

**Foundation Investigation and Design Report  
Noise Barrier Wall Extension  
Hwy #401 Eastbound  
Approaching Choate Road Overpass  
W.P. 274-96-00 (B)  
Agreement No. 4005-A-000103  
Ministry of Transportation, Ontario  
Eastern Region**

**November 2000**

**Terraspec Project No. 00-6-5450**

**TERRASPEC ENGINEERING INC.  
GEOTECHNICAL ENGINEERS**

973 Crawford Drive  
Peterborough, Ontario  
K9J 3X1  
Phone: 705-743-7880  
Fax: 705-743-9592

## TABLE OF CONTENTS

### **Part A**      **Foundation Investigation**

1.0	Introduction.....	2
2.0	Site Description.....	2
3.0	Investigation.....	2
4.0	Description of Subsurface Conditions.....	2

### **Part B**      **Soil Parameters for Foundation Design**

5.0	Soil Parameters and Recommendations.....	5
-----	--	---

## APPENDICES

Borehole Logs and Laboratory Test Data

Drawing No. 1

**Part A**  
**Foundation Investigation**  
**Noise Barrier Wall**  
**W.P. 274-96-00**

## **1.0 Introduction**

Terraspec Engineering Inc. was retained by The Greer Galloway Group Inc. to investigate subsoil conditions and provide soils information for the design of a noise barrier wall extension. The wall extension will be included in the construction contract being prepared for W.P. 274-96-00, which consists of median widening and rehabilitation of Hwy 401 between County Roads 2 and 28, near the Town of Port Hope.

## **2.0 Site Description**

The project site is located on Hwy 401 eastbound, approximately 300m west of the Choate Road overpass structure. The existing noise barrier wall along Hwy 401 eastbound utilizes a steel post and panelling design and is located near the limit of the right-of-way, to the south of the highway. The existing wall ends approximately 300m west of the Choate Road structure. The extension is proposed to be located on the right edge of outside shoulder, using a similar wall design which incorporates a concrete barrier at its base. The noise barrier wall will extend easterly 300m to the west limit of the Choate Road structure. The wall height is anticipated to be a maximum of 5m.

## **3.0 Investigation**

On October 12, 2000, six boreholes were placed along the proposed alignment of the noise barrier wall extension, at roughly 50m intervals, in accordance with the existing site accessibility. The boreholes were located on the existing gravel shoulder of Hwy 401 eastbound, on the embankment that approaches the Choate Road Bridge. Each borehole was extended to a depth of 5.0m. Subsoil types and conditions were recorded at each borehole. Standard Penetration Testing (SPT) was conducted at 1.5m intervals within each borehole. Standpipes were not installed as groundwater was not encountered in any of the boreholes. Representative samples of the subsoils were returned to the Terraspec laboratory for classification testing. The northing and easting references and elevations of the boreholes were determined by The Greer Galloway Group Inc. The borehole locations have been listed as follows, and are also indicated on Drawing No. 1.

Borehole	Station	Northing	Easting	Elevation
1	22+483	4870342.25	401115.73	119.6
2	22+537	4870352.83	401168.76	116.9
3	22+587	4870361.71	401217.99	115.4
4	22+639	4870370.69	401269.23	113.1
5	22+680	4870377.25	401309.71	111.8
6	22+721	4870381.45	401350.53	110.4

## **4.0 Description of Subsurface Conditions**

The project lies within the physiographic region known as the Iroquois Plain. This region is characterized by lacustrine deposits of sand and silt till materials. The overburden within the

project site consisted mainly of a silty sand till material. The subsoils within this area are relatively well-drained.

All boreholes were located on the outside shoulder of the highway. Boreholes #1 to #5 were located to the north of the existing steel cable and wood post guiderail. These boreholes encountered previously placed granular shouldering materials near the surface. Borehole #6 was located on the south side of existing steel cable and wood post guiderail, hence a layer of topsoil was encountered on the surface.

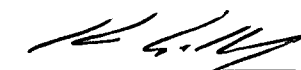
The crushed gravel with silt material on surface was originally Granular "A" base material. This material was observed to be silt contaminated and would not meet Granular "A" gradation requirements. The material directly below the crushed gravel consisted of a medium sand and gravel with silt, which was originally a Granular "B" Type 1 subbase material. This material typically had a slightly elevated fines content at 9%, hence it does not meet Granular "B" Type 1 gradation requirements. The average thickness of the crushed gravel with silt was 140mm. The average thickness of the medium sand and gravel with silt was 500mm. The medium sand and gravel with silt was found to be in a moist and compact state.

Below the granular materials, a silty sand trace gravel material was encountered, which extended to the end of the borehole depth at each borehole location. This material is typical of the silty sand till deposits in the surrounding area, and contained 10 to 20% gravel sized particles. At Borehole #1, this material was classified as a silty sand with gravel, due to a slightly higher gravel content. The sand content was typically 50 to 70%, and the fines content ranged from 20 to 40%. During the drilling operations, it was evident that traces of cobbles were present within the silty sand till material. Based on the gradation data, the silty sand till material can be classified as having a low susceptibility to frost heaving. This material was typically found to be in a moist and dense condition to a depth of 3.0m, and very dense from a depth of 3.0m to the end of each borehole. Individual N values at 1.5m intervals have been recorded in the borehole log data.

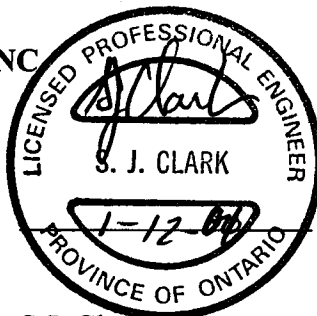
No wet soil conditions or groundwater was encountered within any of the boreholes, and no bedrock materials were encountered within any of the boreholes.

Prepared by:

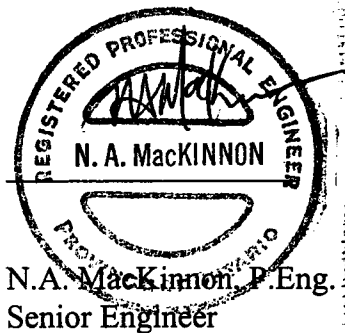
**TERRASPEC ENGINEERING INC**  
**GEOTECHNICAL ENGINEERS**



Shane Galloway, B.A.  
Designer



S.J. Clark, P.Eng.  
Senior Engineer



N.A. MacKinnon, P.Eng.  
Senior Engineer

**Part B**  
**Soil Parameters for Foundation Design**  
**Noise Barrier Wall**  
**W.P. 274-96-00**

## **5.0 Soil Parameters and Recommendations**

The existing grade line of the shoulder and the existing storm drain system approaching the Choate Road overpass are anticipated to provide sufficient surface drainage of the roadway. The crushed gravel with silt material present on the surface of the shoulder is silt contaminated and should be replaced with new OPSS Granular "A" material. The subsurface medium sand and gravel with silt material appears to be providing acceptable lateral subdrainage. This section of the highway is anticipated to have catch basins with lateral ditch outlets installed along the length of the new noise barrier wall, since an integral concrete barrier wall will be placed at the base of the new noise barrier. The new noise barrier wall is anticipated to consist of a proprietary system which is typically constructed by boring a 460mm diameter footing excavation, inserting hot dip galvanized steel posts, and concreting the posts with a 20MPa concrete mix. The embedment depth for the steel posts will be determined by the proprietary system designer. Since the concrete footings for the steel posts will be installed within 1m from a downward slope of 3:1 or steeper, a minimum 0.5m increase in embedment depth is anticipated to be required.

For placement of the integral concrete barrier wall, it is recommended that the existing crushed gravel materials present on surface be removed to a minimum depth of 300mm and replaced with a minimum 300mm of new OPSS Granular "A" material. Compaction of granular materials should be as per OPSS 501, Method A, utilizing a compaction standard of 100% of Standard Proctor Maximum Dry Density.

As the subgrade soils encountered on site consist of sand and gravel and silty sand till materials, shear strength values have not been listed. Shear strength measurements within the till materials yielded values greater than 200kPa. The following SPT N values, angle of internal friction, and unit weight values have been listed for the soil types encountered at the borehole locations.

	<b>BH1</b>	<b>BH2</b>	<b>BH3</b>	<b>BH4</b>	<b>BH5</b>	<b>BH6</b>
N value @1.5m	44	23	29	33	28	34
N value @3.0m	100	75	69	57	48	48
N value @4.6m	120	97	85	124	66	77

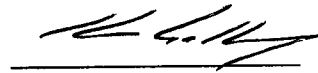
	<b>Angle of Friction</b>	<b>Unit Weight (kN/m<sup>3</sup>)</b>
Medium Sand and Gravel with Silt	32°	21
Silty Sand with/trace Gravel	31°	21

For the placement of new Granular "A" materials, the following parameters are recommended.

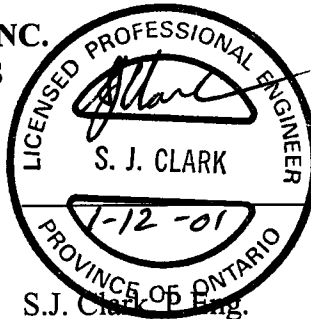
	<b>Angle of Friction</b>	<b>Unit Weight (kN/m<sup>3</sup>)</b>
New OPSS Granular "A"	35°	22

Prepared by:

**TERRASPEC ENGINEERING INC.  
GEOTECHNICAL ENGINEERS**



Shane Galloway, B.A.  
Designer



S.J. Clark, P.Eng.  
Senior Engineer



N.A. MacKinnon, P.Eng.  
Senior Engineer



## **BOREHOLE LOGS AND LABORATORY TEST DATA**

**Noise Barrier Wall Extension  
Hwy #401 Eastbound Approaching Choate Road Overpass  
W.P. 274-96-00  
Ministry of Transportation, Ontario  
Eastern Region**

**Terraspec Engineering Inc. Project No. 00-6-5450**

---

### **Notes**

1. The boundaries between strata have been established only at borehole locations.
2. Soils are described according to the MTO Classification System.
3. Offsets are from the existing EP.
4. Dimensions are in millimetres and metres.

### **ABBREVIATIONS**

Asph	-	asphalt
Blds	-	boulders
Blk	-	black
Br	-	brown
BR	-	bedrock
Cl	-	clay(ey)
Co	-	coarse
Cob	-	cobbles
Cr	-	crushed
F	-	fine
Gr	-	gravel(ly)
Med	-	medium
NFP	-	no further progress
Org	-	organic
Sa	-	sand(y)
Sat	-	saturated
Si	-	silt(y)
So	-	some
Stn	-	stones
Tps	-	topsoil
Tr	-	trace
w	-	with
LSFH	-	Low Susceptibility to Frost Heave
MSFH	-	Moderate Susceptibility to Frost Heave
HSFH	-	High Susceptibility to Frost Heave
Cu	-	Apparent Cohesion (kPa)
W <sub>L</sub>	-	Liquid Limit
W <sub>P</sub>	-	Plastic Limit
I <sub>P</sub>	-	Plastic Index
W	-	Moisture Content
N	-	SPT Blowcount per 0.3m

BH1 N=4870342.25 E=401115.73 Station 22+483 3.3m Rt

0 - 150 Cr Gr w Si

150 - 710 Br Med Sa & Gr w Si - moist, compact  
@0.5m

S1

Sieve %Passing

26.5mm 100

19.0mm 94.6

16.0mm 90.1

13.2mm 85.3

9.50mm 72.6

4.75mm 52.4

2.36mm 44.7

1.18mm 38.2

600um 32.3

300um 16.7

150um 11.8

75um 8.9

SP-SM

W 5.3

710 - 5.0 Br Si Sa w Gr - moist, compact to dense  
@1.5m N=44

S2

Sieve %Passing

13.2mm 100

9.50mm 96.8

4.75mm 84.8

2.36mm 81.0

1.18mm 76.3

600um 70.5

300um 56.6

150um 41.3

75um 28.7

SM

W 5.8

- dry, very dense @3.0m

- Tr Cob @3.0m

@3.0m N=100

S3

Sieve %Passing

16.0mm 100

13.2mm 98.7

9.50mm 89.2

4.75mm 78.4

2.36mm 73.5

1.18mm 69.0

600um 64.1

300um 52.9

150um 40.5

75um 28.8

SM

W 6.0

@4.6m N=120

S4

Sieve %Passing

13.2mm 100

9.50mm 95.9

4.75mm 82.8  
 2.36mm 78.3  
 1.18mm 72.2  
 600um 67.6  
 300um 51.2  
 150um 37.4  
 75um 18.8  
 SM  
 W 5.1

5.0m End of Borehole

**BH2** N=4870352.83 E=401168.76 Station 22+537 2.5m Rt

0 - 150 Cr Gr w Si  
 150 - 450 Br Med Sa & Gr w Si - moist, compact  
 450 - 5.0 Br Si Sa Tr Gr - moist, compact

@1.5m N=23 S5  
 @3.0m N=75 S6

Sieve %Passing  
 13.2mm 100  
 9.50mm 99.0  
 4.75mm 97.5  
 2.36mm 95.7  
 1.18mm 92.9  
 600um 83.3  
 300um 45.8  
 150um 29.6  
 75um 21.0  
 SM  
 W 5.9

- moist, very dense @3.0m  
 - So Cob @4.3m  
 @ 4.6m N=97

S7  
Sieve %Passing  
 13.2mm 100  
 9.50mm 99.0  
 4.75mm 97.8  
 2.36mm 96.4  
 1.18mm 93.5  
 600um 82.8  
 300um 47.1  
 150um 30.3  
 75um 22.2  
 SM  
 W 5.1

5.0m End of Borehole

**BH3** N=4870361.71 E=401217.99 Station 22+587 2.5m Rt  
 0 - 130 Cr Gr w Si  
 130 - 610 Br Med Sa & Gr w Si - moist, compact  
 @300

S8  
Sieve %Passing  
 37.5mm 100  
 26.5mm 96.3  
 19.0mm 90.4  
 16.0mm 86.2  
 13.2mm 81.1  
 9.50mm 71.0  
 4.75mm 56.3  
 2.36mm 48.7  
 1.18mm 42.5  
 600um 36.3  
 300um 17.8  
 150um 12.4  
 75um 9.2  
 SP-SM  
 W 3.4

610 - 5.0 Br Si Sa Tr Gr - moist, compact  
 -100mm gravel seam from 1.4 to 1.5m  
 @1.5m N=29 S9  
 - moist, very dense @2.4m  
 @3.0m N=69 S10

Sieve %Passing  
 13.2mm 100  
 9.50mm 99.8  
 4.75mm 97.6  
 2.36mm 95.2  
 1.18mm 91.6  
 600um 81.7  
 300um 38.8  
 150um 25.7  
 75um 17.7  
 SM  
 W 5.1  
 S11

@4.6m N=85

5.0m End of Borehole

**BH4** N=4870370.69 E=401269.23 Station 22+639 2.3m Rt  
 0 - 170 Cr Gr w Si  
 170 - 680 Br Med Sa & Gr w Si - moist, compact  
 680 - 5.0 Br Si Sa Tr Gr - moist, compact  
 - moist, dense @1.5m  
 @1.5m N=33 S12

Sieve %Passing  
 16.0mm 100  
 13.2mm 96.4  
 9.50mm 95.9  
 4.75mm 88.5  
 2.36mm 83.7

1.18mm 78.5  
600um 72.6  
300um 43.3  
150um 33.6  
75um 22.1  
SM  
W 7.6  
W<sub>L</sub> 13.5  
W<sub>p</sub> 7.2  
I<sub>p</sub> 6.3

- moist, very dense @3.0m

@3.0m N=57 S13

- dry, very dense @4.3m

@4.6m N=124 S14

Sieve %Passing

16.0mm 100  
13.2mm 92.5  
9.50mm 91.1  
4.75mm 86.2  
2.36mm 82.3  
1.18mm 76.6  
600um 69.4  
300um 41.2  
150um 31.2  
75um 19.1  
SM  
W 5.1

- So Cob from 3.9m to 4.7m

5.0m End of Borehole

**BH5** N=4870377.25 E=401309.71 Station 22+680 2.2m Rt

0 - 110 Cr Gr w Si

110 - 740 Br Med Sa & Gr w Si - moist, compact

740 - 5.0 Br Si Sa Tr Gr - moist, compact

@1.5m N=28 S15

Sieve %Passing

16.0mm 100  
13.2mm 95.1  
9.50mm 93.8  
4.75mm 87.2  
2.36mm 82.5  
1.18mm 76.2  
600um 69.7  
300um 41.1  
150um 32.4  
75um 20.8  
SM  
W 7.1

- moist, dense @2.5m

-Tr Cob @2.8m

@3.0m N=48 S16

- moist, very dense @4.0m

5.0m End of Borehole @4.6m N=66 S17

**BH6** N=4870381.45 E=401350.53 Station 22+721 3.5m Rt  
 0 - 300 Br Sa Tps  
 300 - 810 Br Med Sa & Gr w Si - dry, compact  
 810 - 5.0 Br Si Sa Tr Gr - moist, compact  
 @1.5m N=34  
 - moist, dense @3.0m  
 @3.0m N=48










S18  
Sieve %Passing  
 19.0mm 100  
 13.2mm 98.4  
 9.50mm 97.0  
 4.75mm 93.3  
 2.00mm 73.8  
 850um 71.3  
 425um 66.7  
 250um 59.6  
 106um 49.8  
 75um 40.1  
 SM LSFH  
 W 8.8

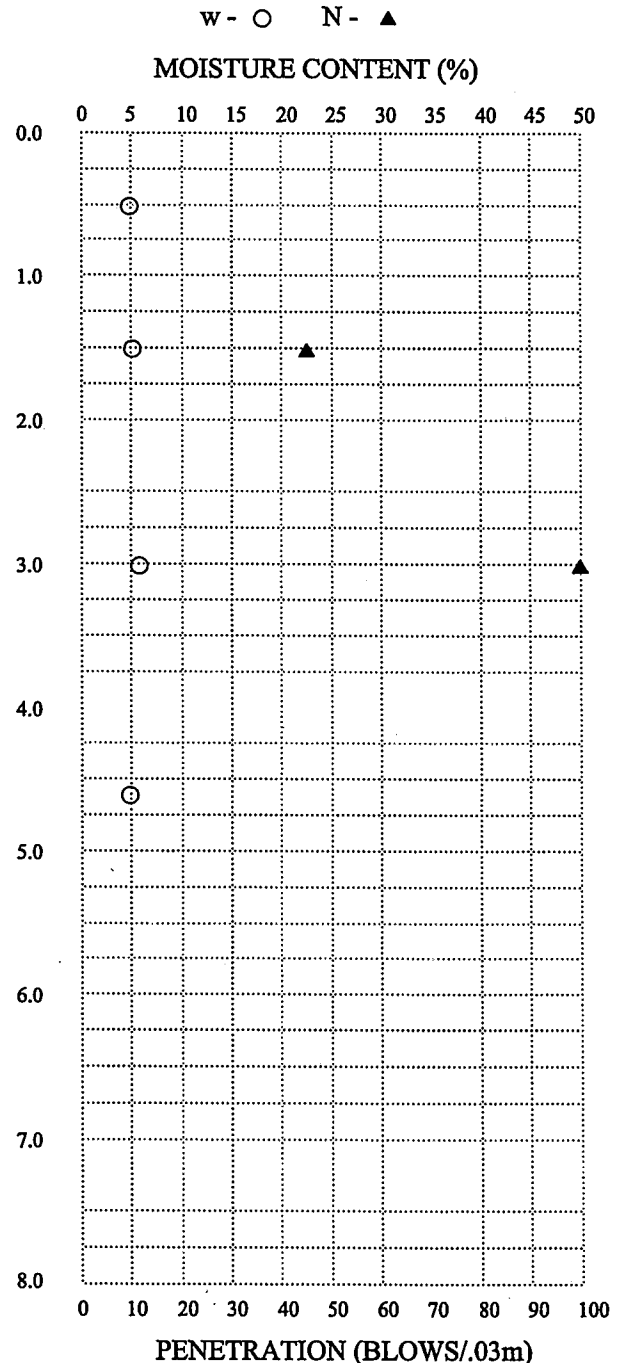
- moist, very dense @4.6m  
 @4.6m N=77 S19  
 5.0m End of Borehole

# BOREHOLE LOG NO: 1

PROJECT No.: 0065450  
 CLIENT: MINISTRY OF TRANSPORTATION  
 PROJECT: WP 274-96-00  
 LOCATION: N=4870342.25 E=401115.73  
 STATION: 22+483  
 DATE: OCT 12, 2000

**DRILLING DATA**  
 METHOD: CME  
 BIT SIZE AND TYPE: 130mm  
 DEPTH OF HOLE: 5.0m  
 TOTAL CORE RECOVERY:  
 TOP OF HOLE ELEVATION: 119.6m

E L E V (m)	D E P T H	P R O F I L E	DESCRIPTION	W A T E R	S A M P L E #	B L O W S
119.6						
119.45	.150		Cr Gr w Si			
			Br Med Sa & Gr w Si - moist, compact		S1	
118.89	.710					
			Br Si Sa w Gr moist, compact to dense		S2	44
						
					S3	100
			- dry, very dense@3.0m - Tr Cob@3.0m			
					S4	120
114.6	5.0					
			End of Borehole			






REMARKS:

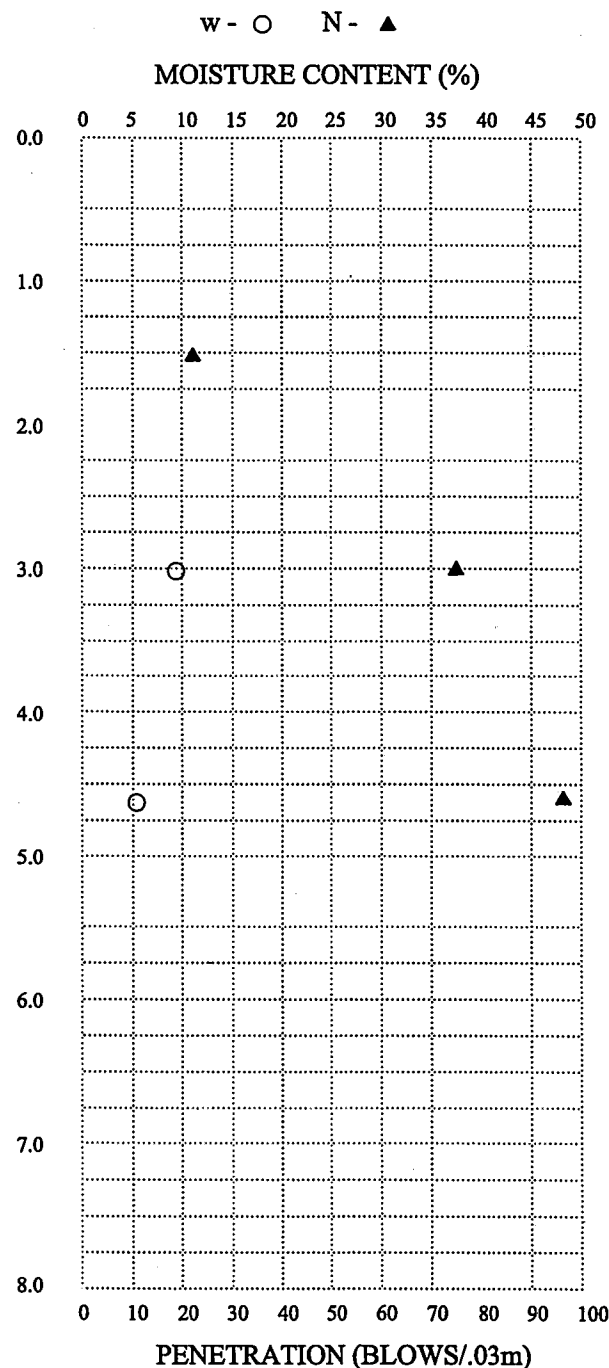
**terraspec engineering inc.**  
 geotechnical engineers and materials testing

# BOREHOLE LOG NO: 2

PROJECT No.: 0065450  
 CLIENT: MINISTRY OF TRANSPORTATION  
 PROJECT: WP 274-96-00  
 LOCATION: N=4870352.83 E=401168.76  
 STATION: 22+537  
 DATE: OCT 12, 2000

**DRILLING DATA**  
 METHOD: CME  
 BIT SIZE AND TYPE: 130mm  
 DEPTH OF HOLE: 5.0m  
 TOTAL CORE RECOVERY:  
 TOP OF HOLE ELEVATION: 116.9m

E L E V (m)	D E P T H	P R O F I L E	DESCRIPTION	W A T E R	S A M P L E #	B L O W S
116.9						
116.75	.150		Cr Gr w Si			
116.45	.450		Br Med Sa & Gr w Si moist, compact			
			Br Si Sa Tr Gr moist, compact			
			- moist, very dense @3.0m - So Cob @4.3m		S5	23
					S6	75
111.9	5.0				S7	97
			End of Borehole			



REMARKS:




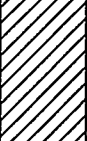
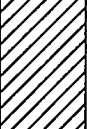
**terraspec engineering inc.**  
 geotechnical engineers and materials testing

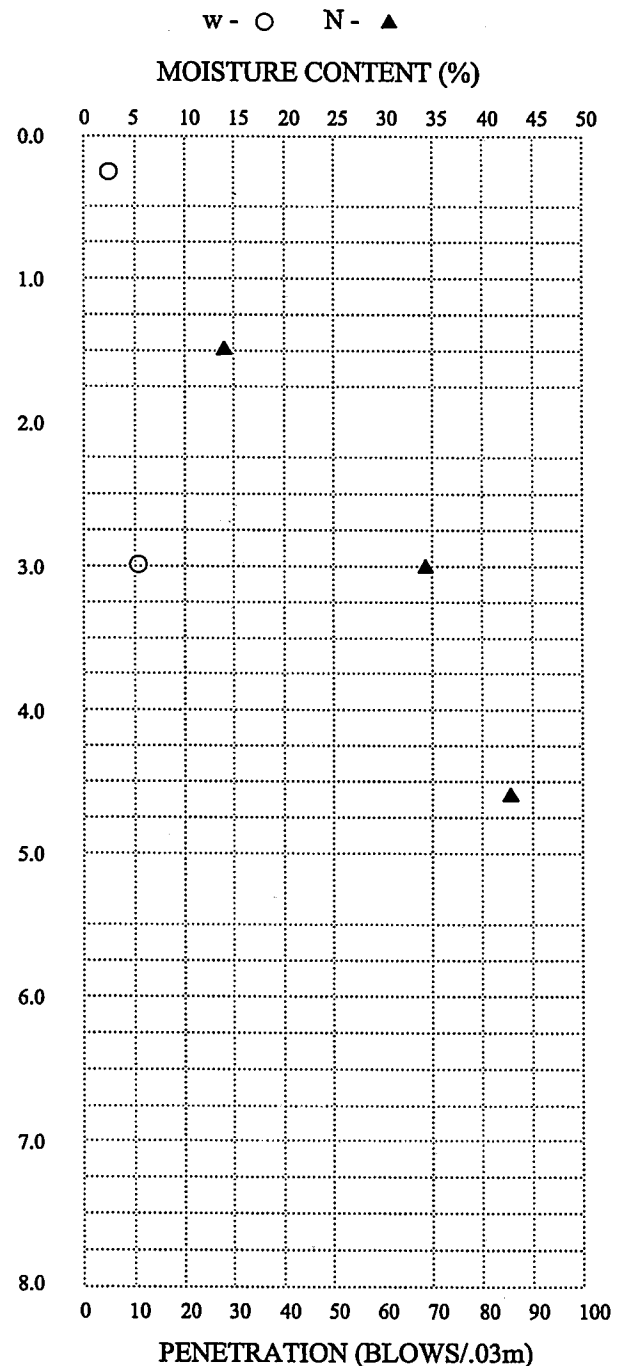


# BOREHOLE LOG NO: 3

PROJECT No.: 0065450  
 CLIENT: MINISTRY OF TRANSPORTATION  
 PROJECT: WP 274-96-00  
 LOCATION: N=4870361.71 E=401217.99  
 STATION: 22+587  
 DATE: OCT 12, 2000

**DRILLING DATA**  
 METHOD: CME  
 BIT SIZE AND TYPE: 130mm  
 DEPTH OF HOLE: 5.0m  
 TOTAL CORE RECOVERY:  
 TOP OF HOLE ELEVATION: 115.4m

E L E V (m)	D E P T H	P R O F I L E	DESCRIPTION	W A T E R	S A M P L E #	B L O W S
115.4						
115.27	.130		Cr Gr w Si			
			Br Med Sa & Gr w Si moist, compact		S8	
114.79	.610		Br Si Sa Tr Gr moist, compact			
			-100mm gravel seam from 1.4 to 1.5m		S9	29
			- moist, very dense @2.4m			
					S10	69
					S11	85
110.4	5.0					
			End of Borehole			



REMARKS:

**terraspec engineering inc.**  
 geotechnical engineers and materials testing

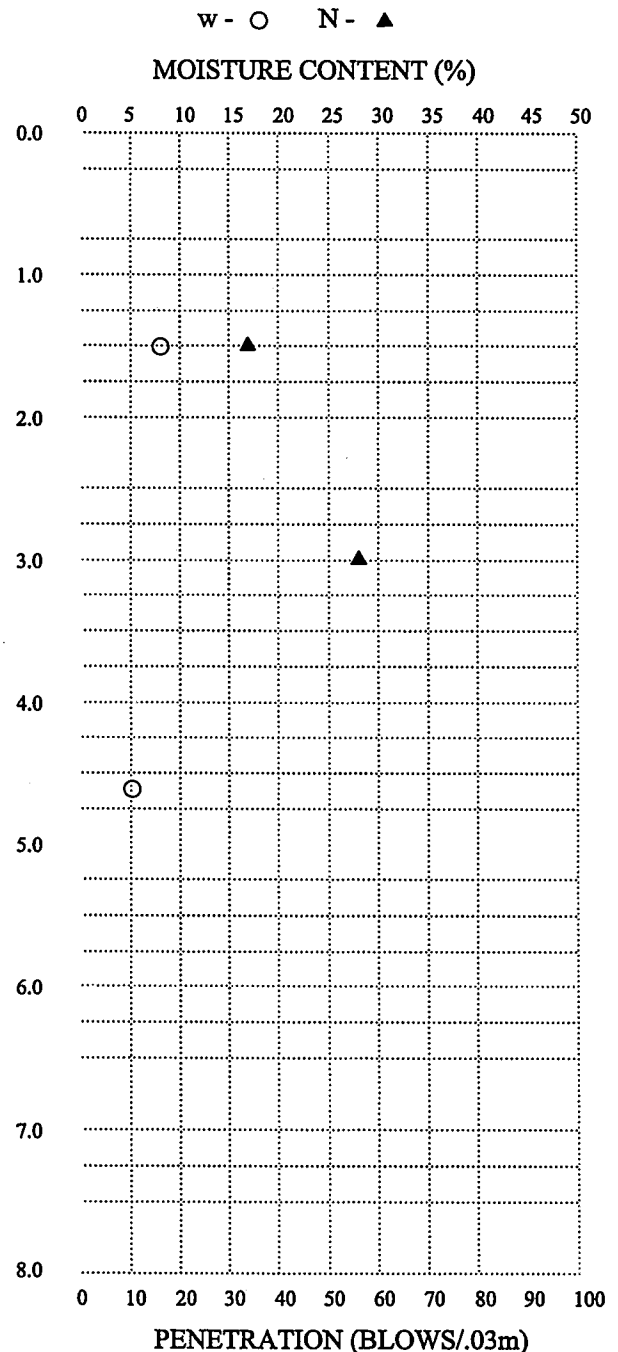
# BOREHOLE LOG NO: 4

PROJECT No.: 0065450  
 CLIENT: MINISTRY OF TRANSPORTATION  
 PROJECT: WP 274-96-00  
 LOCATION: N=4870370.69 E=401269.23  
 STATION: 22+639  
 DATE: OCT 12, 2000

## DRILLING DATA

METHOD: CME  
 BIT SIZE AND TYPE: 130mm  
 DEPTH OF HOLE: 5.0m  
 TOTAL CORE RECOVERY:  
 TOP OF HOLE ELEVATION: 113.1m

E L E V (m)	D E P T H	P R O F I L E	DESCRIPTION	W A T E R	S A M P L E #	B L O W S
113.1						
112.93	.170		Cr Gr w Si			
112.42	.680		Br Med Sa & Gr w Si moist, compact			
			Br Si Sa Tr Gr moist, compact			
			- moist, dense @1.5m		S12	33
			- moist, very dense @3.0m		S13	57
			- dry, very dense @4.3m			
			- So Cob from 3.9m to 4.7m		S14	124
108.1	5.0		End of Borehole			



REMARKS:

terraspec engineering inc.  
 geotechnical engineers and materials testing

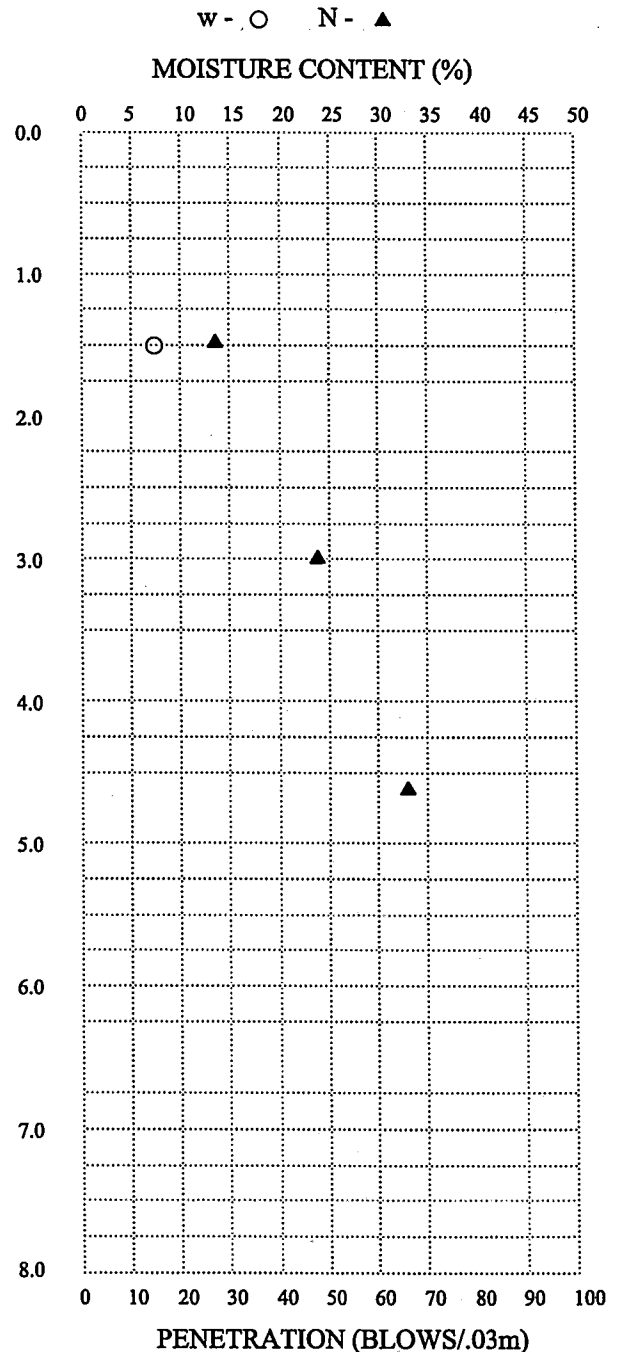
# BOREHOLE LOG NO: 5

PROJECT No.: 0065450  
 CLIENT: MINISTRY OF TRANSPORTATION  
 PROJECT: WP 274-96-00  
 LOCATION: N=4870377.25 E=401309.71  
 STATION: 22+680  
 DATE: OCT 12, 2000

## DRILLING DATA

METHOD: CME  
 BIT SIZE AND TYPE: 130mm  
 DEPTH OF HOLE: 5.0m  
 TOTAL CORE RECOVERY:  
 TOP OF HOLE ELEVATION: 111.8m

E L E V (m)	D E P T H	P R O F I L E	DESCRIPTION	W A T E R	S A M P L E #	B L O W S
111.8						
111.69	.110		Cr Gr w Si			
			Br Med Sa & Gr w Si moist, compact			
111.06	.740		Br Si Sa Tr Gr moist, compact			
			- moist, dense @2.5m		S15	28
			- Tr Cob @2.8m		S16	48
			- moist, very dense @4.0m		S17	66
106.8	5.0		End of Borehole			



REMARKS:

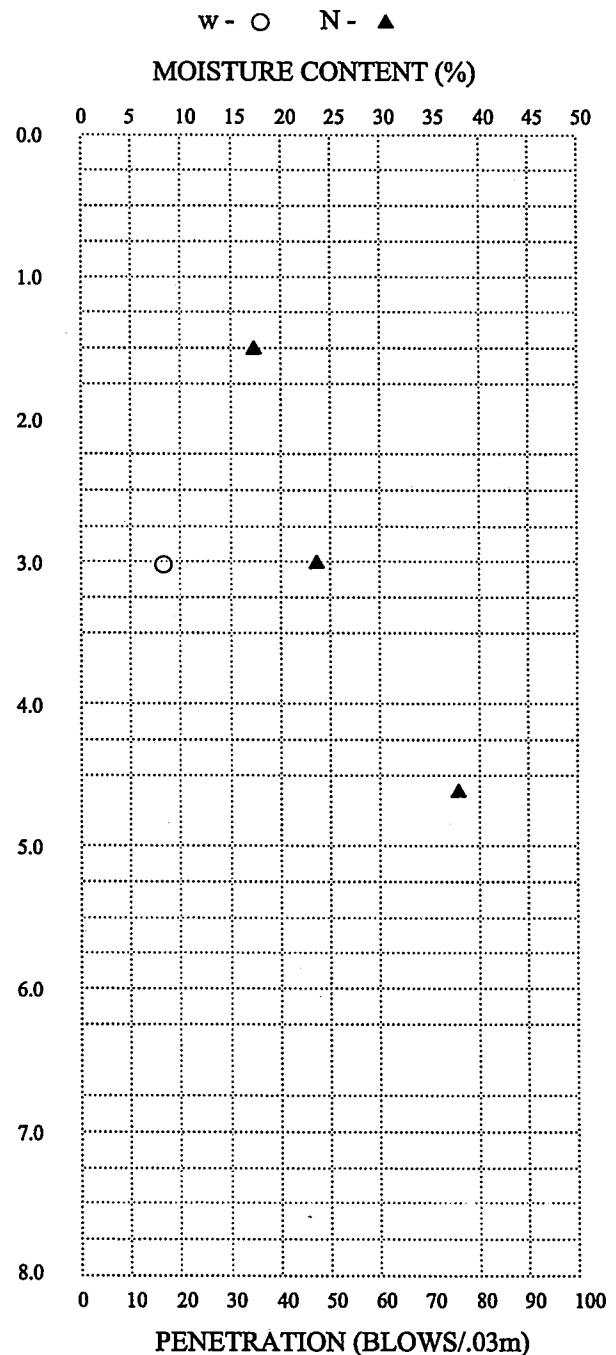
**terraspec engineering inc.**  
 geotechnical engineers and materials testing

# BOREHOLE LOG NO: 6

PROJECT No.: 0065450  
 CLIENT: MINISTRY OF TRANSPORTATION  
 PROJECT: WP 274-96-00  
 LOCATION: N=4870381.45 E=401350.53  
 STATION: 22+721  
 DATE: OCT 12, 2000

DRILLING DATA  
 METHOD: CME  
 BIT SIZE AND TYPE: 130mm  
 DEPTH OF HOLE: 5.0m  
 TOTAL CORE RECOVERY:  
 TOP OF HOLE ELEVATION: 110.4m

E L E V (m)	D E P T H	P R O F I L E	DESCRIPTION	W A T E R	S A M P L E #	B L O W S
110.4						
110.1	.300		Br Sa Tps			
109.59	.810		Br Med Sa & Gr w Si dry, compact			
			Br Si Sa Tr Gr moist, compact			34
			- moist, dense @3.0m		S18	48
			- moist, very dense @4.6m		S19	77
105.4	5.0		End of Borehole			



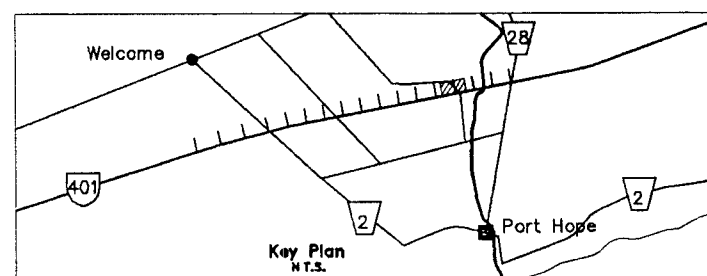
REMARKS:

**terraspec engineering inc.**  
 geotechnical engineers and materials testing

MINISTRY OF TRANSPORTATION, ONTARIO  
PR-D-707 88-05

# PLAN VIEW

Horizontal Scale: 1:1000  
Vertical Scale: 1:1000




## METRIC

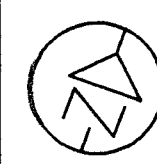
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No 274-96-00

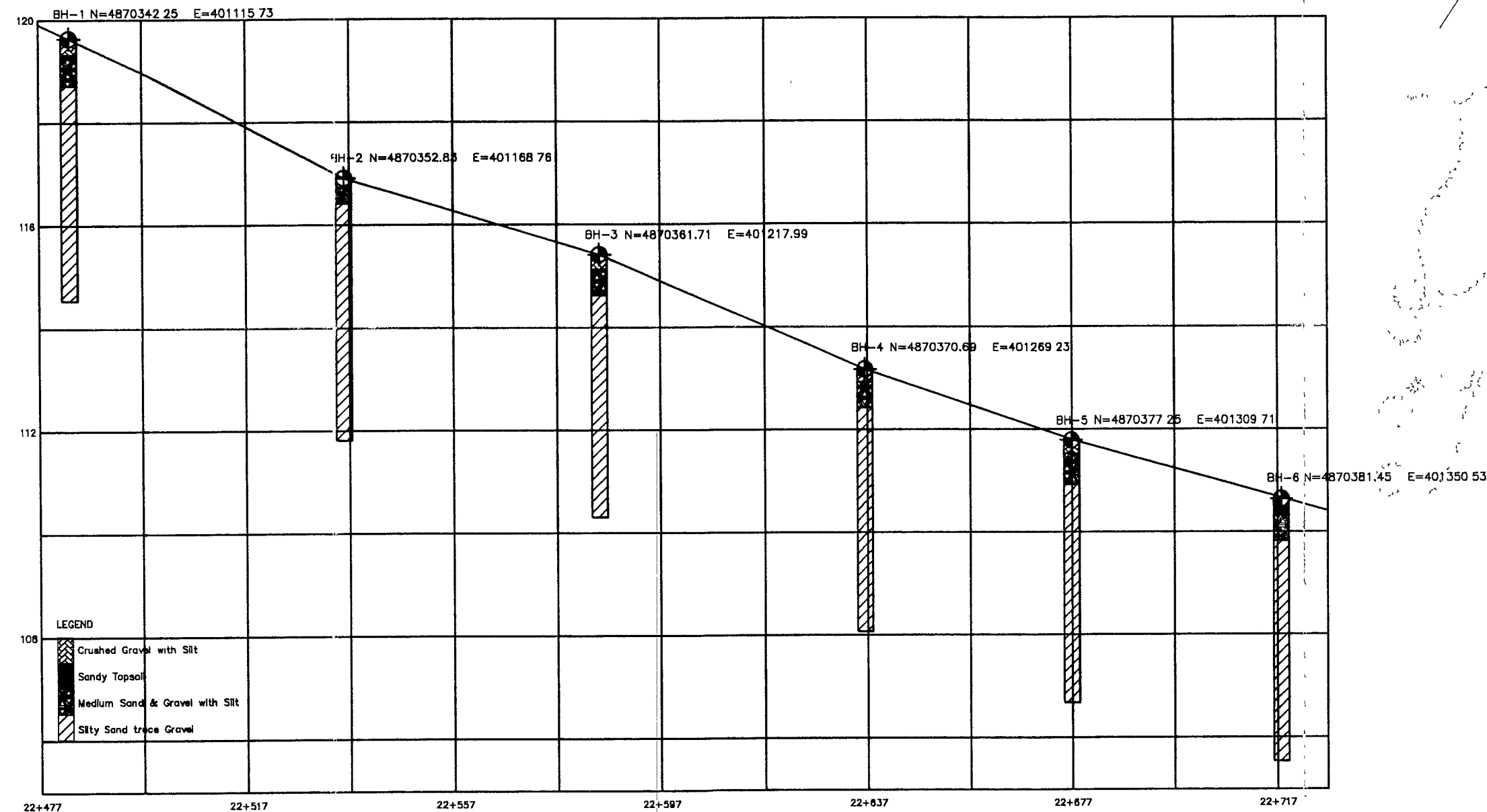
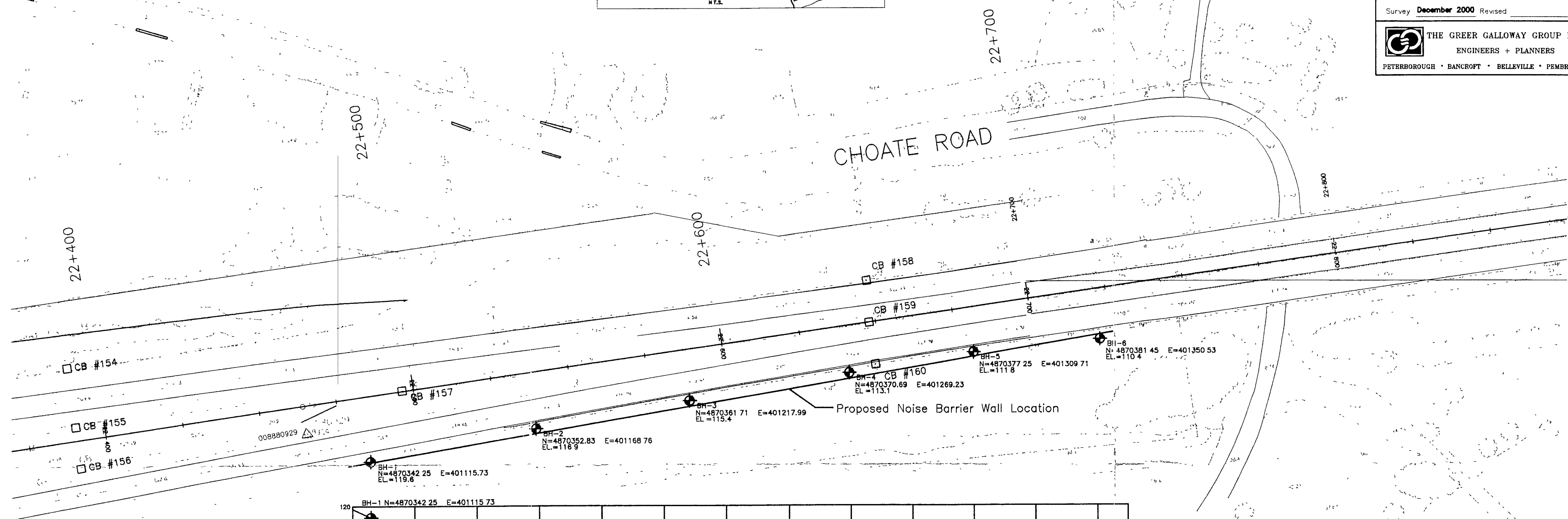
### NOISE BARRIER WALL

Survey December 2000 Revised

 THE GREER GALLOWAY GROUP INC.  
ENGINEERS + PLANNERS  
PETERBOROUGH • BANCROFT • BELLEVILLE • PEMBROKE



SHEET  
1



# PROFILE

Horizontal Scale: 1:1000  
Vertical Scale: 1:100