT Pen. Resist. Blows/0.3m Piezometer Construction DEPTH ELEV. SOIL DESCRIPTION • 50 mm Dia. Cone (m) (m) VALUE STRATA RECOVERY NUMBER O Water Content % N O **GROUND SURFACE** 20 40 60 80 0 + 85.57TOPSOIL 0.25 Brown medium SAND, trace silt 1 + 84.57\_ 1.81 End of Monitoring Well Monitoring well terminated on silty clay @ 1.81m depth (GWL @ 0.86m-May 5/06) 40 60 80 100 Shear Strength (kPa) ▲ Undisturbed △ Remoulded

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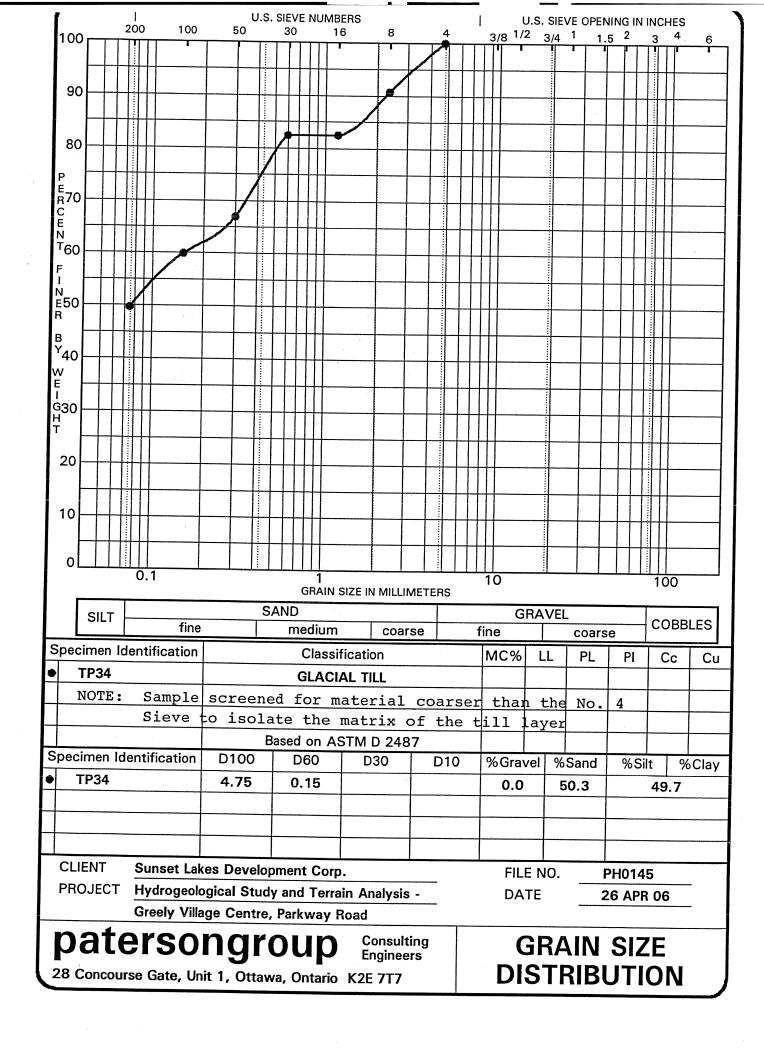
#### patersongroup **SOIL PROFILE & TEST DATA** Consulting **Engineers** Hydrogeological Study and Terrain Analysis Greely Village Centre, Parkway Road 28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7 Ottawa (Greely), Ontario **DATUM** Approximate geodetic FILE NO. PH0145 **REMARKS** HOLE NO. BORINGS BY Backhoe MW 5-3 **DATE 26 APR 06 SAMPLE** PLOT Pen. Resist. Blows/0.3m DEPTH ELEV. SOIL DESCRIPTION • 50 mm Dia. Cone (m) (m) % RECOVERY N VALUE or ROD STRATA NUMBER TYPE O Water Content % **GROUND SURFACE** 40 20 60 0 + 85.52**TOPSOIL** 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 80 100 Shear Strength (kPa) ▲ Undisturbed △ Remoulded

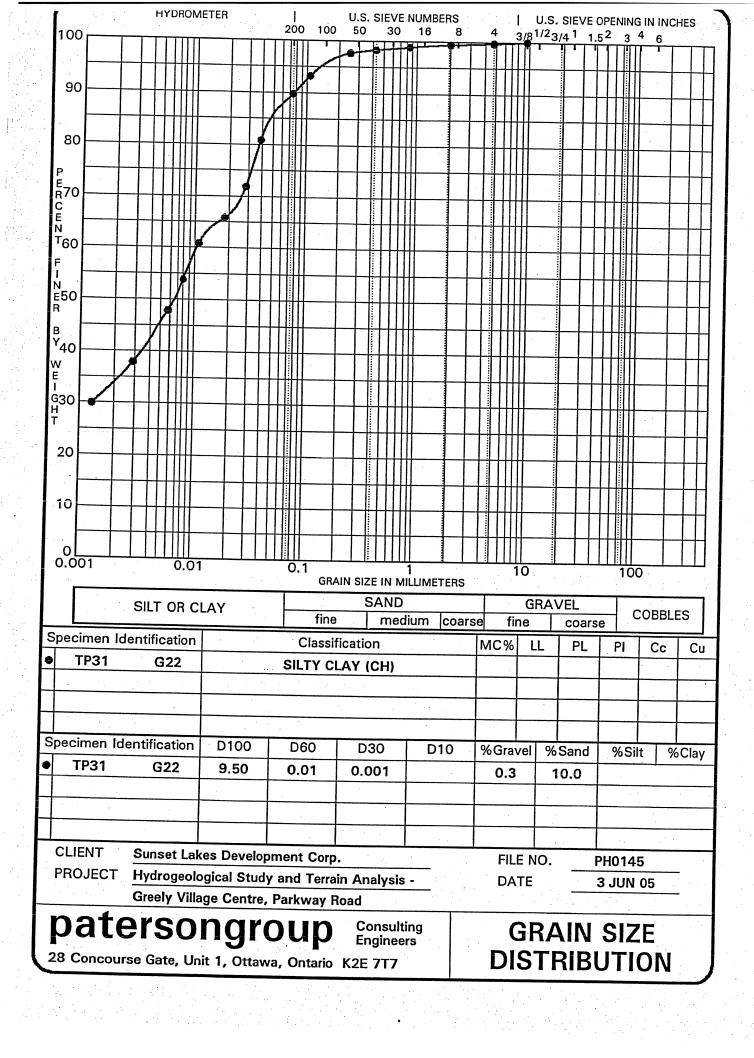
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(GWL @ 1.25-May 5/06)											
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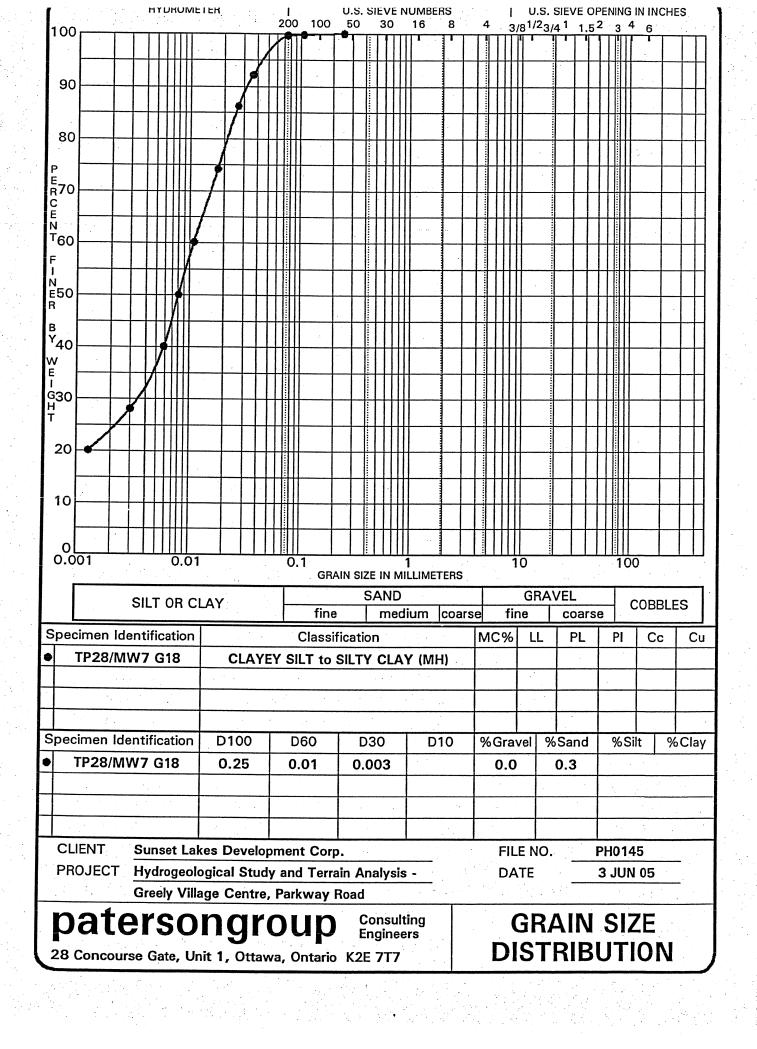
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Brown medium SAND, trace silt					-	1-	-86.57						
End of Monitoring Well1.9	0												
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(GWL @ 1.43m-May 5/06)					٠								
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								Shea	r Strength (	kPa)			
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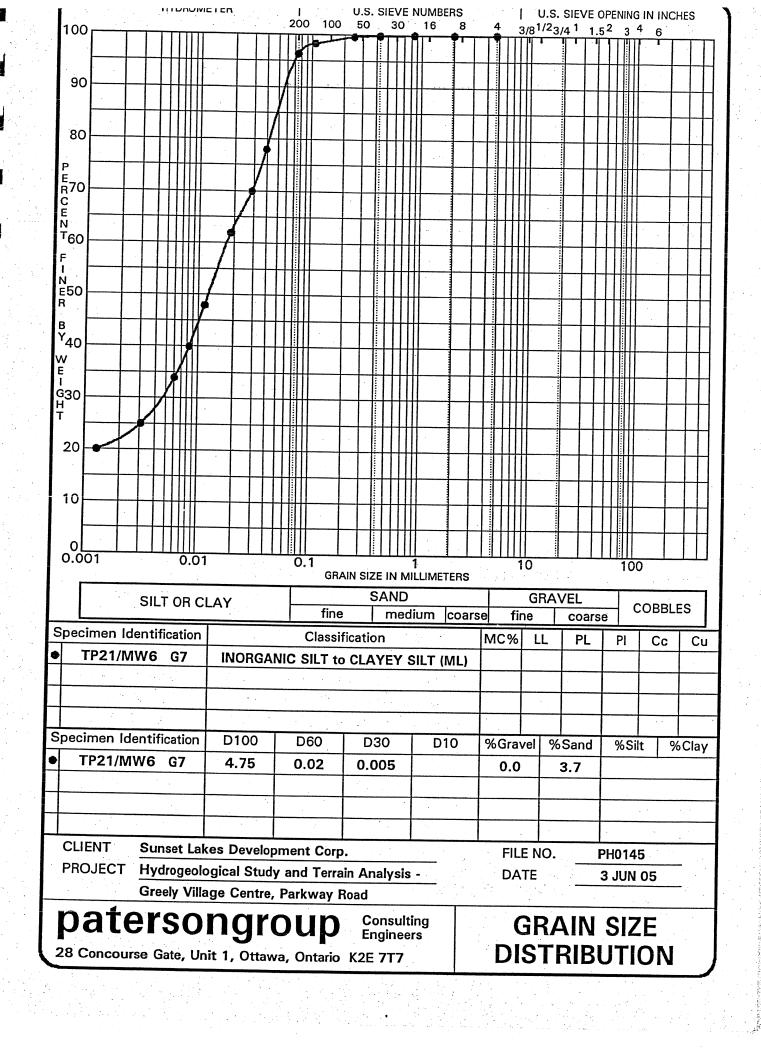
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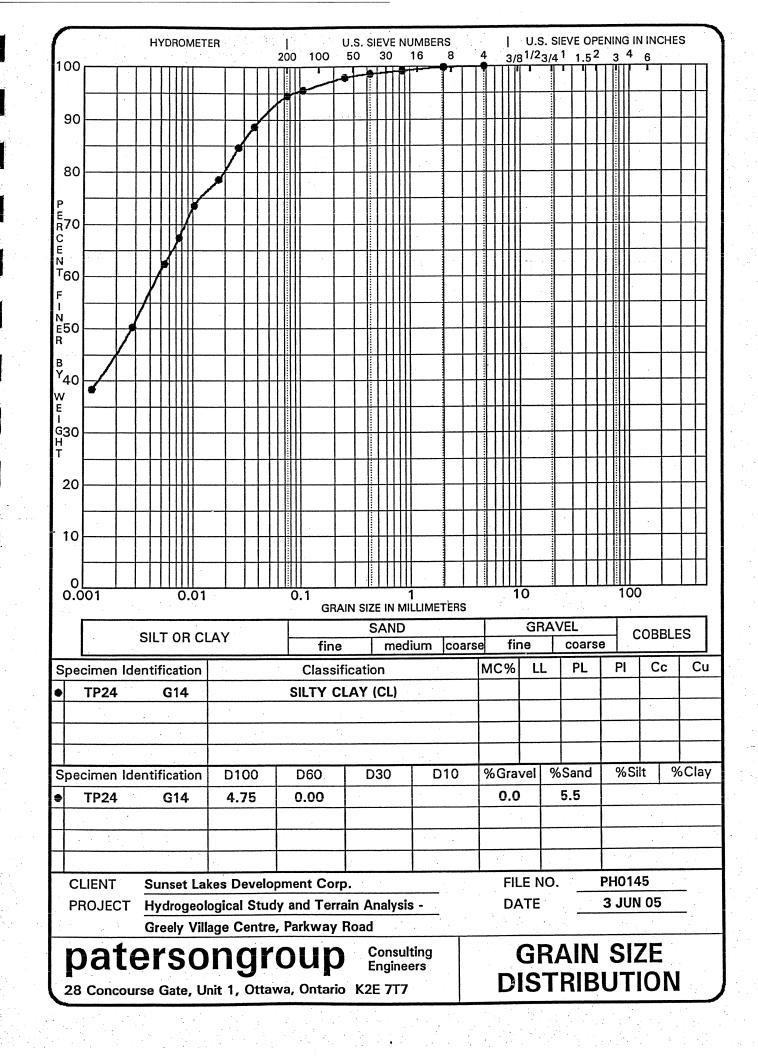
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1.78.						2-	85.66				-
SILTY CLAY						3-	-84.66				-
4.00						4-	-83.66				
						5-	-82.66				
CLAYEY SILT						6-	81.66				
						7-	80.66				
End of Monitoring Well						8-	79.66				
(GWL @ 1.62m-May 5/06)								20 Shea	40 60  ar Strength turbed ΔR	· ·	00











### **APPENDIX 2**

## SUPPORTING DOCUMENTATION WATER WELLS

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

	stry of Environment	Well T	)3616	s9	ber below)	Requistion 903 O	Well Record		
		An	36	169			page of		
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	All Sections must be completed in full to avoid delays in processing, I didnot included the water Well Management Coordinator at 416-235-6203.  Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.								
All metre measurements si Please print clearly in blue o	nali pe reportec	to 1/10 <sup>th</sup> of a			CON	Ministry Use C	Only LOT		
ell Owner's Information an	d·Location of V	Vell Informati		AUN		ame, RR Lot, Conces	ision)		
Surset	as Name Le	S o/Clty/Town(Village	طا	576 Provin	تطالك	ode Teleph	one Number (Include area code)		
ounty/District/Municipality		Ceely rown villa		Onta		PIES	Concession		
dress of Well Location (County/Di	Hict/Municipality)	ton .	Toward	200			ment/Block/Tract etc.		
R#/Street Number/Name	Bank	Street	<del>1</del>   (	y Town/Yillag	2 J.J		aruntlated NA Avuraged		
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	1XS look	Fibroglass			07	Pumping rate - (litres/mix	1 1,59 1 1,72		
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Gas Salty Minerals	[_]Galva	nized				Recommended pump	4 1.62 4 1.45		
Frush Sulphur	1 1 1					Recommended punis	5 60 5 50		
Other:	[ ] Galva		crean			Recommended pump			
m   Fresh   Sulphur   Gas   Solty   Minerals	Outside Steel	Fibreglass	Slot No.			rate. (litres/hilh) If flowing give rate -	15 1 74 15 20 20 20		
After test of well yield, water was	Plast	ic [ ]Concrete -				(litres/min)	25 1 79 25 30 8 30		
Other, specific Company	Liouis		ing or Scr	een	<u> </u>	ued, give rooson.	40 1.85 40		
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Cable Tool Rotary Rotary (conventional)		Diamond Jetting		Digging Other	BANK STAR				
Rolary (reverse) Boring	Water Use	Driving		1 2 2 1	- SKW				
Opomestic Industr		Public Supply Not used	1	Other	京新	1 .			
rrigation : Munici	sel Final Status of	Cooling & air o	conditioning		Audit No. Z	39983	Date Well Completed		
Water Supply Recharge w		Unfinished Downtering	Aban	doned, (Other)	Was the well of package duliver	WING SAIGHBERS	Date Delivered YYYY MM Da		
Test Hole Abandoned	poor quality	Replacement				Ministry i			
Name of Well Contractor DOIL	unto C			Licence No.	Data Source		Contractor		
	ber, city etc.)	Q 100	V-D	220	Date Received	YYYY MM DD	Date of Inspection YYYY MM DD		
Name of Well Technician (last name,	(emegateril	Well	Technician'	s Licence No.	Remarks		Well Record Number		
Signature of Technician/Contractor	- CATIV	Düle	Submitted YY	YY', MM, DD					
U506E (09/03)	Contracto	's Copy Min	istry's Cop	y   Well Ow	ner's Copy	Cett	e formule est disponible en français		
• •		/4							

## Well Inspection

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

Client: Project: Location	
Address: 1508 HEADER DL Homeowner Interviewed? (Y) N Well Inspected? (Y) N	Field Supervisor: <u>DB/4</u> Date: <u>MMY 3, 06</u>
Quality Comments:  Taste: Geo S Od  Colour: Good Ha  Bacteria Testing: No	our: No ardness: Viny Huno
Quantity Comments:  Flow Rate: 10-5 0 = 6/77216 Pu  Pump Depth: Pro	mp:oblems:
Well Details: Type of Well: <u>Dにには</u> Dep Age of Well: Dril Well Record Available: <u>ド/A</u>	oth of Well:
Environmental Concerns: Surface Water: Septic System: Land Use: Neighbouring Properties:	
Sketch: RENTAL	

## **Well Inspection**

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

Client: Grely Animal Project: Location	Hospital.
Address: 7200 Parkway Road Homeowner Interviewed? (Y) N	Field Supervisor: CHRISTOPHER FLENZ
Well Inspected? YHN MA	Date: 3rd May Ole
Quality Comments:	
Taste:O	dour. N/A ardness: YES, SOME RUST.  2 years
Colour: N/A H	ardness: YES, SOME RUST.
Bacteria Testing: A every /-	2 years
Quantity Comments:	
Flow Rate: Pump Depth: P	roblems:
rump Deptin r	Toblettis
Well Details:  Type of Well: dulled De Age of Well: 18 years Dr Well Record Available:	pth of Well:
Environmental Concerns: Surface Water: Septic System:	
Land Use:	
Neighbouring Properties:	
	· · · · · · · · · · · · · · · · · · ·
Sketch:	

**Well Inspection** 

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

Client: Jaha Quan	
Project: Location 164 Parkway Rd.	
Address:	Field Supervisor: Christopher Fischer Date: 3rd May Ole
Quality Comments: Taste: 以这 Od Colour: NA Ha Bacteria Testing:	our: NA rdness: Vata Salar
Quantity Comments:  Flow Rate: Pu Pump Depth: Pro	mp:
Well Details: (unknown)  Type of Well: Dep  Age of Well: Drill  Well Record Available:	er:
Environmental Concerns: Surface Water: Septic System: Land Use: Neighbouring Properties:	
Sketch:	

# Well Inspection

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

Client: Nina Jencz Project: Location	
Address: 7377 Parkway Road Homeowner Interviewed? (V) N Well Inspected? (V) N	Field Supervisor: Christopher Fischer  Date: 3rd May 06
Quality Comments: Taste: Yes Colour: No Hacteria Testing: 1 year ago	Odour: Yes Hardness: NO
Quantity Comments: Flow Rate:F	Pump:
Well Details: Type of Well: <u>Drilled אבון</u> De	
Environmental Concerns: Surface Water: Septic System: Land Use:	
Neighbouring Properties: Sketch:	

## **Well Inspection**

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

Juse same well as

Client: Joyce Bicker Project: Location	
Address: 7281 Hockway Rd - Homeowner Interviewed? Y/N Well Inspected? Y/N	Field Supervisor: Christopher Fischer Date: 3rd May OC
Quality Comments:  Taste: <u>Lasturates</u> Od  Colour: Ha  Bacteria Testing:	our:Suffer ·
	mp:bblems:
Well Details:  Type of Well: Dep Age of Well: Drill  Well Record Available:	er:
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
- Letter From TechnaLinks Concerning Maximum Treatable Limits for Aesthetic Parameters in Ground Water

2608758 2006-05-05 2006-05-02	
Report Number: Date: Date Submitted:	
Group course Gale nt.	

REPORI OF ANALYSIS

Attention: Robert Passmore Client Palerson Gro 1-28 Concoun Ottawa, Orl. K1V 1T6

2006-05-02	PH0145	***************************************
Date Submitted:	Project:	
-		

1474	Water
	Matrix:

Oberten Contraction Management 20042						Matrix:		Water		
Chain of custoby number: 223 is	LABID	459818	459819	459820	459821			GUIDELINE		
	Sample Date:	Ž	20106-05-02	2008-05-02	2006-05-02					
	Sample 10:	_	TW2,	TW3, WS	TW5, WS			SOSMOO		
			WS05/08	90/50	90/50					
							ě	TIMIT	UNITS	
PARAMETER	UNITS MDL							1	1007	
	ct/100ml	0	0	D	0		MAC	>	THOOL OF	
		-	_	0	0		MAC	0	d/100ml	
Escherichia Coli		> 0	, -	•	<		MAG	80	cd/1mL	
Heterotrophic Plate Count	COLUMN.	>	- ;	> 4	> 6		200		rt/100ml	
Faecal Coliforns	cV100mL	0	0	0	9 1			,		
Faecal Streptococus	cu/100mL	0	0	0	<b>3</b>					
					1					
	•								•	

Microbiology Analyst APPROVAL:

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

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

REPORT OF ANALYSIS

Results rakets only to the parameters tested on the samples submitted for analysi	.gi	
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- 22	븉	
Results relate only to the parameters tested on the	-22	
Results relate only to the parameters tested on	ŝ	
Results relate only to the parameters tested	5	
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Resu	#	
	es.	

Ewari McRobbie Inorganic Lab Supevisor

it: it MAC AO AO AO AO AO AO AO AO AO AO AO AO AO	Client: Paterson Group							Report Number:	Ľ	2608757	
Project: Paramorn   Project:	1-26 Concourse care Ottawa, Ont.							Date Submitte	ä	2008-05-02	
Cacco							ere ye	Project:		PH0145	
Custody Number: 22517   PARAMETER   Cutting Date: Sample Date: Sampl											
Sample Date   2000-65-02   20								P.O. Number:		4241 ·	
Sample Drive         Sample Drive         Trivity of Trivity Wis         Trivity Wis			AR ID:	459814	459815	459818	459817			GUIDELINE	
Sample ID:   TWT, WS   TWS, WS   T		Samp	le Darte:	2008-05-02	2006-05-02	2008-05-02	2006-05-02				
PARAMETER   UNITS   ND     S27   289   301   OG   550		SBC	nple ID:	TW1, WS-	TW2, WS 05/06	TW3, WS 05/06	TW5, WS 05,06			ODWSOG	-
PARAMETER   UNITS   MDL											
yes CaCO3         mg/L         5         327         289         288         301         OG         500           sin/V         mg/L         1         37         22         2         3         AO         5           sin/V         mg/L         1         37         264         1220         130         AO         5           sin/V         mg/L         0.15         40         0.17         0.18         0.16         MAC         15           ad Oganic Carbon         mg/L         0.10         0.11         0.11         0.17         0.18         0.16         MAC         15           an Sulpkide         mg/L         0.10         0.11         0.11         0.11         0.11         0.16	PARAMETER	UNITS	MDF						TYPE	LIMIT	SI NA
Fig. 1		mol	2	327	289	288	301		ဗ္ဗ	8	mg/L
Triple   2		mg/L	-	527	625	650	136	-	8	250	mg/L
tight         Listen         5         2370         2640         2720         1120         AO         5           ad Organic Carbon         mg/L         0.15         0.14         0.16         0.16         MAC         1.5           an Subplace         mg/L         0.01         -0.02         -0.02         -0.01         -0.01         -0.01         -0.01         -0.01         -0.02	Solvin	TC.	7	n	8	8	<b>.</b>		¥0	۵.	5
Partic Carbon   mg/L   0.5   0.05   0.15		uS/cm	40	2370	2640	2720	1120				•
mg/L         0.10         0.11         0.17         0.18         0.16         MAC         1.5           mg/L         0.01         0.01         0.01         0.01         0.01         0.00	Dissolved Organic Carbon	mg/L	0.5	<0.5	2.1	<0.5	1.9		¥0	ָ מי	mg/L
Hard Americal	diam's	mg/L	0.10	0.11	0.17	0.18	0.16		MAC	5:	mg/L
Harden   H	Notice Subhide	mg/L	0.01	<0.01	<0.01	<0.01	<0.01		Ao	0.05	mg/L
mg/L   0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10   <0.10	N-NH3 (Ammonia)	mg/L	0.02	60.0	60.0	0.13	0.07				
mg/L   0.10   -0.10   -0.10   -0.10   -0.10   -0.10   -0.10   MAC   10.0   -0.10   MAC   10.0   -0.10   MAC   10.0   -0.10	N-NO2 (Nitrite)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10		WAC S	1.0	T/6E
The color   The	N-NO3 (Nitrate)	ngn.	0.10	<0.10	<0.10	<0.10	<0.10		NAC NAC	10.0	196E
mg/L inin & Light         0.001 40,000 - CALC)         -0.001 98         -0.001 97         -0.001 64         AG         500 500           min & Light inin & Light				7.75	7.78	7.80	7.74		Ą	6.5-6.0	SIEO Ld
Lighth   L	Phenols	mg/L	0.001	<b>*0.001</b>	<0.001	<0.001	<0.001			ć	Ì
Lignin mg/L 0.1 <0.1 <0.1 <0.1 <0.1 <0.1 <0.1 <0.1	Subhate	mg/L	-	115	86	16	\$		Q V	3	E J
mg/L 5 1540 1770 7/28 AO 10 00 00 00 00 00 00 00 00 00 00 00 00	Tannin & Lignin	mg/L	6.1	<0.1	<b>60.1</b>	-0°	₩.		· (	S	1
mg/L 0.05 <0.05 0.09	TDS (COND - CALC)	™g/L	ςς.	1540	1720	1770	728		2	200	) ()
MIO     0.7     1.9     5.7     5.3     474     0.6     100       mg/L     1     511     536     536     0.95     0.95     0.95     109       mg/L     1     132     134     134     124     40     49     49     40       mg/L     2     270     311     318     40     AO     20       mg/L     0.01     0.05     0.05     0.05     0.05     0.05	Total Kjeldahl Nitrogen	Age i	0.05	<0.05	\$0.05	0.09	CU:U5	************	Q	01	DIN
mg/L 0.01 0.83 0.86 0.85 0.86 mg/L 1 132 134 124 124 124 124 134 124 124 1001 0.83 0.63 0.64 1.92 AO 0.05 mg/L 0.01 0.08 0.05 0.06 0.27 AO 0.05	Turbiofity	2 5	i ·	F - F	1.36	536	474		8	100	mgA
mg/L 1 132 134 124 124 124 124 124 124 124 124 134 124 134 124 140 149 140 140 140 140 140 140 140 140 140 140	Hardress as CaCO3		0.01	6.0	98.0	0.95	0.96	,	nangara (E		
mg/L 1 44 49 49 40 40 mg/L 1 4 5 5 2 AO ZO Mg/L 2 270 311 318 40 AO 20 0.3 mg/L 0.01 0.63 0.63 0.64 1.92 AO 0.05 mg/L 0.01 0.08 0.05 0.06 0.27 AO 0.05		mg/L	-	132	134	<del>2</del> <del>2</del> <del>2</del> <del>2</del> <del>2</del> <del>2</del> <del>2</del> <del>2</del> <del>2</del> <del>2</del>	124				
mg/L 1 4 5 5 2 AO AO 20 mg/L 2 270 311 318 40 AO 20 n/2 mg/L 0.01 0.63 0.63 0.64 1.92 AO 0.3 mg/L 0.01 0.08 0.05 0.06 0.27 AO 0.05	Macopellin	EDG/L	-	4	49	48	40			· · · · · · · · · · · · · · · · · · ·	
mg/L 2 270 311 318 40 AO 20 20 mg/L 0.01 0.63 0.63 0.64 1.92 AO 0.3 mg/L 0.01 0.08 0.05 0.06 0.27 AO 0.05	Total and the second	mg/L	-	4	5	KO.	7				
ese mg/L 0.01 0.63 0.64 1.92 AO 0.3 mg/L 0.01 0.08 0.05 0.06 0.27 AO 0.05	milion.	mg/L	7	270	311	318	8		¥0	20	mg/L
ganese 0.05 0.05 0.27 AO 0.05	uo.ll	mg/L	0.01	0.63	0.63	0.64	1.92		φ:	0.3	₽gu
	Manganese	mg/L	0.01	0.08	0.05	90.00	0.27	,	<b>8</b>	0.02	F F
		-				***************************************		ativism (change)			
		-									-
							·				

MOL = Method Detection Limit INC = Incomplete AO = Asstratic Objective Comment:

608 Norris Court, Kingston, ON, K7P 2R9 8-146 Colonnade Road, Oltawa, ON, KZE 7V1

1 of 1

# ACCUIES | LABORATORIES LTD

REPORT OF ANALYSIS

STINO GUIDELINE 2006-05-02 2006-05-04 2608628 PH0145 Water TYPE MDL: Method Detection Limil INC = Incomplete AC = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration Comment: Report Number: Date Submitted; P.O. Number: Project: Matrix: Date: 2006-05-01 TW4, W51-06 459572 Sample ID: Sample Date: LAB ID: 를 ct/100mL ct/100mL ct/100mL ct/100mL UNITS PARAMETER Chain of Custody Number: 43328 Attention: Robert Passmore 1-28 Concourse Gale Client: Paterson Group Heterotrophic Plate Count Ottawa, Ont. K1V 1T6 Faecal Streptococcus Faecal Coliforms Escherichia Coli **Fotal Coliforms** 

APPROVAL: Kista Quantill
Miscobiology Analyst

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

1 of 1

8-146 Colonnade Road, Ottawa, ON, KZE 7Y1 608 Norris Court, Kingston, ON, K7P 2R9

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# ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

2608662 2006-05-05 2006-05-02

Report Number: Date: Date Submitted:

PH0145

Project:

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

							P.O. Number		4241	
Challe of Carlody Market 43128							Matrix:		Water	
		LAB ID:	459635						GUIDELINE	
	Sample Date:	Date:	2006-05-01							
	Sam	Sample ID:	TW4 WS1-06							
PARAMETER	UNITS	MDK						TYPE	LIHIT	UNITS
Alkalinity as CaCO3	mg/L	2	274							
Chloride	mg/L	-	227					en Papas co		
Colour	TC!	7	e							:
Conductivity	пЗусш	υ	1270			-				
Dissolved Organic Carbon	mg/L	0.5	1.5			-				
Fluoride	mg/L	0.10	0.29							
Hydrogen Sulphide	mg/L	0.01	0.15							
N-NH3 (Ammonia)	mg/L	0.02	0.12							
N-NO2 (Nibite)	mg/L	0.10	<b>-0.10</b>							
N-NO3 (Nitrate)	щой	0.10	<0.10	-						
Hd			7.79						,	
Phenois	mg/L	<u>0</u>	<0.001							
Sulphate	mg/L	-	62							
Tannin & Lignin	mg/l.	0.1	<b>6</b> 0.1							
TDS (COND - CALC)	mg/L	ς.	8.25				· etypoper			
Total Kjeldahl Nitrogen	mg/L	0.05	4.0				ar contraction			
Turbidity	Ē	0.	17.9							
Hardness as CaCO3	mg/L	<b>*</b>	472							÷
Ion Balance		0.01	0.97							-
Calcium	mg/L	-	31.6				-			
Magnesium	Agm A	_	₹							
Potassium	mg/L	<del>-</del>	4							
Engoy.	шg/L	8	7.	,	-					
<u> 101</u>	mg/L	0.03	1.41					-		
Manganese	mg/L	0.01	0.20							

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

Comment

APPROVAL: Ewan MeRed

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

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P 2R9	
ngston, ON, K7P 2R9	
608 Norris Court, Kingston	
809	

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Client: Paterson Group		Ĉ
a 20 Canadame Cala		3
1-20 CANDONISE CARE		Č
110		2

2608508	2006-05-02	2006-04-28	PH0145		
Report Number:	Date:	Date Submitted:	Project		
				Φ	

REPURT OF ANALYSIS

P.O. Number Attention: Robert Passmore Ottawa, Ont K1V 1T6

							Matrix:		Water	•	
Chain of Custody Number: 41093	A -	-CI OF	A50177	459178					GUIDELINE		
	Sample Date:	_	2006-04-28	2006-04-28							
	Sample ID:		TW6, WS1	TW6, WS2					ODWSOG		
	$\vdash$	Š						TYPE	רותנו	UNITS	
PARAMETER	GAILS F/100ml		0	2				MAC	0	ct/100m/L	
Total Coliforms Escherichia Coli	ct/100mL	<del></del>	0				-	MAC	0 005	ct/100mL ct/1mL	
Heterotrophic Plate Count	ct/100mL		N 0	- 0				MAC		cl/100mL	
Paeca Comorins Feecal Streptococcus	cl/100mL		0	0							•
						Artic Const					
										-	
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						ot one to see the					
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						·	· <u>·</u>	- man			

ANDL = Method Detaction Limit INC = Incomplete AD = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration Comment:

8-146 Colonnade Road, Ottawa, ON, K2E 7Y1

# ACCUIEST LABORATURIES LTD

REPORT OF ANALYSIS

Client: Paterson Group	Total D	2608643
1-28 Concourse Gate	Date:	2006-05-05
Ottawa, Onf. K1V 176	Date Submitted:	2006-04-28
Attention: Robert Passmore	Project:	PH0145
Chain of Custody Number: 41093	P.O. Number: Matrix:	2860 Water

Chain of Custody Number: 41093						Matrix:		Water		
		LAB ID:	459190	459191				GUIDELINE		
	Samp	Sample Date:	2008-04-28	2006-04-28						
	Sar	Sample ID:	TW6, WS1	TW6, WS2		,		ODWSOG		
PARAMETER	UNITS	MDL					TYPE	LIMIT	STIND	
Alkalinity as CaCO3	шð/L	ιĊ	279	278			90 0	500	Age A	
Chloride	mg/L	-	613	617			Ϋ́	250	mg/L	
Colour	15T	2	Ÿ	\$			AO	40	100	
Conductivity	uS/an	ĸ	2580	2560						
Dissalved Organic Carbon	mg/L	0.5	<0.5	<0.5			Ą	w	mg/L	
Fluoride	mg/L	0.10	0.27	0.26			MAC	1.5	mg/L	
Hydrogen Sulphide	Æ	0.01	0.11	B0.0			Ŷ	0.05	mg/L	
N-NH3 (Ammonia)	щgЛ	0.02	0.27	0.21				٠		
N-NO2 (Nitrite)	mg/L	0.10	<0.10	<0.10			MAC	9.	тву	
N-NO3 (Nitrate)	rng/L	0.10	<0.10	<0.10			MAC	10.0	mg/L	
H			8.00	7.98			Q	6.5-6.5	pH Units	
Phenois	mg/L	0.001	<0.001	<0.001				·		
Suphale	<b>1</b> 94	-	<b>1</b> 20	108			AO A	500	mg/L	
Tannin & Lignin	mg/L	0.1	<0.1	40.1						
TDS (COND - CALC)	mg/L	\$	1680	1660			AO	500	mg/L	
Total Kjeldahi Nitrogen	mg/L	90.0	0.52	0.29						
Turbidity	Ę	0.1	2.0	6.0			¥0	0.1	Z	•
Hardness as CaCO3	mg/l	-	616	640		÷	8	100	- mg/L	
Ion Balance		0.0	0.91	<b>6</b> .9						
Calcium	mg/L	-	141	149			-			•
Wagnesium	Ę	-	4	92						
Potassium	mg/L	_	10	10						
Sodium	Tg.	7	240	246	,		ΑO	20	твл	
Iron	mg/L	0.03	₽.0	<0.03			AO A	0.3	шgЛ	
Manganese	mg/L	0.01	0.05	0.05	٠		AO	0.05	mg/L	
						-				

NDL = Method Detection Limit INC = Incomplete AD = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration Comment

APPROVAL:

1 of 1

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

B-146 Colonnada Road, Ottawa, OM, KZE 7Y1 608 Norris Court, Kingston, ON, K7P 2R9

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

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KIV 1TE Attention: Robert Passmore 1-28 Concourse Gale Client: Paterson Group Oltawa, Ont.

2608926 2006-05-05 2006-05-03 PH0145 Date: Date Submitted: Report Number: Project

P.O. Number:

			Matrix:	Water
LAB (D:	460241			GUIDELÍNE
Sample Date: 2006-05-03	2006-05-03			
Sample ID:	TW4-ORG			

<0.002

MDL 0.002

UNITS щgуr

PARAMETER

Atrazine

Chain of Custody Number: 22840

Water	GUIDEL'INE	
Matrix:		

	,	UNITS				
GUIDELINE		LIMIT	-			
		TYPE				
					·.	

APPROVAL: RIDL = Method Detection Limit INC = Incomplete AO = Assthetic Objective OG = Operational Guidefine MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration Comment:

Organic Lab Coordinator

10/1

8-146 Colonnade Road, Olfawa, ON, K2E 7Y1

808 Norris Court, Kingston, ON, K7P 2R9

REPORT OF ANALYSIS

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

K4P 1E5 Attention: Dave Meikle

Project:

Report Number: Date Submitted: Date:

2608987 2006-05-08 2006-05-04

PH0145

P.O. Number:

UNITS GUIDELINE LIMIT Water Matrix: 2006-05-03 1508 460377 LAB ID: Sample Date: Sample ID: MDL UNITS ct/100mL PARAMETER Chain of Custody Number: 22827 Total Coliforms

00-00

ct/100mL ct/100mL

ct/100mL

ct/1mL

Heterotrophic Plate Count Faecal Coliforms Faecal Streptococcus

Escherichia Coli

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

Comment:

1 of 1

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

Tim McCooeye QC Manager

APPROVAL:

<b>∀</b>	2608975 2006-05-10	06-05-04		PH0145
9	26	2 2		<u>τ</u>
Щ	Report Number:	Date Submitted:		
	Report Date:	Date St		Project:
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-	_			
ZIES	Corporation			
OR	evelopment	מומ הטמע		_
C ST OR MES	Sunset Lakes Developme	Greely, ON	1E5	Dave Meikle
ပ္ပ	Client: Sunset Lakes Development Corporation	Gree	K4P 1E5	Attention: Dave Meikle
I	Ö			∢

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Chain of Custody Number: 22827  Akalinity as CaCO3 Chloride Colour Conductivity Dissolved Organic Carbon Fluoride Hydrogen Sulphide N-NU3 (Nitrite) N-NO2 (Nitrite) Phenols Sulphate Tamin & Lignin TDS (COND - CALC) Total Kjeldahl Nitrogen Turbidity Hardness as CaCO3 Ion Balance Calcium Magnesium Potassium	Samp Samp Samp Mg/L TCU US/cm Mg/L Mg/L Mg/L Mg/L Mg/L Mg/L Mg/L Mg/L	Sample Date: Sample Date: Sample ID: TS MDL  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	460361 2006-05-03 1508 1508 136 22 1130 1.1 0.17 0.13 0.07 20.001 81 20.001 81 20.001 81 44 44 5		Matrix	TYPE	GUIDELINE	ST
Sodium Iron Manganese	mg/L mg/L	2 0.03 0.01	56 1.24 0.05					

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

8-146 Colonnade Road, Ottawa, ON, K2E 7Y1

Client: Sunset Lakes Development Corporation 6576 Apple Orchard Road								Report Number: Date: Date Submitted:		2608988 2006-05-08 2006-05-04	
K4P 1E5								Project:	i	PH0145	
AITERLION: DAVE MEINE								P.O. Number:			
Chain of Custody Number: 22826								Matrix:		Water	
			LAB ID:	2006 05 03						GOIDELINE	
		San	Sample ID:	7164	and the second	-			<b>~</b>		-
									1	FIMI	STINITS
PARAMETER		UNITS	MDF								
Total Coliforms Escherichia Coli Heterotrophic Plate Count Faecal Coliforms Faecal Streptococcus		ct/100mL ct/100mL ct/1mL ct/100mL		00700	<b></b>			·			
			-								
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										was a second	
						di acitorataco	Mariania Ma	MAC = Interim Maximum Allowable Concentration	ncentration		
MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Comment:	etic Objective	OG = Operati	onal Guideli	ne MAC = Ma	Ximum Allowable	Concentation					

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

APPROVAL:
Tim McCooeye
QC Manager

Client: Sunset Lakes Development Corporation 6576 Apple Orchard Road Greely, ON							Report Number: Date: Date Submitted:	u u	2608976 2006-05-10 2006-05-04	
K4P 1E5 Attention: Dave Meikle							Project:		PH0145	
Chain of Custody Number: 22826							P.O. Number: Matrix:	-	Water	
		LAB ID:	460362						GUIDELINE	
	Sam	Sample Date:	2006-05-03							
	Š	Sample ID:	716A						ODWSOG	
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5	316					၅၀	200	mg/L
Chloride	mg/L	-	175					AO	250	mg/L
Colour	5	7	7					AO	5	TCU
Conductivity	mS/cm	2	1260					. ,		;
Dissolved Organic Carbon	mg/L	0.5	<0.5					Q :	ω,	mg/L
Fluoride	mg/L	0.10	0.11					MAC	1.5	mg/L
Hydrogen Sulphide	mg/L	0.01	<0.01					Q Q	0.05	mg/L
N-NH3 (Ammonia)	mg/L	0.02	<0.02					(	7	1/2000
N-NO2 (Nitrite)	mg/L	0.10	<0.10						5. 5	mg/L
N-NO3 (Nitrate)	mg/L	0.10	<0.10					A CA	6.5-8.5	ng/L pH Units
Hd		0 00 1	,			-		2		
Sulphate	mg/L	-	91					Q	200	mg/L
Tannin & Lignin	mg/L	0.1	<0.1							
TDS (COND - CALC)	mg/L	c,	819					Q	200	mg/L
Total Kjeldahl Nitrogen	mg/L	0.05	0.17				-		,	į
Turbidity	<u></u>	0.1	6.8					Q (	0. 5	2 1
Hardness as CaCO3	mg/L	- 3	463					ງ ວ	9	mg/L
Ion Balance	2	 	0.98	-					-	
Calcium	g/L		25.0							
Magnesium	mg/L	- •	8 6							
Potassium 	11g/L	- ‹	ი <u>წ</u>					Q	20	l/om
Sodium	mg/L	7 5	78.					2 5	2 6	g/L
Iron	mg/L	0.03	0.57					2 5	5 6	. IIg/r
Manganese	mg/L	0.0	0.10					₹	60.0	11g/L
						-				
									-	
MDI = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration	OG = Operat	ional Guideli	I ne MAC = Maxim	um Allowable Cor	centration IMA	C = Interim Maxim	I num Allowable Con	l centration		

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

Report Number: Date: Client: Sunset Lakes Development Corporation 6576 Apple Orchard Road Greely, ON

K4P 1E5

Attention: Dave Meikle

Date Submitted:

2608990 2006-05-08 2006-05-04

PH0145

Project:

P.O. Number: Matrix:

Water Chain of Custody Number: 22826

Chair of Custouy Nutribel. 22020		- CI av	460380						GUIDELINE	
-	ď		490390						0000	
	Samp	Sample Date:	2006-05-03							
	Sar	Sample ID:	7200							
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Total Coliforms	ct/100mL		0							
Escherichia Coli	ct/100mL		0							
Heterotrophic Plate Count	ct/1mL		12							
Faecal Coliforms	ct/100mL		0							
Faecal Streptococcus	ct/100mL		0							
								-		
						-				
								-		
				,	-					
							-			
										-
		-								-

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

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

APPROVAL:

Tim McCooeye

QC Manager

2608978 2006-05-10 2006-05-04

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Report Number: Date: Date Submitted:	Project:	P.O. Number:
tion		
Client: Sunset Lakes Development Corpora 6576 Apple Orchard Road Greely, ON	K4P 1E5 Attention: Dave Meikle	

2000 med and 10000						Matrix:		Water	
Chain of Custody Number: 22023		LAB ID:	460364					GUIDELINE	
	Samp	Sample Date:	2006-05-03						
	San	Sample ID:	7200				***		
PARAMETER	UNITS	MDL					TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5	307						
Chloride	mg/L	-	228			,	TO THE PARTY OF TH		
Colour	5	7	<b>~</b>		-				
Conductivity	nS/cm	ις	1390						
Dissolved Organic Carbon	mg/L	0.5	<0.5	,					
Fluoride	mg/L	0.10	0.11						
Hydrogen Sulphide	mg/L	0.01	<0.01						
N-NH3 (Ammonia)	mg/L	0.05	<0.02						
N-NO2 (Nitrite)	mg/L	0.10	<0.10						
N-NO3 (Nitrate)	mg/L	0.10	<0.10						
I			7.88						
Dhenois	mg/L	0.001	<0.001				-		
Silphate	mg/L	-	86						
Tannin & Liania	mg/L	0.1	<0.1						
TDS (COND - CALC)	mg/L	ς,	904						
Total Kieldahl Nitrogen	mg/L	0.05	0.10	·					
Turbidity	NTO	0.1	2.4		-				
Hardness as CaCO3	mg/L	-	486						
Ion Balance		0.01	0.98						
Calcium	mg/L	_	132		 				
Magnesium	mg/L	<u>.                                    </u>	88 °						
Potassium	mg/L	- ,	, i				<del></del>		
Sodium	mg/L	2 5	103						
Iron	mg/L	0.03	0.32	***************************************					
Manganese	mg/L	0.01	90.0				<del>1, 110</del>		
							-		

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

Six							UNITS				Na na ilima			 											
X	2608989 2006-05-08 2006-05-04	PH0145	Water	GUIDELINE			LIMIT													 				******	2
7	22 22	ā	>	၅			TYPE								***************************************	-									Marriago Marriago Marriago Marriago Marriago Marriago Marriago Marriago Marriago Marriago Marriago Marriago M
Щ	Report Number: Date: Date Submitted:		P.O. Number: Matrix:			***************************************						200152-2							440	<del></del>	<del>,</del>				
	Report Date: Date Si	Project:	P.O. Nu Matrix:											 			 <del>,</del>					***************************************		W-1	
1														 											
																								-	
İ				179	5-03																-				<b></b>
				-	20	7281		0 0	-	—— ——		-		 											-
1				LAB ID:	Sample Date:	Sample ID:	MDL									-				 					
' 					San	o,	UNITS	ct/100mL		ct/1mL		ct/100mL	u sanomin				 	-		 					
- <b>1</b>	ition																								
ALE E	t Corpora						TER																		
Ž B	svelopmen ard Road	_	ar: 22824				PARAMETER																		
S	Sunset Lakes Developme 6576 Apple Orchard Road Greely, ON	IES Jave Meikle	ody Numbe						=	Plate Count	ns	snooo													
SS	Client: Sunset Lakes Development Corporation 6576 Apple Orchard Road Greely, ON	K4P 1E3 Attention: Dave Meikle	Chain of Custody Number: 22824					Total Coliforms	Escherichia Coll	Heterotrophic Plate Count	Faecal Coliforms	Faecal Streptococcus											.,,		

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

APPROVAL:

Tim McCooeye

QC Manager

APPROVAL:

Ewan McRobbie
Inorganic Lab Supervisor

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

6576 Apple Orchard Road						Date:	ŧ	2006-05-10	
Greely, ON K4P 1E5						חשוב סמחווווונב	j	10.00.007	
Attention: Dave Meikle						Project:		PH0145	
	•					P.O. Number:			
Chain of Custody Number: 22824						Matrix:		Water	
		LAB ID:	460363					GOIDELINE	
	E BO	Sample Date: Sample ID:	7281						
DABAMETED	SEINI	Į.					TYPE	LIMIT	UNITS
	2 100	121	747						
Alkalinity as CaCO3	mg/L		1536						
Colour	, TCU	7	<b>7</b>						
Conductivity	mS/cm	2	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 0.03			urya di kawada			
N-NH3 (Ammonia) N-NO2 (Nitrite)	mg/L	0.10	<0.10			-			
N-NO3 (Nitrate)	mg/L	0.10	<0.10						
Hd			7.89						
Phenols	mg/L	0.001	<0.001						
Sulphate	mg/L	-	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			2.1						
Hardness as CaCO3	mg/L	- ;	617						
Ion Balance		0.01	0.95						
Calcium	mg/L	-	158						
Magnesium	mg/L	-	54					was do pass	
Potassium	mg/L	_	9						
Sodium	mg/L	7	807						
lron	mg/L	0.03	0.26						
Manganese	mg/L	0.01	90.0						
		. <del> </del>						V	
		_	_						

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

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Client: Sunset Lakes Development Corporation	Report Number:	2608991
6576 Apple Orchard Road	Date:	2006-05-08
Greely, ON	Date Submitted:	2006-05-04
K4P 1E5		
Attention: Dave Meikle	Project:	PH0145
	P.O. Number:	

Chain of Custody Number: 22829				Matrix:	>	Water	
Clail of Custous muliper.	LAB ID:	: 460381			)	GUIDELINE	
	Sample Date:	7					
	Sample ID:	L					
						-	
PARAMETER	UNITS MDL				TYPE	LIMIT	UNITS
	ct/100mL	ō					
Escherichia Coli	ct/100mL	-		-			
Heterotrophic Plate Count	ct/1mL	19					
Faecal Coliforms	ct/100mL	0					
Faecal Streptococcus	ct/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 McCooeye

QC Manager

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Client: Sunset Lakes Development Corporation 6576 Apple Orchard Road	Report Number: Date:	2608979 2006-05-10 2006-05-04
Greely, ON K4P 1E5		D 100445
Attention: Dave Meikle	Project: P.O. Number:	2

					Matrix:		Water	
Chain of Custody Number: 22825		LAB ID:	460365				GUIDELINE	
	Samp	Sample Date:	2006-05-03					
	Sar	Sample ID:	7377					1.44
PARAMETER	UNITS	MDL				TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	2	218					
Chloride	mg/L	-	316					
Colour	75	7	7					
Conductivity	uS/cm	2	1460					
Dissolved Organic Carbon	mg/L	0.5	<0.5					
Flioride	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		-			
			7.99					
Phenols	mg/L	0.001	<0.001					
Sulphate	mg/L	_	47					
Tannin & Linnin	mg/L	0.1	<0.1					
TDS (COND - CALC)	mg/L	2	949					
Total Kieldahl Nitrogen	mg/L	0.05	0.46					
Turbidity	D D	.0	3.5					
Hardness as CaCO3	mg/L	· 	342	 				
Ion Balance		0.01	0.98					
Calcium	mg/L	-	7.1					
Magnesium	mg/L	-	40					
Potassium	mg/L	_	=					
Sodium	mg/L	7	159					
uol	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

8-146 Colonnade Road, Ottawa, ON, K2E 7Y1

UNITS Water GUIDELINE 2608992 2006-05-08 2006-05-04 LIMIT PH0145 MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration Report Number: Date Submitted: P.O. Number: Project: Matrix: 2006-05-03 Sale Barn 460382 0000 LAB ID: Sample Date: Sample ID: MDL ct/100mL ct/100mL UNITS ct/100mL ct/100mL ct/1mL Client: Sunset Lakes Development Corporation PARAMETER Chain of Custody Number: 22828 6576 Apple Orchard Road K4P 1E5 Attention: Dave Meikle Heterotrophic Plate Count Faecal Streptococcus Greely, ON Faecal Coliforms Escherichia Coli Total Coliforms

Comment:

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

APPROVAL:
Tim McCooeye

QC Manager

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

Inorganic Lab Supervisor

APPROVAL:

Ewan McRobbie

Client: Sunset Lakes Development Corporation 6576 Apple Orchard Road Greely, ON							Report Number: Date: Date Submitted:	: #	2608980 2006-05-10 2006-05-04	
Attention: Dave Meikle							Project:		PH0145	
Chain of Custody Number: 22825							P.O. Number: Matrix:		Water	
		LAB ID:	460366						GUIDELINE	
	Samp	Sample Date:	2006-05-03							
	Sa	Sample ID:	Sale Barn							
PABAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
	1/000	1	200							
Alkainniy as GaCO3 Chloride	mg/L mg/L	n —	399							
Colour	TC D	2	\$							
Conductivity	mS/cm	ς.	1930							
Dissolved Organic Carbon	mg/L	0.5	<0.5							
Fluoride	mg/L	0.10	0.51							
Hydrogen Sulphide	mg/L	0.01	1.10							
N-NH3 (Ammonia)	mg/L	0.02	<0.02							
N-NO2 (Nitrite)	mg/L	0.10	<0.10							
N-NO3 (Nitrate)	mg/L	0.10	<0.10							
Hd			8.07			ur <del>ttra</del> na				
Phenols	mg/L	0.001	<0.001		new et a cons					
Sulphate	mg/L	-	69			·				
Tannin & Lignin	mg/L	0.1	1.0							
TDS (COND - CALC)	mg/L	2	1250							
Total Kjeldahl Nitrogen	mg/L	0.05	0.22							
Turbidity	N N	0.7	0.2				-			
Hardness as CaCO3	mg/L	-	2							
Ion Balance		0.01	0.98							
Calcium	mg/L	-	7							
Magnesium	mg/L	<b>,</b> -	V							
Potassium	mg/L	-	₹							
Sodium	mg/L	7	418							
lron	mg/L	0.03	<0.03							
Manganese	mg/L	0.01	<0.01				- Akura			
			ANA ABITTU							
MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration	OG = Operatik	onal Guidelin	e MAC = Maximi	ım Allowable Co	ncentration IMA(	C = Interim Maxir	num Allowable Conc	entration		
Comment:										



International Pump Technology Inc. Distributor of Goulds Pump

ASM Industries Annufacturer of the "Ground Hop" Ground For Pallist of the Ultimate Verning Prod Wall Congus, Ontario Phone: (800) 265-9355

June 7, 2006

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

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
- 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
- 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.
- 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.
- 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 exercised when treating this symptom by chlorination as THM's (trihalomethanes) are a by-product of oxidizing the organics.
- 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 harrnful effects of TDS on appliances and fixtures
- 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 CW\$ III **GM TechnaLinks** 

## **APPENDIX 4**

# SUPPORTING DOCUMENTATION AQUIFER ANALYSIS DATA

- 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

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown plot	Project: PH0145  Evaluated by: RAP
Pumping Test No. 06-2	Test	conducted on: May 1, 2006
TW4	TW4	

Discharg	e 1.88 l/s		Distance from the pumping well 0.150 m			
	ter level: 1.400 m below datum					
0.00.00	Pumping test duration	Water level	Drawdown			
	, amping toot daration					
	[min]	[m]	[m]			
1	0.00	1.400	0.000			
2	0.50	3.010	1.610			
3	1.00	3.660	2.260			
4	1.50	4.350	2.950			
5	2.00	4.920	3.520 3.900			
6	3.00	5.300	4.230			
7	4.00	5.630	4.230			
8	5.00	5.820	4.650			
9	7.00	6.050 6.200	4.800			
10	10.00	6.470	5.070			
11	15.00	6.700	5.300			
12	30.00 45.00	6.780	5.380			
13	60.00	6.820	5.420			
14	90.00	6.880	5.480			
15 16	120.00	6.920	5.520			
17	150.00	6.970	5.570			
18	180.00	6.970	5.570			
19	210.00	6.970	5.570			
20	240.00	6.980	5.580			
21	270.00	7.010	5.610			
22	300.00	7.020	5.620			
23	330.00	7.020				
24	360.00	7.030				
25	360.50	3.920				
26	361.50	3.040				
27	362.00	2.500				
28	363.00	2.090				
29	364.00	1.670				
30	365.00	1.810				
31	367.00	1.730				
32	370.00	1.680 1.640				
33	375.00	1.520				
34	390.00 405.00	1.470				
35	420.00	1.440				
36	420.00	1,11				
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Paters	on Group Ltd.	Pumping test analysis		Date: 10.05.2006	none, Page 3
1-28 Co	ncourse Gate	Time-Drawdown plot		Project: PH0145	
vepean, C	ON K2E 7T7			Evaluated by: RA	P
Pumpin	g Test No. 06-2		Test conducted o	n: May 1, 2006	
TW4		-	MW4-1		
Dischar	ge 1.88 l/s		Distance from the	e pumping well 5.000 r	n
Static w	rater level: 1.550 m below datum				
	Pumping test duration	Water level	Draw	rdown	
	[min]	[m]	[1	n]	
1	0.00	1.550		0.000	
2	60.00	1.550		0.000	
3	90.00	1.550		0.000	
4	120.00	1.550		0.000	
5	150.00	1.560		0.010 0.000	
6	180.00	1.550		0.000	
7	210.00	1.560		0.010	
8	240.00	1.560 1.560		0.010	
9	270.00 300.00	1.560		0.010	
10	330.00	1.560		0.010	
12	360.00	1.560		0.010	
13	390.00	1.560		0.010	
14	420.00	1.560		0.010	
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Paterson Group Ltd.	Pumping test analys	is	Date: 10.05.2006   none, Page 4
1-28 Concourse Gate Nepean, ON K2E 7T7	Time-Drawdown plo	t	Project: PH0145
nopodn, on real riv			Evaluated by: RAP
Pumping Test No. 06-2		Test conducted on:	: May 1, 2006
TW4		MW4-2	
Discharge 1.88 l/s		Distance from the	oumping well 5.000 m

Jischa	arge 1.88 l/s		Distance from the pumping well	5.000 m
Static	water level: 1.250 m below datum			
	Pumping test duration	Water level	Drawdown	·
	[min]	[m]	[m]	υ
1	0.00	1.250	0.000	
2	60.00	1.250	0.000	
3	90.00	1.260	0.010	
4	120.00	1.260	0.010	
5	150.00	1.260	0.010	·
6	180.00	1.250	0.000	
7	210.00	1.250	0.000	
8	240.00	1.250	0.000	
9	270.00	1.260	0.010	
10	300.00	1.260	0.010	
11	330.00	1.250	0.000	
12	360.00	1.250	0.000	
13	390.00	1.250	0.000	
14	420.00	1.250	0.000	
14	420.00	1.250	0.000	
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	Paters	son Group Ltd.	Pumping test analysis	5	Date: 10.05.2006	none, Page 5
		oncourse Ġate ON K2E 7T7	Time-Drawdown plot		Project: PH0145	0145 y: RAP
					Evaluated by: RA	AP
	Pumpir	ng Test No. 06-2		Test conducted on:	May 1, 2006	
	TW4			MW4-3		
	Discha	rge 1.88 l/s	·	Distance from the pu	umping well 5.000	m
	Static v	vater level: 1.390 m below datum				
		Pumping test duration	Water level	Drawdo	wn	
		[min]	[m]	[m]		
	1	0.00	1.390		0.000	
	2	60.00	1.390		0.000	
	3	90.00	1.390		0.000	
	4	120.00	1.390		0.000	
	5	150.00	1.390		0.000	
	6	180.00	1.390		0.000	
	7	210.00	1.390		0.000	
	8	240.00	1.390		0.000	
	9	270.00	1.390		0.000	
	10	300.00	1.390		0.000	
	11	330.00	1.390		0.000	
	12	360.00	1.390		0.000	
	13	390.00	1.390		0.000	
	14	420.00	1.390		0.000	
		420.00	1.590		0.000	
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_	on Group Ltd.  oncourse Gate	Pumping test analysis	3	Date: 10.05.2006	none, Page 6
1	oncourse Gate ON K2E 7T7	Time-Drawdown plot		Project: PH0145	
				Evaluated by: RAI	•
Pumpin	g Test No. 06-2		Test conducted on: I	May 1, 2006	
TW4			TW5		
Dischar	ge 1.88 l/s		Distance from the pu	umping well 277.000	) m
Static w	vater level: 1.060 m below datum				
	Pumping test duration	Water level	Drawdo	wn	
	[min]	[m]	[m]		
1	0.00	1.060		0.000	
2	35.00	1.060		0.000	
3	170.00	1.160		0.100	
4	290.00	1.180		0.120	
5	420.00	0.920		-0.140	
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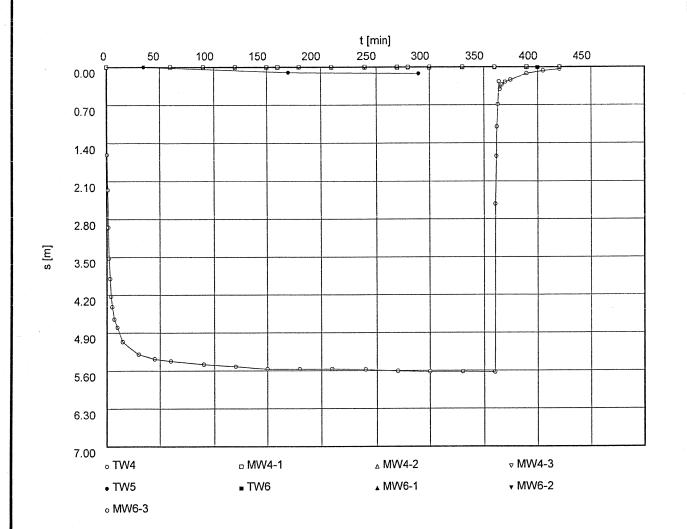
	Pate	rson Group Ltd. Concourse Gate	Pumping test analysis	s	Date: 10.05.2006	none, Page 7
		Concourse Gate n, ON K2E 7T7	Time-Drawdown plot		Project: PH0145	
	Пореш	, 511/22/11			Evaluated by: RA	νP
	Pump	ing Test No. 06-2		Test conducted on: N	May 1, 2006	
	TW4			TW6		
	Disch	arge 1.88 l/s		Distance from the pu	imping well 353.00	0 m
	<b></b>	water level: 0.650 m below datur	<u> </u>			
	Otatio	Pumping test duration	Water level	Drawdov	WD.	
		r umping toot duration		Diames.		
		[min]	[m]	[m]		
	1 2	0.00 160.00	0.650 0.660		0.000 0.010	
	3	280.00	0.660		0.010	
	4	400.00	0.660		0.010	
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Pate	rson Group Ltd.	Pumping test analysis	5	Date: 10.05.2006	none, Page 8
	rson Group Ltd. Concourse Gate	Time-Drawdown plot		Project: PH0145	
мереа	n, ON K2E 7T7			Evaluated by: RA	NP
Pump	ping Test No. 06-2	1	Test conducted on: I	May 1, 2006	
TW4			MW6-1		
	narge 1.88 l/s		Distance from the pu	ımping well 359 00	00 m
	water level: 1.270 m below datum				
Static	Pumping test duration	Water level	Drawdo	wn	
	Tumping test duration	vvater lever	Diawdo	vv.,	
	[min]	[m]	[m]		
1 2		1.270 1.270		0.000	
3	280.00	1.270		0.000	
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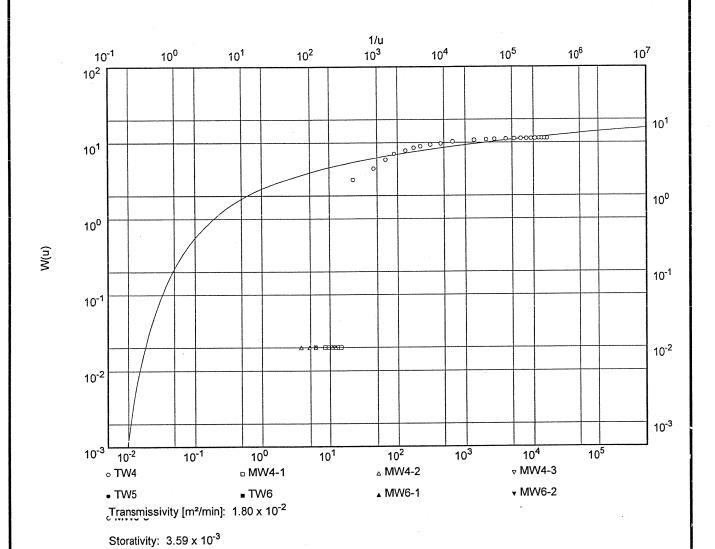
Pater	rson Group Ltd. Concourse Gate	Pumping test analysis	5	Date: 10.05.2006 none, Page 9	
	Concourse Gate n, ON K2E 7T7	Time-Drawdown plot		Project: PH0145	
,				Evaluated by: RAP	
Pump	ing Test No. 06-2		Test conducted on: I	May 1, 2006	
TW4			MW6-2		
Disch	arge 1.88 l/s		Distance from the pu	mping well 364.000 m	
Static	water level: 1.400 m below datum	·			
	Pumping test duration	Water level	Drawdov	vn	
	[min]	[m]	[m]		
1	0.00	1.400	[[11]	0.000	
2	160.00	1.400		0.000	
3	280.00	1.400		0.000	
4	360.00	1.400		0.000	
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Paters	on Group Ltd. ncourse Gate	Pumping test analysis	3		
	ncourse Gate ON K2E 7T7	Time-Drawdown plot			
				Evaluated by: R	AP
Pumping	g Test No. 06-2		Test conducted on:	May 1, 2006	
TW4			MW6-3		
Dischar	ge 1.88 l/s		Distance from the p	Date: 10.05.2006   none, Page 1 Project: PH0145 Evaluated by: RAP  est conducted on: May 1, 2006  IW6-3 iistance from the pumping well 349.000 m  Drawdown [m] 0.000 0.000 0.000 0.000	
	ater level: 1.650 m below datum				
	Pumping test duration	Water level	Drawdo	wn	
	[min]	[m]	[m]		
1	0.00	1.650			
2	160.00	1.650			
3 4	280.00 360.00	1.650 1.650			<u> </u>
4	300.00	1.050		0.000	
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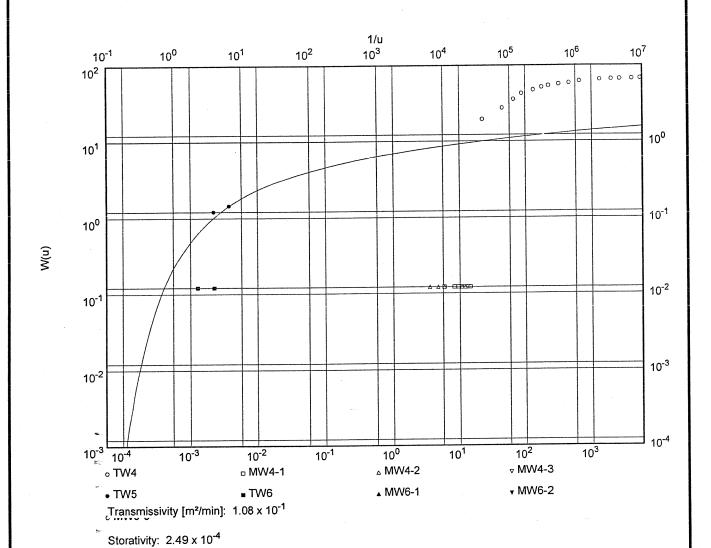
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown plot	Date: 10.05.2006 none, Page 1  Project: PH0145  Evaluated by: RAP		
Pumping Test No. 06-2		Test conducted on: May 1, 2006		
TW4				
Discharge 1.88 l/s				



Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysi Theis analysis metho Confined aquifer		Date: 10.05.2006 none, Page 1 Project: PH0145		
	·		Evaluated by: RAP		
Pumping Test No. 06-2		Test conducted on: May 1, 2006			
TW4					
Discharge 1.88 l/s					



Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Theis analysis method Confined aquifer		Date: 10.05.2006 Project: PH0145 Evaluated by: RAP	none, Page 1	
Pumping Test No. 06-2		Test conducted on: May 1, 2006			
TW4					
Discharge 1.88 l/s					



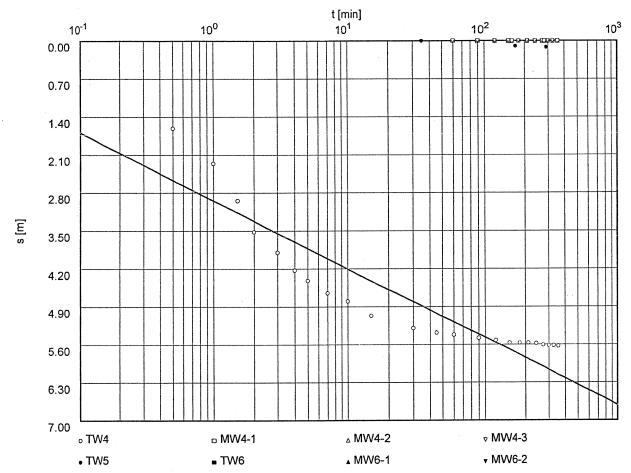
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7 Pumping test analysis
Time-Drawdown-method after
COOPER & JACOB
Confined aquifer

Date: 10.05.2006 none, Page 1

Project: PH0145

Evaluated by: RAP

Pumping Test No. 06-2	Test conducted on: May 1, 2006
TW4	
Discharge 1.88 l/s	



Transmissivity [m²/min]: 1.64 x 10<sup>-2</sup>

Storativity: 7.51 x 10<sup>-3</sup>

Paterson Group Ltd
1-28 Concourse Gate
Nepean, ON K2E 7T7

Pumping test analysis Time-Drawdown plot

Date: 16.05.2006	none, Page 2
Project: PH0145	
Evaluated by: RAP	

Pumping Test No. 3	Test conducted on: May 2, 2006
TW5	TW5
Discharge 1.92 l/s	Distance from the pumping well 0.150 m

talic v	vater level: 1.070 m below datum			
	Pumping test duration	Water level	Drawdown	
	[min]	[m]	[m]	
1	0.00	1.070	0.000	
2	3.00	1.200	0.130	
3	4.00	1.230	0.160	
4	5.00	1.250	0.180	
5	6.00	1.260	0.190	
6	7.00	1.280	0.210	
7	8.00	1.290	0.220	
8	10.00	1.310	0.240	
9	12.00	1.320	0.250	
10	14.00	1.340	0.270	
11	16.00	1.350	0.280	
12	18.00	1.360	0.290	
13	20.00	1.370	0.300	
14	25.00	1.390	0.320	
15	30.00	1.400	0.330	
16	35.00	1.420	0.350	
17	40.00	1.430	0.360	
18	45.00	1.440	0.370	
19	55.00	1.460	0.390	
20	60.00	1.460	0.390	
21	70.00	1.480	0.410	
22	80.00	1.480	0.410	
23	90.00	1.490	0.420	
24	100.00	1.500	0.430	
25	110.00	1.500	0.430	
26	120.00	1.510	0.440	
27	140.00	1.510	0.440	
28	160.00	1.510	0.440	
29	180.00	1.520	0.450	
30	210.00	1.520	0.450	
31	240.00	1.520	0.450	
32	293.00	1.530	0.460	
33	330.00	1.530	0.460	
34	361.00	1.270	0.200	
35	362.00	1.240	0.170	
36	363.00	1.220	0.150	
37	365.00	1.160	0.090	
38	370.00	1.120	0.050	
39	376.00	1.070	. 0.000	
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Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7		Pumping test analysis	<b>3</b>	Date: 16.05.2006	none, Page 3
		Time-Drawdown plot		Project: PH0145	
wepean, ON	TIVE I II			Evaluated by: RA	P
Pumping Test No. 3			Test conducted on:	<u> </u>	
TW5			TW4		
Discharge	e 1.92 l/s		Distance from the p	umping well 277.000	) m
Static wat	ter level: 1.320 m below datum	·			
	Pumping test duration	Water level	Drawdo	wn	
	[min]	[m]	[m]		
1	0.00	1.320		0.000	
2	50.00	1.560		0.240	And the second s
3	85.00	1.600		0.280	
4	146.00	1.630		0.310	
5	210.00	1.640		0.320 0.320	
6	256.00	1.640		0.320	
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Paterson Group Ltd. 1-28 Concourse Gate		Pumping test analysis		Date: 16.05.2006	none, Page 4	
i e	Concourse Gate n, ON K2E 7T7	Time-Drawdown plot		Project: PH0145		
Nepear	1, ON KZE / 1/			Evaluated by: RAP		
Pump	ing Test No. 3		Test conducted on: May 2, 2006			
TW5			MW5-1			
Disch	arge 1.92 l/s		Distance from the pu	ımping well 5.000 m	1	
Static	water level: 0.860 m below datum	I				
	Pumping test duration	Water level	Drawdov	wn		
	[min]	[m]	[m]			
1	0.00	0.860	[111]	0.000		
2	14.00	0.860		0.000		
3	25.00	0.860		0.000		
4	40.00	0.860		0.000		
5	55.00	0.860		0.000		
6	80.00	0.860		0.000		
7	90.00	0.860		0.000		
8	110.00	0.860		0.000		
9	140.00	0.860		0.000		
10	210.00	0.860		0.000		
11	293.00	0.860		0.000		
12	330.00	0.860		0.000		
13	360.00	0.860		0.000		
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Paterson Group Ltd. 1-28 Concourse Gate		Pumping test analysis		Date: 16.05.2	2006 none, Pa
1-28 Concou		Time-Drawdown plot		Project: PH0	145
				Evaluated by	: RAP
Pumping Te	st No. 3		Test conduc	ted on: May 2, 2006	
TW5			MW5-2		
Discharge 1	.92 l/s		Distance fro	m the pumping well 5.0	000 m
Static water	level: 0.820 m below datum				
Pi	umping test duration	Water level		Drawdown	
	[min]	[m]		[m]	
1	0.00	0.820		0.000	
2	14.00	0.820		0.000	<u> </u>
3	25.00	0.820		0.000	<del> </del>
4	40.00	0.820 0.820		0.000 0.000	
5	55.00 80.00	0.820		0.000	
7	90.00	0.820		0.000	-
8	110.00	0.820		0.000	
9	140.00	0.820	)	0.000	
10	210.00	0.820		0.000	
11	293.00	0.820		0.000	
12	330.00	0.820		0.000 0.000	
13	360.00	0.820	<u></u>	0.000	
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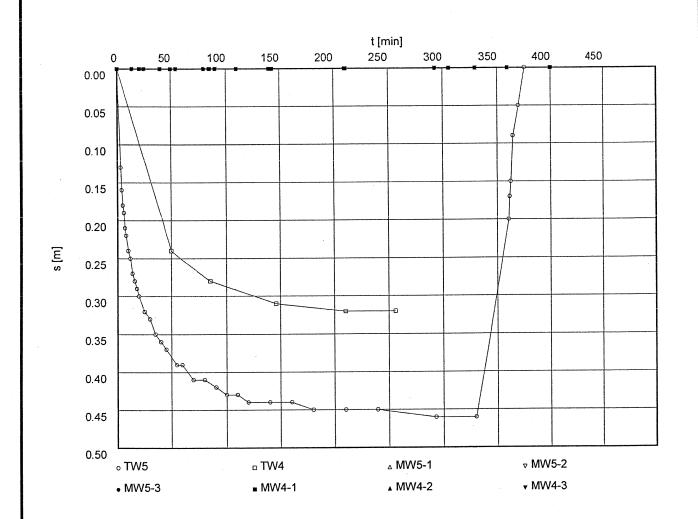
Pater	son Group Ltd.	Pumping test analysis		Date: 16.05.2006	none, Page 6
· ·		Time-Drawdown plot		Project: PH0145	
Nepean	Nepean, ON K2E 7T7			Evaluated by: RAP	
Pumpi	ing Test No. 3	Т	est conducted on: I	иау 2, 2006	
TW5			1W5-3		
	orgo 1 02 l/o			ımping well 5.000 m	
	arge 1.92 l/s	<u> </u>	istance nom the pe	imping wen e.eee in	
Static	water level: 0.800 m below datum		Daniela		
	Pumping test duration	Water level	Drawdo	WII	
ı	[min]	[m]	[m]		
1	0.00	0.800	·	0.000	
2	14.00	0.800		0.000	
3	25.00	0.800 0.800	ļ	0.000	
4 5	40.00 55.00	0.800		0.000	
6	80.00	0.800		0.000	
7	90.00	0.800		0.000	
8	110.00	0.800		0.000	
9	140.00	0.800		0.000	
10	210.00 293.00	0.800 0.800		0.000	
11 12	330.00	0.800		0.000	
13	360.00	0.800		0.000	
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Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7		Pumping test analysis	Pumping test analysis		none, Page 7	
		Time-Drawdown plot		Project: PH0145		
Nepean, (	ON K2E 7T7			Evaluated by: RA	lated by: RAP	
Pumping Test No. 3			Test conducted or	n: May 2, 2006		
TW5			MW4-1			
Dischar	ge 1.92 l/s		Distance from the	pumping well 267.00	00 m	
Static w	vater level: 1.460 m below datum		-			
	Pumping test duration	Water level	Drawo	down		
	[min]	[m]	m]	1]		
1	0.00	1.460		0.000		
2	21.00	1.460		0.000		
3	50.00	1.460		0.000		
4	85.00	1.460		0.000		
5	143.00	1.460		0.000		
6	306.00	1.460		0.000	The state of the s	
7	400.00	1.460	<u> </u>	0.000		
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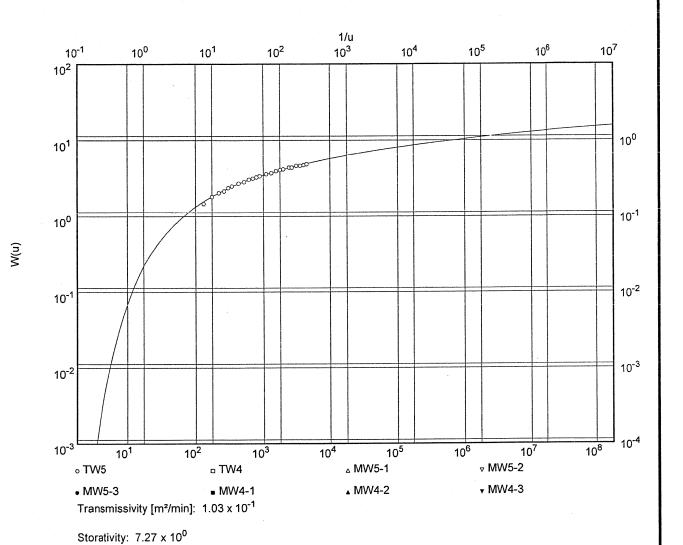
Paterson Group Ltd. 1-28 Concourse Gate		Pumping test analysis		Date: 16.05.2006	none, Page 8
	Concourse Gate , ON K2E 7T7	Time-Drawdown plot		Project: PH0145	
Перса	, ON NEE 111			Evaluated by: RAP	
Pump	ing Test No. 3		Test conducted on:	May 2, 2006	
TW5			MW4-2		
Disch	arge 1.92 l/s		Distance from the p	umping well 277.000	m ·
Static	water level: 1.240 m below datum				
	Pumping test duration	Water level	Drawdo	own	
	[min]	[m]	[m]		
1	0.00	1.240		0.000	
2	50.00	1.240		0.000	
3	85.00	1.240		0.000	
4	143.00	1.240		0.000	
5 6	211.00 306.00	1.240 1.240		0.000	
7	400.00	1.240		0.000	
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Paterson Group Ltd.		Pumping test analysis	Date: 16.05	.2006 none, Page 9		
1-28 (	Concourse Gate	Time-Drawdown plot	Project: PH	0145		
Nepear	n, ON K2E 7T7		Evaluated t	by: RAP		
Pump	ing Test No. 3	-	Test conducted on: May 2, 2006			
TW5	***************************************		MVV4-3			
Disch	arge 1.92 l/s		Distance from the pumping well 2	89.000 m		
Static	water level: 1.480 m below datum					
	Pumping test duration	Water level	Drawdown			
	Imin	(m)	[m]			
1	[min] 0.00	[m] 1.480	0.000	·		
2	50.00	1.480	0.000			
3	85.00	1.480	0.000			
5	143.00 211.00	1.480 1.480	0.000 0.000			
6	306.00	1.480	0.000			
7	400.00	1.480	0.000			
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Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analys Time-Drawdown plot		Date: 16.05.2006   none, Page 1  Project: PH0145		
, contact the second se			Evaluated by: RAP		
Pumping Test No. 3		Test conducted on:	est conducted on: May 2, 2006		
TW5					
Discharge 1.92 l/s					
		L			



Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Theis analysis method Confined aquifer		Date: 16.05.2006 none, Page 1  Project: PH0145  Evaluated by: RAP		
Pumping Test No. 3		Test conducted on: May 2, 2006			
TW5					
Discharge 1.92 l/s					

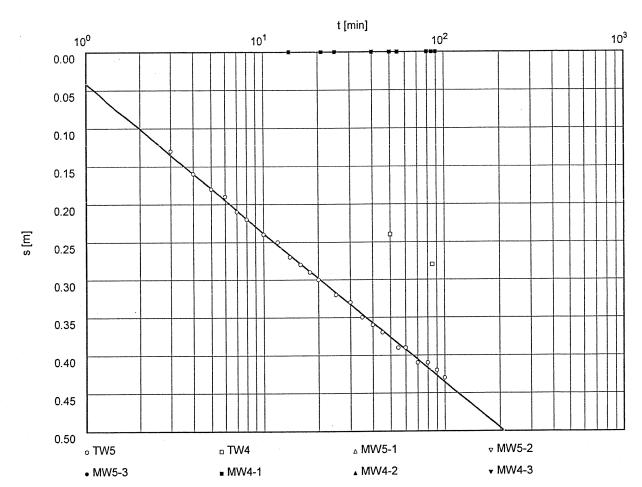


Paterson Group Ltd.
1-28 Concourse Gate
Nepean, ON K2E 7T7

Pumping test analysis
Time-Drawdown-method after
COOPER & JACOB
Confined aquifer

Date: 16.05.2006	none, Page 1	7
Project: PH0145		
Evaluated by: RAP		

Pumping Test No. 3	Test conducted on: May 2, 2006
TW5	
Discharge 1.92 l/s	



Transmissivity [m²/min]: 1.06 x 10<sup>-1</sup>

Storativity: 6.61 x 10<sup>0</sup>

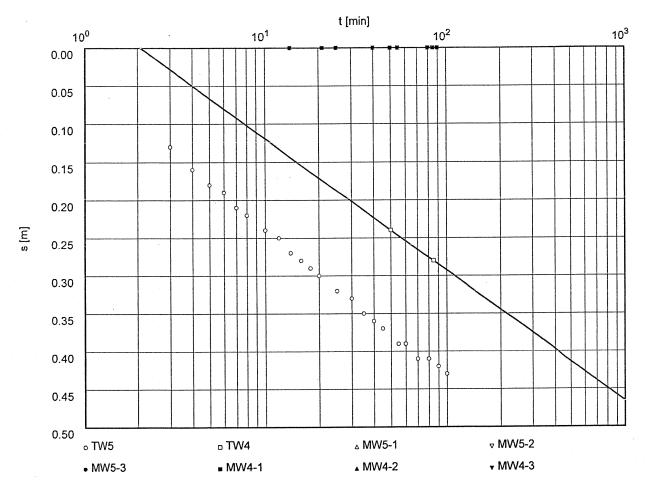
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7 Pumping test analysis
Time-Drawdown-method after
COOPER & JACOB
Confined aquifer

Date: 16.05.2006 none, Page 1

Project: PH0145

Evaluated by: RAP

Pumping Test No. 3	Test conducted on: May 2, 2006
TW5	
Discharge 1.92 l/s	



Transmissivity [m²/min]: 1.21 x 10<sup>-1</sup>

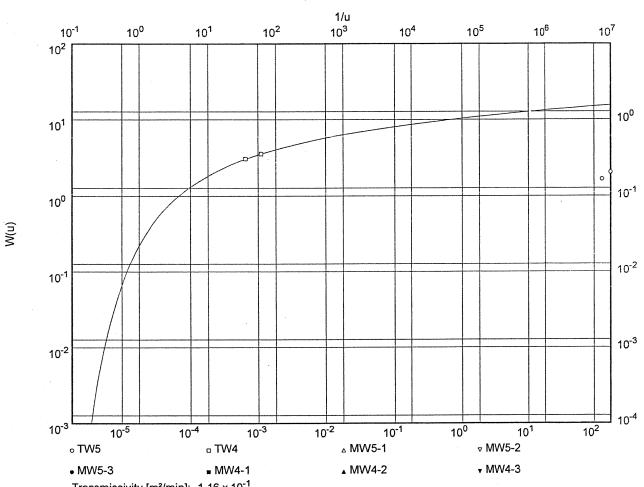
Storativity:  $7.37 \times 10^{-6}$ 

Paterson Group Ltd.
1-28 Concourse Gate
Nepean, ON K2E 7T7

Pumping test analysis Theis analysis method Confined aquifer

Date: 16.05.2006 none, Page 1 Project: PH0145 Evaluated by: RAP

Pumping Test No. 3	Test conducted on: May 2, 2006
TW5	
Discharge 1.92 l/s	



Transmissivity [m²/min]: 1.16 x 10<sup>-1</sup>

Storativity: 8.34 x 10<sup>-6</sup>

Paterson Group Ltd.		Pumping test analysis		Date: 05.05.2006 none, Page 2		
	ncourse Gate ON K2E 7T7	Time-Drawdown plot	Time-Drawdown plot		Project: PHO145	
Nepean, C	N 122 / 11			Evaluated by: RA	Р	
Pumping	g Test No. O6/01	Test conducted on: April 28, 2006				
TW6	TW6		Test Well 6			
Dischar	ge 2.14 l/s		Distance from the	pumping well 0.150 n	n	
Static w	ater level: 0.870 m below datum					
Pumping test duration		Water level	Draw	Drawdown		
,	[min]	[m]	[r	n]		
1	0.00	0.870		0.000		
2	0.50	0.970		0.100		
3	1.00	1.120		0.250		
4	1.50	1.150		0.280		
5	2.00	1.180		0.310		
6	2.50	1.190		0.320		
7	3.00	1.200		0.330		
8	4.00	1.220		0.350 0.380		
9	5.00	1.250		0.400		
10	7.00	1.270 1.320		0.450		
11	10.00 15.00	1.320		0.490		
13	30.00	1.440		0.570		
14	45.00	1.500		0.630		
15	60.00	1.550		0.680		
16	90.00	1.610		0.740		
17	120.00	1.640		0.770		
18	150.00	1.670		0.800		
19	180.00	1.680		0.810		
20	210.00	1.690	)	0.820		
21	240.00	1.690	)	0.820		
22	270.00	1.690	)	0.820		
23	300.00	1.690	)	0.820		
24	330.00	1.700		0.830		
25	360.00	1.710		0.840		
26	360.50	1.380		0.510		
27	361.00	1.350		0.480 0.470		
28	361.50	1.34		0.450		
29	362.00	1.320 1.32		0.450		
30	363.00 364.00	1.32		0.400		
31 32	366.00	1.24		0.370		
33	370.00	1.20		0.330		
34	375.00	1.15		0.280		
35	380.00	1.10		0.230		
36	390.00	1.04		0.170		
37	405.00	0.98	0	0.110		
38	420.00	0.93	0	0.060		
39	435.00	0.89	0	0.020		
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Paterson Group Ltd. 1-28 Concourse Gate		Pumping test analysis	s Date: 05.05		5.2006 none, Page 3	
	oncourse Gate ON K2E 7T7	Time-Drawdown plot		Project: PHO14	'HO145	
				Evaluated by: RAP		
Pumpin	ng Test No. O6/01	Test conducted or	: April 28, 2006	And the second s		
TW6	and the control of th		TW4  Distance from the pumping well 353.000 m			
Dischar	rge 2.14 l/s					
	vater level: 1.400 m below datum	·				
	Pumping test duration	Water level	Drawdown			
	[min]	r	F	,		
1	[min] 0.00	[m] 1.400	[m	0.000		
2	180.00	1.280		-0.120		
3 4	330.00 428.00	1.280 1.420		-0.120 0.020		
-4	420.UU	1.420		0.020		
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Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7		Pumping test analysis	8	Date: 05.05.2006 none, Page 4			
		Time-Drawdown plot		Project: PHO145			
Nepean	, ON K2E /1/			Evaluated by: RAP			
Pump	ng Test No. O6/01		Test conducted on: April 28, 2006				
TW6			TW2				
Discha	arge 2.14 l/s		Distance from the p	oumping well 260.000	) m		
Static	water level: 1.848 m below datum						
	Pumping test duration	Water level	Drawde	own			
	[min]	[m]	[m]				
1	0.00	1.848		0.000			
2	150.00	1.890		0.042			
3	300.00	1.900 1.890		0.052 0.042			
4 5	385.00 456.00	1.890		0.042			
5	438.00	1.000		0.0.2			
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Paters	son Group Ltd.	Pumping test analysis		Date: 05.05.2006	none, Page 5	
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7		Time-Drawdown plot		Project: PHO145		
ivepean,	Nepedit, ON NZE 7 17			Evaluated by: RAP		
Pumpir	ng Test No. 06/01	Test conducted on: April 28, 2006				
TW6 TW3						
<u></u>	Discharge 2.14 l/s  Distance from the pumping well 280.000 m			m		
<b>]</b>						
Static	water level: 0.550 m below datum	Water level	Drawdo	wn		
	Pumping test duration	vvaler level	Drawdo	7711		
	[min]	[m]	[m]		And the second s	
1	0.00	0.550 0.590		0.000 0.040		
2	150.00 300.00	0.590		0.040		
4	385.00	0.590		0.040		
5	456.00	0.560		0.010		
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Paterson Group Ltd. 1-28 Concourse Gate		Pumping test analysis	Pumping test analysis		none, Page 6	
		Time-Drawdown plot		Project: PHO145	5	
Nepean, Of	N K2E 7T7			Evaluated by: RAP		
Dumning	Tost No. 06/01		Test conducted o	n: April 28, 2006		
Pumping Test No. 06/01			MW6-1			
TW6						
Discharg	e 2.14 l/s		Distance from the	e pumping well 5.000	m	
Static wa	ter level: 1.250 m below datum					
	Pumping test duration	Water level	Draw	vdown		
				mi		
	[min] 0.00	[m] 1.250		m] 0.000		
1 2	60.00	1.240		-0.010		
3	90.00	1.240		-0.010		
4	120.00	1.240		-0.010		
5	150.00	1.240		-0.010		
6	180.00	1.230		-0.020 -0.020		
7	210.00 240.00	1.230 1.230		-0.020		
8	270.00	1.230		-0.020		
10	300.00	1.230		-0.020		
11	330.00	1.230		-0.020		
12	360.00	1.230		-0.020		
13	365.00	1.230		-0.020 -0.020		
14	440.00	1.230	)	-0.020		
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Paterson Group Ltd. 1-28 Concourse Gate		Pumping test analysis Time-Drawdown plot	Pumping test analysis Time-Drawdown plot		Date: 05.05.2006 none, Page 7	
Nepean, ON				Project: PHO145		
				Evaluated by: RAI		
Pumping	Test No. O6/01			eted on: April 28, 2006		
TW6	•		MW6-2			
Discharg	e 2.14 l/s		Distance fro	m the pumping well 5.000 n	1	
Static wa	ter level: 1.430 m below datum					
	Pumping test duration	Water level		Drawdown		
	[min]	[m]		[m]		
1	0.00	1.430		0.000		
2	60.00	1.430		0.000		
3	90.00	1.430		0.000		
4	120.00	1.410		-0.020		
5	150.00	1.410		-0.020 -0.020		
6	180.00 210.00	1,410 1,410		-0.020		
7 8	240.00	1.400		-0.030		
9	270.00	1.400		-0.030		
10	300.00	1.410		-0.020		
11	330.00	1.410		-0.020		
12	360.00	1.400		-0.030		
13	365.00	1.390		-0.040		
14	440.00	1.390	)	-0.040		

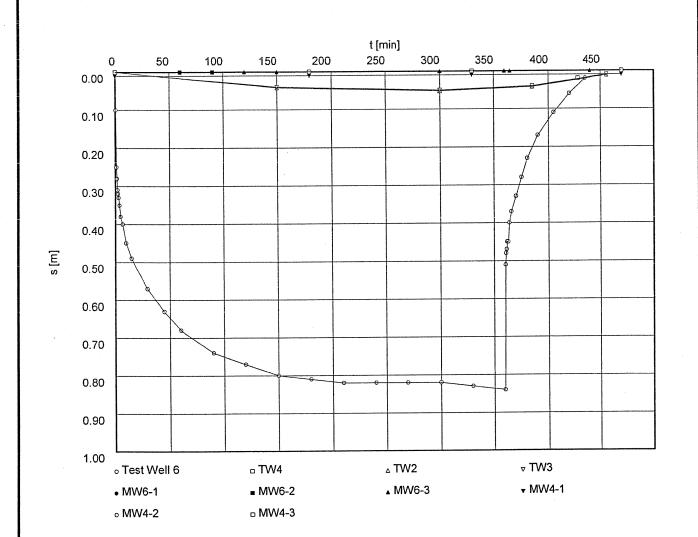
Paterso 1-28 Cor	on Group Ltd.	Pumping test analysis Time-Drawdown plot	S	Date: 05.05.2006 none, Page 8  Project: PHO145  Evaluated by: RAP			
	ON K2E 7T7						
Pumping	Test No. O6/01		Test conducted	on: April 28, 2006			
TW6	1001110.00701		MW6-3				
ļ	e 2.14 l/s			ne numning well 5 000	m		
			Distance from the pumping well 5.000 m				
Static wa	Pumping test duration	Water level	Dra	wdown			
	[min]	[m]		[m]			
1	0.00	1.620		0.000			
2	60.00	1.620		0.000			
3 4	90.00	1.620		0.000 0.000			
5	120.00 150.00	1.620 1.620		0.000			
6	180.00	1.620		0.000			
7	240.00	1.610		-0.010			
8	270.00	1.610		-0.010			
9	300.00	1.620		0.000			
10	330.00	1.620		0.000			
11	360.00	1.620		0.000			
12 13	365.00 440.00	1.620 1.620		0.000			
.5	77.00	1.020			4-		
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Patersor	Group Ltd.	Pumping test analysis		Date: 05.05.2006	none, Page 9
	Group Ltd. ourse Gate	Time-Drawdown plot	Time-Drawdown plot		
Nepean, ON	K2E 7T7			Project: PHO145  Evaluated by: RA	
Pumning <sup>-</sup>	Гest No. O6/01		Test conducted o		
			MW4-1		
TW6				259.00	)O m
Discharge	2.14 l/s		Distance from the	pumping well 358.00	JU M
Static wat	er level: 1.430 m below datum				
	Pumping test duration	Water level	Draw	down	
	[min]	[m]		n]	
1	0.00	1.440		0.010	
2	180.00	1.440 1.440		0.010 0.010	
3 4	330.00 470.00	1.440		0.010	
	470.00	1.110	,		
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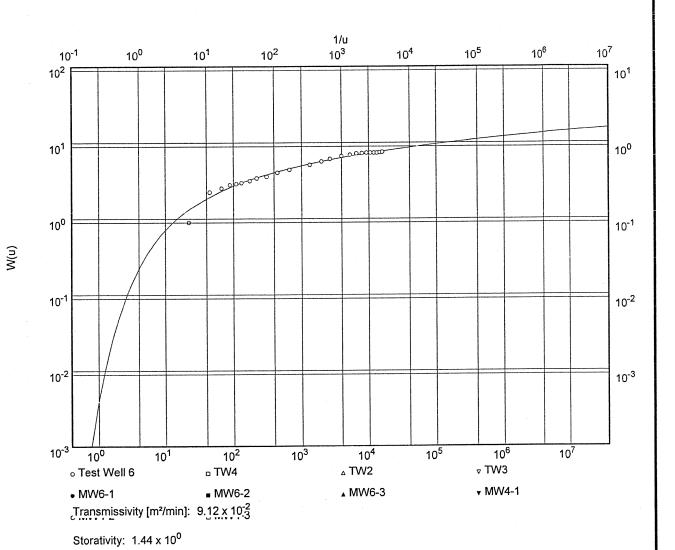
Paterson	<b>Group Ltd.</b> ourse Gate	Pumping test analysis	<b>S</b> .	Date: 05.05.2006	none, Page 1	
1-28 Conco		Time-Drawdown plot		Project: PHO145		
Hopouri, ON N	,,			Evaluated by: RAP	)	
Pumping To	est No. 06/01		Test conducted on:	: April 28, 2006		
TW6			MW4-2			
Discharge 2	2.14 l/s		Distance from the	pumping well 353.000	m	
	r level: 1.250 m below datum					
	Pumping test duration	Water level	Drawd	own		
			2.500			
	[min]	[m]	[m]	]		
1 2	0.00	1.250 1.250		0.000		
3	330.00	1.240		-0.010		
4	470.00	1.240		-0.010		
	<u> </u>					
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Paterson G 1-28 Concou		Pumping test analysi	Pumping test analysis Time-Drawdown plot		none, Page 11
1-28 Concou Nepean, ON K2		Time-Drawdown plot			Project: PHO145
Nepean, ON NZ	E/1/		7	Evaluated by: RAP	)
Pumping Tes	st No. O6/01		Test conducted on:	April 28, 2006	
TW6			MVV4-3		
	4 4 11_			oumping well 362.000	l m
Discharge 2.			Distance from the p	uniping wen 502.000	111
	level: 1.440 m below datum				
Pu	umping test duration	Water level	Drawdo	own	
•	[min]	[m]	[m]		
1	0.00	1.440	0	0.000	
2	180.00	1.440		0.000	
3 4	330.00 470.00	1.440 1.440		0.000	
4	470.00	1.770		0.000	
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Paterson Group Ltd. 1-28 Corricourse Gate		Pumping test analysis Time-Drawdown plot		none, Page 1
Nepean, ON K2E 7T7				Evaluated by: RAP
Pumping Test No. O6/01	Test conducted on: April 28, 2006			
TW6				
Discharge 2.14 l/s				



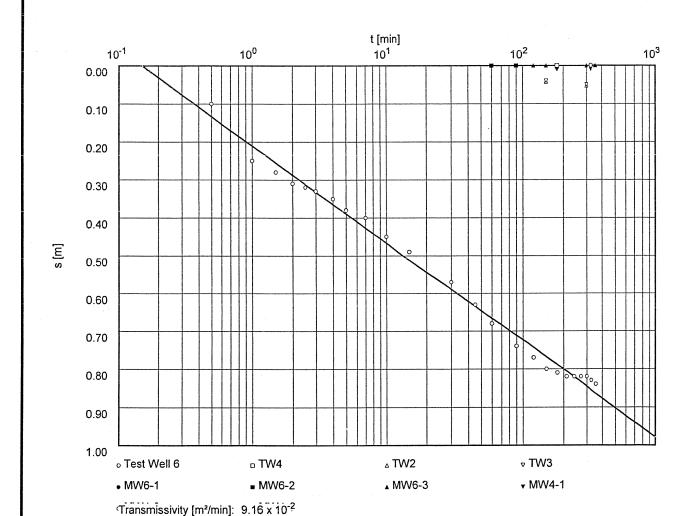
		Date: 05.05.2006   none, Page 1  Project: PHO145  Evaluated by: RAP	
1	Test conducted on: April 28, 2006		
	. •		
	Theis analysis metho		



Paterson Group Ltd.
1-28 Concourse Gate
Nepean, ON K2E 7T7
Pumping Test No. O6/01
Pumping Test No. O6/01
Pumping Test No. O6/01
Pumping Test No. O6/01

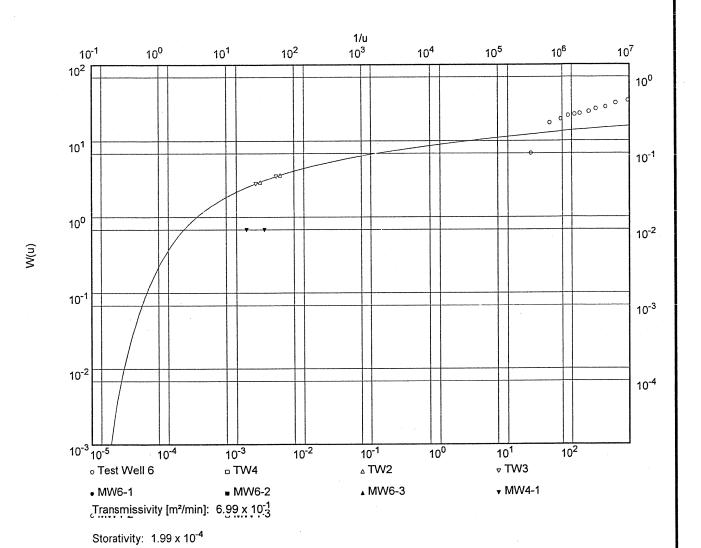
Test conducted on: April 28, 2006

TW6
Discharge 2.14 l/s

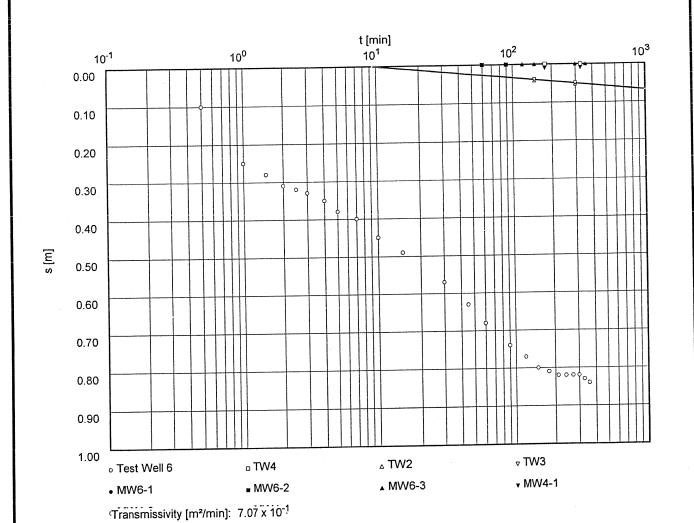


Storativity: 1.39 x 10<sup>0</sup>

Pumping test analysis Theis analysis method Confined aquifer	Date: 05.05.2006 none, Page 1  Project: PHO145  Evaluated by: RAP		
Test conducte	Test conducted on: April 28, 2006		
	Theis analysis method Confined aquifer		

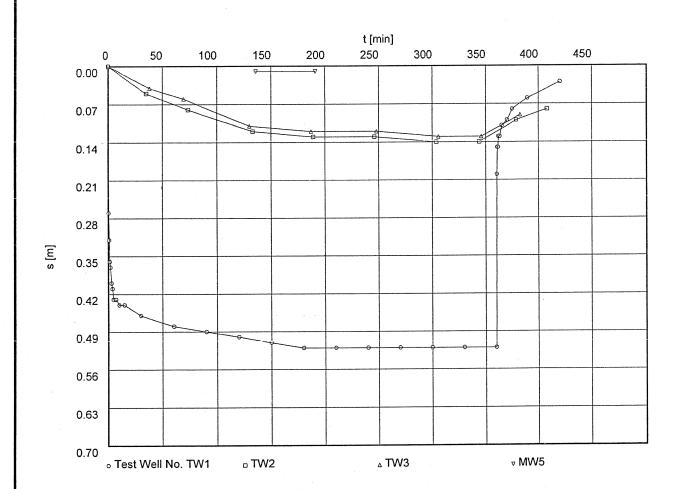


Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Confined aquifer		Project: PHO145  Evaluated by: RAP		
Pumping Test No. O6/01	Test conducted on: April 28, 2006				
TW6	·				
Discharge 2.14 l/s					



Storativity: 1.90 x 10<sup>-4</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7		Pumping test analysis Time-Drawdown plot		none, Page 1 kes
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Pumping Test No. 1	Test conducted on: June 23, 2005			
TW1	-			
Discharge 1.44 l/s				



Pater	rson Group Ltd.	Pumping test analysis		Date: 25.07.200	5 none, Page 2		
1-28 (	Concourse Gate	Time-Drawdown plot		Project: Sunset Lakes			
Nepear	n, ON K2E 7T7			Evaluated by: R	AP		
Pump	ing Test No. 1		Test conducted on: June 23, 2005				
TW1			Test Well No. TW1				
Disch	arge 1.44 l/s		Distance from the pumping well 0.100 m				
	water level: 1.650 m below datum						
	Pumping test duration	Water level	Drawdo	wn			
		[m]	[m]				
1	[min] 0.00	[m] 1.650		0.000			
2	0.50	1.920		0.270			
3	1.00	1.970		0.320			
4	1.50	2.010		0.360			
5	2.00	2.020		0.370			
6	3.00	2.050		0.400			
7	4.00	2.060		0.410			
8	5.00	2.080		0.430 0.430	,		
9	7.00	2.080 2.090		0.440			
10	10.00 15.00	2.090		0.440			
11 12	30.00	2.110		0.460			
13	60.00	2.130		0.480	-		
14	90.00	2.140		0.490			
15	120.00	2.150		0.500			
16	150.00	2.160		0.510			
17	180.00	2.170		0.520			
18	210.00	2.170		0.520			
19	240.00	2.170		0.520			
20	270.00	2.170		0.520			
21	300.00	2.170		0.520 0.520			
22	330.00	2.170 2.170		0.520			
23	360.00			0.200			
24 25	360.50 361.00	1.850 1.800		0.150			
26	361.50	1.800		0.150			
27	362.00	1.780		0.130			
28	363.00	1.780		0.130			
29	365.00	1.760		0.110			
30	370.00	1.750		0.100			
31	375.00	1.730		0.080			
32	390.00	1.710		0.060			
33	420.00	1.680	)	0.030			
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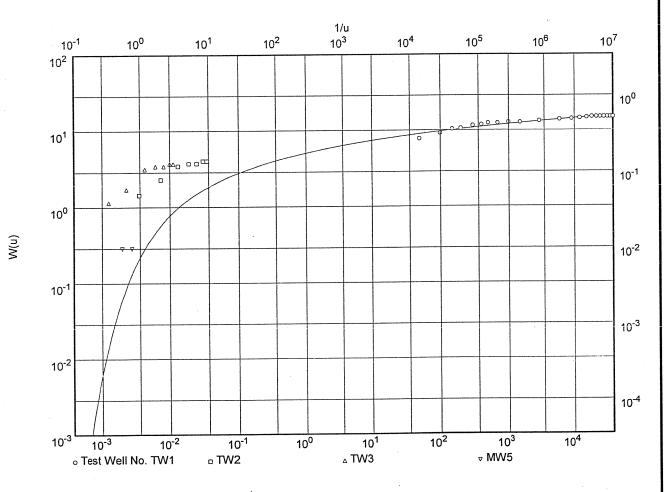
Paterson Group Ltd.		Pumping test analysis		Date: 25.07.2005	none, Page 3
1-28 C	Concourse Gate	Time-Drawdown plot		Project: Sunset Lakes	
Nepean	, ON K2E 7T7			Evaluated by: RAP	
Pumping Test No. 1			Test conducted on: June 23, 2005		
TW1			Constant rate pump test		
	arge 1.44 l/s				
DISCHA	arge 1.44 i/s				
	Pumping test duration	Discharge			
	Pumping test duration	Discharge			
	[min]	[l/s]			
1	0.00	1.68			
2	10.00	1.68			
3	300.00	1.68			
4	360.00	1.68 0.00			
5	360.10 420.00	0.00			
6	420.00	0.00			
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Paterson Group Ltd. Pumping test analysis			is	Date: 25.07.2005	none, Page 4
1-28 (	Concourse Gate	Time-Drawdown plot		Project: Sunset Lakes	
Nepear	n, ON K2E 7T7			Evaluated by: RAP	
Pump	ing Test No. 1		Test conducted on:		
TW1			TW2		
	arge 1.44 l/s		Distance from the p	umping well 100.000	m
	water level: 1.650 m below datum	1			
	Pumping test duration Water level		Drawdo	own	
	fusio 1	[m]	[m]		
1	[min] 0.00	[m] 1.650		0.000	
2	35.00	1.700		0.050	
3	73.00	1.730		0.080	
4	133.00	1.770		0.120	
5	189.00	1.780		0.130 0.130	
6	246.00	1.780 1.790		0.130	
7	304.00 344.00	1.790		0.140	
8	379.00	1.790		0.100	
10	408.00	1.730		0.080	
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Paterson G	roup Ltd.	Pumping test analysis Time-Drawdown plot		Date: 25.07.2005	none, Page 5		
1-28 Concour Nepean, ON K2E	se Gate			Project: Sunset Lakes			
Nepeall, ON NZE	. / 1 /			Evaluated by: RAP	Evaluated by: RAP		
Pumping Test	t No. 1		Test conducted on: June 23, 2005				
TW1			TW3				
Discharge 1.4	14 l/s		Distance from the	e pumping well 175.000	m		
	evel: 0.360 m below datum						
Pumping test duration		Water level	Draw	/down			
	[min]	[m] 0.360		m] 0.000			
1 2	0.00 38.00	0.400		0.040			
3	69.00	0.420		0.060			
4	130.00	0.470		0.110			
5	187.00	0.480		0.120 0.120			
6 7	248.00 306.00	0.480 0.490		0.120			
8	346.00	0.490		0.130			
9	383.00	0.450		0.090			
	·						
				"			

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7		Pumping test analysi	Pumping test analysis		none, Page 6
		Time-Drawdown plot		Project: Sunset L	_akes
				Evaluated by: RA	<b>\</b> P
Pumping Test	t No. 1		Test conducted	on: June 23, 2005	
TW1			MW5		
Discharge 1.4	44 l/s		Distance from th	ne pumping well 264.00	00 m
	evel: 0.970 m below datum				
	mping test duration	Water level	Dra	wdown	
		f 1		[m]	
1	[min] 0.00	[m] 0.970		[m] 0.000	
1 2	76.00	0.960		-0.010	
3	136.00	0.980		0.010	
4	191.00	0.980		0.010	
5	308.00	0.960		-0.010	
6	348.00	0.960		-0.010	
7	399.00	0.960		-0.010	
	039.00	0.000	-		
					-
		•			
	·				
	·				
					-
			•		

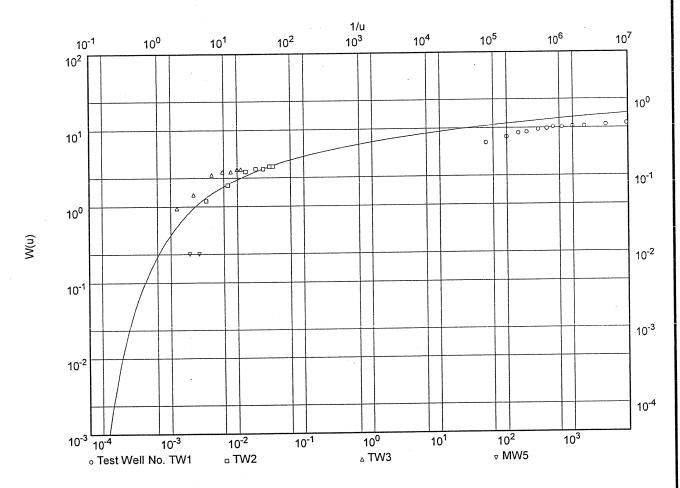
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Theis analysis method Confined aquifer		Project: Sunset Lakes	
Nepeall, ON NZE / 17			Evaluated by: RAP	
Pumping Test No. 1	Test conducted on: June 23, 2005			
TW1				
Discharge 1.44 l/s				



Transmissivity [m²/min]: 1.96 x 10<sup>-1</sup>

Storativity: 2.82 x 10<sup>-3</sup>

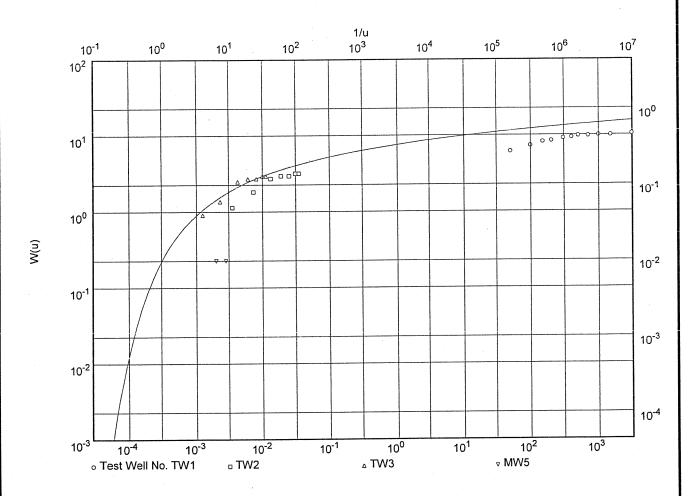
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Theis analysis method Confined aquifer		Date: 25.07.2005  Project: Sunset Lab  Evaluated by: RAP	kes
Pumping Test No. 1		Test conducted on: .	June 23, 2005	
TW1				
Discharge 1.44 l/s				
			•	



Transmissivity [m²/min]: 1.62 x 10<sup>-1</sup>

Storativity: 4.13 x 10<sup>-4</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Theis analysis method Confined aquifer		Date: 25.07.2005 Project: Sunset Lal	
			Evaluated by: RAP	
Pumping Test No. 1		Test conducted on: June 23, 2005		
TW1				
Discharge 1.44 l/s				
				1



Transmissivity [m²/min]: 1.55 x 10<sup>-1</sup>

Storativity: 1.89 x 10<sup>-4</sup>

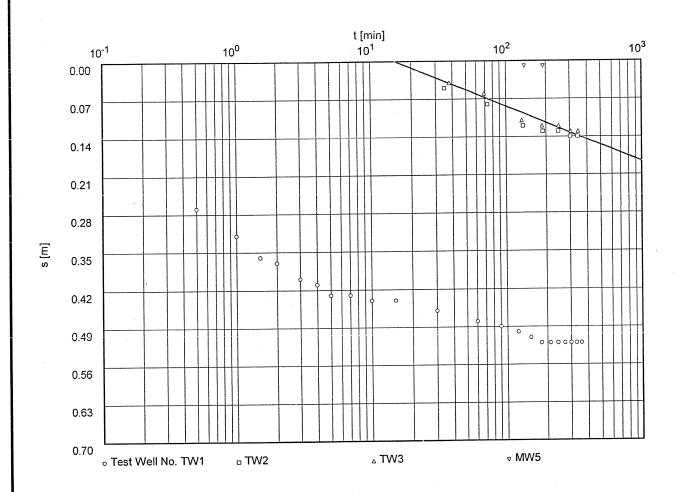
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7 Pumping test analysis
Time-Drawdown-method after
COOPER & JACOB
Confined aquifer

Date: 25.07.2005 none, Page 1
Project: Sunset Lakes
Evaluated by: RAP

Pumping Test No. 1 Test conducted on: June 23, 2005

TW1

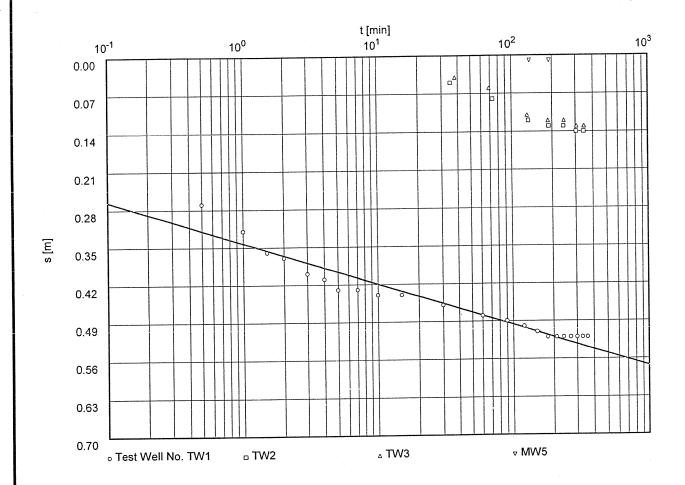
Discharge 1.44 I/s



Transmissivity [m²/min]: 1.55 x 10<sup>-1</sup>

Storativity: 1.72 x 10<sup>-4</sup>

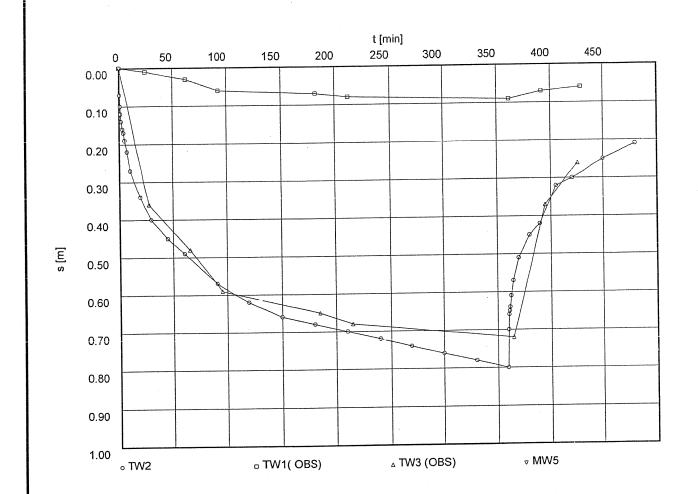
Paterson Group Ltd.	Pumping test analy		Date: 25.07.2005	none, Page 1
1-28 Concourse Gate	Time-Drawdown-m		Project: Sunset Lal	(es
Nepean, ON K2E 7T7	Confined aquifer		Evaluated by: RAP	
Pumping Test No. 1		Test conducted	on: June 23, 2005	
TW1				
Discharge 1.44 l/s				



Transmissivity [m²/min]: 2.05 x 10<sup>-1</sup>

Storativity: 1.61 x 10<sup>-3</sup>

Paterson Group Ltd.		Pumping test analysis Time-Drawdown plot		none, Page 1
1-28 Concourse Gate	Time-Drawdown plo			Project: Sunset Lakes
Nepean, ON K2E 7T7			Evaluated by: RAP	
Pumping Test No. 2		Test conducted or	: June 27, 2005	
TW2	·			
Discharge 1.40 l/s				Control of the Contro
		AAAA		



Paterso	n Group Ltd. acourse Gate	Pumping test analys	is	Date: 25.07.2005 none, Pag
		Time-Drawdown plot		Project: Sunset Lakes
Nepean, O	N NZC / I /			Evaluated by: RAP
Pumping	Test No. 2	<del></del>	Test conducte	ed on: June 27, 2005
TW2			Constant Rate	
	e 1.40 l/s			
	Pumping test duration	Discharge		
	, amping took as a second	_,	·	
	[min] 0.00	[l/s] 1.68		,
2	7.00	1.68		
3	300.00	1.68	3	
4	360.00	0.00	)	
		Waste 1		
		The state of the s		
		,		
1		•		

Paterson Group Ltd.
1-28 Concourse Gate
Nepean ON K2E 7T7

Pumping test analysis Time-Drawdown plot

Date: 25.07.2005

none, Page 3

Project: Sunset Lakes

Evaluated by: RAP

Pumping Test No. 2

Test conducted on: June 27, 2005

TW2

TW2

Discharge 1.40 l/s

Distance from the pumping well 0.100 m

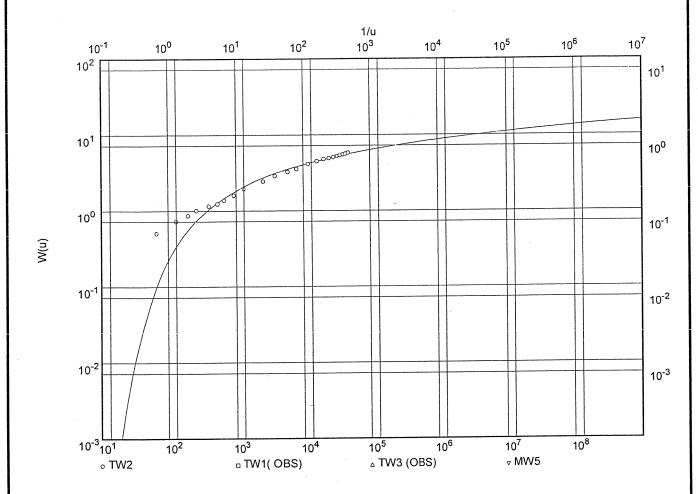
	Pumping test duration	Water level	Drawdown	
	[min]	[m]	[m]	
1	0.00	1.980	0.000	
2	0.50	2.050	0.070	
3	1.00	2.080	0.100	
4	1.50	2.100	0.120	
5	2.00	2.120	0.140	
	3.00	2.140	0.160	
6	4.00	2.150	0.170	
7 8	5.00	2.170	0.190	
	7.00	2.200	0.220	
9	10.00	2.250	0.270	
10	20.00	2.320	0.340	
11		2.380	0.400	
12	30.00	2.430	0.450	
13	45.00	2.470	0.490	
14	60.00	2.550	0.570	
15	90.00	2.600	0.620	
16	120.00	2.640	0.660	
17	150.00	2.660	0.680	
18	180.00	2.680	0.700	
19	210.00	2.700	0.720	
20	240.00	2.720	0.740	
21	270.00		0.760	
22	300.00	2.740	0.780	
23	330.00	2.760	0.800	
24	360.00	2.780	0.700	<i>*</i> :
25	360.50	2.680	0.660	
26	361.00	2.640		
27	361.50	2.630	0.650	
28	362.00	2.620	0.640	
29	363.00	2.590	0.610	
30	365.00	2.550	0.570	and the second s
31	370.00	2.490	0.510	
32	380.00	2.430	0.450	
33	390.00	2.400	0.420	
34	405.00	2.300	0.320	
35	420.00	2.280	0.300	
36	450.00	2.230	0.250	
37	480.00	2.190	0.210	
-+				
-+				
- 1				

Paterson 1-28 Conce	<b>Group Ltd.</b> ourse Gate	Pumping test analysis Time-Drawdown plot	5	Date: 25.07.200	
Nepean, ON K		Time-blawdown plot		Project: Sunset	
				Evaluated by: R	AP
Pumping To	est No. 2		Test conducted on:	June 27, 2005	
TW2			TW1( OBS)		
Discharge	1.40 l/s		Distance from the p	umping well 100.0	00 m
Static wate	r level: 1.810 m below datum				
F	Pumping test duration	Water level	Drawdo	own	
	[min]	[m]	[m]		
1	0.00	1.810		0.000	
2	25.00	1.820		0.010	
3	62.00	1.840		0.030	
4	92.00	1.870		0.060	
5	182.00	1.880		0.070	
6	212.00	1.890		0.080	
7	362.00	1.900		0.090	
8	392.00	1.880		0.070	
9	428.00	1.870		0.060	

Paterson	Group Ltd.	Pumping test analysi	3	Date: 25.07.200	5 none, Page
1-28 Conco		Time-Drawdown plot		Project: Sunset	Lakes
Nepean, ON N				Evaluated by: R	AP
Pumping Te	est No. 2		Test conducted or	n: June 27, 2005	
TW2			TW3 (OBS)		
Discharge 1	1.40 l/s		Distance from the	pumping well 50.00	0 m
Static water	r level: 0.690 m below datum				
Р	umping test duration	Water level	Draw	down	
	[min]	[m]	[n	าไ	
1	0.00	0.690		0.000	
2	28.00	1.050		0.360	
3	65.00	1.170		0.480	
4	95.00	1.280		0.590	
5	185.00	1.340		0.650	
6	215.00	1.370		0.680	
7	365.00	1.410		0.720	
8	395.00	1.060		0.370	
9	425.00	0.950		0.260	
		*			
	. •				

Patersor	ı Group Ltd.	Pumping test analys	is	Date: 25.07.2005	none, Page 6
1-28 Cond	course Gate	Time-Drawdown plot		Project: Sunset La	kes
Nepean, ON	NZE ( ) (			Evaluated by: RAF	)
Pumpina <sup>-</sup>	Test No. 2		Test conducted or		
TW2			MW5		
	1 10 Va			pumping well 70.000 i	m
Discharge			Distance nom the	pamping wen 10.000 i	••
	er level: 1.030 m below datum	10/-41	Draw	down	
	Pumping test duration	Water level	Diaw	down	
	[min]	[m]	[n		
1	0.00	1.030		0.000	
2	67.00 97.00	1.020 1.020		-0.010 -0.010	
3 4	187.00	1.020		-0.010	
5	217.00	1.020		-0.010	
6	367.00	1.020		-0.010	
		,			
				·	,
				·	
				·	
			ı		

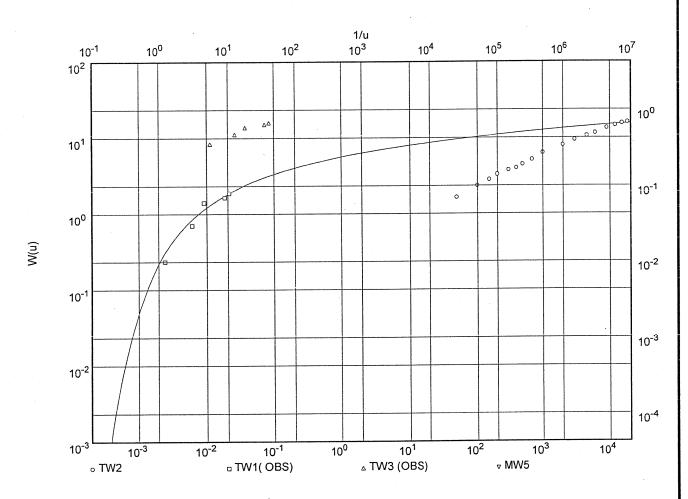
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analys Theis analysis metho Confined aquifer	
Pumping Test No. 2	•	Test conducted on: June 27, 2005
TW2		
Discharge 1.40 l/s		



Transmissivity [m²/min]: 4.83 x 10<sup>-2</sup>

Storativity: 1.45 x 10<sup>1</sup>

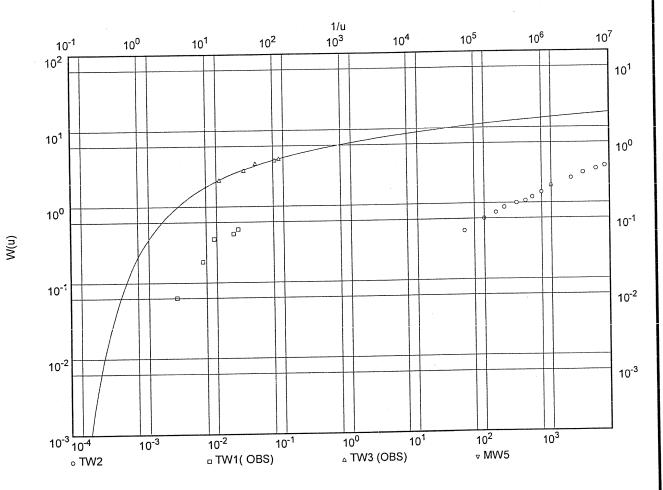
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7		Pumping test analysis Theis analysis method Confined aquifer		none, Page 1	
Repeat, or the 177	•		Evaluated by: RAP		
Pumping Test No. 2		Test conducted on: June 27, 2005			
TW2					
Discharge 1.40 l/s					



Transmissivity [m²/min]: 1.56 x 10<sup>-1</sup>

Storativity: 1.25 x 10<sup>-3</sup>

Paterson Group Ltd. 1-28 Concourse Gate		Pumping test analysis Theis analysis method Confined aquifer		none, Page 1
Nepean, ON K2E 7T7	Oommod aquito		Evaluated by: RAP	
Pumping Test No. 2		Test conducted on: June 27, 2005		
TW2				
Discharge 1.40 l/s				



Transmissivity [m²/min]: 4.16 x 10<sup>-2</sup>

Storativity: 1.16 x 10<sup>-4</sup>

Paterson Group Ltd. 1-28 Concourse Gate
Nepean, ON K2E 7T7

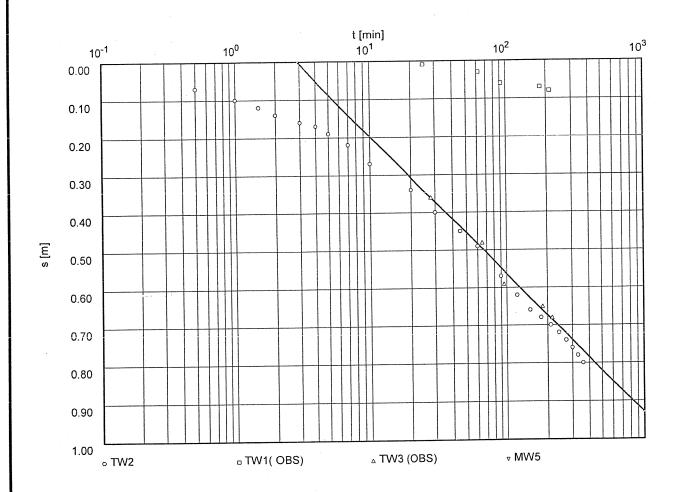
Pumping test analysis
Time-Drawdown-method after
COOPER & JACOB
Confined aquifer

Date: 25.07.2005 none, Page 1

Project: Sunset Lakes

Evaluated by: RAP

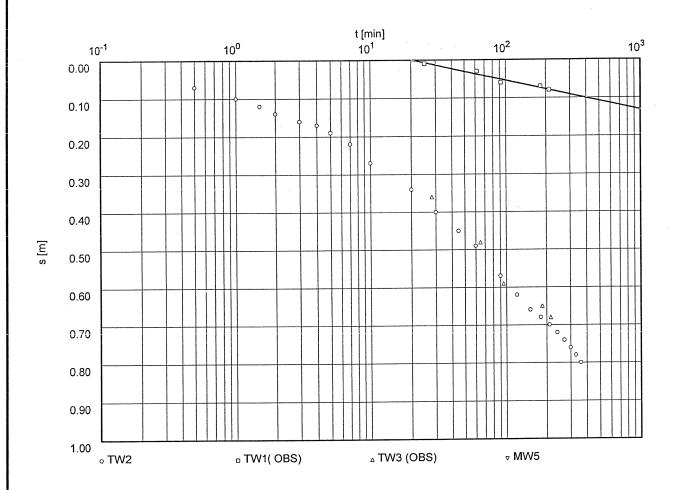
	1	
Pumping Test No. 2		Test conducted on: June 27, 2005
TW2		
Discharge 1.40 l/s		



Transmissivity [m²/min]: 4.19 x 10<sup>-2</sup>

Storativity: 1.09 x 10<sup>-4</sup>

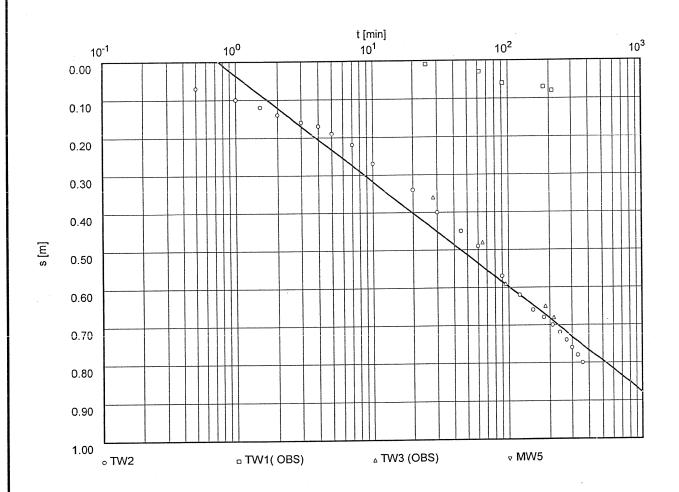
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysi Time-Drawdown-met COOPER & JACOB		Date: 25.07.2005  Project: Sunset Lak	none, Page 1 kes
Nepeall, ON NZL / I/	Confined aquifer		Evaluated by: RAP	
Pumping Test No. 2		Test conducted on: June 27, 2005		
TW2				
Discharge 1.40 l/s				



Transmissivity [m²/min]: 1.98 x 10<sup>-1</sup>

Storativity: 8.96 x 10<sup>-4</sup>

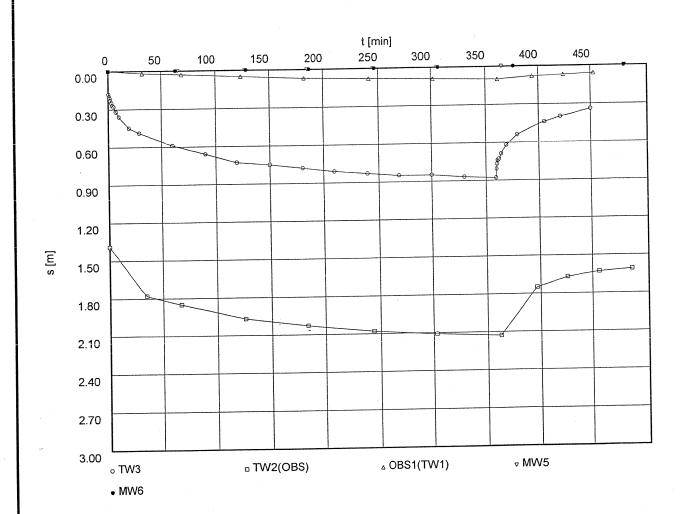
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analys Time-Drawdown-me COOPER & JACOB	thod after	Project: Sunset Lakes		
Nepean, ON RZE 717	Confined aquifer	I i		Evaluated by: RAP	
Pumping Test No. 2		Test conducted on: June 27, 2005			
TW2					
Discharge 1.40 l/s					



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

Storativity: 9.11 x 10<sup>0</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown plot		kes
Pumping Test No. 3	Test conducted o	n: June 28, 2005	
TW 3			
Discharge 1.68 l/s			



Paterson Group Ltd.		Pumping test analysis		Date: 27.07.2005 none, Page 2	
1-28 Concourse Ĝate Nepean, ON K2E 7T7		Time-Drawdown plot		Project: Sunset Lakes	
iepean, ON IV. L / II				Evaluated by: RAp	
Pumping Test No. 3			Test conducted	i on: June 28, 2005	
W 3	,		TW3		
Discharge 1.68 l/s			Distance from t	the pumping well 0.100 m	
Static water level: 0.700 m bel	ow datum		<u> </u>		
Pumping test duration	on	Water level	Dra	awdown	
[min]		[m]		[m]	
	0.00	0.700		0.000	
2 (	0.50	0.880		0.180	
	1.00	0.900		0.200	
1	1.50	0.910		0.210	
	2.00	0.930		0.230	
	3.00	0.950		0.250	
	4.00	0.970		0.270	
	5.00	0.980		0.280 0.320	
	7.00	1.020		0.320	
	0.00	1.060		0.350	
	0.00	1.150 1.190		0.490	
	0.00	1.190		0.590	
	0.00	1.290		0.660	
	0.00	1.430		0.730	
	0.00	1.450		0.750	
	0.00	1.480		0.780	
1	0.00	1.510		0.810	
	0.00	1.530		0.830	
	0.00	1.550		0.850	
	0.00	1.550		0.850	
	0.00	1.570		0.870	
	0.00	1.580		0.880	
	0.50	1.510		0.810	
	1.00	1.470		0.770	
	1.50	1.440		0.740	
	2.00	1.440		0.740	
	3.00	1.430		0.730	
	5.00	1.390		0.690	
	0.00	1.320		0.620	
	0.00	1.240		0.540	
	5.00	1.140		0.440	
	0.00	1.100		0.400	
34 45	0.00	1.040	U	0.340	
		And the last of th			

Patersor	Group Ltd.	Pumping test analysi	S	Date: 27.07.200	5 none, Page 3
	n Group Ltd. course Gate	Time-Drawdown plot		Project: Sunset	Lakes
Nepean, ON	K2E 7T7			Evaluated by: R	Ар
Dumaina	Test No. 3		Test conduc	oted on: June 28, 2005	
	rescrive. U		Constant ra		
TW 3			Constant la		
Discharge	e 1.68 l/s				
	_				
	Pumping test duration	Discharge			
	[min]	[l/s]			
1	0.00	1.68			
2	7.00	1.6 1.6			
3	300.00	1.0			
			<u>'</u>		
<b> </b>					
	-				
				ı	

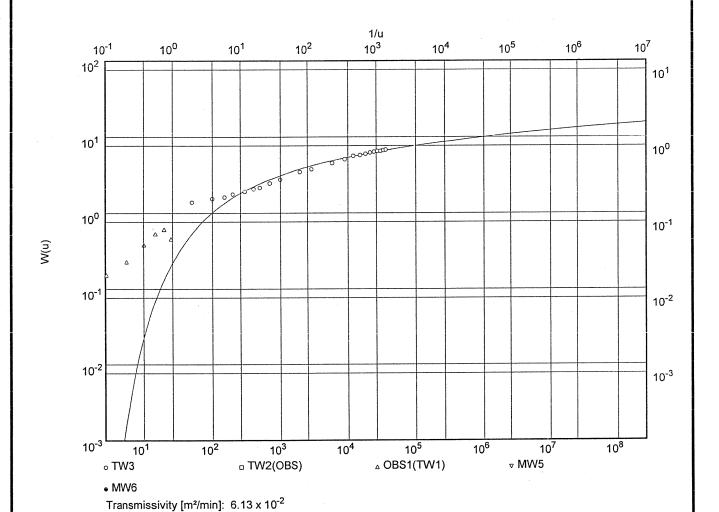
Paterson Group Ltd.		Pumping test analysis	S	Date: 27.07.2005	none, Page 4
1-28 Concou	rse Gate	Time-Drawdown plot		Project: Sunset La	akes
Nepean, ON K2E	= / 1 /			Evaluated by: RA	)
Pumping Tes	st No. 3		Test conducted or	n: June 28, 2005	
TW 3			TW2(OBS)		
Discharge 1.	68 l/s		Distance from the	pumping well 122.000	) m
	level: 0.700 m below datum				
	mping test duration	Water level	Draw	down	
		[m]	[r	nl	
	[min] 0.00	[m] 2.090		1.390	
2	35.00	2.480		1.780	
3	66.00	2.550		1.850	
4	126.00	2.670		1.970	
5	183.00	2.730		2.030	
6	244.00	2.780	)	2.080	
7	303.00	2.810		2.110	
8	363.00	2.830		2.130	
9	397.00	2.450		1.750	
10	425.00	2.370		1.670	
11	456.00	2.330		1.630 1.610	
12	485.00	2.310	0	1.010	
					<u> </u>
				·	
				l l	

Paterson Gr	oup Ltd.	Pumping test analysis		Date: 27.07.2005	none, Page 5
1-28 Concours	se Gate	Time-Drawdown plot		Project: Sunset Lal	kes
Nepean, ON K2E	111			Evaluated by: RAp	)
Pumping Test	No. 3	·	Test conducted on	ı: June 28, 2005	
TW 3			OBS1(TW1)		
Discharge 1.6	8 l/s		Distance from the	pumping well 3.500 m	)
	evel: 1.860 m below datum				
	mping test duration	Water level	Drawo	nwot	
	[min]	[m]	[m	1]	
1	[min] 0.00	1.860	L'	0.000	
2	33.00	1.880		0.020	
3	68.00	1.890	·	0.030	
3 4	124.00	1.910		0.050	
5	182.00	1.930		0.070	
6	242.00	1.940		0.080	
7	302.00	1.950		0.090	
8	362.00	1.960		0.100	
9	395.00	1.940		0.080	
10	423.00	1.930		0.070	
10	453.00	1.920		0.060	
	.55.56				
					Venezue de di sunt de sant de
		-			
			<u> </u>		
		,			

Paterso	n Group Ltd.	Pumping test analysis	;	Date: 27.07.200	none, Page 6
1-28 Con	course Gate	Time-Drawdown plot		Project: Sunset	Lakes
Nepean, Of	N K2E 717	·		Evaluated by: R	!Ap
Pumping	Test No. 3		Test conducte	ed on: June 28, 2005	
TW 3			MW5		
Discharg	e 1 68 l/s		Distance from	the pumping well 72.00	00 m
	ter level: 1.040 m below datum				
Static wa	Pumping test duration	Water level	D	rawdown	
	- uniping test duration	· ·			
	[min]	[m]		[m] 0.000	
1 2	0.00 65.00	1.040 1.040		0.000	
3	128.00	1.040		0.000	
4	185.00	1.040		0.000	
5	246.00	1.040 1.040		0.000	
6 7	306.00 366.00	1.040		0.000	
8	480.00	1.040		0.000	
					-
<b> </b>					

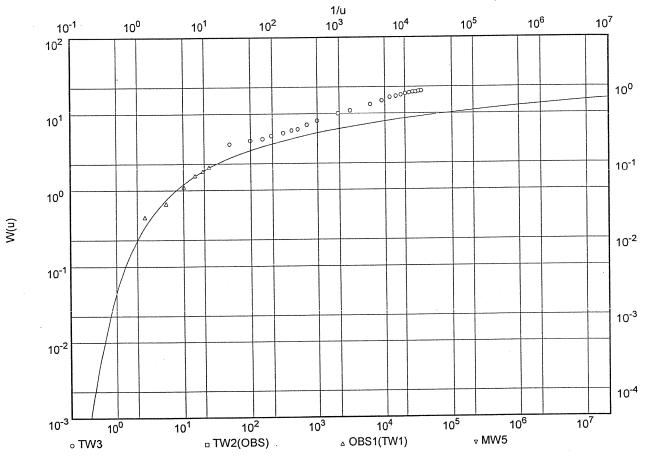
Paterson Group Ltd.		Pumping test analysis	3	Date: 27.07.2005	none, Page 7
1-28 Conce	ourse Gate	Time-Drawdown plot		Project: Sunset Lak	es
Nepean, ON h	(2E 717			Evaluated by: RAp	
Pumping T	est No. 3		Test conducted on:	June 28, 2005	
TW 3			MW6		
Discharge	1 68 1/s			oumping well 82.000 n	1
	er level: 0.680 m below datum				
	Pumping test duration	Water level	Drawd	own	
ļ r	-uniping test duration	THE PARTY OF THE P			
	[min]	[m]	[m]		
1	0.00	0.680		0.000	
2	63.00	0.680		0.000	
3	129.00	0.680		0.000	
4	187.00	0.680		0.000	
5	247.00	0.680 0.680		0.000	
6	307.00 377.00	0.680		0.000	
7 8	480.00	0.680		0.000	
0	400.00	0.000			
	:				

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Theis analysis method Confined aquifer	Date: 27.07.2005   none, Page 1  Project: Sunset Lakes	
Repeal, ON NEE 117		Evaluated by: RAp	
Pumping Test No. 3		Test conducted on: June 28, 2005	
TW 3			
Discharge 1.68 l/s			



Storativity: 6.35 x 10<sup>0</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysi Theis analysis metho Confined aquifer		Project: Sunset Lak	
			Evaluated by: RAp	
Pumping Test No. 3		Test conducted on: June 28, 2005		
TW 3				
Discharge 1.68 l/s				

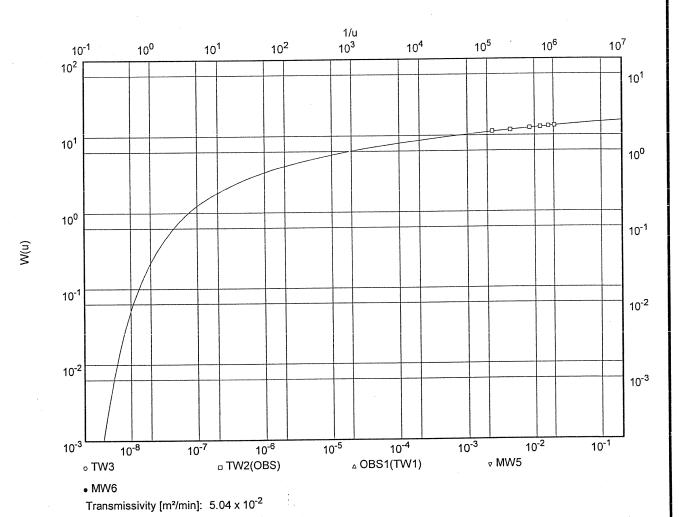


• MW6

Transmissivity [m²/min]: 1.78 x 10<sup>-1</sup>

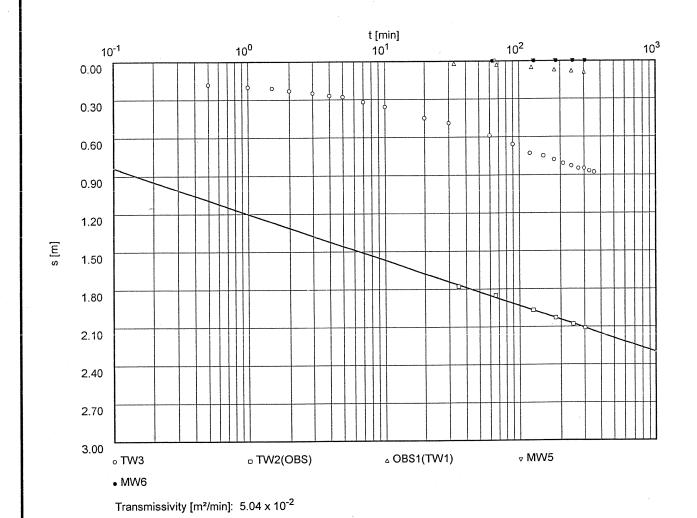
Storativity: 1.47 x 10<sup>0</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Theis analysis method Confined aquifer		Date: 27.07.2005 Project: Sunset Lak	L
Nopouli, ONTICE IT			Evaluated by: RAp	
Pumping Test No. 3		Test conducted on: June 28, 2005		
TW 3				
Discharge 1.68 l/s				



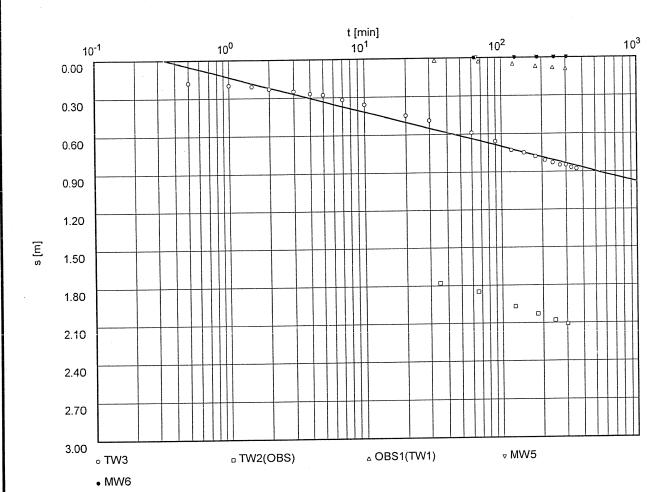
Storativity: 3.98 x 10<sup>-9</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Confined aquifer		Date: 27.07.2005  Project: Sunset Lak	none, Page 1
110000000			Evaluated by: RAp	
Pumping Test No. 3		Test conducted on: June 28, 2005		
TW 3				
Discharge 1.68 l/s				



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

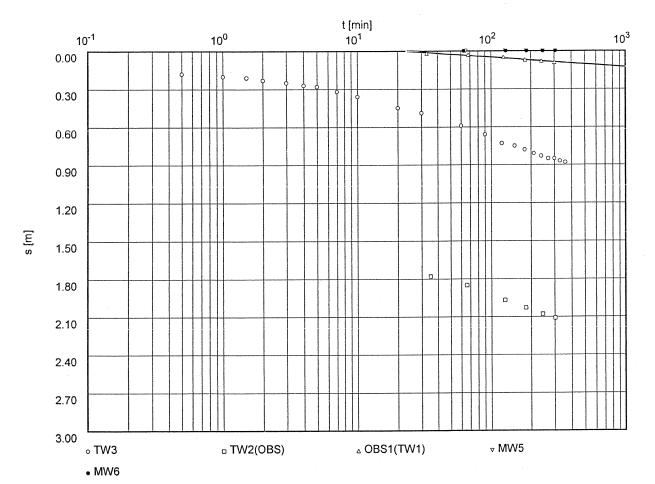
Paterson Group Ltd. 1-28 Concourse Gate		Pumping test analysis Time-Drawdown-method after COOPER & JACOB		none, Page 1 kes
Nepean, ON K2E 7T7	Confined aquifer		Evaluated by: RAp	
Pumping Test No. 3 TW 3		Test conducted on: June 28, 2005		
Discharge 1.68 l/s				



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

Storativity: 4.88 x 10<sup>0</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Time-Drawdown-me	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Confined aquifer		none, Page 1
	Confined aquifer			Evaluated by: RAp
Pumping Test No. 3 TW 3		Test conducted on: June 28, 2005		
Discharge 1.68 l/s				



Transmissivity [m²/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
1. 1 1 10 1 10 11	THE SOMENT DLAN

2. PH0145-2: LOT DEVELOPMENT PLAN

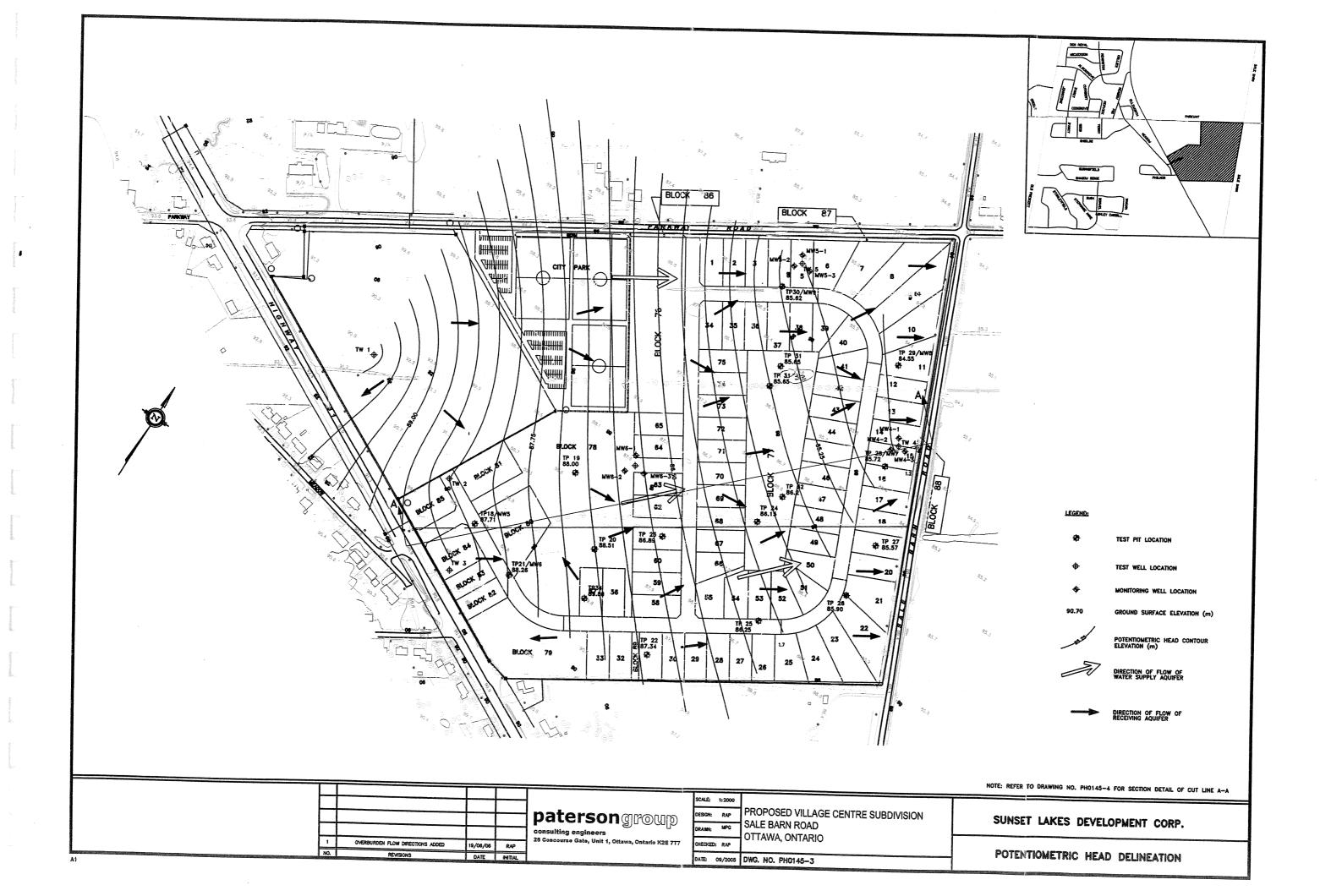
3. PH0145-3: PIEZOMETRIC HEAD DELINATION

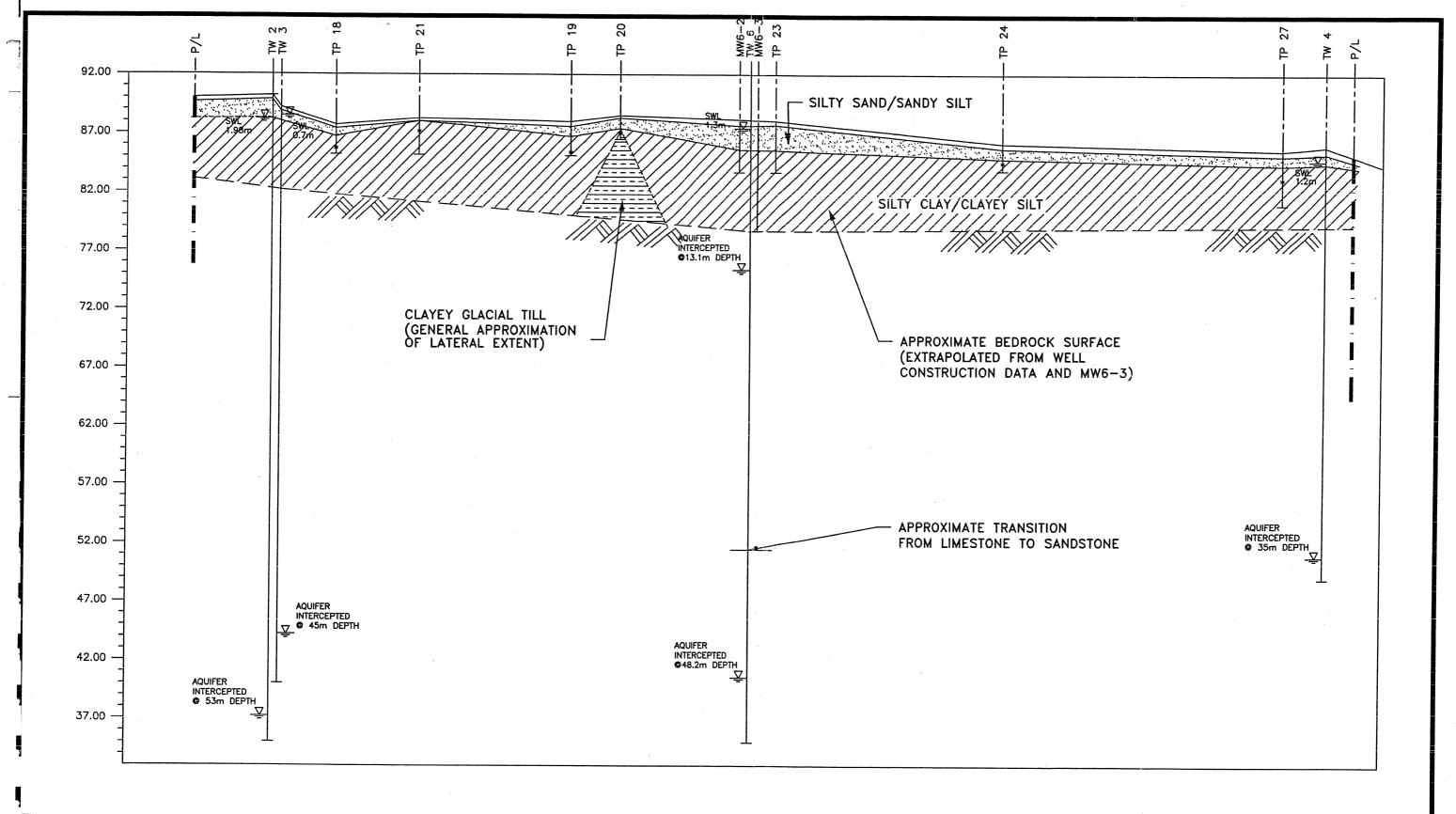
4. PH0145-4: STRATIGRAPHIC CROSS SECTION A-A

5. FIGURE 1: LOCATION PLAN OF NEIGHBOURING

SAMPLING

6. FIGURE 2: GRAPHICAL ANALYSIS OF MONITORING WELL DATA





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

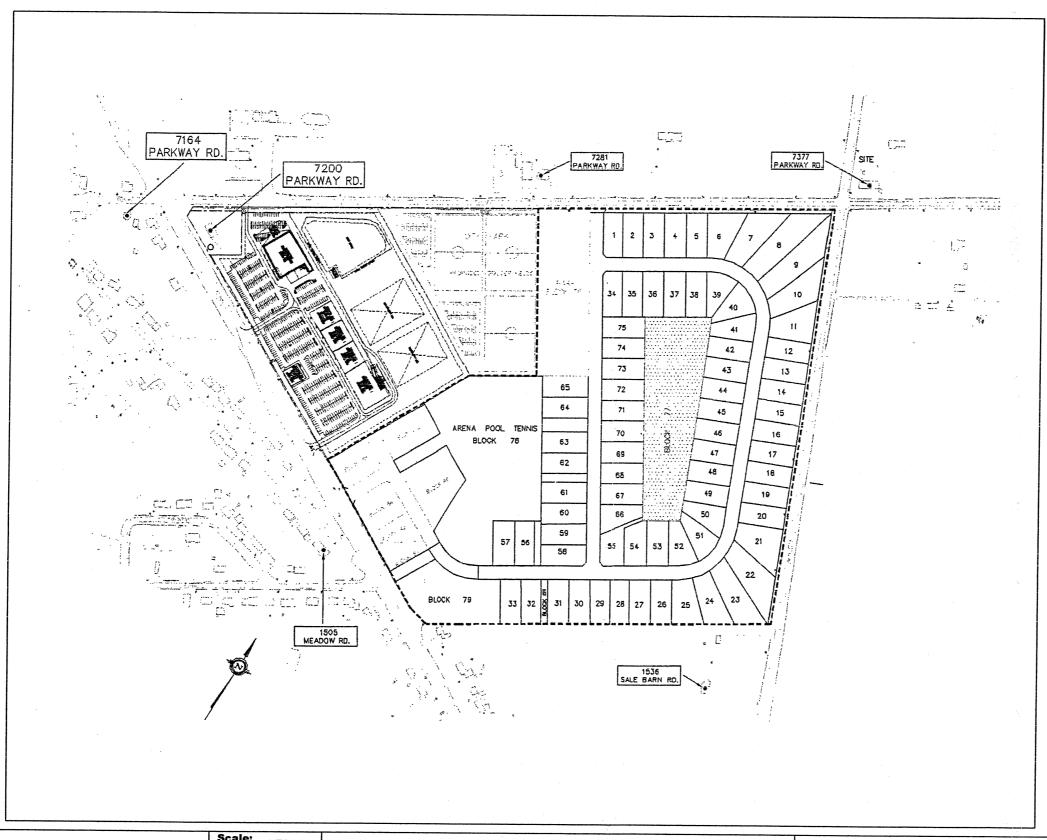
SUNSET LAKES DEVELOPMENT CORP. PROPOSED VILLAGE CENTRE SUBDIVISION SALES BARN ROAD OTTAWA,

ONTARIO

CROSS-SECTION A-A (GENERAL SITE STRATIGRAPHY)

Dwg. No. PH0145-4 **Report No.:** PH0145-01 Date:

09/2005



patersongroup

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,

LOCATION OF NEIGHBOURING WATER SAMPLE COLLECTION

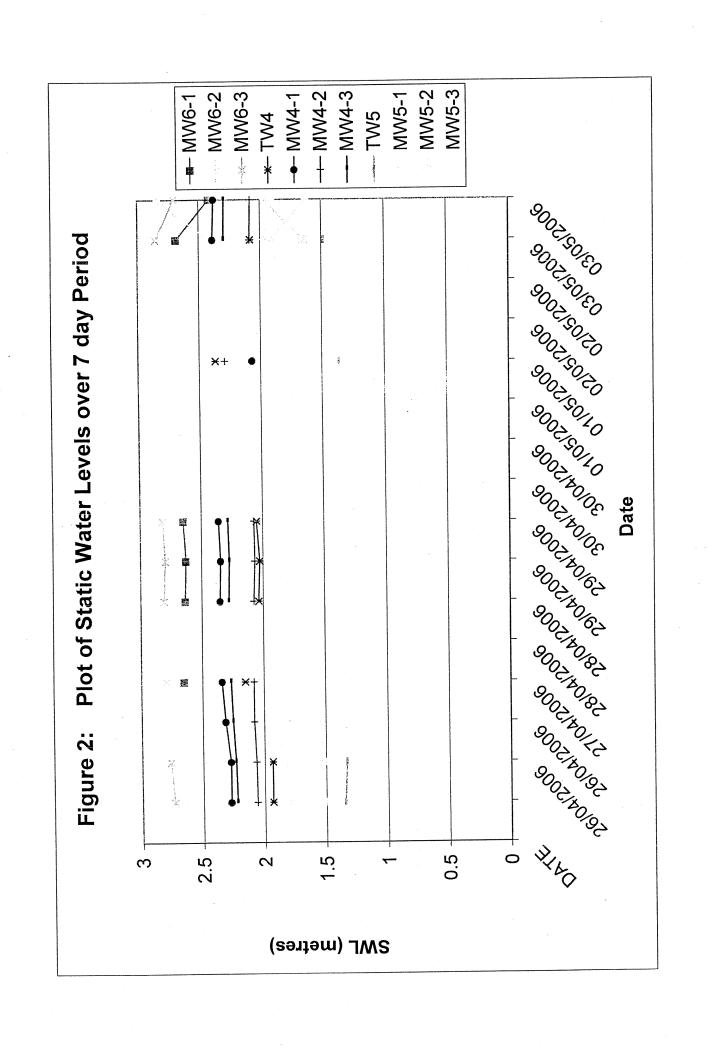
ONTARIO

 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** 

**Consulting Engineers** 

28 Concourse Gate, Unit 1 Ottawa, Ontario Canada K2E 7T7 Tel: (613) 226-7381

Tel: (613) 226-7381 Fax: (613) 226-6344

Geotechnical Engineering Environmental Engineering Hydrogeology Geological Engineering Materials Testing Building Science

www.patersongroup.ca

Subject:

Response to Conservation Partners Comments of August 3rd, 2006

**Greely Centre Subdivision** 

Sunset Lakes Development Corporation

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.

Ms. Jennifer L. Boyer September 28, 2006 Page 2

#### 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 <u>conductive</u> (?) 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.

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,

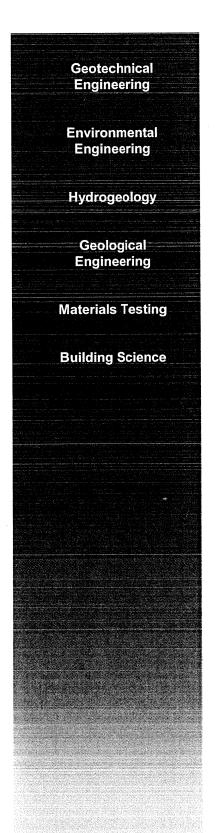
Paterson Group Inc.

Stephen J. Walker, P.Eng.

cc: City of Ottawa (Charles Warnock)

Rideau Valley Conservation Authority (Asher Rizvi)

Sunset Lakes Development Corporation (Dan Anderson)



# patersongroup

# 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

# Paterson Group Inc.

Consulting Engineers 28 Concourse Gate - Unit 1 Ottawa (Nepean), Ontario Canada K2E 7T7

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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 hydrogeolgical 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

# patersongroup Ottawa North Bay

Supplemental Hydrogeological Assessment Part of Lot 73 and Part of Lot 74, Concession 5, Township of Osgoode Ottawa (Osgoode), Ontario

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 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.

Report: PH0145-REP.05

February 22, 2007



#### 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 verfied 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

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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.

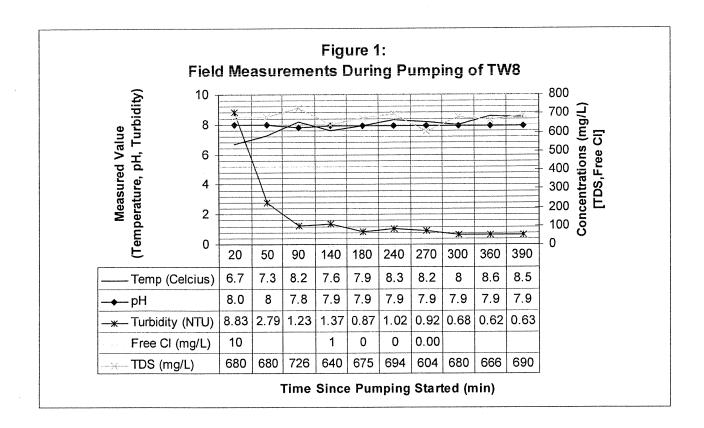
Table 1: Summary of Sandstone Aquifer Characteristics Resulting from Analysis of Pumping Test Data for TW 8				
Aquifer Parameter	Result of Analysis			
Storativity	1.20 x 10 <sup>-1</sup>			
Transmissivity (m²/min)	9.42x 10 <sup>-3</sup>			
Transmissivity (T) (m²/day)	13.56			
Available Drawdown (s) (m)	60			
Specific Capacity (L/min/m drawdown)	15.9			
20 year safe yield (m³/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.



Summary of He	Tab alth and Aesthetic/Op	le2: eration Objec	tive Parame	eters for TW8	plate and a second
Parameter	Units	TW No. 8		Ontario Drinking Water Standards <sup>1</sup>	
		3 Hour	6 Hour	Type	Limit
Microbiological Parameters <sup>2</sup>	The Control of the Co				
Escherichia Coli	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
Chemical Parameters (Health R	elated)				
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
Chemical Parameters with Aest	hetic Objectives/ Ope	rational Guid	elines	\$ 10 OF \$	
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

<sup>1.</sup> Ontario Drinking Water Standards identifies the following types of parameters: MAC= Maximum Allowable Concentration; AO=Aesthetic Objective; OG=Operational Guideline.

<sup>2.</sup> Free chlorine residuals verified to be non-detectable prior to collection of water samples.



Table 3: Summary of General Chemical Parameters for TW8					
		TW	TW No. 8		
Parameter	Units	3 Hour	6 Hour		
General Chemical Parameters		Company of the second of the s			
Conductivity	uS/cm	1150	1120		
N-NH <sub>3</sub> (Ammonia)	mg/L	0.09	0.09		
Phenois	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:

Table 4: Summary of Explanation of Langelier Saturation Index Values				
LSI Value	Explanation			
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.

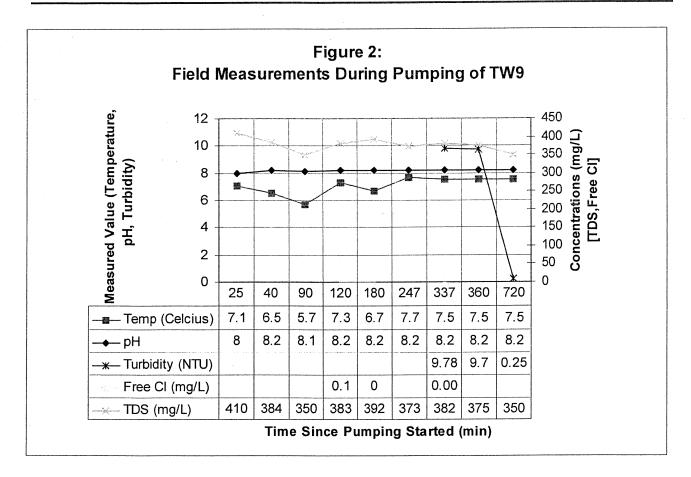
Table 5: Summary of Sandstone Aquifer Characteristics Resulting from Analysis of Pumping Test Data for TW 9				
Aquifer Parameter	Result of Analysis			
Storativity	1.19 x 10 <sup>-1</sup>			
Transmissivity (m²/min)	1.12 x 10 <sup>-3</sup>			
Transmissivity (T) (m²/day)	1.61			
Available Drawdown (s) (m)	73.2			
Specific Capacity (L/min/m drawdown)	2.44			
20 year safe yield (m³/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 <u>field turbidity measurement</u> after six hours of extended pumping was recorded to be <u>0.25 NTU</u>. 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.



Summary of Health		le 6: eration Object	ive Paramete	rs for TW9	
Parameter	Units	TW No. 9		Ontario Drinking Water Standards <sup>1</sup>	
		3 Hour	6 hour³	Туре	Limit
Microbiological Parameters <sup>2</sup>					
Escherichia Coli	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
Chemical Parameters (Health Related)					
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
Chemical Parameters with Aesthetic Obj	ectives/ Operation	nal Guidelines			
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
рН		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

<sup>1.</sup> Ontario Drinking Water Standards identifies the following types of parameters: MAC= Maximum Allowable Concentration; AO=Aesthetic Objective; OG=Operational Guideline.

<sup>2.</sup> Free chlorine residuals verified to be non-detectable prior to collection of water samples.

<sup>3.</sup> Water quality analysis of water collected after an additional six hours of extended pumping.



Table 7: Summary of General Chemical Parameters for TW9					
		TW No. 9			
Parameter	Units	3 Hour	6 Hour <sup>1</sup>		
General Chemical Parameters		A Company of the Comp			
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		

<sup>1.</sup> 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.

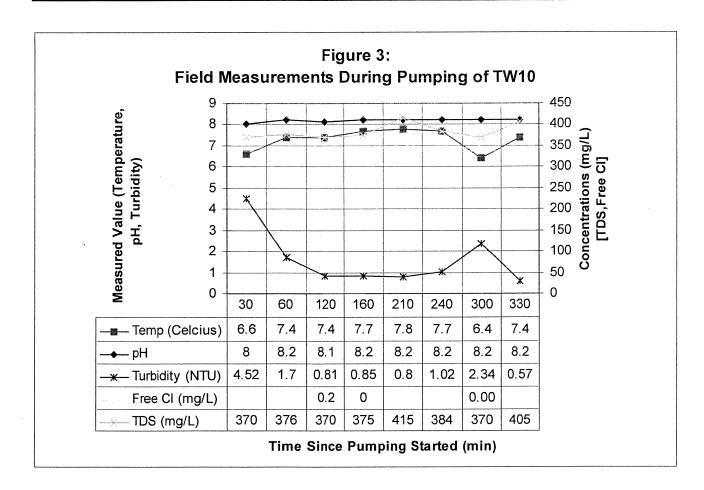
Table 8: Summary of Sandstone Aquifer Characteristics Resulting from Analysis of Pumping Test Data for TW 10				
Aquifer Parameter	Result of Analysis			
Storativity	7.24 x 10 <sup>-2</sup>			
Transmissivity (m²/min)	1.77 x 10 <sup>-3</sup>			
Transmissivity (T) (m²/day)	2.55			
Available Drawdown (s) (m)	70			
Specific Capacity (L/min/m drawdown)	3.7			
20 year safe yield (m³/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.



Summary of Heal	Tab th and Aesthetic/Ope		tive Parame	ters for TW10	
Parameter	Units	TW No. 10		Ontario Drinking Water Standards <sup>1</sup>	
	The second secon	3 Hour	6 Hour	Туре	Limit
Microbiological Parameters <sup>2</sup>	and the second				
Escherichia Coli	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
Chemical Parameters (Health Re	lated)				
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
Chemical Parameters with Aesth	etic Objectives/ Ope	rational Guid	elines		
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
pН		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

<sup>1.</sup> Ontario Drinking Water Standards identifies the following types of parameters: MAC= Maximum Allowable Concentration; AO=Aesthetic Objective; OG=Operational Guideline.

<sup>2.</sup> Free chlorine residuals verified to be non-detectable prior to collection of water samples.



Table 10: Summary of General Chemical Parameters for TW10					
TW No. 10					
Parameter Un		1000	3 Hour	6 Hour	
General Chemical Parameters			100 mm		
Conductivity	uS	/cm	676	680	
N-NH <sub>3</sub> (Ammonia)	m	g/L	0.09	0.09	
Phenols	m	g/L	<0.001	<0.001	
Tannin & Lignin	m	g/L	0.2	0.2	
Total Kjeldahl Nitrogen	m	ıg/L	0.13	0.12	
Ion Balance	Un	itless	0.90	0.97	
Calcium	m	ıg/L	54	58	
Magnesium	m	ng/L	25	26	
Potassium	m	ng/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.

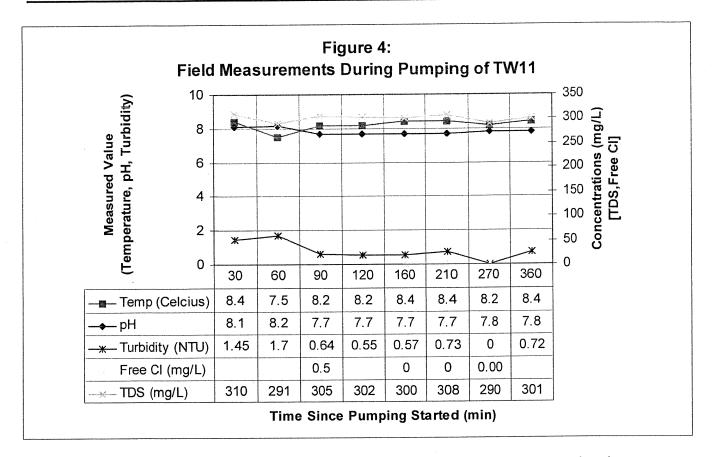
Table 11: Summary of Sandstone Aquifer Characteristics Resulting from Analysis of Pumping Test Data for TW 11				
Aquifer Parameter	Result of Analysis			
Storativity	7.15 x 10 <sup>-4</sup>			
Transmissivity (m²/min)	2.32 x 10 <sup>-1</sup>			
Transmissivity (T) (m²/day)	33.4			
Available Drawdown (s) (m)	57			
Specific Capacity (L/min/m drawdown)	181.1			
20 year safe yield (m³/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.





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.



Summary of Hea	Table		tive Paramet	ters for TW11		
Parameter	Units	TWN		Ontario Drinking Water Standards <sup>1</sup>		
		3 Hour	6 Hour	Туре	Limit	
Microbiological Parameters <sup>2</sup>						
Escherichia Coli	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	
Chemical Parameters (Health R	elated)				And the second second	
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	
Chemical Parameters with Aest	hetic Objectives/ Ope	rational Guid	elines			
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	
pН		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	

Ontario Drinking Water Standards identifies the following types of parameters: MAC= Maximum Allowable
 Concentration; AO=Aesthetic Objective; OG=Operational Guideline.

<sup>2.</sup> Free chlorine residuals verified to be non-detectable prior to collection of water samples.



Table 14: Summary of General Chemical Parameters for TW11						
		TW No. 11				
Parameter	Units	3 Hour	6 Hour			
General Chemical Parameters						
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<sup>-</sup> 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.

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#### 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.

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## 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 a 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 a 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.
- 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:**

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- □ Paterson Group (1 copy)

## **APPENDIX 1**

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

Ministry of the Environment

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Well Record
Regulation 903 Ontario Water Resources Act

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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 metre measurements shall be reported to 1/10th of a metre. County/District/Municipality

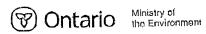
Actoreselof Well i.coation (County/District/Municipality)

Actoreselof Well i.coation (County/District/Municipality) umber/Name, EIR.Lot, Cencession) Malling Address (Street ) -coal Flet Name one Number (Include area coco) Codp 4P Province Ontario Concession Slin/Compartmen GPS Rending NAD Zope F artment/Blc GPS Rending NAD Zope Feeling S74 Northing A3 Log of Overburden and Bedrock Materials (see Instructions) Mpdn of Operation: 12637 Guneral Description Most common material Olher Materials General Colour and S3 4050 muel Test of Well Yield Construction Record Holo Dismeter Draw Down Metres Diameter Dooth Melres Wall Depth Inside Timo Water Level Material thickness conlimetres Fram Ťΰ Commetre mclb. mln Metros From То 1523 ntimotro 15 64 2015 Level Do (metres ) Casing Pumping rate (litres/m/45 310 1 17,63 72 Stock Fibropless 53.82 Plastic Concrete 48 2 14 80 0 purplier of pumping 2 4.44 Bosinovia Water Record Lh's . Onl Water lourid / Kind of Water Steel Fibrogias rinal writer level-end Fresh Suphur |Plactic | Concrete Honomranded pump Galvanized | Frank | Trafiphur Heorymended pump 73-\_\_\_\_talnatio \_\_\_ Concrete Golyanizod 10 D 20 10 5 3 15 15 20 12 20 12 3 Othor: Preorpingoded pump rate (hites/mih) Screen Clas Outside 20 1.23 ∐ Stoci ☐ Fibregiase Slot No. 5.73 25 1.11 16.76 30 1.11 18.63 40 Pinstio Concrete 25 (Illnes/min) After test of well yield, water was Il numping disconline Galvanizad No Casing or Scroon Other spack 50 13,15 01 Chlorinaiod <del>D</del>Ana Ppon hole 58 60 3 60 |"|No Location of Well Annular apace Plugging and Sealing Record Abandonment diagram below show distances of well from part, let line, and building, discate north by arrow. Volumo Placod (cubia matros) Depth set at - Motron Material and type (bentonlin alumy, next cement alumy) atc. Indicate north by arroy 1816 > (cut 1) 4 જ 55.17 STEER Method of Construction Diamond Ligging Light ☐ Bolory (nir) Cable Tool Air percussion Other Jetting ☐ Hatary (annonlièhel) ☐ Driving Rotary (roverso) Water Use ☐ Public Supply [
☐ Not used ---☐ Cooling & nir conditioning □ Othor Industrial B Domestic \_\_\_\_\_Slock Commercial irrigation Municipal z 64734 Final Statue of Wall Was the well awner's intermation package delivered? Abandoned, (Other -Writer Supply l i Untiplaiseri ☐ Downtering ☐ Roplecoment packaga.dalivared? Abandoned, insufficient supply-Altendoned, poor quality Test Hole Ministry Use Only Well Contractor/Technician Information Dala Source Davies Received Date of Inspection YYYY מנו אוא MM ממ Well Flocard Number Bemarks

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Well Record
Regulation 903 Ontario Water Resources Act

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

instructions for	Completing	Form	L
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All metro measurements     Please print clearly in blue	aball bo c	oponed to 1/10 t	of a metre.			Minietry Use C	Only	
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First Name ( ) (	Lost Name	Carp Name of the last	SPAN PROMISE	ha Addines (	Street Number/	Name, FIF.Lot, Conses	Pard	The
County/District/Municipality		Township/City/Town	ا ـ حـــــــان	Prov			ione Number (Include	strea code)
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Address of Well Location (County/			Tew	nship Sacra	lo.	Loy		
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# 1268 Fa	1 KW			Int Make/Mod	Mode of	of Operation: Unditte	arentlated Myor	agnd
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Hole Dismeter		Cons	truction Reco			Pumping test method		Recovery
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Well Tag	Æ,	052506	or balow)
A	- /	~5°25	506

Well Record
Regulation 903 Ontario Water Resources Act

Well Record Number

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Instructions for Completing Form	104	2 <i>32</i>	06		paga ot
	is document is a perm:	anent legal	document. Ple	ase retain for future	reference.
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<ul> <li>Please print clearly in blue or black ink only.</li> </ul>	210 1710 01 (1111)11 111			Ministry Use (	
Well Owner's Information and Location of	Well Information	MUN	ÇÔ	l l. l. l. l. animal	I,,OT
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Address gravell Location (County/District/Municipality)		qidanı	1 6 7	Lot	Concession
Uttout Corlos			DOCKE		<u> </u>
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THE STONE	4 5 1 -	7			2271 55
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Alter ics of well yield, prefer who	bosi			If purping diffContin-	30 1.24 30
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Chlorinatect 7 You   No V Ppon t	nolo	K1 2	60,96		50 Jan 50
Chlorinated Yes L No		J4. 5	(CD)	<u> </u>	60 1.24 60
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5100 0 Bestrute Sluce	-64 ( 10	10.	7		(A) (A)
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		Diaging			M
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	Driving			51	
Water Use	Public Supply	Other		200	
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☐ Irdgallon ☐ Municipat ☐	Cooling & air conditioning		Audit No. Z	64736	in Well Completed
Final Status of W	<del></del>				ta Ballyonari YYY MM DO
Woler Supply □ Becharge well     Observation wat □ Abandoned, Insufficient supply □	Unlinkhod Aban Dowatering .	rloned, (Other)	peckage deliver	ARTICLE D. REMOVED THE PROPERTY.	2027 2015
Tost Hole Abandonad, poor quality [	Hoplacoment well				o Only
Well Contractor/Technicing		Unaines No	Data Source	Ministry.Us	e Only ontractor
Name of Wall Contractor DRILLING	Well Contractor	Licogen No.	Daia Sourco		
Bushesa Address (street ashte, number, city etc.)	N Al		Date Received	איין מם אוא אייץ	on Mik yyyy nofioegani to eti
	A LV	- (I)-	1 1	1 1 1	1 1

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## APPENDIX 2

Laboratory Test Data Reports of Water Quality Analyses

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2702286

Report Number:	Date:	Date Submitted	
	Client: Paterson Group	1-28 Concourse Gate	Ottawa, Ont.

ACCUTEST LABORATORIES LTD

K1V 1T6

Attention: Robert Pass

Chloride

ıρ e Gate	Date Submitted:		2007-02-05 2007-02-02	
SSTOOF	Pro)ect:	)Hd	PH0145	
•	P.O. Number:		iter	
1001		-		

UNITS щÃ mg/L mg/L ODWSOG LIMI 500 20 20 20 250 TYPE § § 9 2007-02-02 522033 191 1090 708 52 LAB ID: Sample Date: Sample ID: MDL UNITS mg/L uS/cm mg/L mg/L PARAMETER Chain of Custody Number: Canductivity TDS (COND - CALC) Sodium

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Afowable Concentration IMAC = Inferite Maximum Afowable Concentration Comments:

Inorganic Lab Supervisor

APPROVAL:

GUIDELINE

Water

ODWSOG

NEPOL OF ANALYSIS

ES

JR4

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 $\tilde{S}$ 

28 Concourse Gate, Unit 1

Client: Paterson Group

2702746 2007-02-12

Report Number:

2007-02-09

PH0145

cl/100mL ct/100mL

00

UNITS

LIMIT

TYPE MAC Dertou

APPROVAL:

Microbiology Analyst

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Atowable Concentration Date Submitted: P.O. Number: Project: Matrix: 2007-02-09 TW 8 WS 3 523364 00000 2007-02-09 TW8WS2 523363 00000 Sample ID: LAB ID: Sample Date: MDL c4/100mL c4/100mL ct/100mL ct/100mL ct/100mL UNITS PARAMETER Chain of Custody Number: 53219 Attention: Mr. Robert Passmore INVOICE: Paterson Group Inc. Heterotrophic Plate Count Nepean, ON Faecal Sfreptococcus K2E 717 Faecal Coliforms **Escherichia Colt** Fotal Coliforms

10/1

608 Norris Court, Kingston, ON, K7P 2R9

8-146 Colonitade Road, Ottawa, ON, K2E 7Y1

Comment:

Client: Deterson Grain	Report Number:
28 Concourse Gate, Unit 1	Date;
Nepean, ON	
K2E 7T7	Decision
Attention: Mr. Robert Passmore	129/61
on and an and an analysis of the last	P.O. Number:

ACCUTEST LABORATORIES LTD

REPORIUF AINALYSIN

2702749 2007-02-14 2007-02-09

PHO 145

INVOICE: Debased Grain los						u.	P.O. Number:			
Chair of Chefody Number 53219						Ž.	Matrix:	>	Water	
Citation Costony nations: Edition		LAB ID:	523367	523368					GUIDELINE	
	Sampl	Sample Date:	2007-02-09	2007-02-09						
	San	Sample ID:	TW 8 WS2	TWBWS3		-	***************************************		ODWSOG	
	3							TYPE	LIMIT	UNITS
PARAMETER	מוויס	MDL	240	2002				90	200	mg/L
Alkalinity as CaCO3	mg/L	Ω	017	707				04	250	mc/L
Chloride	mg/L	_	205	204				2 5	ìп	
	TCU	2	7	2				Q.	'n	3
Section of the sectio	uS/cm	לט	1150	1120						1)20
Cut industrial	mg/L	0.5	6.0	6.0				₹ ;	n '	1 10 11
	mo/L	0.10	0.25	0.25				PIAC	C. C	1 E
	ma/L	0.01	<0.01	<0.01			areas and the	Q Q	25.55 25.55	7
aniidine liabdipali	maß	0.02	60.0	60.0		-		,		174
N-NH3 (Armionia)	E DOM	0.10	<0.10	<0.10				MAC	1.0	J.
N-NOZ (Nitrie)	Nom.	0.10	<0.10	<0.10		•••		MAC	10.0	J &
N-NO3 (Nitrate)			Ф. 8.	90.8				AO	6.5-8.5	
La i	J/Dau/	0.00	<0.001	<0.001						
Phenois	T GIL	-	55	53				AO	<u> </u>	J/ß
Supplies	ma/L	0.1	<0.1	<0.1					i i	-
Lannia & Lighin	mg/L	2	748	728	A-100-A-100-			AO	2	1851 1
FULL CALCA	mg/L	0.05	0.16	6.09						IL
Total Nethania Minuscon	DIN	0.1	2.5	0.2				Q (	2 5	200
	mg/L	_	40 <del>4</del>	381				<i>y</i>	3	- C
וופותו למא מש ספס ספ		0.01	0.95	0.92	-	-				
Ion: Balance	⊞a/L	<b>-</b>	\$	06						
Carcial	, <u>F</u>	·	40	38						
Magnesium		_	7	٤				:		
Potassium	1.67	<b>-</b> (	- 3					AO AO	20	пg/L
Sodium	mg/L	7 .	7 %	3 6				Ϋ́O	0.3	mg/L
LEGI .	J/gm	0.03	77.0	0.23				Q	0.05	mg/L
Mannanese	Tig/L	0.0	Ø.0	<b>4</b> 5.5	-					,
								-		
-										
						  -  -	0	A companyion		

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

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

APPROVAL:

APPROVAL: Mista Quantiiii
Mista Quantiiii
Mistotichogy Analyst

## ACCUTEST LABORATORIES LTD

F., JR, J. A....YE.

						В	Description Number		2702685	
Client: Paterson Group							Date:		2007-02-12	
28 Corpourse Gate, Unit 1							Date: Date Submitted:		2007-02-08	
Nepean, ON										
K2E 7T7						ц	Project.	۵.	PH0145	
Attention: Mr. Robert Passmore						•	امادهن			
						<b>L</b>	P.O. Number:			
INVOICE: Paterson Group Inc.							Matrix	>	Waler	
Chain of Custody Number: 53990		-		70000					GUIDELINE	
	LAB ID:	_	523230	523231						
	Sample Date:		7-02-08	2007-02-08						
	Sample ID:		TW9 WS2	TW9 WS3					ODWSOG	
					-,					
	-							TYPE	LIMIT	UNITS
PARAMETER	UNITS	MDL						MAG	C	C4/100mL
	H/1 (Nm)		0	0				2 :	· c	and the
Total Coliforms	ct/100ml		0	0				MAC		11100110
Escherichia Coti			, ,	_						
Hatarotrophic Plate Gount	C(/1mL		_							
	cV100mL		0	0						,
Faecal Conforms	c4/100ml.		0	0				n tomou		
Faecal Streptococcus	3									
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MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration Comment:

104

608 Noris Court, Kingston, ON, K7P 2R9 8-146 Colonnade Road, Oltawa, ON, KZE 7Y1 **REPORT OF ANALYSIS** 

Chain of Custody Number: 53938	Date Submitted: Project: Matrix: Matrix:	## 2007-02-07 ### 2007-02-06  Water  Guideline  TYPE  LIMIT	STIMU
Custady Number: 53938  Custady Number: 53938	Project: Matrix:	TWE	STAND
Custody Number: 53938  Custody Number: 53938  LAB ID: Sample Date: Sample Date: Sample ID: Sample I	P.O. Number: Matrix:		SIND
Custody Number: 53938  LAB ID: Sample Date: Sample Date: Sample ID: mg/L 1 mg/L 1 mg/L 2	P.O. Number: Matrix:		STIMU
Sample Date: Sample Date: Sample Date: Sample ID:  8s CaCO3  mg/L  mg/L  mg/L  1  mg/L  2			STIND
Sample Date: Sample Date: Sample ID: as CaCO3  mg/L  mg/L  mg/L  2			UNITS
Sample ID:  PARAMETER MDL  as CaCO3  mg/L 1  mg/L 1  mg/L 2			UNITS
as CaCO3  mg/L  mg/L  mg/L  mg/L  2			UNITS
8s CaCO3 mg/L 1 mg/L 1 mg/L 1 mg/L 2 mg/L 2			UNITS
as CaCO3 mg/L 1 mg/L 2 mg/L 2			
mg/L 2			
		-	
	-		

APPROVAL:

1 of 1

6-146 Colonnade Road, Otlawa, ON, K2E 7Y1 608 Norris Court, Kingston, ON, K7P 2R9

....'Of., JF ,.... LY ...

3CL \_ST \_\_\_ SK.....IES \_\_\_

Admition: Robert Pression on Principle (Castody Number: 53536)  Chain of Castody Number: 53536  Chain of Castody Number: 53536  Chain of Castody Number: 53536  Chain of Castody Number: 53536  Sample Date: 2007/20/49  Chain of Castody Number: 53536  Chain	K1V 116 Hention: Robert Passmore					Date Submitted:		2007-02-06	
Custody Number: 53336						Project:	ħ.	PH0145	
PARAMETER   UNITS   May						P.O. Number:		141	
Sample Date   2007-02-08   20	hain of Custody Number: 53938	19 -	2	Footban		Marix:		Water Ciline INF	
PARAMETER   UNITS   MOL   World   Wo		alome?		92.2630 90.70.7000				GOIDELINE	
ity		Sampl	<u> </u>	TW9 WS1					
ity uS/cm 5 uS/cm 5 mg/L 5 mg/L 5	PARAMETER	-	ADL.				TYPE	ГІМП	UNITS
mg/L 5		-	-	S6					
	onductivity DS (COND - CALC)	us/cm mg/L	n n	657 427					
				-					
				50120W1720V4604					
								4.4	
								·	
		•							
		-		-					

APPROVAL:

Ewan McGodotha
Inorganic Lab Supervisor

## 6-146 Colowade Road, Ottawa, ON, K2E 7Y1

Client: Paterson Group	Report Number:	2702686
28 Concourse Gate, Unit 1	Date:	2007-02-14
Nepean, ON	Date Submitted:	2007-02-08
K2E 777		
Attention: Mr. Robert Passmore	Project:	P <del>1</del> 0145
INVOICE: Paterson Group Inc.	P.O. Number:	
Chair of Custody Number 53390	Matrix:	Water

ACCUILEST LABORATORIES LTD

KEPOKI OF ANALYSIS

Matrix

		LAB ID:	523232	523233					GUIDECINE	
	Samp	Sample Date:	2007-02-08	2007-02-08						
	Sar	Sample ID:	TW9 WS2	TW9 WS3					ODWSOG	
GETENAGRO	HNTS	Z M						TYPE	LIMIT	UNITS
		1	202	203				90	200	mgA
Alkalimily as Cacus	1 100	, -	<u> </u>	63				AO AO	250	1√gm
Chloride	1001	- (	5 5	3 9				ΟΨ	'n	TCU
Colour	3	.7	7	7 !				?	)	)
Conductivity	uS/cm	LT)	670	229				(	ı	Ī
Dissolved Organic Carbon	що <mark>Г</mark>	0.5	1.0	<u>بر</u> بر				Q :	ο (	
apiron III	mg/L	0.10	0.42	0.42				MAC	t.	mg/L
Livering Subbids	mg/L	0.01	<0.01	<0.01				40	0.05	mg/L
MAN (Ammina)	mg/L	0.02	0.10	0.09			-			•
William CON N	rmg/L	0.10	<0.10	<0.10				MAC	0.	mg/L
VI NOS (Michely)	ma/L	0.10	<0.10	<0.10				MAC	10.0	TIGHT.
אין אינט (אווין פובי)	)		8.23	8.24				AO.	6.5-8.5	
יוסניאנו	mg/L	0.001	<0.001	<0.001			,			
THE RUS	mg/L	-	45	46				8	200	mg/L
Tomin & Lionin	, Pie	0.1	0.1	0.2	,					:
TDS (COND - CALC)	щg/L	c	435	440				φ	200	mg/L
Total Keldani Nifrogen	шg/L	0.05	0.16	0.18				9	•	Ē
Turbidity	D E	0.1	16.5	26.8		-		Ď ť	2.5	
Hardness as CaCO3	mg/L	-	217	210				3	100	III A
ton Balance		90.0	26.0	0.92						
Calcium	mg/L	-	48	48		,				
Маgnesium	mg/L	<del></del>	23	. 22						
Potassium	ПgР	-	9	9				(	Ç	1
Sodium	ПдЛ	2	44	46		······		Ş	70	انگر انگرا
UUJ	mg/L	0.03	2.25	3.96				ΑĊ	0.3	mg/L
Manoanese	Lug/L	0.0	0.05	0.07				AO	0.05	mg/L
								1760		
·		-								

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

APPROVAL:

mg/L mg/L

20 0.3 0.05

8 8 8 8

mg/L mg/L mg/L mg/L

Hardness as CaCO3

**Furbidity** 

on Balance

Magnesium

Calcium

Potassium

Sodium

Manganese

annin & Lignin

Phenols Sufphate

N-NO3 (Nitrate) N-NO2 (Nifrite)

Conductivity

Fluoride

Chloride

Solour

## ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

2703210

Chent	Client: Paterson Group	
	28 Concourse Gate, Unit 1	
	Nepean, OM	
	K2E 7T7	
Attentic	Attention: Mr. Robert Passmore	

Report Number: Project:

2007-02-15 2007-02-19 PH0145 Date Submitted: P.O. Number:

INVOICE: Paterson Group Inc.

UNITS mg/L mg/L mg/L TCU щg/L NTU mg.h mg/L mg/L GUIDELINE opws06 1.0 10.0 5.5-8.5 LE LE 5 1.5 0.05 500 500 1.0 5 550 Water TYPE MAC MAC AO ΥO 8 8 90 A0 A0 AO. Matrix: 2007-02-15 TW9 WS4 0.36 <0.01 0.09 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0.00 <0 524762 207 80 670 1.3 Sample Date: Sample (D: 0.001 0.1 5 0.05 0.05 1 1 1 1 2 0.03 0.03 0.01 0.02 0.10 0.10 뎦 SHIND mg/L TCU uS/cm mg/L mg/L mg/L mg/L mg/L mg/L Tagh Tagh Tagh Tagh PARAMETER Chain of Custody Number: 53221 Dissolved Organic Carbon otal Kjeldahl Nitrogen TDS (COND - CALC) Alkalinity as CaCO3 Hydrogen Sulphide N-NH3 (Ammonia)

MCX = Method Detection Limit INC = Incomplete AD = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration INAC = Interim Maximum Allowable Concentration Comment:



REPORT OF AIMALY SIS

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Sample ID: Sample Date: Sample ID: Sumple Date: Sample ID: Cult00mL Cult00mL Cult00mL Cult00mL Cult00mL Cult00mL Cult00mL Cult00mL Cult00mL Cult00mL	523515 2007-02-12 TW10 WS1 0 0 0 0	P.O. Number:	W8 GI TYPE MAC MAC	Water GUIDELINE ODWSOG 0 0	UNITS CV100mL CV100mL
Sample Date: Sample Date: Sample ID: CV100mL CV100mL CV100mL CV100mL CV100mL CV100mL	523515 2007-02-12 TW10 WS1 0 0 0			UIDELINE  UIDELINE  0  0  0	UNITS CV100mL CV100mL
Sample Date: Sample ID: Sample ID: CultoonL CultoonL CultoonL CultoonL CultoonL CultoonL CultoonL CultoonL CultoonL CultoonL CultoonL CultoonL CultoonL	2007-02-12 TW10 WS1 0 0 0 0 0			DDWSOG 0 0	UNITS CV100mL CV100mL
Sample ID: PARAMETER CU100mL CU100mL CU100mL CU100mL CU100mL	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			DDWSOG 0 0	UNITS CV100mL CV100mL
PARAMETER UNITS cu/100mL cu/100mL cu/100mL cu/100mL	0 0 0 0		MAC MAC	0 0	CV100mL CV100mL
ount cuttoomL cuttonL cuttonL cuttonL cuttonL cuttonL cuttoomL cuttoomL cuttoomL	0 0 0		MAC	00	cv100ml cv100ml
nun	0000		MAAC	O	c <i>t</i> /100mL
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			-		

APPROVAL: Krista Quantrill
Microbiology Analyst

## ACCUIEST LABORALORIES LID

Client: Paterson Group

Nepean, ON K2E 7T7

Date Submitted: Report Number: Project: Attention: Mr. Robert Passmore 28 Concourse Gate, Unit 1

her Offi of Analyon

2702834 2007-02-14 2007-02-12

PH 0145

P.O. Number:

MANONE: Determined Green Inc.					P.O. Number:			
Chain of Curtada Number 58158					Matrix:		Water	
Oldill Ol Gustouy Pullurel. Susse		LAB ID:	523572				GUIDELINE	
	Samp	le Date:	2007-02-12					
	Sar	nple ID:	Sample ID: TW 10WS2				ODWSOG	
CHILLEGAR	STIMIL	Q E				TYPE	LIMIT	UNITS
	2	1						

								֡	
		LAB ID:	523572					GUIDELINE	
	Samp	Sample Date:	2007-02-12					(	
	2							500M200	
DADAMETER	STIND	MOL					TYPE	LIMIT	UNITS
Total California	ct/100mL		0				MAC	0	cl/100mL
Forberichia Coli	cl/f00mL		0				MAC	0	ct/100mL
Helerotrophic Plate Count	ct/1mL		0						
Faecal Colliorms	ct/100mL		D			-			
Faecal Streplococcus	ct/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: Krista Quantuil Microbiology Analyst

Rusailis relate only to the parameters tasted on the samples submitted for analysis.

## ACCL. LST LABORAL URIES LID

Client: Paterson Group	Report Number:
1-28 Concourse Gate	Date:
Ottawa, Onl.	Date Submitted:
K1V 1T6	
Attention: Robert Passmore	Project:

KEPOKI OF ANALYSIS

2702812 2007-02-16 2007-02-12

P.O. Number:

Chain of Custody Number: 58471						Matrix:		Water		
		LAB ID:	523535					GUIDELINE		
	Samp	Sample Date:	2007-02-12							
	Sar	Sample ID:	TW10 WS1					ODWSOG		
PARAMETER	UNITS	HDL					TYPE	LIMIT	UNITS	
Alkalinity as CaCO3	mg/L	2	208				8	900	mg/L	
Chloride	Tug/L	-	33	***************************************			ΑO	250	шg/L	
Colour	7C	2	m				AO	чņ	TCD	
Conductivity	uS/cm	נט	676							
Dissolved Organic Carbon	mg/L	0.5		<del></del>			AO	47	mg/L	
Fluoride	mg/L	0.10	96.96	***************************************			MAC	1.5	шg/L	
Hydrogen Sulphide	mg/L	0.01	<0.01				AO	50.0	∏⁄gш	
N-NH3 (Ammonia)	щg/L	0.02	0.09				•			
N-NO2 (Nilrite)	mg/L	0.10	<0.10				NAC	1.0	mg/L	
N-NO3 (Nilrate)	щg/L	0.10	<0.10				RAC	10.0	шg/L	
Ha			8.14	*****			AO	6.5-8.5		
Phenals	T/G/L	0.001	<0.001	au manad						
Sulphate	J/g∕r	-	48				AO	900	пgʻľ	
Tannin & Lignin	mg/L	0.1	0.2							
TDS (COND - CALC)	J/g⊔	r,	439				AO	200	mg/L	
Total Kjeldahl Nitrogen	Шg/L	0.05	0.13	<del>Marine.</del>						
Turbidity	NTC	0.1	1.0	<del></del>			AÇ	1.0	DT/N	
Hardness as CaCO3	1,6ш	-	231				8	100	mg/L	
Ion Balance		0.01	0.90					***************************************		
Calcium	ЩФ.	•	72							
Magnesium	∏g/L	-	25							
Potassium	∏g/L	-	ιΩ				<del></del>			
Sodium	mg/L	2	36				AO	23	mg/L	
Kron	mg/L	0.03	0.09				ΑO	0.3	mg/L	
Manganese	mg/L	0.01	0.03				AO	0.05	mg/L	
			Augustus (Marie					44.44.44.47		

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

Inorgar APPRCVAL:

2R9	
K7P 2R9	
NO.	
Kingston,	
COULT,	
Nornis	
90	
E 7Y1	
X2E	

Client: Paterson Group	Report Number:	2702831
28 Concourse Gate, Unit 1	Dafe:	2007-02-16
Nepean, ON	Date Submitted:	2007-02-12
K2E 777		
Attention: Mr. Robert Passmore	Project:	PH 0145
INVOICE: Paterson Group Inc.	P.O. Number:	

, CCL, ST LANORAL UNIES LID

REPOR! OF ANALYSIS

INVOICE: Paterson Group Inc. Chain of Custody Number: 58356						P.O. Number: Matrix:		Water		
	_	LAB ID:	523566					GUIDELINE		
	Sampl	Sample Date:	2007-02-12							
	Sarr	Sample ID:	TW 10WS2				<b>T</b>	000000		
PARAMETER	UNITS	MDL					TYPE	LIMI7	UNITS	
Akalinity as CaCO3	mg/L	5	207				90	500	mg/L	
Chloride	mg/L	-	59				ΑO	250	mg/L	
Colour	JOL	2	7		-		AO	w	TCU	
Conductivity	uS/cm	rΩ	089							
Dissalved Organic Carbon	mg/L	0.5	1:				AO	ιo.	mg/L	
Fluoride	mg/L	0.10	0.38				MAC	1.5	mg/L	
Hydrogen Sulphide	ш9/L	0.01	<0.01				AC	0.05	mg/L	
N-NH3 (Ammonia)	mg/L	0.02	. 60.0						•••	
N-NO2 (Nitrite)	√L mg/L	0.10	<0.10				MAC	1.0	mg/L	
N-NO3 (Nitrate)	mg/L	0.10	<0.10				MAC	10.0	rng/L	
На			8.09				AO	6.5-8.5		
Phenols	шg/L	0.001	<0.001							
Sulphate	шg/L	-	48		-		AO	200	mg/L	
Tannin & Lignin	шg/L	0.1	0.2							
TDS (COND - CALC)	⊞g/L	c,	442				AO	500	mgʻl	
Total Kjeldahl Nifrogen	mg/L	0.05	0.12					***************************************		
Turbidity	D L N	0.1	0.7				90	1.0	NTU	
Hardness as CaCO3	mg/L	-	252				90	100	mg/L	
lon Balance		0.01	0.97							
Calcium	mg/L	-	53							
Magnesium	mg/L	<del>-</del>	26							
Potassium	mg/L	<del>-</del>	9							
Sodium	mg/L	2	37				Ş	20	mg/L	
Iron	mg/L	0.03	0.09				Ş	0.3	mg/L	
Manganese	mg/L	0.01	0.03				AQ.	0.05	mg/L	
							a makant park			

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

APPROVAL:

APPROVAL: Krista Quantrill

Macrobiology Analyst

## ACCU I EST LABORATORIES LTD

REPORT OF ANALYSIS

Client: Paterson Group			-				Report Number:		2702985	
28 Concourse Gate, Unit 1							Date:		2007-02-16	
Nepean, ON							Date Submitted:		2007-02-13	
K2E 7T7										
Attention: Mr. Robert Passmore							Project	ш.	PHO145	
INVOICE: Paterson Group Inc.							P.O. Number:			
Chain of Custody Number: 49794							Matrix:		Water	
		LAB ID:	524055	524056					GUIDELINE	
	Samp	Sample Date:	2007-02-13	2007-02-13						
	San	Sample (D:	TW11 WS1	TW11 WS2					ODWSOG	
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Total Coliforns	ct/100ml		0	0				MAC	0	ct/100mL
Figure Colinaria Coli	ct/100mL		) <b>O</b>	0				MAC	0	cV100mL
Helemtrophic Plate Count	ct/fm		Ç	-						
Faeca Coliforns	ct/100mL		O	0						
Faecal Streptococcus	ct/100mL		Ф	0				***************************************		
								•		
								-		
								***************************************		
								Lateratory de Citaly Cons		
								nacements (AA		
								50 PECENTAL TO SEE		
	-				-					
-										
MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interior Maximum Allowable Concentration	OG = Operatio	nal Guidelir	TE MAC = Maxin	num Atowable Co	nowntration IMAC	= Interim Max	num Allowable Conce	entration		
Comment										

REPORI OF ANALYSIS

ACCUI EST LABORALURIES LID

Incomenie Lab Supervisor

Client: Paterson Group						Renort Number		2702988		
						Date:		2007-02-1E		
NO DESTRUCTION						Date Submitted	į	2007 03 42		
K2E 7T7							į	21-20-1007		
Attention: Mr. Robert Passmore						Project:		PHO145		
INVOICE: Paterson Group Inc.						P.O. Number				
Chain of Custody Number: 49794						Matrix:		Waler		
		LAB ID:	524059	524060				GUIDELINE		
	Samp	Sample Date:	2007-02-13	2007-02-13						
	Sa	Sample ID:	TW11 WS1	TW11 WS2				ODWSOG		
PARAMETER	UNITS	MDL					TYPE	LIMIT	UNITS	
Alkalinity as CaCO3	πg/L	5	203	205			9	500	mg/L	
Chloride	шg/L	<b>-</b>	43	42	***************************************		AG	250	mg/L	
Colour	100	2	<b>~</b>	\$			Ao	5	TCU	
Conductivity	uS/cm	r2	590	591						
Dissolved Organic Carbon	Пg/L	0.5	1.0	6.0			γ	40	mg/L	
Fluoride	∏⁄gш	0.10	0.40	0.40			MAC	2:1	mg/L	
Hydragen Sulphide	mg/L	0.01	<0.01	<0.01			AO	0.05	mg/L	
N-NH3 (Ammonia)	шg/L	0.02	60.0	0.09						
N-NO2 (Nitrite)	mg/L	0.10	<0.10	<0.10			MAC	1.0	mg/L	
N-NO3 (Nitrate)	щg/L	0.10	<0.10	<0.10			MAC	10.0	тщЛ	
На			8.09	B.13			AO	6.5-8.5		
Phenods	mg/L	0.001	<0.001	<0.001						
Sulphate	щg/L	-	99	33			AO	200	mg/L	
Tannin & Lignin	mg/L	0.1	<0.1	0.1				***************************************		
TDS (COND - CALC)	mg/L	un	384	384			8	00g	.mg∕L	
Total Kjeldahl Nitrogen	mg/L	0.05	0.12	0.13						
Turbidity	2	0.1	6.1	4.2			A V	1.0	DTN DTN	
Hardness as CaCO3	mg/L	-	203	203	•		<u>5</u> 0	100	mg/L	
fon Balance		0.01	0.95	0.95						
Calcium	mg/L	-	45	45	toto dana					
Magnesium	mg/L	-	72	22				7.	,	
Potassium	mg/L	-	9	. 9						
Sodium	mg/L	2	37	37			8	20	mg/L	
Iron	mg/L	0.03	0.23	0.40			AO	6.0	mg/L	
Manganese	mgЛ	0.01	0.03	0.03			AO A	0.05	mg/L	

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

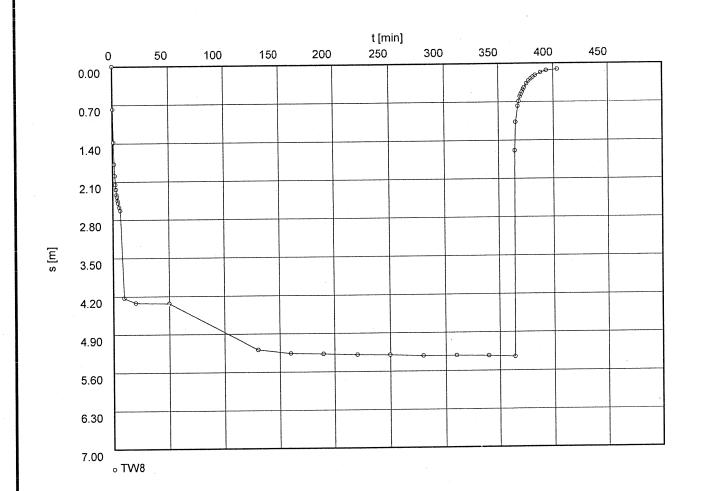
1 0/ 1

608 Norris Court, Kingston, ON, K7P 2R9

## **APPENDIX 3**

**Aquifer Analysis Data for Additional Test Wells** 

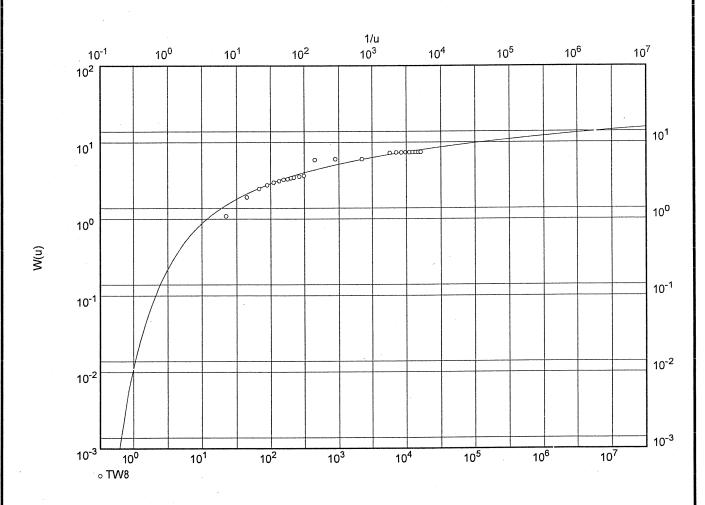
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown plot		Date: 23.02.2007 Project: PH0145	none, Page 1
Nepeall, ON KZE 717		-	Evaluated by: RAP	
Pumping Test No. 2	Te	est conducted on: F	eb. 9, 2007	
TW8				
Discharge 1.42 l/s		· · · · · · · · · · · · · · · · · · ·		



Paterson Group Ltd.	Pumping test analysis		Date: 23.02.2007	none, Page 2
1-28 Concourse Gate	Time-Drawdown plot		Project: PH0145	
Nepean, ON K2E 7T7			Evaluated by: RAP	
Pumping Test No. 2		Test conducted on: Feb. 9, 2007		
TW8	TW8			
Discharge 1.42 l/s		Distance from the pumping well 0.150 m		

	Pumping test duration	Water level	Drawdown	
	[min]	[m]	[m]	
1	0.00	2.820	0.000	
2	0.50	3.600	0.780	
3	1.00	4.200	1.380	
4	1.50	4.600	1.780	
5	2.00	4.810	1.990	
6	2.50	4.970	2.150	
7	3.00	5.060	2.240	
8	3.50	5.160	2.340	
9	4.00	5.200	2.380	
0	4.50	5.270	2.450	
1	5.00	5.310	2.490	
2	6.00	5.390	2.570	
3	7.00	5.450	2.630	
4	10.00	7.050	4.230	
5	20.00	7.140	4.320	
6	50.00	7.150	4.330	
17	130.00	8.010	5.190	
18	160.00	8.080	5.260	
19	190.00	8.090	5.270	
20	220.00	8.110	5.290	
21	250.00	8.120	5.300	
22	280.00	8.140	5.320	
23	310.00	8.140	5.320	
24	340.00	8.150	5.330	
25	364.00	8.170	5.350	
26	365.00	4.410	1.590	
27	366.00	3.890	1.070	
28	368.00	3.600	0.780	
29	369.00	3.510	0.690	
30	370.00	3.430	0.610	
31	371.00	3.380	0.560	
32	372.00	3.340	0.520	
33	373.00	3.290	0.470	
	374.00	3.260	0.440	
34 35	374.00	3.190	0.370	
36	378.00	3.140	. 0.320	
	380.00	3.100	0.280	
37 38	382.00	3.070	0.250	
1	384.00	3.040	0.220	
39	389.00	2.990	0.170	
40	394.00	2.950	0.130	
41	404.00	2.930	0.110	
42		2.000		
$\dashv$				
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Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Theis analysis method Confined aquifer		Date: 23.02.2007 Project: PH0145 Evaluated by: RAP	none, Page 1
Pumping Test No. 2	•	Test conducted on:	Feb. 9, 2007	
TW8				
Discharge 1.42 l/s				

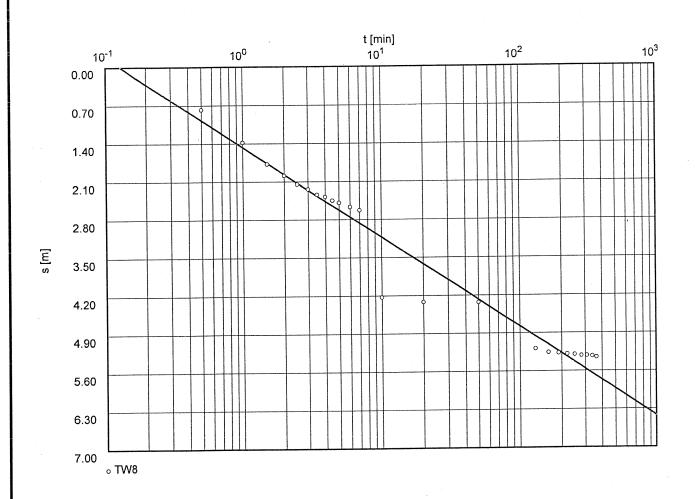


Transmissivity [m²/min]: 9.41 x 10<sup>-3</sup>

Storativity: 1.18 x 10<sup>-1</sup>

Paterson Group Ltd.	Pumping test analy		Date: 23.02.2007	none, Page 1
1-28 Concourse Gate		Time-Drawdown-method after COOPER & JACOB Confined aquifer		
Nepean, ON K2E 7T7				Evaluated by: RAP
Pumping Test No. 2		Test conducted on: Feb. 9, 2007		
TW8				
Discharge 1.42 l/s				

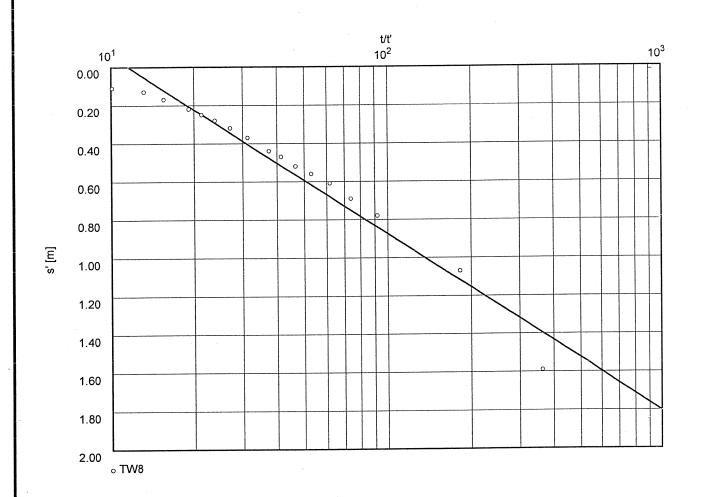
Date: 23.02.2007 none, Page 1



Transmissivity [m²/min]: 9.44 x 10<sup>-3</sup>

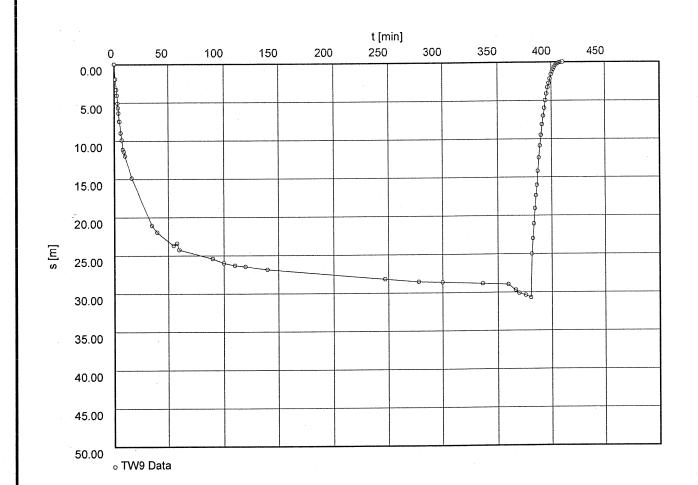
Storativity: 1.21 x 10<sup>-1</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7			none, Page 1
Pumping Test No. 2	Test conducted on: I	Feb. 9, 2007	
TW8			
Discharge 1.42 l/s			
	Pumping test duration	on: 364.00 min	



Transmissivity [m²/min]: 1.67 x 10<sup>-2</sup>

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown plot		Project: PH0145 Evaluated by: RAP	none, Page 1
Pumping Test No. 1		Test conducted on:	February 8, 2007	
TW9		. ,		
Discharge 1.50 l/s				



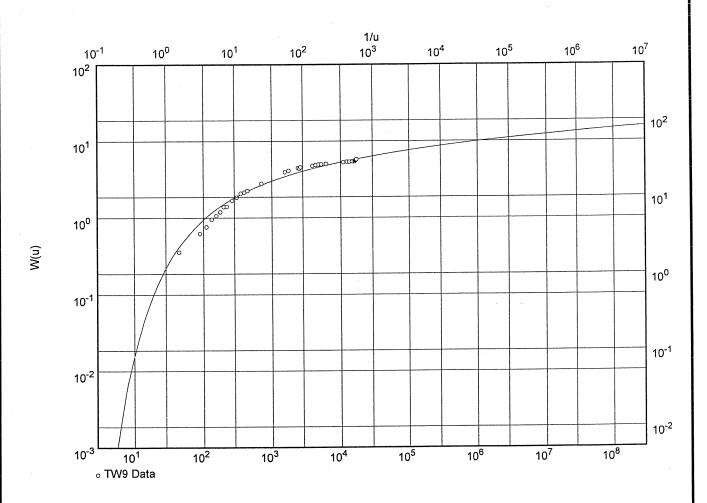
Paterson Group Ltd. 1-28 Concourse Gate	Time-Drawdown plot		Date: 22.02.2007 Project: PH0145	none, Page 2
Nepean, ON K2E 7T7			Evaluated by: RAP	
Pumping Test No. 1		Test conducted on: February 8, 2007		
TW9		TW9 Data		
Discharge 1.50 l/s		Distance from the pumping well 0.150 m		

Static w	rater 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	B
	55.00	24.660	23.690	
18	58.00	24.370	23.400	
19	60.00	25.200	24.230	
20		26.380	25.410	
21	90.00	26.960	25.990	
22	100.00	27.280	26.310	
23	110.00	27.420	26.450	
24	120.00		26.860	
25	140.00	27.830	28.190	
26	247.00	29.160	28.570	
27	278.00	29.540	28.650	
28	300.00	29.620	28.840	
29	337.00	29.810		
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	

Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7		Pumping test analysis Time-Drawdown plot		Date: 22.02.2007	none, Page 3
				Project: PH0145	
Nepean.	, ON K2E / 1 /			Evaluated by: RAP	
Pumpi	ng Test No. 1		Test conducted on:	February 8, 2007	
TW9			TW9 Data		
	arge 1.50 l/s		Distance from the p	oumping well 0.150 m	
	water level: 0.970 m below datum				
- 13.10	Pumping test duration	Water level	Drawde	own	
		P 3	From T		
51	[min] 398.00	[m] 3.720	[m]	2.750	
51	399.00	3.130		2.160	
53	400.00	2.580		1.610	
54	401.00	2.230		1.260	
55	402.00	1.900		0.930	
56	403.00	1.640		0.670	
57	404.00	1.400		0.430	
58	405.00	1.290	)	0.320	
59	406.00	1.170		0.200	
60	407.00	1.100		0.130	, , , , , , , , , , , , , , , , , , ,
61	408.00	1.040		0.070	
62	409.00	1.010		0.040	
63	410.00	0.980		0.010	
64	411.00	0.970	)	0.000	
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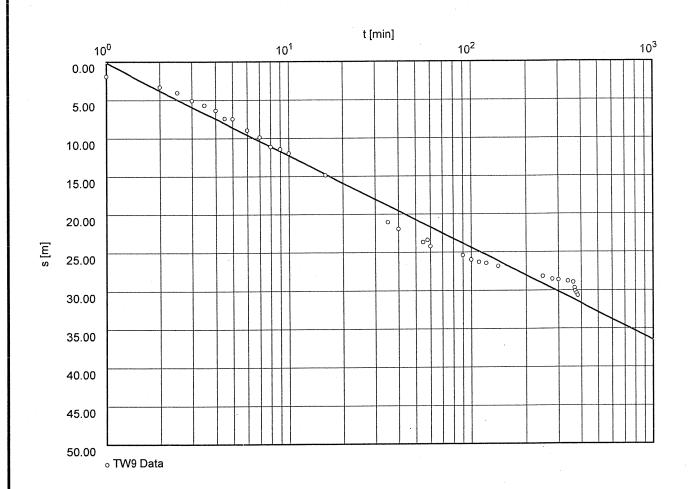
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Theis analysis method Confined aquifer	Date: 22.02.2007 none, Page 1 Project: PH0145 Evaluated by: RAP		
Pumping Test No. 1	Test conduct	Test conducted on: February 8, 2007		
TW9				
Discharge 1.50 l/s				



Transmissivity [m²/min]: 1.33 x 10<sup>-3</sup>

Storativity: 1.52 x 10<sup>-1</sup>

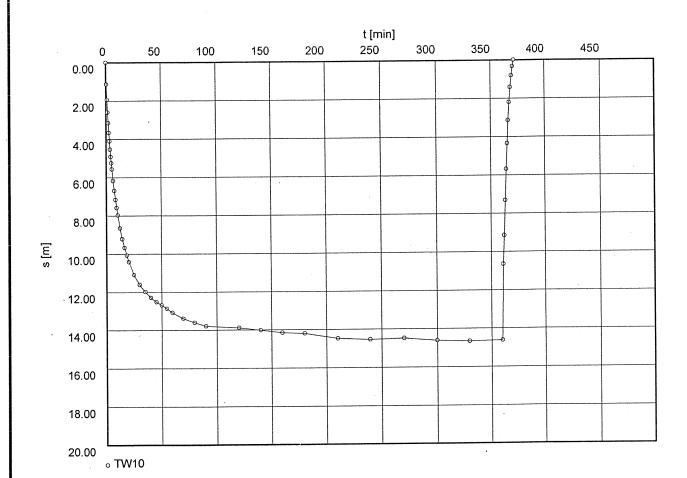
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Time-Drawdown-method after COOPER & JACOB		Date: 22.02.2007 none, Page 1 Project: PH0145	
	Confined aquifer	•	Evaluated by: RAP	
Pumping Test No. 1		Test conducted on: February 8, 2007		
TW9				
Discharge 1.50 l/s				



Transmissivity [m²/min]: 1.35 x 10<sup>-3</sup>

Storativity: 1.32 x 10<sup>-1</sup>

Paterson Group Ltd.	Pumping test analysis	Pumping test analysis Time-Drawdown plot		none, Page 1
1-28 Concourse Ĝate	Time-Drawdown plot			
Nepean, ON K2E 7T7	, ON K2E 7T7		Evaluated by: RAP	
Pumping Test No. 3	•	Test conducted on: Feb. 12, 2007		
TW10				
Discharge 0.90 l/s				

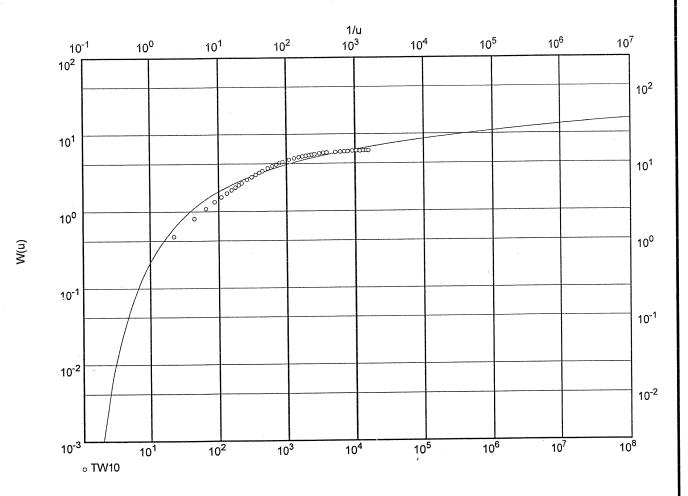


Pater	son Group Ltd.	Pumping test analysi	Pumping test analysis		none, Page 2		
1-28 (	Concourse Gate	Time-Drawdown plot		Project: PH0145			
Nepean, ON K2E 7T7					Evaluated by: RAP		
Pumping Test No. 3			Test conducted on: Feb. 12, 2007				
TW10	/10		TW10				
Disch	arge 0.90 l/s	Distance from the pumping well 0.150 m					
Static	water level: 0.000 m below datum	1	1				
	Pumping test duration	Water level	Draw	down			
	[min]	[m]	ſn	nl			

	Distance from the pumping well 6. 700 m								
	Static w	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	i				
	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 14.160					
	35	160.00	14.160						
	36	180.00	14.200	14.200 14.470					
	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	14.660					
	41	330.00	14.660	14.620					
	42	360.00	14.620	10.650					
-	43	361.00	10.650	9.140					
	44	362.00	9.140 7.310						
	45	363.00	5.680	1					
	46	364.00	4.340						
	47	365.00	3.150						
	48	366.00	2.200						
	49	367.00	1.420						
i	50	368.00	1.420	1.420					

Paterson Group Ltd. 1-28 Concourse Gate Pumping tes Time-Drawd		Pumping test analysis	3	Date: 23.02.2007	none, Page 3
		Time-Drawdown plot		Project: PH0145	
Nepean	, ON K2E 7T7			Evaluated by: RAF	
Pumpi	ng Test No. 3		Test conducted on:	Feb. 12, 2007	
TW10			TW10		
	arge 0.90 l/s		Distance from the p	umping well 0.150 m	
	water level: 0.000 m below datum				
Static	Pumping test duration	Water level	Drawdo	wn	
	Tumping tool daration		·		
54	[min]	[m] 0.810	[m]	0.810	
51 52	369.00 370.00	0.330		0.330	
53	371.00	0.000		0.000	
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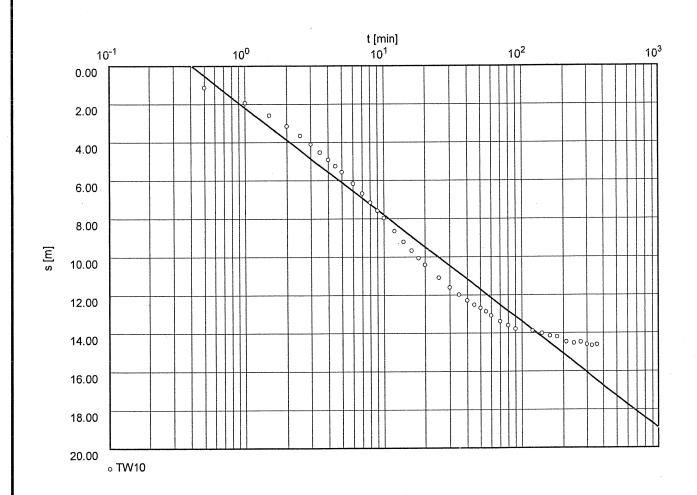
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7	Pumping test analysis Theis analysis method Confined aquifer		Date: 23.02.2007 none, Page 1  Project: PH0145  Evaluated by: RAP			
Pumping Test No. 3	Те	Test conducted on: Feb. 12, 2007				
TW10						
Discharge 0.90 l/s						



Transmissivity [m²/min]: 1.78 x 10<sup>-3</sup>

Storativity: 7.31 x 10<sup>-2</sup>

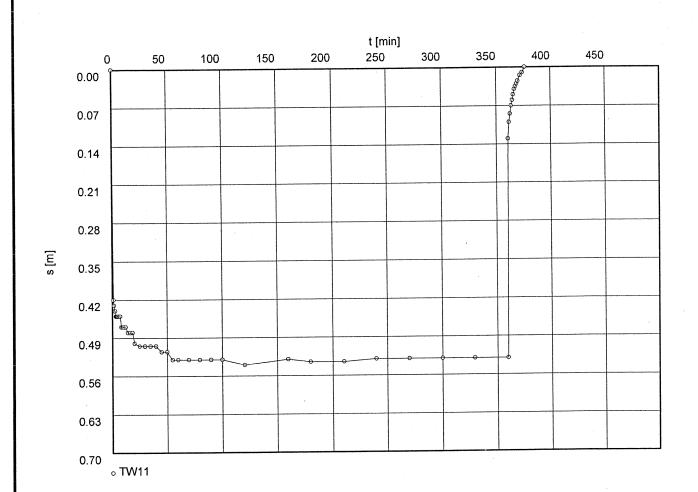
Paterson Group Ltd. Pumping test analys			Date: 23.02.2007 none, Page 1		
1-28 Concourse Gate Nepean, ON K2E 7T7	COOPER & JACOB				
1000011, 011, 22 111	Confined aquifer			Evaluated by: RAP	
Pumping Test No. 3	Test conducted on: Feb. 12, 2007				
TW10					
Discharge 0.90 l/s					



Transmissivity [m²/min]: 1.76 x 10<sup>-3</sup>

Storativity: 7.16 x 10<sup>-2</sup>

Paterson Group Ltd. 1-28 Concourse Gate	Pumping test analysis Time-Drawdown plot		Date: 23.02.2007   none, Page 1   Project: PH0145		
Nepean, ON K2E 7T7			Evaluated by: RAP		
Pumping Test No. 4	Test conducted on: Feb.13, 2007				
TW11					
Discharge 1.60 l/s			•		



Paterson Group Ltd.		aterson Group Ltd. Pumping test analysis		Date: 23.02.2007	7 none, Page 2	
1-28 C	oncourse Ĝate			Project: PH0145		
Nepean,	ON K2E /1/			Evaluated by: R/	AΡ	
Pumpir	ng Test No. 4		Test conducted of	n: Feb.13, 2007		
TW11			TW11			
Discharge 1.60 l/s			Distance from the	pumping well 0.150	m	
Static v	vater level: 0.800 m below datum				·	
	Pumping test duration	Water level	Drav	down		
	[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 1.330 0.530 80.00 0.530 1.330 31 90.00 0.530 1.330 100.00 32 0:540 33 120.00 1.340 0.530 160.00 1.330 34 0.535 1.335 35 180.00 0.535 1.335 210.00 36 0.530 37 240.00 1.330 0.530 270.00 1.330 38 0.530 1.330 39 300.00 40 330.00 1.330 0.530 1.330 0.530 360.00 41 0.930 0.130 361.00 42 0.100 0.900 362.00 43 0.085 363.00 0.885 44 0.070 364.00 0.870 45 0.060 365.00 0.860 46 0.850 0.050 47 366.00 0.040 48 367.00 0.840 0.035 0.835 368.00 49 0.030 369.00 0.830 50

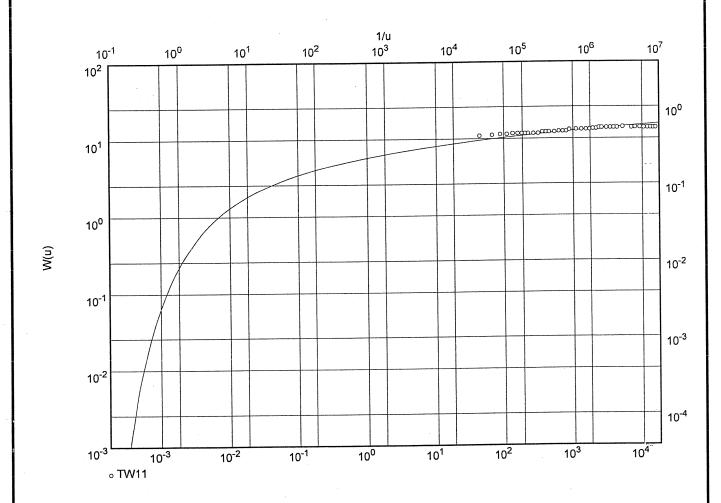
Paterson Group Ltd. 1-28 Concourse Gate Nepean, ON K2E 7T7		Pumping test analysis Time-Drawdown plot		Date: 23.02.2007	none, Page 3		
				Project: PH0145			
тереап,	ONIZE / II			Evaluated by: RAP			
Pumpir	ng Test No. 4		Test conducted on: Feb.13, 2007				
TW11			TW11				
Discha	rge 1.60 l/s		Distance from the pu	ımping well 0.150 m	- Company of the Comp		
Static v	water level: 0.800 m below datum						
	Pumping test duration	Water level	Drawdov	wn .			
51	[min] 370.00	[m] 0.825	[m]	0.025			
52	372.00	0.815		0.015			
53	374.00	0.810		0.010			
54	376.00	0.800		0.000			
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Paterson Group Ltd.
1-28 Concourse Gate
Nepean, ON K2E 7T7

Pumping test analysis method Confined aquifer

Project: PH0145
Evaluated by: RAP

Test conducted on: Feb.13, 2007



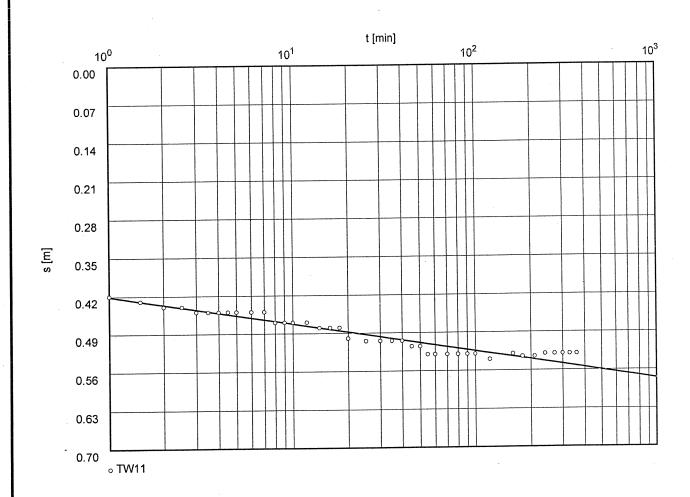
Transmissivity [m²/min]: 1.97 x 10<sup>-1</sup>

Storativity: 1.43 x 10<sup>-3</sup>

Discharge 1.60 l/s

Paterson Group Ltd. 1-28 Concourse Gate	Time-Drawdown-metho	Pumping test analysis Time-Drawdown-method after COOPER & JACOB		none, Page 1		
Nepean, ON K2E 7T7	Confined aquifer		Evaluated by: RAP			
Pumping Test No. 4		Test conducted on: Feb.13, 2007				
TW11						
Discharge 1.60 l/s				·		

Date: 23.02.2007 none, Page 1



Transmissivity [m²/min]: 3.41 x 10<sup>-1</sup>

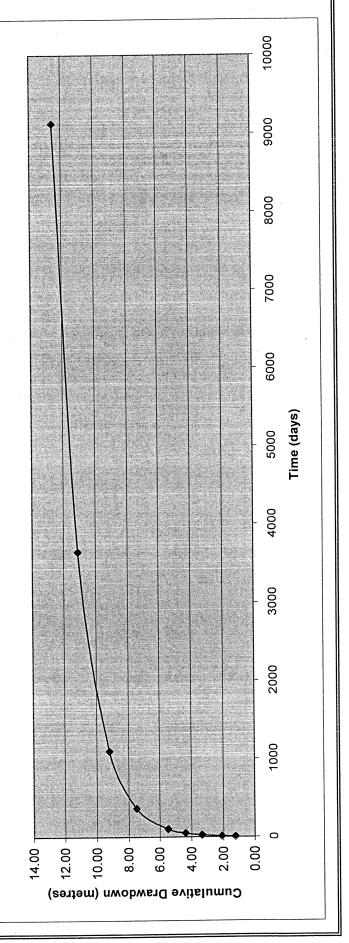
Storativity: 2.20 x 10<sup>-7</sup>

# **Determination of Potential Well Interference**

7	12.52	25	0.0423
Pumping Rate (Q) m3/day	Transmissivity (T) m2/day	Average Well Spacing (m)	Coefficient of Storage S

Orawdown									
Dra m	1.26	2.10	3.36	4.39	5.47	7.48	9.19	11.10	12.56
ouping W(u)	0.5848	1.0762	1.8695	2.5068	3.1763	4.4652	5.5443	6.7620	7.6779
5th Well Grouping u W(u)	4.8E-01	2.4E-01	9.5E-02	4.8E-02	2.4E-02	6.5E-03	2.2E-03	6.5E-04	2.6E-04
l Grouping W(u)	0.7554	1.3098	2.0991	2.7563	3.4581	4.7064	5.8016	7.0044	7.9402
4th Well Gr u	3.7E-01	1.8E-01	7.4E-02	3.7E-02	1.8E-02	5.1E-03	1.7E-03	5.1E-04	2.0E-04
rouping W(u)	1.0139	1.5889	2.4126	3.0983	3.7785	5.0532	6.1494	7.3526	8.2968
3rd Well Grouping u W(u)	2.6E-01	1.3E-01	5.3E-02	2.6E-02	1.3E-02	3.6E-03	1.2E-03	3.6E-04	1.4E-04
rouping W(u)	1.4092	2.0386	2.8965	3.5739	4.2716	5.5443	6.6598	7.8449	8.7725
2nd Well Grouping u W(u)	1.6E-01	7.9E-02	3.2E-02	1.6E-02	7.9E-03	2.2E-03	7.2E-04	2.2E-04	8.7E-05
ouping W(u)	2.4126	3.0983	3.9436	4.6681	5.3776	6.6598	7,7579	8.9617	9.8710
1st Well Grouping u W(u)	5.3E-02	2.6E-02	1.1E-02	5.3F-03	2.6E-03	7.2E-04	2 4F-04	7.2E-05	2.9E-05
Time (days)	22	, <del>C</del>	25	5.05	100	365	1100	3650	9125

## 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

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 m2 of office space. Based on our understanding that the typical office building will be of the order of 186 m2, 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 <u>MOEE Hydrogeological Technical Information Requirements for Land Development Applications</u>" 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."

## **Consulting Engineers**

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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 Soil Type Cover	Flat Land (controlled through stormwater management) Open Sandy Loam (weighted for anomolous areas) Cultivated Lands (Grass Covered)	0.30 0.35 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

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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.

	Nitr	Nitrate Impact Assessment	Asse	ssment	
Project: File: Condition:	Greely Village Centre PH0145 : 71 Village Lots with 6 Office Blocks - 75 % of Runoff retained on site	ned on site			
Groundwa	Groundwater Flow Calculation			Weighted Infiltration Factors	
1877 A 1880 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	Background Nitrate Concentration (C <sub>b</sub> ) = Hydraulic Conductivity (k) = Horizontal Gradient (i) = Length (L) = Aquifer Thickness (t) = Groundwater Flow (Q <sub>b</sub> ) =	0 mg/L 0 m/s 0 m 0 m 0 m3/day		Topography Soil Cover Total Septic Effluent	0.3 0.35 0.1 0.75
Infiltration	Infiltration Calculation			Concentration of Effluent (Cs) =	40 mg/L
	Nitrate Concentration in Precipitation (C <sub>I</sub> ) = Surplus Water (Environment Canada) 3 Factored Water Surplus = 27 Additional Surplus from Landscape Runoff = 6 Infiltration Flow Entering the System (Q <sub>I</sub> ) = 29	0 mg/L 372.2 mm/yr 279.15 mm/yr 69.79 mm/yr 291.50 m³/day		Number of Lots: Daily Sewage Flow (Qs)= Site Characteristics	74 m³
Mass Bala	Mass Balance Model (MOEE 1995)			Area of Site: Roof Areas: Length of Roadways: Driveways: Impervious Area	320000 m <sup>2</sup> 15400 m <sup>2</sup> 1850 m 15400 m <sup>2</sup>
	$C_T = (Q_bC_b + Q_eC_e + Q_iC_i)/(Q_b + Q_e + Q_i) = Cumulative \ Nitrate \ Concentration$	Concentration		Percent Impervious Area = Infiltration Area =	13.09 % 278100 m²
where:	$Q_b$ = flow entering the system across the upgradient area $C_b$ = background nitrate concentration = $Q_e$ = flow entering the system from the septic drainfield = $C_e$ = concentration of nitrates in the septic effluent = $Q_t$ = flow entering the system from infiltration = $C_t$ = Concentration of nitrates in the infiltrate =	= 0 0 74 40 291.50	0 m³/day 0 mg/L 4 m³/day 0 mg/L 0 m³/day		
Therefore:	$C_T = 8.1 \text{ mg/L}$				

		Nitrate Impact Assessment	essment	
Project: File: Condition:	Greely Village Centre PH0145 71 Village Lots with 6 Office Blocks	- 75 % of Runoff retained on site		
Groundwa	Groundwater Flow Calculation		Weighted Infiltration Factors	
	Background Nitrate Concentration (C <sub>b</sub> ) = Hydraulic Conductivity (k) = Horizontal Gradient (i) = Length (L) = Aquifer Thickness (t) = Groundwater Flow (Q <sub>b</sub> ) =	0 mg/L 0 m/s 0 0 m 0 m 0 m	Topography Soil Cover Total Septic Effluent	0.2 0.3 <b>0.6</b>
Infiltration	Infiltration Calculation		Concentration of Effluent (Cs) =	40 mg/L
	Nitrate Concentration in Precipitation (C <sub>i</sub> ) = Surplus Water (Environment Canada) Factored Water Surplus = Additional Surplus from Landscape Runoff = Infiltration Flow Entering the System (Q <sub>i</sub> ) =	0 mg/L 372.2 mm/yr 223.32 mm/yr 111.66 mm/yr 275.74 m³/day	National of Lots.  Daily Sewage Flow (Qs)=  Site Characteristics	74 m <sup>3</sup>
			Area of Site : Roof Areas: Length of Roadways:	320000 m <sup>2</sup> 15400 m <sup>2</sup> 1850 m
Mass Bala	Mass Balance Model (MOEE 1995) $C_T = (Q_bC_b + Q_cC_e + Q_iC_j)/(Q_b + Q_c + Q_i) = Cumulative$	= Cumulative Nitrate Concentration	Unveways. Impervious Area Percent Impervious Area = Infiltration Area =:	41900 m <sup>2</sup> 13.09 % 278100 m <sup>2</sup>
where:	$Q_b$ = flow entering the system across the upgradient area $C_b$ = background nitrate concentration = $Q_e$ = flow entering the system from the septic drainfield = $C_b$ = concentration of nitrates in the septic effluent = $Q_i$ = flow entering the system from infiltration = $C_i$ = Concentration of nitrates in the infiltrate =	nt area = 0 m³/day 0 mg/L field = 74 m³/day = 275.74 m³/day 0 mg/L		
Therefore:	C <sub>τ</sub> = 8.5 mg/L			

	Nitrate Impact Assessment	ssessment	
Project: File: Condition:	Greely Village Centre PH0145 71 Village Lots with 6 Office Blocks - 75 % of Runoff retained on site and using sports fields	s fields	
Groundwat	Groundwater Flow Calculation	Weighted Infiltration Factors	
	Background Nitrate Concentration $(C_b)$ = 0 mg/L Hydraulic Conductivity $(k)$ = 0 m/s Horizontal Gradient $(i)$ = 0 m Aquifer Thickness $(t)$ = 0 m	Topography Soil Cover Total	0.3 0.35 0.1
	Groundwater Flow $(Q_b) = 0$ m3/day	Septic Effluent	
Infiltration	Infiltration Calculation  Nitrate Concentration in Precipitation (C.) = 0 mo/L.	Concentration of Effluent (Cs) =  Number of Lots:  Daily Sewage Flow (Qs)=	40 mg/L 74 74 m <sup>3</sup>
	372. 279.1 = 69.7	Site Characteristics	
		Area of Site: Roof Areas: Length of Roadways: Drivewavs:	361400 m <sup>2</sup> 15400 m <sup>2</sup> 1850 m 15400 m <sup>2</sup>
Mass Balar	Mass Balance Model (MOEE 1995) $C_T = (Q_bC_b + Q_eC_e + Q_iC_i)/(Q_b + Q_e) = Cumulative \ Nitrate \ Concentration$	Area oervious Area = ırea =	41900 m² 11.59 % 319500 m²
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 = 331.08 m <sup>3</sup> /day $C_i$ = Concentration of nitrates in the infiltrate = 0 mg/L	ay ay ay	
Therefore:	$C_T = 7.3 \text{ mg/L}$		