TABLE 1

SUMMARY OF SUBSURFACE CONDITIONS

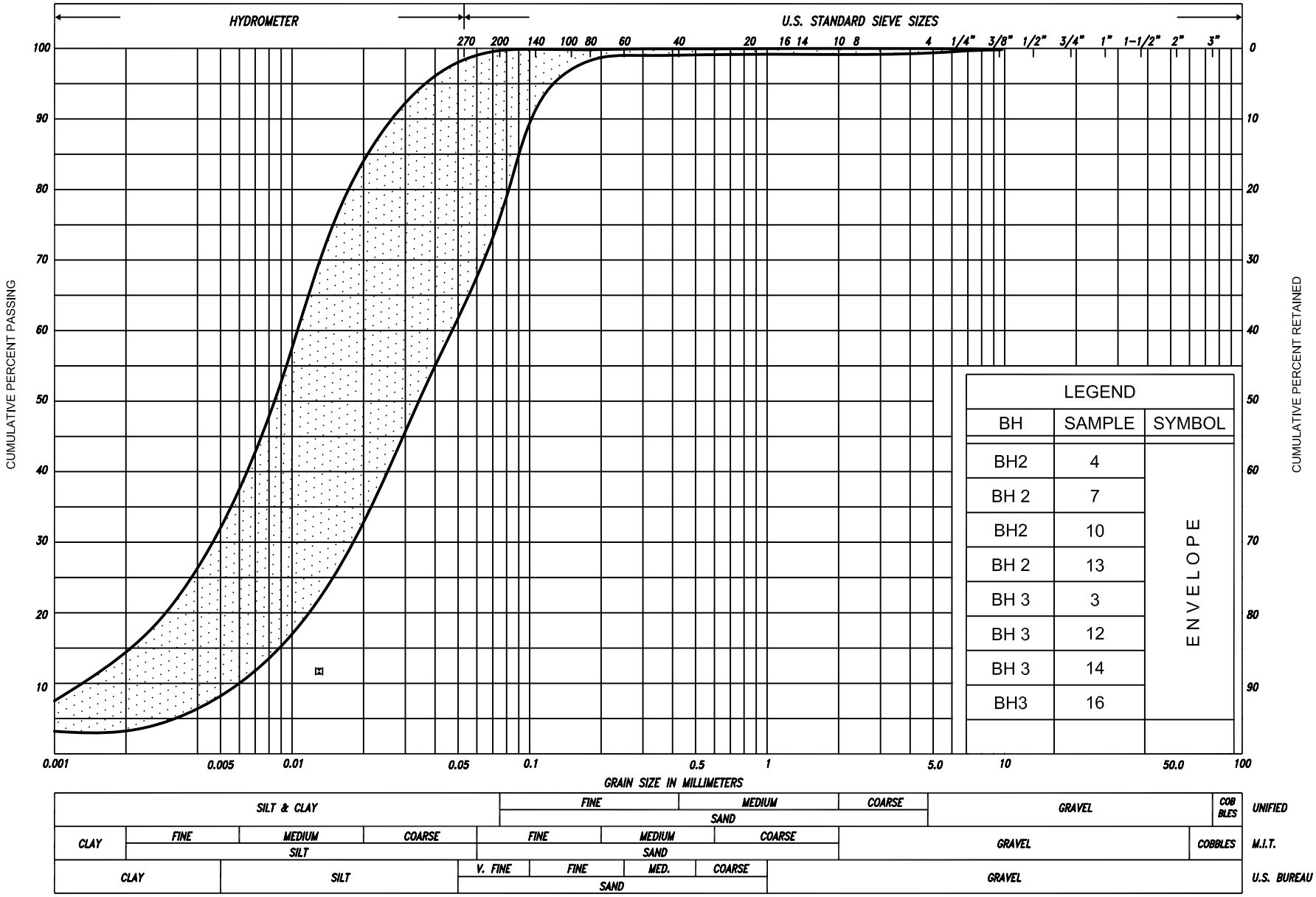
LOCATION AT THE BRIDGE SITE	SUMMARY OF SUBSURFACE CONDITIONS
East Abutment (Probe Hole 1)	Soil stratigraphy included a 300 mm thick topsoil over 800 mm cohesionless deposits of silt. Probable bedrock surface encountered at 1.1 m depth, elevation 291.0 m.
Centre Pier (Borehole 2)	Soil stratigraphy included 500 mm topsoil overlying 9.7 m thick silt unit which in turn underlain by 2.9 m thick cohesive silty clay matrix. A 22.9 m thick cohesionless silt unit was encountered below the silty clay, which mantled the probable bedrock at 36.0 m depth, elevation 253.9 m.
West Abutment (Borehole 3)	Soil stratigraphy encountered at the west abutment location included 600 mm fill overlying 500 mm thick topsoil unit which in turn overlying a 4.4 m thick silt matrix. A 6.4 m thick cohesive clayey unit is underlying the silt unit, which in turn is overlying 26.2 m thick cohesionless silt unit, which mantled the probable bedrock at 38.1 m depth, elevation 249.6 m.

TABLE 2

ADVANTAGES AND DISADVANTAGES, RELATIVE COSTS AND RISKS/CONSEQUENCES

ALLENSVILLE UNDERPASS

STRUCTURE FOUNDATION TYPE	ADVANTAGES	DISADVANTAGES	RELATIVE COSTS	RISKS/CONSEQUENCES	RANK
East Abutment Shallow Foundations - Spread footings	• Conventional construction methods • Spread footings on engineered fill may use higher bearing resistances	• Low geotechnical resistances requires large footings	• Less costly than deep foundations	• Low risk	1
	• Semi-integral abutment design is possible	• Requires bedrock trench to provide adequate pile length	• Costly than shallow foundations	• Work with piling equipment near existing highway requires special care	2
Centre Pier and West Abutment Deep Foundations - Steel H-Piles	• High load carrying capacities are obtained on piles to the bedrock • Integral abutment design is possible with pile foundations	• Requires heavy pile driving equipment • Higher cost than shallow foundations • Requires surcharging of site to reduce negative skin friction	• More costly than shallow foundations	• Work with piling equipment near existing highway requires special care	1
Deep Foundations - Caissons	• High load bearing capacity	• Low soil resistances require deep installations below water table (not practical)	• More costly than shallow foundations	• Unwatering of caisson holes may not be feasible	2 (not practical)
APPROACH EMBANKMENTS	ADVANTAGES	DISADVANTAGES	RELATIVE COSTS	RISKS/CONSEQUENCES	RANK
Surcharging without Soil Removal	• Excavation near existing embankment are not required • Post-construction settlements are mitigated	• Requires preloading/surcharging to mitigate long-term settlement of approach embankment	• Lower cost than soil removal option	• Possible post-construction settlements of new roadway may need repair or maintenance	1
Removal of Compressible Soils	• Reduced long-term settlements	• Excavation of cohesive soil not practical	• Higher cost than surcharge option	• Excavation may cause instability to existing highway embankment	2 (not practical)



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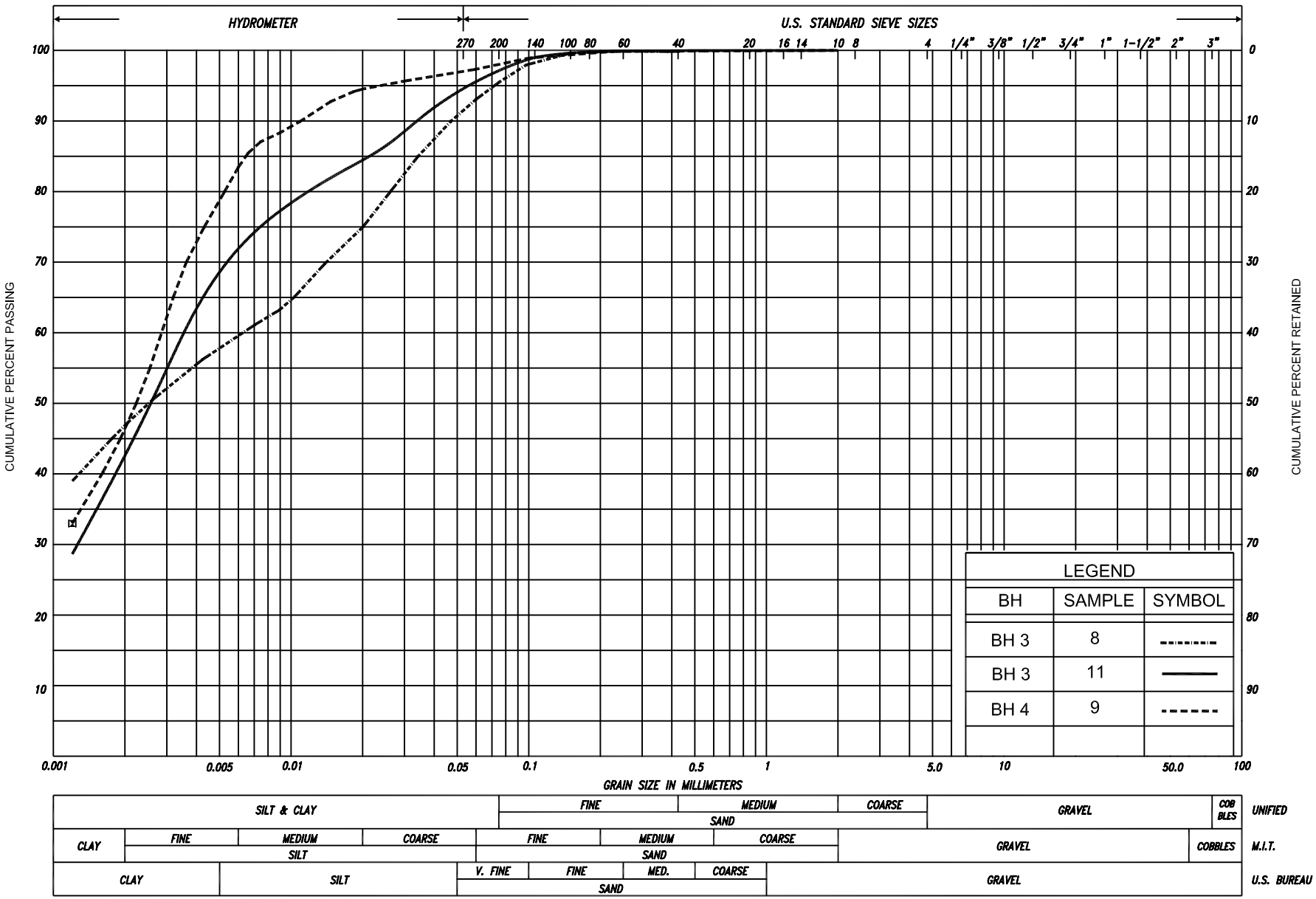
GRAIN SIZE DISTRIBUTION

SILT, some to with sand, trace clay, trace gravel

FIG No.	AR-GS-1
HWY	11
W.P. No.	320-00-00



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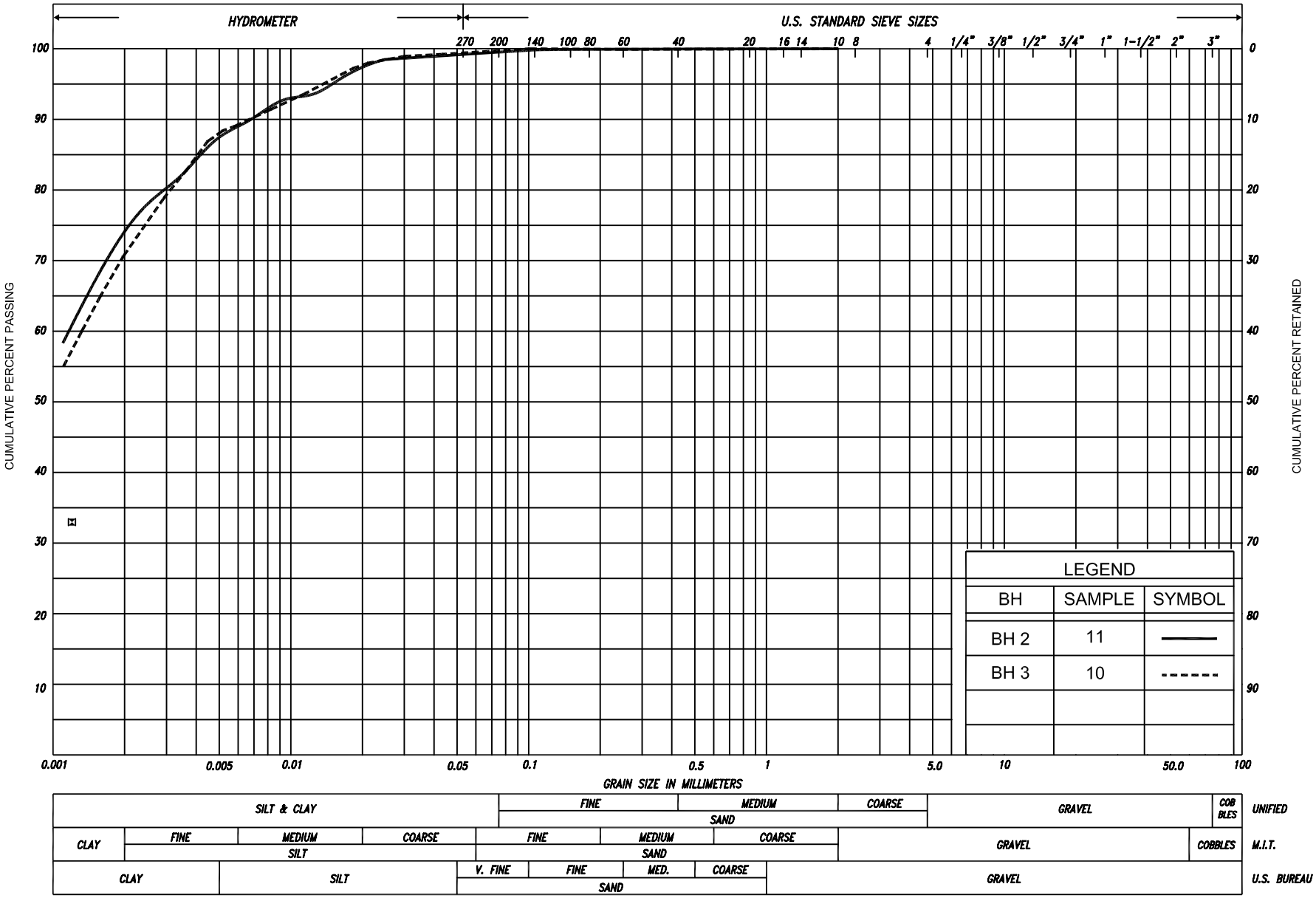
GRAIN SIZE DISTRIBUTION

CLAYEY SILT, trace sand

FIG No.	AR-GS-2
HWY	11
W.P. No.	320-00-00



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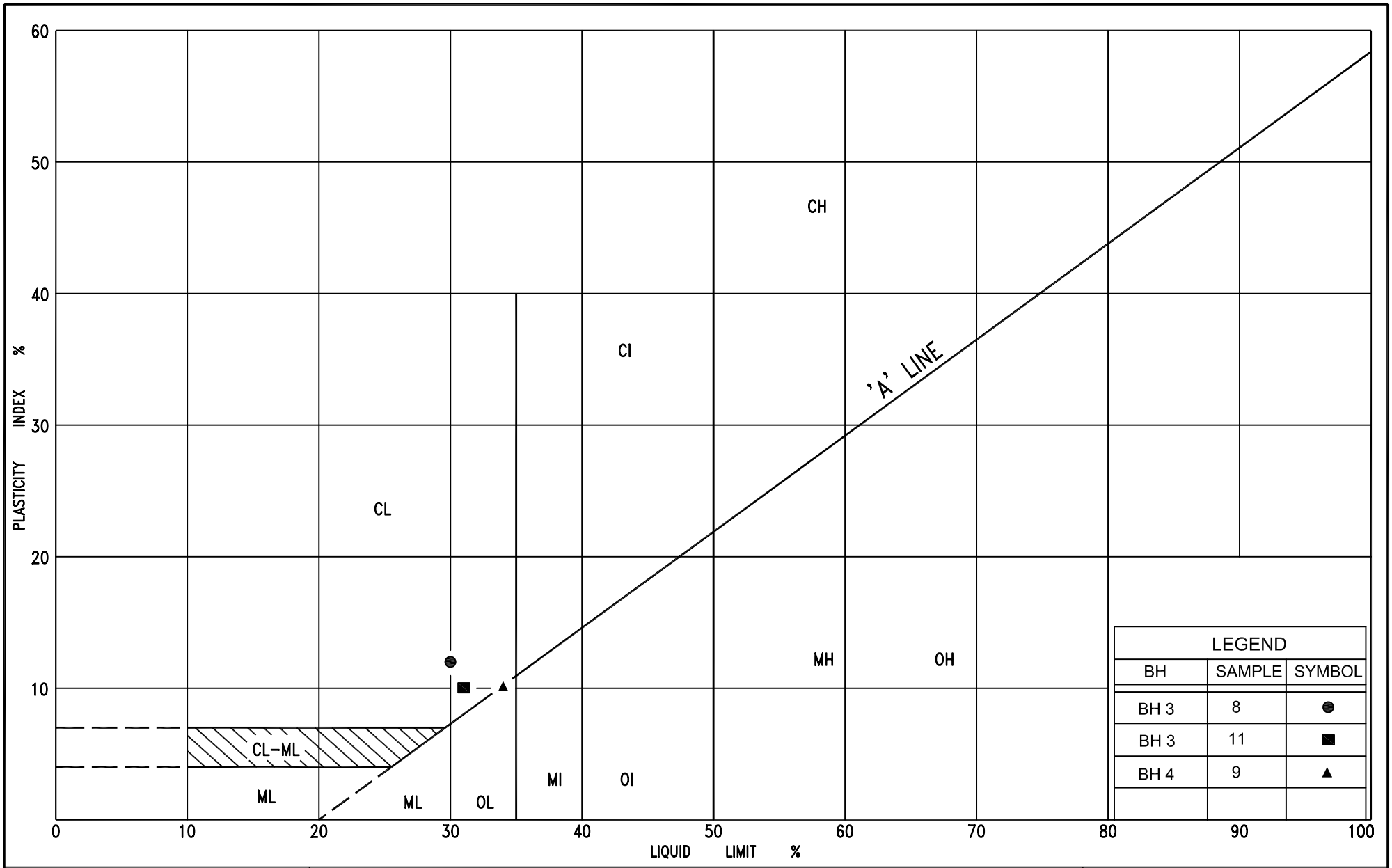
GRAIN SIZE DISTRIBUTION

SILTY CLAY, trace sand

FIG No.	AR-GS-3
HWY	11
W.P. No.	320-00-00



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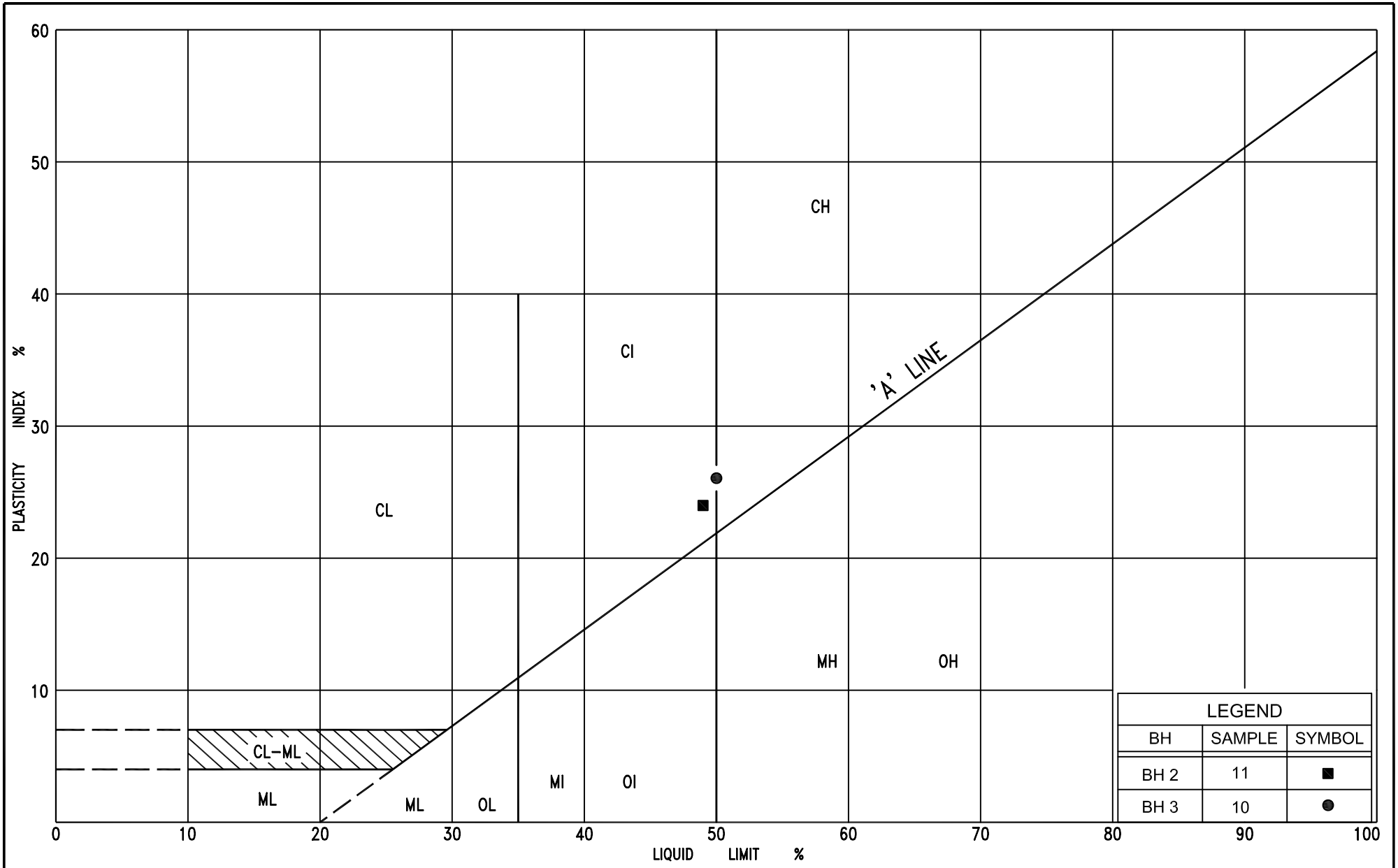
PLASTICITY CHART

CLAYEY SILT, trace sand

FIG No.	AR-PC-1
HWY:	11
W.P. No.	320-00-00



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PLASTICITY CHART

SILTY CLAY, trace sand

FIG No.	AR-PC-2
HWY:	11
W.P. No.	320-00-00

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS $\tilde{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
F V	FIELD VANE		

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL
e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $w_L - w_P$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
DTPL		DRIER THAN PLASTIC LIMIT
APL		ABOUT PLASTIC LIMIT
WTPL		WETTER THAN PLASTIC LIMIT
e_{max}	1,%	VOID RATIO IN LOOSEST STATE
e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

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RECORD OF BOREHOLE No 1

1 of 1

METRIC

Highway 11

G.W.P. 320-00-00 LOCATION Coords: 5 011 811.6 N; 320 660.4 E ORIGINATED BY F.P.

DIST 54 HWY 11 BOREHOLE TYPE Manual Probe COMPILED BY N.R.

DATUM Geodetic DATE April 09, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
292.1											
0.0 / 291.8	Topsoil						292				
0.3	Silt, some sand, trace gravel cobbles										
291.0	Brown Moist						291				
1.1	End of borehole										
	Refusal on probable bedrock										
	* Borehole dry										
	Bedrock exposed 5m east of probe hole location.										

$+^{7}$, $\times^{5}$: Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 2 1 of 3 METRIC

G.W.P. 320-00-00 LOCATION Highway 11 Coords: 5 011 823.5 N; 320 621.7 E ORIGINATED BY F.P.

DIST 54 HWY 11 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.R.

DATUM Geodetic DATE April 13, 2009 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
289.9											
0.0 / 289.4	Topsoil		1	SS	3				○		
0.5	Silt, trace to with sand trace clay organic inclusions		2	SS	6	▽*	289		○		
	Loose Brown Moist										
	oxidized pockets		3	SS	11		288		○		
	Compact										
			4	SS	10		287		○		0 14 78 8
			5	SS	11				○		
			6	SS	12		286		○		
			7	SS	12		285		○		0 24 72 4
	clayey silt layers										
	Loose						284				
			8	SS	6						
	Grey						283				
			9	SS	4		282		○		
	some clay						281				
			10	SS	6				○		0 7 79 14
279.7							280				
10.2	Silty clay, trace sand clayey silt layers										
	Stiff Grey Wet		11	SS	7		279		○		0 1 25 74
				FV				+4			
							278				
			12	SS	3				○		
276.8				FV			277	+4			
13.1	Silt some clay, trace sand		13	SS	23				○		0 1 85 14
	Compact Grey Moist						276				
274.9	Cont'd						275				

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+7, ×5 : Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 2

2 of 3

METRIC

G.W.P. 320-00-00 LOCATION Highway 11 Coords: 5 011 823.5 N; 320 621.7 E ORIGINATED BY F.P.

DIST 54 HWY 11 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.R.

DATUM Geodetic DATE April 13, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
274.9											
15.0	Silt trace to some clay, trace sand Compact Grey Moist		14	SS	17		274				
							273				
							272				
			15	SS	20		271				
							270				
							269				
			16	SS	20		268				
	Loose						267				
							266				
			17	SS	7		265				
	Compact						264				
							263				
			18	SS	18		262				
							261				
259.9	Cont'd						260				

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RECORD OF BOREHOLE No 2 3 of 3 METRIC

G.W.P. 320-00-00 LOCATION Highway 11 Coords: 5 011 823.5 N; 320 621.7 E ORIGINATED BY F.P.

DIST 54 HWY 11 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.R.

DATUM Geodetic DATE April 13, 2009 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
259.9											
30.0	Silt, trace to some clay trace sand Compact Grey Moist		19	SS	18		259				
258.8							258				
31.1	End of borehole Probable silt Compact to dense						257				
							256				
							255				
253.9							254	141			
36.0	End of dynamic cone penetration test										

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE; 20 40 60 80 100

WATER CONTENT (%): 20 40 60

* 2009 04 13

▽ Water level observed during drilling

■ Penetrometer test

C.F.H.S.A. Denotes Continuous Flight Hollow Stem Augers

+7, ×5 : Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 3 1 of 3 METRIC

G.W.P. 320-00-00 LOCATION Highway 11 Coords: 5 011 834.8 N; 320 586.9 E ORIGINATED BY F.P.

DIST 54 HWY 11 BOREHOLE TYPE C.F.H.S.A. + Wash Boring COMPILED BY N.R.

DATUM Geodetic DATE April 07 & 08, 2009 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
287.7											
0.0	Sandy silt topsoil inclusions		1	SS	2				○		
287.1	Brown Moist						287				
0.6	(FILL)		2	SS	16	▽*			○		
286.6	Topsoil										
1.1	Silt, trace to some sand trace clay oxidized layers		3	SS	16		286		○		1 15 77 7
	Compact Grey Wet										
	Brown										
	trace sand		4	SS	10		285		○		
	Loose Grey										
			5	SS	7		284		○		
			6	SS	8				○		
							283				
			7	SS	6						
282.2											
5.5	Clayey silt, trace sand						282				
	Stiff Grey Wet		8	SS	3				○		0 5 48 47
				FV			281	+5			
			9	SS	2		280		○		
279.2											
8.5	Silty clay. trace sand silt layers						279				
	Stiff Grey Wet		10	SS	4				○		0 1 28 71
				FV			278	+5			
277.2											
10.5	Clayey silt, trace sand						277				
	Firm to stiff Grey Wet		11	TW	PM				○		17.3 0 3 54 43
				FV				+6			
275.8							276				
11.9	Silt some clay, trace sand										
	Compact Grey Moist		12	SS	20		275		○		0 1 85 14
	sandy silt layers		13	SS	14		274		○		
272.7	Cont'd						273				

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15 — 20 / 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 3 2 of 3 METRIC

G.W.P. 320-00-00 LOCATION Highway 11 Coords: 5 011 834.8 N; 320 586.9 E ORIGINATED BY F.P.

DIST 54 HWY 11 BOREHOLE TYPE C.F.H.S.A. + Wash Boring COMPILED BY N.R.

DATUM Geodetic DATE April 07 & 08, 2009 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
272.7											
15.0	Silt trace clay, trace sand Compact Grey Moist		14	SS	11		272		○		0 6 90 4
							271				
							270				
			15	SS	26		269		○		
							268				
							267				
	dense		16	SS	34		266		○		0 6 91 3
							265				
	compact						264				
			17	SS	11		263		⊙		
							262				
							261				
			18	SS	18		260		○		
							259				
257.7	Cont'd						258				

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+7, ×5 : Numbers refer to Sensitivity

20
15 — 5
10
(%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 3

3 of 3

METRIC

G.W.P. 320-00-00 LOCATION Highway 11 Coords: 5 011 834.8 N; 320 586.9 E ORIGINATED BY F.P.

DIST 54 HWY 11 BOREHOLE TYPE C.F.H.S.A. + Wash Boring COMPILED BY N.R.

DATUM Geodetic DATE April 07 & 08, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
257.7											
30.0	Silt trace clay, trace sand Compact Grey Moist										
			19	SS	29		257		○		
							256				
							255				
			20	SS	18		254		○		
							253				
							252				
			21	SS	17		251		○		
							250				
249.6											
38.1	End of borehole Refusal on probable bedrock										

* 2009 04 07, 08

▽ Water level observed during drilling

▼ Water level measured after drilling

C.F.H.S.A. Denotes Continuous Flight Hollow Stem Augers

+7, ×5 : Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 4 1 of 2 METRIC

G.W.P. 320-00-00 LOCATION Highway 11 Coords: 5 011 744.9 N; 320 575.2 E ORIGINATED BY F.P.

DIST 54 HWY 11 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.R.

DATUM Geodetic DATE April 09, 2009 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
287.1											
0.0 / 286.6	Peat		1	SS	1	▽*	287				
0.5	Silt, trace to some sand trace clay organic inclusions		2	SS	9		286		○		
	Loose Grey / brown Wet										
	Compact Reddish brown Moist		3	SS	15		285		○		
			4	SS	13				○		
	Loose		5	SS	8		284		○		
			6	SS	6		283		○		
	clayey silt layers		7	SS	6		282		○		
281.5											
5.6	Clayey silt, trace sand										
	Stiff Grey Wet		8	SS	4		281	■ +6	○		
				FV							
			9	TW			280		⊢ ○		0 2 52 46
				FV				+5	○		
278.3											
8.8	Silt trace clay, trace sand										
	Compact Grey Moist		10	SS	25		278		○		
			11	SS	17		277		○		
	Loose		12	SS	9		276		○		
	Compact		13	SS	16		275		○		
272.8							274				
14.3	End of borehole						273				
	Cont'd										

ON_MOT VER3 08TF008.GPJ ON_MOT.GDT 6/16/2009 11:01:08 AM

+7, ×5 : Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 4 2 of 2 METRIC

G.W.P. 320-00-00 LOCATION Highway 11 Coords: 5 011 744.9 N; 320 575.2 E ORIGINATED BY F.P.

DIST 54 HWY 11 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.R.

DATUM Geodetic DATE April 09, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	* 2009 04 09 ▽ Water level observed during drilling ▼ Water level measured after drilling ■ Penetrometer test										

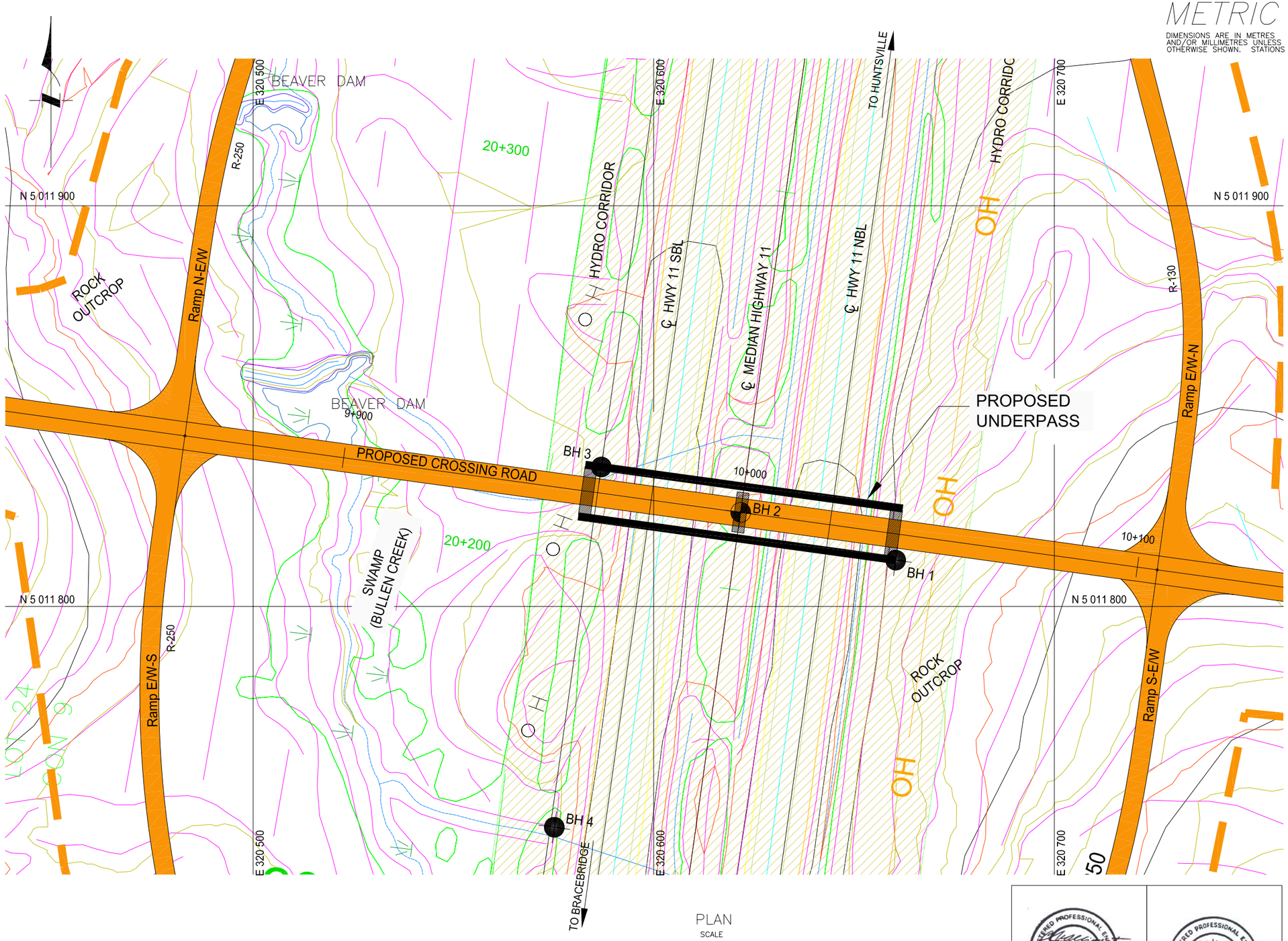
ON_MOT VER3 08TF008.GPJ ON_MOT.GDT 6/16/2009 11:01:08 AM

+7, ×5 : Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS



PLAN

SCALE

10 0 10 20m

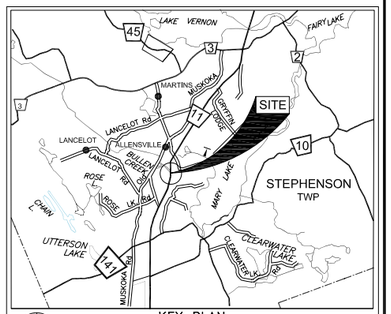
CONT No

GWP No 320-00-00

CROSSING ROAD I/C UNDERPASS
HIGHWAY 11
BOREHOLE LOCATIONS

SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS



KEY PLAN

SCALE

2 0 2 4 6km

LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60 Cone, 475 J/blow)
- W L at time of investigation: April, 2009
- Head ARTESIAN WATER Encountered
- PIEZOMETER

BH No	ELEVATION	CO-ORDINATES NORTHINGS	EASTINGS
1	292.1	5 011 811.6	320 660.4
2	289.9	5 011 823.5	320 621.7
3	287.7	5 011 834.8	320 586.9
4	287.1	5 011 744.9	320 575.2

NOTE:

1. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.

REGISTERED PROFESSIONAL ENGINEER C M P Nascimento June 17, 2009 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER B. R. GRAY June 17, 2009 PROVINCE OF ONTARIO

REF No. STANTEC Drawing; 674-design_Recommended.dwg; dated February 25, 2009

– NOTE –

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

REVISIONS		
DATE	BY	DESCRIPTION

Geocres No. 31E-295

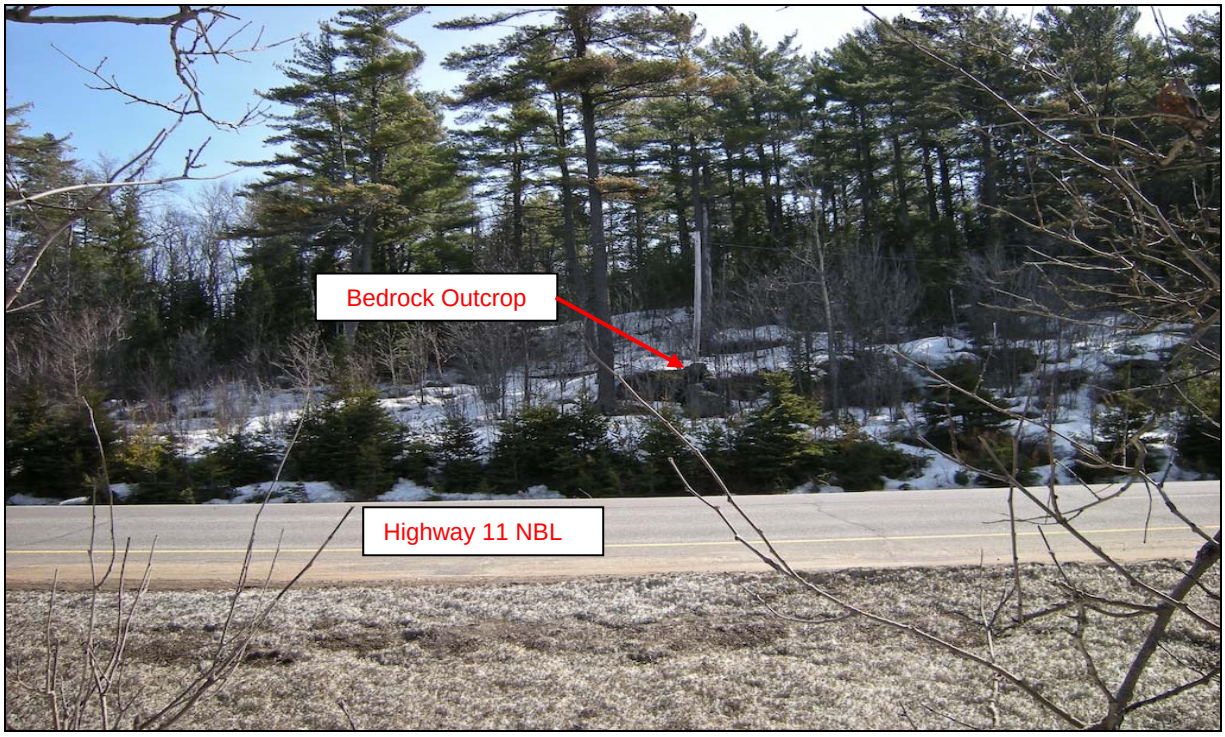
HWY No	11			DIST	52
SUBM'D	MN	CHECKED	NR	DATE JUNE 17, 2009	SITE --
DRAWN	NA	CHECKED	CN	APPROVED BRG	DWG AR-1

APPENDIX A

SITE PHOTOGRAPHS

Photograph 1: Looking west from the west shoulder of Highway 11 SBL, approximate Station 20+215 Tip of a plastic culvert visible at the foreground of the photograph.

Photograph 2: Looking east from the median at about Sta. 20+215. A thick underbrush visible in the median of the Highway 11 lanes.



Photograph 3: Viewing east from the median to the east side of Highway 11 NBL at approximate Sta. 20+215. A hill is visible in the background of the photograph with bedrock outcrops exposed.

Photograph 4: Viewing east from the east shoulder of Highway 11 NBL at approximate Sta. 20+215. Bedrock outcrops exposed in the background of the photograph.

APPENDIX B

Slope Stability Analyses Results

SLOPE STABILITY ANALYSIS RESULTS

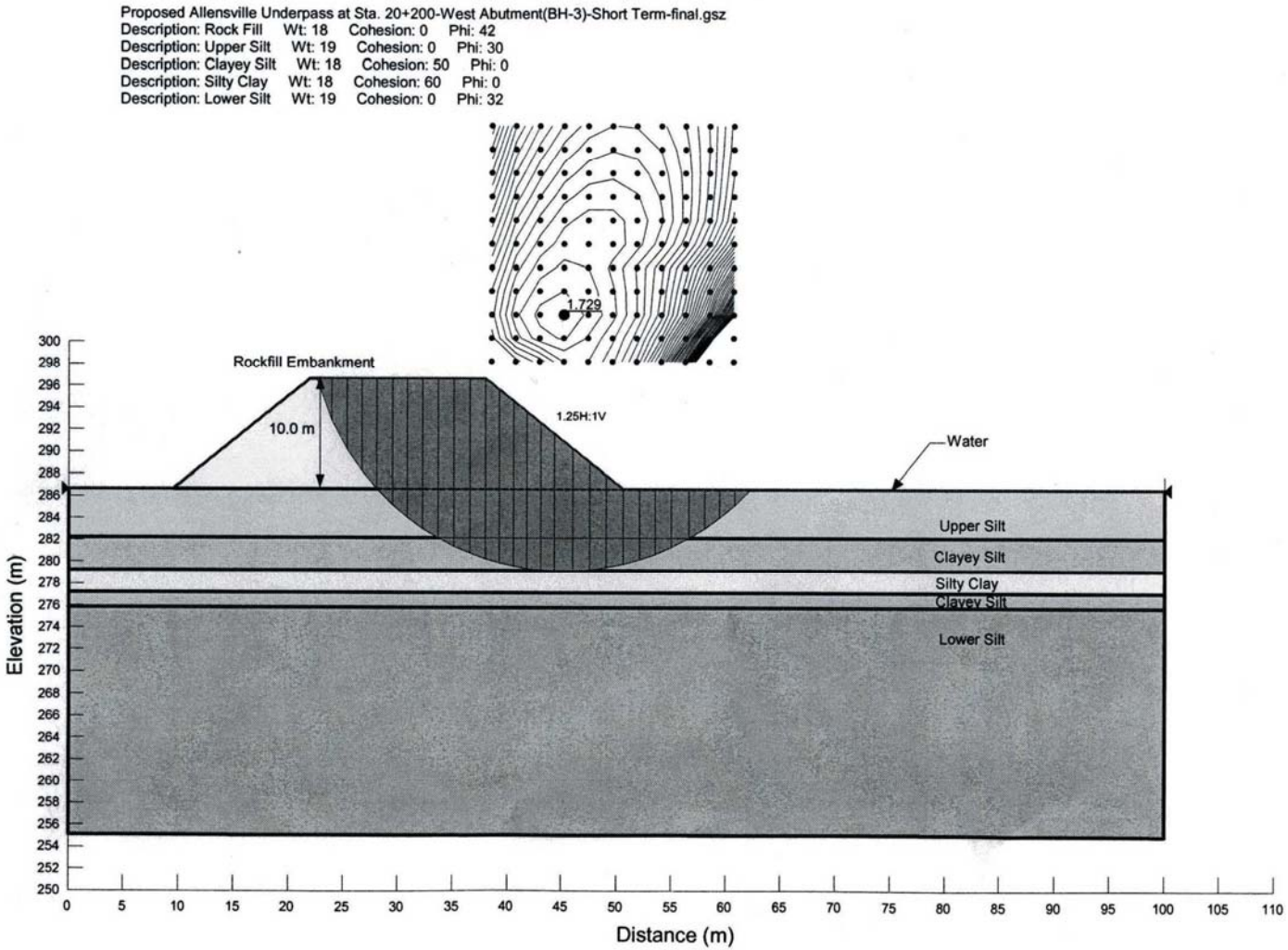


Figure 1

SLOPE STABILITY ANALYSIS RESULTS

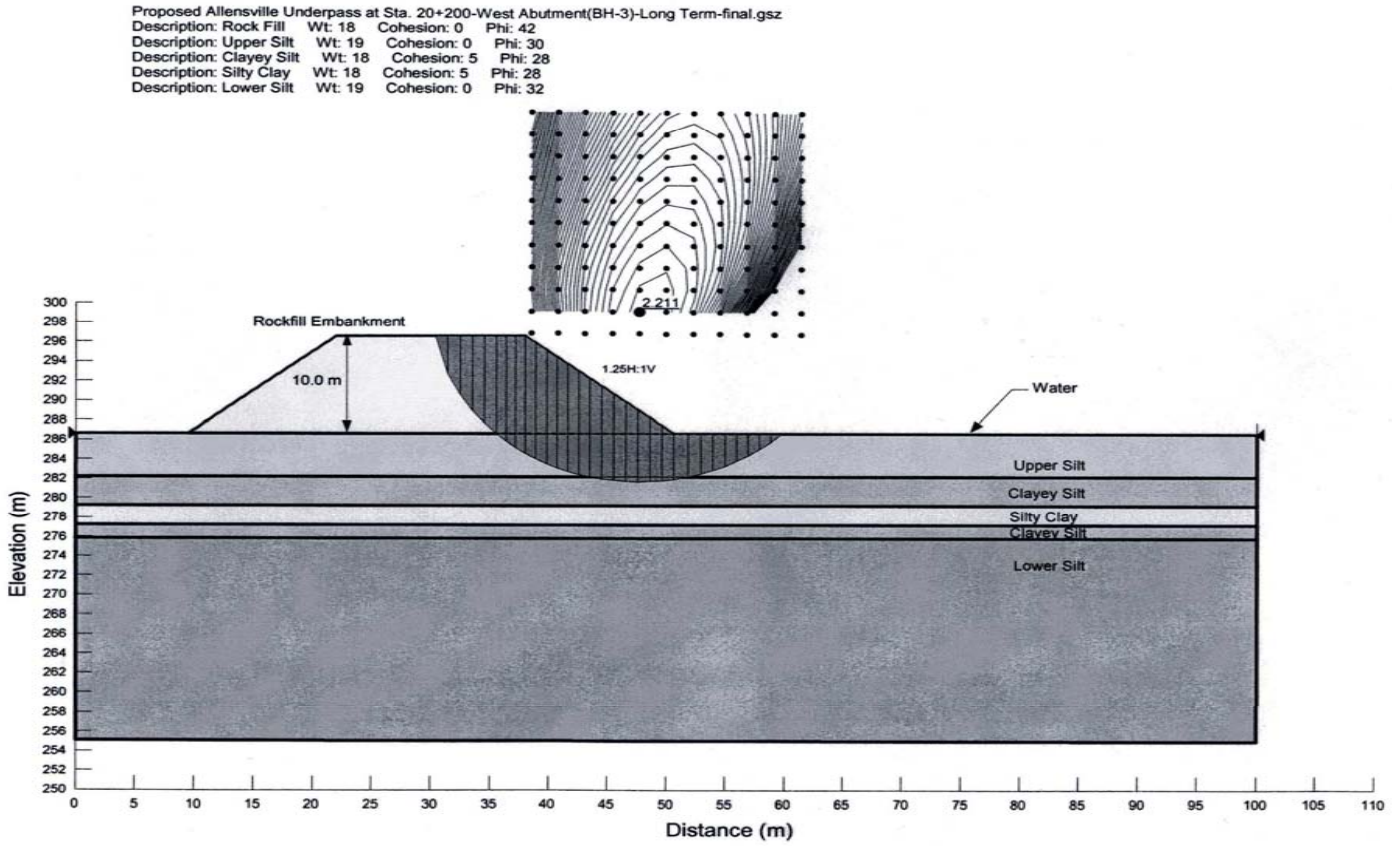


Figure 2

SLOPE STABILITY ANALYSIS RESULTS

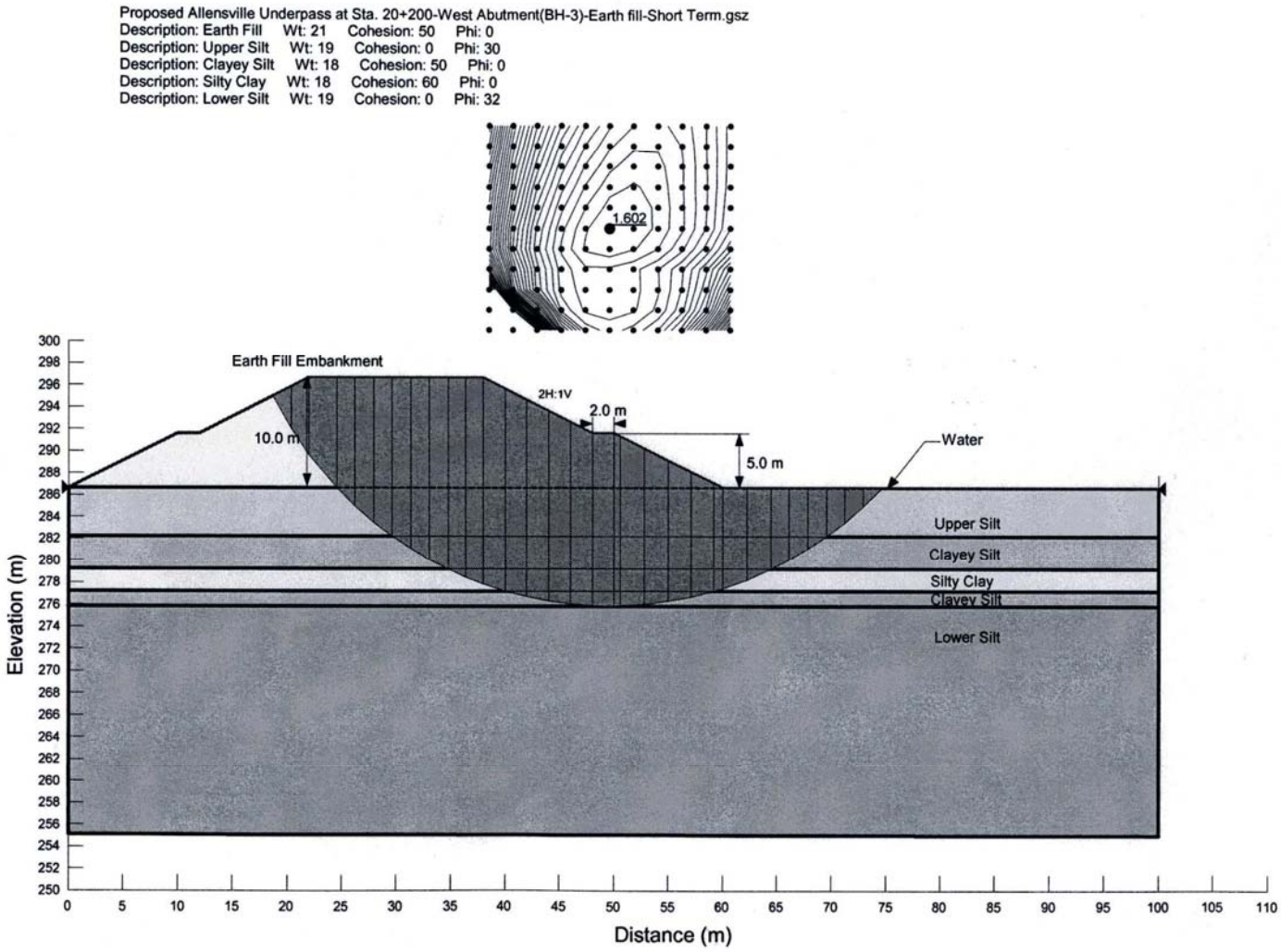


Figure 3

SLOPE STABILITY ANALYSIS RESULTS

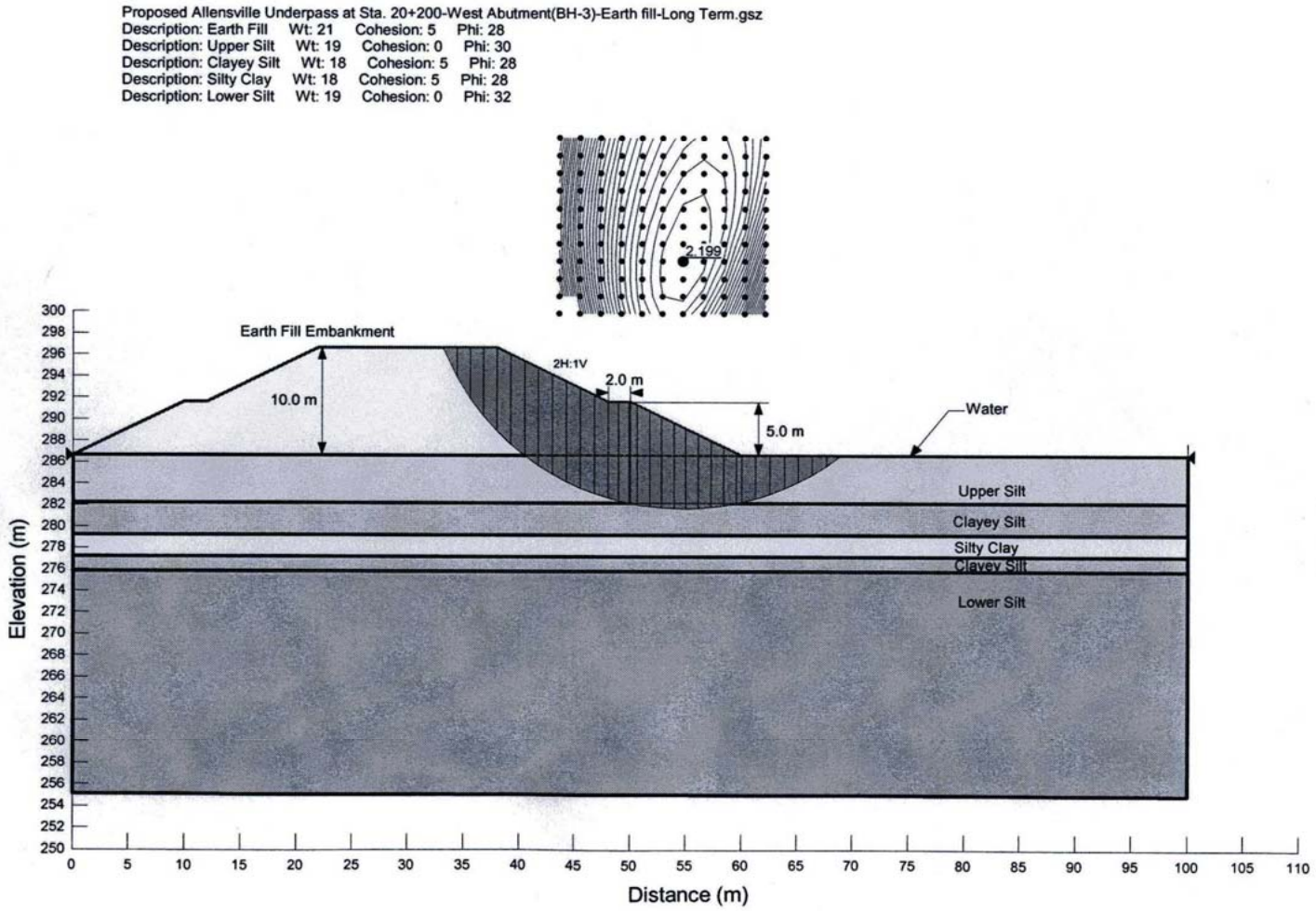


Figure 4