



CHUNG & VANDER DOELEN ENGINEERING LTD.

Geotechnical Engineering, Construction Inspecting
& Testing, Environmental Services

280 Victoria Street North, Unit # 8
Kitchener, Ontario, N2H 5E2
Telephone: 519-742-8979
Facsimile: 519-742-7739
E-Mail: cvd@bellnet.ca

June 1, 2006
File No.: 06-3-K3

Henderson Paddon & Associates Limited
101-14th Avenue
Hanover, Ontario
N4N 3W1

Attention: Mr. George A. Davis, P.Eng.

**Re: Geotechnical Investigation
Proposed Commercial Subdivision
Highway 9 and Bruce County Road 1
Town of Clifford, Ontario**

CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD) has been retained by Henderson Paddon & Associates Limited to conduct a geotechnical investigation for the proposed commercial subdivision at the above-noted site.

The site has a plan area of 6.4 ha and is located on the northeast corner of Highway 9 and Bruce County Road 1 in the Town of Clifford, Ontario. Presently, the site is an uncultivated farmland that is bare of vegetation with corn stalk stubs. This commercial subdivision will have a paved road ending in a cul-de-sac and a storm water management pond (SWMP).

FIELD WORK

In order to investigate the subsurface conditions at the site, six (6) test pits were excavated at the locations shown on Drawing No. 1, Test Pit Location Plan. The test pits were excavated by a rubber-tired backhoe on March 21, 2006 to depths of 2.1 to 3.4 m below existing grades. This work was under the supervision of a soils technologist who logged the subsurface profiles and monitored the groundwater conditions.

Due to consistent cave-ins caused by perched and groundwater conditions, the excavations at Test Pits 1, 3, 4 and 5 were aborted at shallower depths.

The location and elevation of the test pits were surveyed by the client and was supplied to this office for use in this report.

SITE CONDITION

The site has a plan area of 6.4 ha and is located on the northeast corner of Highway 9 and Bruce County Road 1 in the Town of Clifford, Ontario. Presently, the site is an uncultivated farmland that is bare of vegetation with corn stalk stubs.

Topographically, the site is relatively flat, with minor undulations and two knolls. The ground surface elevations ranged from 96.12 to 99.95 m at the test pit locations, sloping downward in an easterly direction.

SUBSURFACE CONDITION

The subsurface conditions encountered in the test pits are detailed on the Test Pit Log Sheets, Enclosures 1 to 6 of this report. The following notes are intended to amplify and comment on the subsurface data.

Topsoil was contacted at the ground surface of all six (6) test pits with measured thicknesses of 300 to 460 mm.

The predominant inorganic soil deposit encountered at the site is a compact to dense, brown sand and silt till. Minor layers of sand and gravel, silt sand and sandy silt were encountered at Test Pits 3, 4, 5 and 6. It is noted that the sand and gravel deposit was contacted at Test Pits 4 and 5, with measured thickness of 0.74 and 0.94 m respectively. Typical grain size distribution of the sand and silt till and the sand and gravel deposit are provided in Enclosures 7 and 8.

The sand and silt till exhibited typically moist to wet moisture condition. The sand and gravel and the sandy silt and silty sand layers are water-bearing and had high moisture contents which revealed moist to saturated moisture condition..

GROUNDWATER CONDITION

Groundwater conditions were monitored during and following completion of the test pit excavations. All six (6) test pits encountered minor to heavy seepage flow during excavation, between depths of 1.2 and 2.0 m below ground surface. This condition could be the result of the spring thaw and recent rainfall.

It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.

DISCUSSION AND RECOMMENDATIONS

Site Grading

Where the existing grades are to be raised, the fill should be placed and compacted in accordance with the following general procedures in order to support the future building foundations and roadways:

- 1) All topsoil, fill, organic and deleterious materials should be stripped prior to placing fill;
- 2) The exposed subgrade surface is to be thoroughly recompact by large heavy compaction equipment (10 tonne recommended) and inspected by qualified geotechnical personnel. Any loose or soft areas identified should be excavated to the level of competent soil;
- 3) The required grades can then be achieved by placing excavated on-site soils (cut from higher areas), in maximum 300 mm thick lifts and compact them to a minimum of 98% SPMDD within the building envelopes and to 95% SPMDD within the roadways;
- 4) The engineered fill must be placed such that the fill pad extends horizontally outward and downward from the building foundations or roadways at a 45° angle to the approved native earth subgrade;
- 5) All engineered fill placement and compaction operations must be supervised by qualified geotechnical personnel to approve fill material and ensure the specified degree of compaction has been achieved.

Building Foundations

Based on the results of the test pits, the native soil deposits at the site are suitable to support the proposed buildings. Conventional strip or spread footing foundations can be founded onto the native compact inorganic soil deposits and can be designed to an allowable net soil bearing pressure of 150 kPa (3000 psf).

The approved engineered fill, placed and compacted to the above recommended procedures, can support a soil bearing pressure of 150 kPa (2000 psf).

Exterior footings and footings in unheated portions of the building should be provided with a soil cover of not less than 1.2 m for adequate frost protection. Spacing between adjacent footing steps should not be steeper than 10H to 7V.

occur during winter conditions, care must be taken to ensure no frozen backfill is placed.

The native soils and engineered fill exposed at these depths are considered to be Type 3 soils in accordance with the latest Occupational Health and Safety Act. Excavations in the Type 3 soils are expected to remain stable during the construction period provided that side slopes are cut to 1H:1V from the bottom of the excavation and suitably protected from erosion processes. Below the groundwater table and where perched condition is encountered, the groundwater must be adequately controlled. Otherwise, the side slopes should be cut to more stable configurations of 2H to 1V or flatter.

In general, the construction should be carried out in the drier summer months when the groundwater table is expected to be lower. This will reduce the requirements for groundwater control and facilitate backfill and road construction.

Excavations into the saturated sand and gravel and silty sand deposits could be more problematic. The groundwater inflow could be moderate to high and will require pumping from closely spaced, filtered sump pits. The trench will need to be wider than normal to locate the sump pits in order to intercept and drain the groundwater.

Lateral Earth Pressure

Unbalanced foundation walls and retaining walls should be designed to resist the lateral earth pressure acting against these walls. The following formula may be used for these calculations.

$$P = K(\gamma H + q)$$

where:

P =	lateral earth pressure	kPa
K =	earth pressure coefficient, 0.5 for non-yielding foundation wall earth pressure coefficient, 0.3 for yielding retaining wall	
γ =	unit weight of granular backfill (imported sand and gravel)	22 kN/m ³
H =	unbalanced height of wall	m
q =	surcharge load at ground surface	kPa

Roadway Pavement

Based on the results of the field work, the predominant subgrade materials at the site will consist of silt to sandy silt.

The following table summarizes the recommended pavement component thicknesses based upon the anticipated traffic loading and a silt earth subgrade:

Component	Heavy Duty Pavement (Access Routes) (mm)	Light Duty Pavement (Car Parking Areas) (mm)
Asphaltic Concrete	90 mm	75
Granular "A" Base	150 mm	150
Granular "B" Sub-base	350 mm	250

The pavement design considers that road construction will be carried out during the drier time of the year and that the subgrade is stable, not heaving under construction equipment traffic. If the subgrade is wet or unstable, additional granular sub-base may be required.

After stripping the topsoil and any deleterious materials and cut to the proposed subgrade level, the exposed subgrade should be proof-rolled. Any soft or unstable areas detected during the proof-rolling process should be removed and can be replaced with on-site non-organic soils or imported granular fills. The fill should be within 3% of its optimum moisture content and be thoroughly compacted in thin lifts to at least 95% SPMDD.

The base and sub-base materials should be produced in accordance with the current OPSS Specifications, and placed and uniformly compacted to at least 100% SPMDD.

The asphaltic concrete should be placed and compacted in accordance with OPSS Form 310 and to between 92 and 97.5% of the Marshall Density (MRD). Frequent in situ density testing by this office should be carried out to verify that the specified degree of compaction is being achieved and maintained.

Infiltration Rate for SWMP

Based on the laboratory results and our past experience, the coefficient of permeability and infiltration rate of the encountered inorganic soil types are estimated in the following table:

MATERIAL	PERMEABILITY (K) (cm/sec)	Infiltration Rate (mm/hr)
Sand and Silt Till (See Enclosure 7)	1×10^{-5}	0.036
Sand and Gravel, some silt (See Enclosure 8)	1×10^{-2}	360

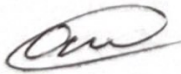
In light the low permeability soils and the high groundwater table at the site, the site is considered not feasible for storm water infiltration.

CLOSURE

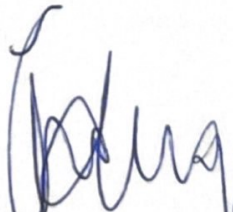
The Limitations of Report, as quoted in Appendix "A", is an integral part of this report.

We trust that the information presented herein is sufficient for your requirements. Should you have any questions regarding this report, please contact our office at your convenience.

Respectfully yours,
CHUNG & VANDER DOELEN ENGINEERING LTD.


Augustine A. Walker, C.E.T.
Senior Technologist

encl.


Eric Y. Chung, M. Eng., P. Eng.
Principal Engineer



CHUNG & VANDER DOELEN ENGINEERING LTD.

APPENDIX "A"

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. CHUNG & VANDER DOELEN ENGINEERING LIMITED accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report does not reflect the environmental issues or concerns unless otherwise stated in the report. The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

FILE No: 06-3-K3

TEST PIT No. 1

Enclosure No.: 1

Sheet 1 of 1



Client: **Henderson Paddon & Associates Limited**

Project: **Proposed Commercial Subdivision**

Location: **Highway 9 & Bruce County Road. 1, Clifford**

EQUIPMENT DATA

Machine: **Excavator**Method: **Excavator**

Size:

Date: **Mar 21 06 TO Mar 21 06**

SOIL LITHOLOGY			SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS	
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30					
Ground Elevation: 99.46 m																
99.00 0.46	TOPSOIL 460 mm															
	compact to dense brown SAND AND SILT TILL some gravel occasional boulders moist to wet	0.5														
97.36 2.10	End of Test Pit	2.0														
		2.5														
		3.0														
		3.5														

test pit side walls caved in, seepage encountered

major ponding at bottom of test pit after 2 hrs.

could not excavate deeper due to cave-in of side walls

ENGINEER: **Eric Chung**

CHUNG & VANDER DOELEN
ENGINEERING LTD.

280 Victoria Street North, Unit 8

Kitchener, Ontario N2H 5E2

ph. (519) 742-8979, fx. (519) 742-7739

CVD TEST PIT 06-3-K3 CLIFFORD GPJ CVD ENG GDT 6/1/06



Client: Henderson Paddon & Associates Limited

Project: Proposed Commercial Subdivision

Location: Highway 9 & Bruce County Road. 1,
Clifford

EQUIPMENT DATA

Machine: Excavator

Method: Excavator

Size:

Date: Mar 21 06 TO Mar 21 06

SOIL LITHOLOGY			SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS	
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W _w W _L					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30					
Ground Elevation: 96.12 m																
95.82 0.30	TOPSOIL 300 mm															
	compact to dense brown SAND AND SILT TILL some gravel occasional boulders moist to wet	0.5													0.5	
		1.0													1.0	
		1.5		1	BS										1.5	test pit side walls caved in, seepage encountered
		2.0													2.0	
92.92 3.20	End of Test Pit	3.0												3.0	minor ponding at bottom of test pit after 2 hrs.	
		3.5												3.5		

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Client: **Henderson Paddon & Associates Limited**Project: **Proposed Commercial Subdivision**Location: **Highway 9 & Bruce County Road. 1,
Clifford**

EQUIPMENT DATA

Machine: **Excavator**Method: **Excavator**

Size:

Date: **Mar 21 06 TO Mar 21 06**

SOIL LITHOLOGY				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30					
98.11 0.46	TOPSOIL 460 mm															
		0.5														
97.17 1.40	compact to dense brown SAND AND SILT TILL some gravel occasional boulders moist to wet	1.0														
		1.5		1	BS											
95.67 2.90	compact to dense brown SILTY SAND some gravel wet to saturated	2.0														water encountered
		2.5														
	End of Test Pit	3.0														major ponding at bottom of test pit after 2 hrs.
		3.5														could not excavate deeper due to cave-in of side walls

ENGINEER: **Eric Chung****CHUNG & VANDER DOELEN
ENGINEERING LTD.**

280 Victoria Street North, Unit 8

Kitchener, Ontario N2H 5E2

ph. (519) 742-8979, fx. (519) 742-7739

FILE No: 06-3-K3

TEST PIT No. 4

Enclosure No.: 4

Sheet 1 of 1



Client: Henderson Paddon & Associates Limited

Project: Proposed Commercial Subdivision

Location: Highway 9 & Bruce County Road. 1,
Clifford

EQUIPMENT DATA

Machine: Excavator

Method: Excavator

Size:

Date: Mar 21 06 TO Mar 21 06

SOIL LITHOLOGY			SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS	
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30					
Ground Elevation: 97.57 m																
	TOPSOIL 300 mm															
97.27 0.30																
	compact, brown SANDY SILT some gravel wet	0.5														
96.81 0.76																
	compact to dense brown SAND AND GRAVEL some silt moist to saturated	1.0		1	BS											
96.07 1.50																
	compact to dense brown SAND AND SILT TILL some gravel occasional boulders moist to wet	2.0		2	BS											
		2.5														
		3.0														
94.17 3.40	End of Test Pit	3.5														

ENGINEER: Eric Chung

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ENGINEERING LTD.

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Kitchener, Ontario N2H 5E2

ph. (519) 742-8979, fx. (519) 742-7739

CVD TEST PIT 06-3-K3 CLIFFORD.GPJ CVD_ENG.GDT 6/1/06

FILE No: 06-3-K3

TEST PIT No. 5

Enclosure No.: 5

Sheet 1 of 1



Client: Henderson Paddon & Associates Limited

Project: Proposed Commercial Subdivision

Location: Highway 9 & Bruce County Road. 1,
Clifford

EQUIPMENT DATA

Machine: Excavator

Method: Excavator

Size:

Date: Mar 21 06 TO Mar 21 06

SOIL LITHOLOGY			SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS	
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30					
Ground Elevation: 98.69 m																
98.23 0.46	TOPSOIL 460 mm															
	compact to dense brown SAND AND GRAVEL some silt moist to saturated	0.5													0.5	
97.19 1.50		compact to dense brown SAND AND SILT TILL some gravel occasional boulders moist to wet	1.0												1.0	
	1.5													1.5	▼ water encountered	
95.69 3.00	End of Test Pit	2.0		1	BS									2.0		
		2.5												2.5		
		3.0												3.0	major ponding at bottom of test pit after 2 hrs.	
		3.5												3.5	could not excavate deeper due to cave-in of side walls	

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ph. (519) 742-8979, fx. (519) 742-7739



Client: Henderson Paddon & Associates Limited

Project: Proposed Commercial Subdivision

Location: Highway 9 & Bruce County Road. 1,
Clifford

EQUIPMENT DATA

Machine: Excavator

Method: Excavator

Size:

Date: Mar 21 06 TO Mar 21 06

SOIL LITHOLOGY			SAMPLE		SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L			
Ground Elevation: 99.95 m							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30			
	TOPSOIL 460 mm													
99.49 0.46		0.5											0.5	
	compact, brown SANDY SILT some gravel wet													
99.19 0.76		1.0											1.0	drainage tile encountered
	compact to dense brown SAND AND GRAVEL some silt moist to saturated													
98.45 1.50		1.5											1.5	
	compact to dense brown SAND AND SILT TILL some gravel occasional boulders moist to wet												2.0	minor seepage encountered
		2.5											2.5	
		3.0											3.0	
96.75 3.20	End of Test Pit													no free water at completion
		3.5											3.5	

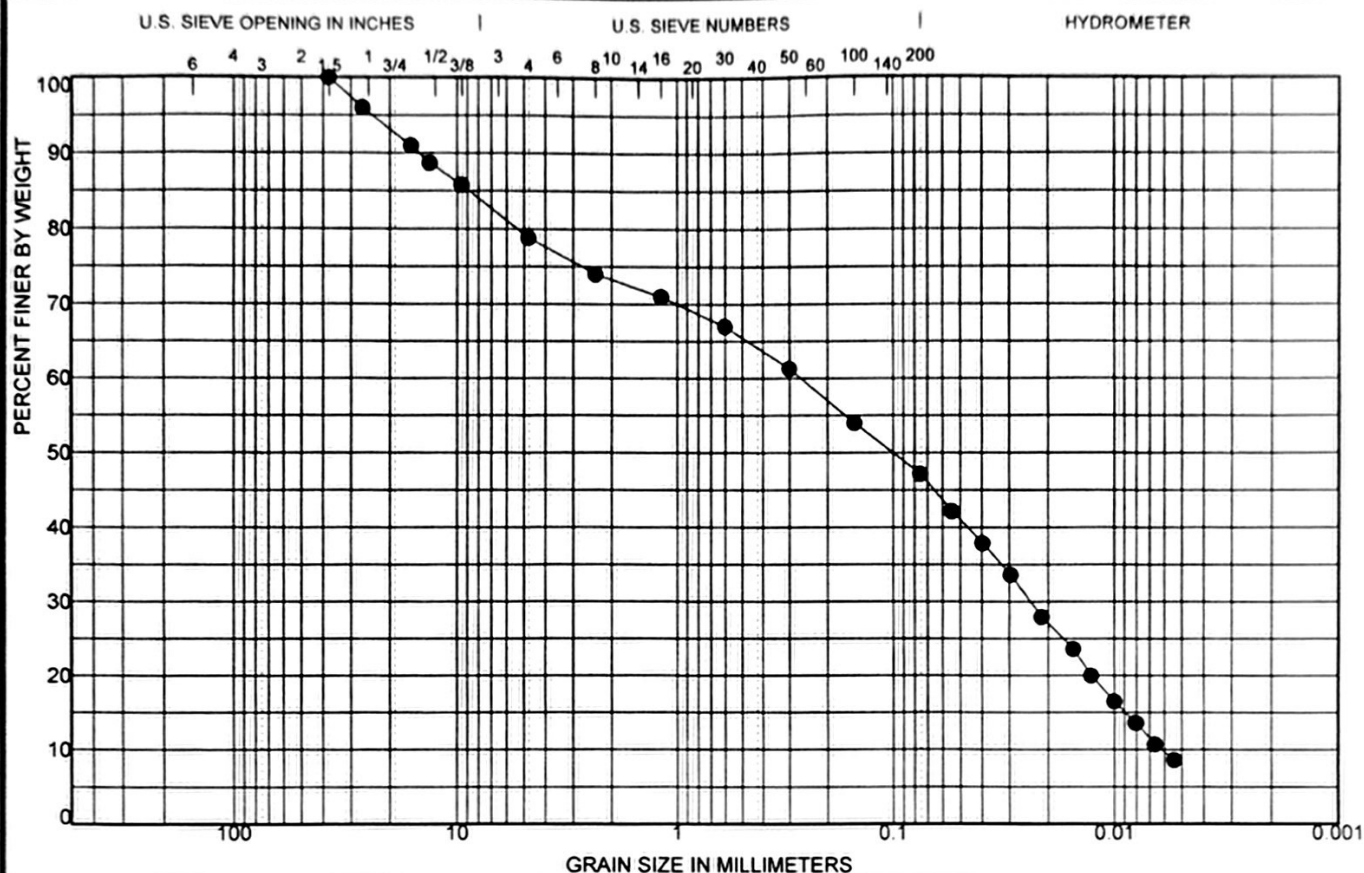
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification				LL	PL	PI	Cc	Cu
LAB. NO.: 3018									0.35	42.96
FM	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
	37.5	0.265	0.024	0.006	21.2	31.6		47.2		

Type of Material: Sand and Silt Till

Sample No.

Source:

Sampled From: Test Pit 2, Sample 1, 1.2 to 1.5 m depth

Date: 06/01/2006

Client: Henderson Paddon & Associates Limited

Contractor:

Sampled By: GW

Date Sampled: 03/22/2006

Tested By: DF

Date Tested: 03/27/2006

SIEVE SIZES _{mm}	PERCENT PASSING	No Specifications
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CHUNG & VANDER DOELEN
ENGINEERING LTD.
280 Victoria Street North, Unit 8
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Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: cvd@bellnet.ca

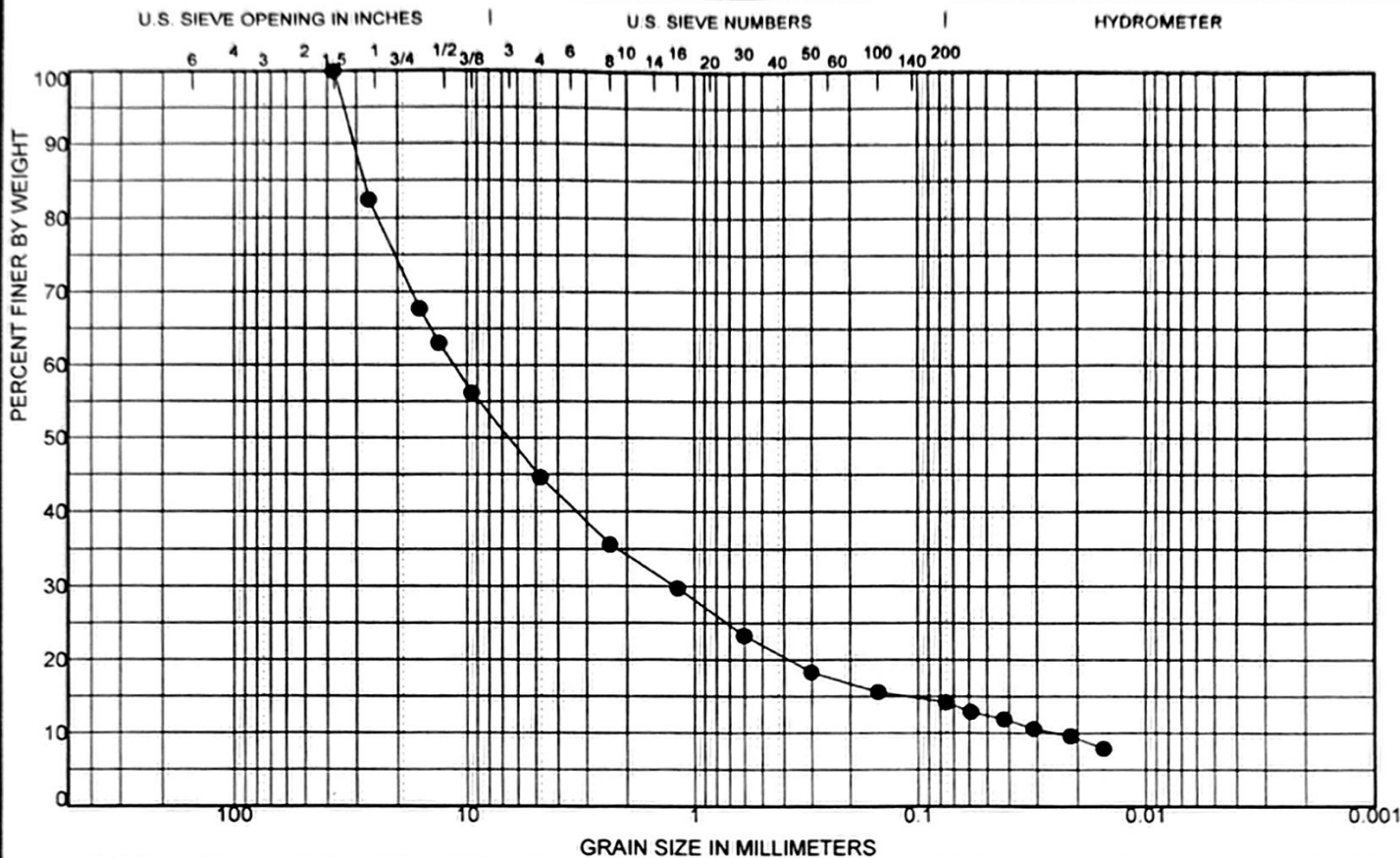
GRAIN SIZE DISTRIBUTION

Project: Proposed Commercial Subdivision

Location: Highway 9 & Bruce County Road. 1, Clifford

File No.: 06-3-K3

Enclosure No.: 7



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification				LL	PL	PI	Cc	Cu
LAB. NO.: 3019									5.29	461.30
FM	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
	37.5	11.417	1.222	0.025	55.4	30.4		14.2		

Type of Material: Sand and Gravel, some silt

Sample No.

Source:

Sampled From: Test Pit 4, Sample 1, 1.0 to 1.3 m depth

Date: 06/01/2006

Client: Henderson Paddon & Associates Limited

Contractor:

Sampled By: GW

Date Sampled: 03/22/2006

Tested By: DF

Date Tested: 03/27/2006

SIEVE
SIZES_{mm}

PERCENT
PASSING

No
Specifications

CHUNG & VANDER DOELEN
ENGINEERING LTD.

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Kitchener, Ontario N2H 5E2

Telephone: 519-742-8979

Fax: 519-742-7739

e-mail: cvd@bellnet.ca



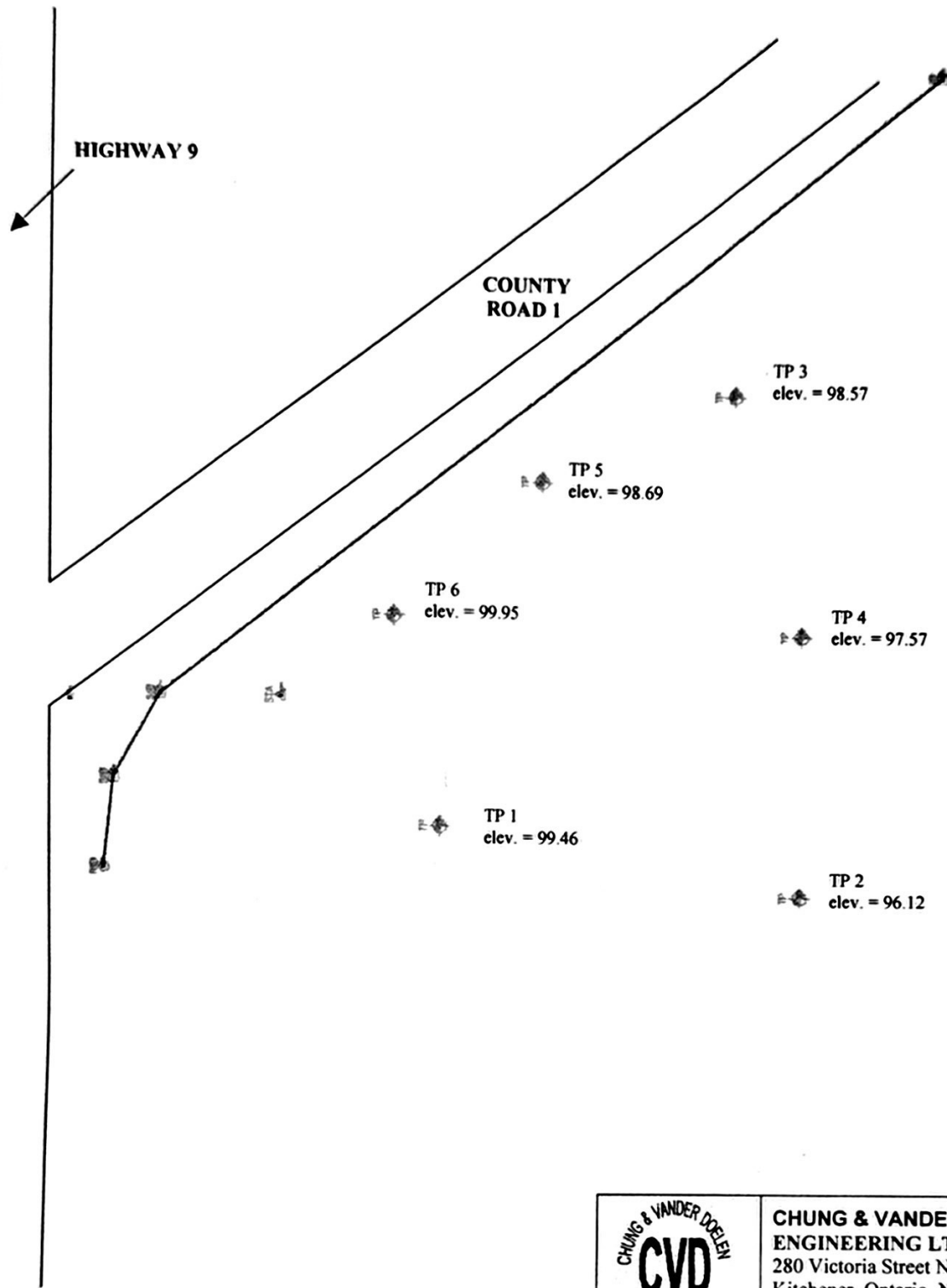
GRAIN SIZE DISTRIBUTION

Project: Proposed Commercial Subdivision

Location: Highway 9 & Bruce County Road. 1, Clifford

File No.: 06-3-K3

Enclosure No.: 8



Legend:

▼ = Test Pit Location



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Phone: (519) 742-8979 Fax: (519) 742-7739
e-mail: cvd@bellnet.ca

TEST PIT LOCATION PLAN

HWY. 9 AT
BRUCE COUNTY RD. 1
CLIFFORD, ONTARIO.

Date: June 2006

Scale: 1:2000

File No.: 06-3-K3

Drawing: 1

(b) AADT GROWTH RATE

AADT Growth

