



**FOUNDATION INVESTIGATION
REPORT
JUMBO CREEK ALIGNMENT
HIGHWAY 537
TOWNSHIP OF CLELAND,
SUDBURY AREA
AGREEMENT NO: 5009-E-0061
GWP 5279-03-00**

**5Th July 2012
GS-TB-014485**

**PREPARED FOR:
MINISTRY OF TRANSPORTATION OF ONTARIO
NORTHEASTERN REGION OFFICE
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PART 1: FACTUAL INFORMATION**

1. INTRODUCTION

DST Consulting Engineers Inc. was retained by the Ministry of Transportation (MTO), Northeastern Region, to conduct a foundation investigation report for the 700 m Road Alignment and proposed highway re-alignment on Highway 537 near to Jumbo Creek. This work was carried out under Agreement No.: 5009-E-0061, to design and evaluate two alignment options. Option 1 consists of a 1.0 m grade raise on the existing road alignment and Option 2 consists of a construction a new 750 m re-aligned new highway (proposed highway re-alignment) as shown in Drawing 1.

This report addresses the field investigation, laboratory test program, factual report on field findings.

Geological information is available from *Northern Ontario Geology Terrain Study* published by the Ontario Ministry of Natural Resources for the Districts of Nippising, Parry Sound, and Sudbury. This indicates, Organic terrain (OT) commonly occurs, most commonly in poor drained depressions within bedrock terrain. A typical terrain unit letter code is: pOT (RN) / Lp-W

This indicates that the peaty organic terrain has low relief and a planar surface. The water table is at the surface giving rise to wet drainage conditions. Rock knobs are common subordinate landform and can be seen at both south and north part of the area of study.

Bedrock and lacustrine plain are the dominant terrain units in Sudbury map area. Aggregate resources are scarce and organic materials are common in low areas.

2. SITE DESCRIPTION

The site is located on Highway 537, approximately 7.0 km south of Trans-Canada Highway, Township of Cleland, Sudbury Area.

Five (5) boreholes were drilled along existing highway alignment and six (6) boreholes were drilled along proposed highway re-alignment to investigate, design and evaluate two alignment options. These eleven (11) boreholes were drilled between stations 18+350 and 18+715.

The following photos show locations on the existing alignment and proposed highway re-alignment.



Figure 2.1 At station 18+350, looking from highway towards proposed centre line



Figure 2.2 At station 18+400, looking north from highway



Figure 2.3 At station point 18+400, looking south from highway



Figure 2.4 At proposed highway re-alignment, station 18+525 looking south



Figure 2.5 At proposed highway re-alignment, station 18+600 looking south



Figure 2.6 At proposed highway re-alignment, station 18+650 looking out towards highway

3. INVESTIGATION PROCEDURES AND LABORATORY TESTING

Site work was carried out in a period between February 27th, 2012 and March 9th, 2012 utilizing a CME 750 drill rig and was operated by DST personnel. A total of eleven (11) drilled boreholes were drilled using hollow stem auger for the purpose of road section foundation design at this site.

Five boreholes were drilled on the existing highway alignment and six boreholes were drilled on the proposed highway re-alignment. Borehole locations are shown on the Borehole Location Plans, (Drawings 1).

The borehole locations are referenced to the MTO Station numbering system as indicated in the Drawing 1 to 6. The ground surface elevations at the borehole locations were surveyed by DST personnel. At approximately Station 18+715, MTC benchmark with an elevation of 225.927 m was used as reference point to measure ground surface and groundwater elevations at the borehole locations. Table 3.1 summarizes the detail of borehole locations, ground surface elevations, offsets and depths.

Table 3.1 Detail of borehole locations

Borehole ID	Station	Elevation (m)	Depth (m)	Offset (m)
BH1*	18+412	221.76	15.5	2.2 Lt
BH2*	18+450	221.84	22.5	0
BH3*	18+500	221.94	22.0	0.9 Rt
BH4*	18+550	221.97	26.0	0
BH5*	18+600	221.89	22.9	2.3 Lt
BH6*	18+650	221.82	21.5	0
BH7	18+715	225.30	4.6	3.0 Lt
BH8	18+675	222.81	9.1	4.0 Rt
BH9	18+575	221.83	21.3	4.0 Lt
BH10	18+475	221.97	21.3	4.8 Rt
BH11	18+350	222.13	18.9	3.0 Lt

* New proposed alignment

The fieldwork was conducted on a full-time basis by DST personnel who located the boreholes in the field, performed sampling and in-situ testing and logged the boreholes. Standard Penetration Tests (SPT) was performed in each borehole and Filed Vane Shear tests were performed in eight boreholes. The soil samples collected during drilling were identified in the field, placed in labelled bags and transported to DST's laboratory in Thunder Bay for further analyses.

All aspects of implementation of foundation test holes (including planning, licensing, construction, maintenance, abandonment, and reporting), were carried out in accordance with the Ministry of the Environment (MOE) Regulation 903, as amended by Regulation 128/03 (the water well regulation under the Ontario Water Resources Act). Specifically, all boreholes, test holes or wells that are no longer in use, due to location in the right-of-way, or no longer needed for groundwater monitoring were properly decommissioned. Proper abandonment procedures specified and followed are as per MOE Regulation 903. All boreholes, test holes and dewatering wells were effectively sealed at surface and at depth as appropriate.

Classification and index tests were subsequently performed in the laboratory on samples collected from the boreholes to aid in the selection of engineering properties. Laboratory tests included moisture contents, particle size analyses and Atterberg limits including plastic limit and liquid limit. A total of one hundred and eighteen (118) moisture contents, nine (9) particle size analyses and twenty nine (29) Atterberg limit tests have been carried out for this assignment. Five (5) one dimensional consolidation tests were carried out. Laboratory test results are presented in the Boreholes Logs (Enclosures 1 to 11), Plots (Enclosures 12 to 34).

4. DESCRIPTION OF SUBSURFACE CONDITIONS OF THE PROPOSED HIGHWAY RE-ALIGNMENT

The subsurface conditions are presented based on the information obtained during field and laboratory testing.

The generalized stratigraphy of the proposed highway re-alignment, based on the conditions encountered in boreholes, consists of a layer of organics (fibres, roots etc.) that is underlain by very soft to stiff clay. The subsurface condition of proposed highway re-alignment is described below.

4.1 Top Soil

Top soil layer of 0.3 m thickness was encountered at Borehole 2 location; this corresponds to top and bottom elevations of 221.8 m and 221.5 m.

4.2 Organics

Organics were encountered in Boreholes 1 to 6 along the proposed highway re-alignment at depths from 0 to 3.1 m, 0.3 to 5.3 m, 0 to 6.1 m, 0 to 6.1 m, 0 to 6.1 m and 0 to 4.6 m respectively; these correspond to top and bottom elevations of 221.8 to 218.7 m, 221.5 to 216.5 m, 221.9 to 215.8 m, 222.0 to 215.9 m, 221.9 to 215.8 m and 221.8 to 217.2 m respectively. The thickness of this stratum is from 3.1 m to 6.1 m. Von Post tests were carried out on samples from Boreholes 1, 2, 3, 4, and 6 at depths of 2.3 m, 3.1 m, 4.6 m, 0.3 m and 1.5 m respectively indicate decomposition very strong to complete decomposition, water contents ranged from 344% to 1037%, fine fibers were low to moderate contents, nil (0) coarse fibers, wood and shrubs contents were nil to low.

4.3 Clay

Clay was encountered in Boreholes 1 to 6 at depths from 3.1 to 15.5 m, 5.3 m to 22.5 m, 6.1 to 22.0 m, 6.1 to 26 m, 6.1 to 22.9 m, 4.6 to 21.5 m respectively; these correspond to top and bottom elevations of 218.7 to 206.3 m, 216.5 m to 199.3 m, 215.8 to 199.9 m, 215.9 to 196 m, 215.8 to 199.0 m and 217.2 to 200.3 m respectively. The thickness of this stratum is from 12.4 m to 19.9 m. Sixteen (16) Atterberg limit tests were carried out on samples from Boreholes 1, 2, 3, 5 and 6 indicate medium to high plasticity clay and organic clay with liquid limits and plasticity index of 25% to 56% and 6% to 32% respectively. In-situ field vane tests carried out in the clay indicate soft to stiff consistency with undrained shear strengths between 14 to 60 kPa and sensitivities ranging from 2 to

3, however in a great part of the clay layer field vane test was not carried out due to insufficient resistance, even the drilling rods were sinking with itself weight. This indicates the soil at this depth has shear strength of less than 10 kPa. Moisture contents of samples ranged from 36% to 75%.

Table 4.1 Summary of clay by Atterberg limit Test

Clay	
Property	Water Content
Liquid Limit	25% to 56%
Plasticity Index	6% to 32%

5. DESCRIPTION OF SUBSURFACE CONDITIONS OF THE EXISTING ROAD ALIGNMENT

The generalized stratigraphy of the existing road alignment, based on the conditions encountered in boreholes, consists of wood chips, sand and gravel fill that is underlain by soft to very stiff clay. Organic materials were encountered in the Boreholes 8, 9 and 10 at between 3.0 m and 5.8 m depths. The thickness was approximately between 0.8 m and 1.6 m. Sand layer was encountered in Borehole 8 at 7.6 m and approximately 1.5 m in thickness. Silt was encountered in Boreholes 7 at approximately 3.8 m depth. Silt was found approximately 0.8 m in thickness.

The subsurface condition of existing road alignment is further described below;

5.1 Sand and Gravel Fill

Sand and gravel fill layer was encountered in Borehole 8 and 10 at the depths of 0 to 2.2 m, 0 to 1.5 m below surface respectively; these correspond to top and bottom elevations of 222.8 m to 220.6 m, 222.0 m to 220.5 m respectively. The thickness of this layer was approximately 1.5 to 2.2m. Gradation analyses conducted on the samples from Boreholes 8 and 10 indicate gravel, sand, and fine contents of 43 to 45%, 48 to 49%, and 6 to 9% respectively. Moisture contents of samples ranged from 1 to 27%.

Table 5.1 Summary of sand and gravel layers particle size distribution

Sand and Gravel	
Soil Type	Percentage
Gravel	43 to 45%
Sand	48 to 49%
Silt	6 to 9%
Clay	

5.2 Gravel Fill

Gravel fill material layer with some sand, trace fines was encountered in Borehole 7 at depths 2.9 m to 3.8 m below surface; this corresponds to top and bottom elevations of 222.4 m and 221.5 m. The thickness of this layer was 0.9 m. SPT 'N' value of 13 indicates a compact condition. Gradation analyses conducted on the sample indicate gravel, sand, and fine contents of 71%, 22%, and 7% respectively. A moisture content of sample was found to be 12%.

Table 5.2 Summary of gravel layer particle size distribution

Gravel	
Soil Type	Percentage
Gravel	71%
Sand	22%
Silt	7%
Clay	

5.3 Sand Fill

Sand fill layer with some gravel, trace to some fines was encountered in Boreholes 7, 9 and 11 at depths of 0 to 2.9 m, 0 to 1.1 m and 1.5 to 3.8 m, 0 to 3.4 m respectively; these correspond to top and bottom elevations of 225.3 m to 222.4 m, 221.8 m to 220.7 m and 220.3 m and 218.0 m, 222.1 m to 218.7 m respectively. The thickness of this layer was between 1.1 m to 3.4 m. SPT 'N' value of 9 to 55 indicates loose to very dense condition. Gradation analyses conducted on the four (4) samples from boreholes 7, 9 and 11 indicate gravel, sand, and fine contents of 24 to 27%, 62 to 67%, and 6 to 11% respectively. Moisture contents of samples ranged from 1 to 27%.

Table 5.3 Summary of sand layers particle size distribution

Sand	
Soil Type	Percentage
Gravel	24 to 27%
Sand	62 to 67%
Silt	6 to 11%
Clay	

5.4 Wood Chips Fill

Wood chips fill layer with sand, trace silt and gravel was encountered in Boreholes 8, 9 and 10 on the existing road alignment at the depths of 2.2 to 3.0 m and 3.8 to 4.5 m, 1.1 to 1.5 m, 1.5 to 4.6 m respectively; this corresponds to top and bottom elevations of 220.6 m to 219.8 m and 219.1 to 218.3 m, 220.7 m to 220.3 m, 220.5 m to 217.4 m respectively. The thickness of this stratum is from 0.4 m to 3.1 m. Von Post tests were carried out on samples from Boreholes 8 at depths of 2.3 m indicates none decomposition, water contents were 499%, fine fibers contents were moderate, coarse fibers contents were high, wood and shrubs contents were high.

5.5 Organics

Organics were encountered in Boreholes 8, 9 and 10 on the existing road alignment at the depths of 3 to 3.8 m, 3.8 to 5.4 m and 4.6 to 5.8 m respectively; this corresponds to top and bottom elevations of 219.8 m to 219.1 m, 218.0 m to 216.4 m and 217.4 m to 216.2 m respectively. The thickness of this stratum is from 0.8 m to 1.6 m. Von Post tests were carried out on samples from Boreholes 9 and 10 at depths of 3.8 m and 4.6 m respectively indicate insignificant to moderately strong decomposition, water contents were 154% and 549%, fine fibers were moderate to high contents, coarse fibers were low to high contents, wood and shrubs contents were nil to low.

5.6 Sand

A layer of native sand material was encountered in Borehole 8 at depth of 7.6 m to 9.1 m below surface; this corresponds to top and bottom elevations of 215.2 m to 213.7 m. The thickness of this layer was approximately 1.5 m. SPT 'N' value of 8 indicates compact condition.

5.7 Silt

Silt layer with some sand, trace clay was encountered in Borehole 7 at depth between 3.8 m to 4.6 m below surface; this corresponds to top and bottom elevation of 221.5 m and 220.7 m respectively. The thickness of the layer was 0.8 m. SPT 'N' value of 5 indicates loose condition. Hydrometer test carried out on sample indicate gravel, sand, silt and clay contents of 0%, 20%, 70% and 9% respectively. Moisture content of sample was found to be 24%.

Table 5.1 Summary of Silt layer particle size distribution

Silt	
Soil Type	Percentage
Gravel	0%
Sand	20%
Silt	70%
Clay	9%

5.8 Clay

Clay was encountered in Boreholes 8 to 11 at depths 4.5 to 7.6 m, 5.4 to 21.3 m, 5.8 to 21.3 m, 3.4 to 18.9 m respectively; these correspond to top and bottom elevations of 218.3 m to 215.2 m, 216.3 m to 200.5 m, 216.2 m to 200.7 m, 218.7 m to 203.2 m respectively. The thickness of this layer is

between 3.1 m to 15.9 m. Thirteen (13) Atterberg limit tests carried out on samples from Boreholes 8, 9, 10 and 11 indicate low to high plasticity clay with liquid limits and plasticity index of 32% to 57% and 12% to 32% respectively. In-situ field vane tests taken in Boreholes indicate soft to very stiff consistency with undrained shear strengths between 19 to 118 kPa and sensitivities ranging from 2 to 12. Moisture contents of samples ranged from 26% to 65%.

Table 5.2 Summary of clay by Atterberg limits Test

Clay	
Property	Water Content
Liquid Limit	32% to 57%
Plasticity Index	12% to 32%

6. GROUNDWATER

The groundwater levels can be expected to vary with season and precipitation events. Table 6.1 below summarize the groundwater level measured during the Boreholes drilling.

Table 6.1 Groundwater table at boreholes

Date Water Level Recorded	Borehole ID	Borehole elevation (m)	Groundwater elevation (m)	Depth below ground surface (m)
27/02/2012	BH1	221.76	221.76	0.00
28/02/2012	BH2	221.84	221.84	0.00
01/03/2012	BH3	221.94	221.94	0.00
02/03/2012	BH4	221.97	221.97	0.00
05/03/2012	BH5	221.89	221.89	0.00
05/03/2012	BH6	221.82	221.42	0.40
06/03/2012	BH7	225.30	222.45	2.85
06/03/2012	BH8	222.81	221.86	0.95
07/03/2012	BH9	221.83	220.83	1.00
08/03/2012	BH10	221.97	221.57	0.40
08/03/2012	BH11	222.13	221.68	0.45

7. MISCELLANEOUS

Site work was carried out in a period between February 27th, 2012 and March 9th, 2012 utilizing a CME 750 drill rig and was operated by DST personnel. Fieldwork was conducted on a full time basis by Joe Forgues and Carl Dumas who located the boreholes in the field, performed sampling, in-situ testing and logged the boreholes. Soil samples collected during drilling were identified in the field, placed in labelled containers and transported to DST's laboratory in Thunder Bay for further analysis. Interpretation of the data and preparation of the report was completed by Tanveer Mubarik P.Eng, Bernardo Villegas, and Tun Lwin and reviewed by Prof. Myint Win Bo, P.Eng a designated principal contact for MTO projects.

8. LIMITATION OF REPORT

A description of limitations which are inherent in carrying out site investigation studies is given in Appendix 'A', and this forms an integral part of this report.

For DST CONSULTING ENGINEERS INC.

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APPENDIX 'A'

LIMITATIONS OF REPORT

LIMITATIONS OF REPORT

GEOTECHNICAL STUDIES

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the Client. Note that no scope of work, no matter how exhaustive, can identify all conditions below ground. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the site investigation. Conditions can also change with time. It is recommended practice that a Quality Verification 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 benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavation, planning, development, etc.

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 details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

Unless otherwise noted, the information contained herein in no way reflects on environmental aspects of either the site or the subsurface conditions.

The comments given 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, e.g. 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.

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the client.

APPENDIX 'B'
DESCRIPTIVE TERMS
FOR SOIL CLASSIFICATION

EXPLANATION OF TERMS USED IN REPORT

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

DYNAMIC CONE PENETRATION TEST (DCPT): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51 mm 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 0.3 m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS

TEXTURAL CLASSIFICATION OF SOILS

BOULDERS	COBBLES	GRAVEL	SAND	SILT	CLAY
GREATER THAN 200 mm	75 TO 200 mm	4.75 TO 75 mm	0.075 TO 4.75 mm	0.002 TO 0.075 mm	LESS THAN 0.002 mm

COARSE GRAIN SOIL DESCRIPTION (50% GREATER THAN 0.075 mm)

TERMINOLOGY	TRACE OR OCCASIONAL	SOME	ADJECTIVE (e.g. SILTY OR SANDY)	AND (e.g. SAND AND SILT)
	LESS THAN 10%	10 TO 20%	20 TO 35%	35 TO 50%

CONSISTENCY*: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (C_u) AND SPT 'N' VALUES AS FOLLOWS

C_u (kPa)	0 – 12	12 – 25	25 – 50	50 - 100	100 - 200	> 200
N (BLOWS / 0.3 m)	<2	2 - 4	4 - 8	8 - 15	15 - 30	>30
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

N (BLOWS / 0.3 m)	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, 100 mm+ IN LENGTH EXPRESSED AS A PERCENTAGE OF THE LENGTH OF THE CORING RUN.

THE **ROCK QUALITY DESIGNATION (R.Q.D)** FOR MODIFIED RECOVERY IS:

R.Q.D (%)	0 – 25	25 – 50	50 – 75	75 – 90	90 – 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

LEGEND OF RECORDS FOR BOREHOLES: SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE

SS	SPLIT SPOON SAMPLE	WS	WASH SAMPLE
TW	THIN WALL SHELBY TUBE SAMPLE	AS	AUGER (GRAB) SAMPLE
PH	SAMPLER ADVANCED BY HYDRAULIC PRESSURE	TP	THIN WALL PISTON SAMPLE
WH	SAMPLER ADVANCED BY SELF STATIC WEIGHT	PM	SAMPLER ADVANCED BY MANUAL PRESSURE
SC	SOIL CORE	RC	ROCK CORE
	WATER LEVEL	$SENSITIVITY = \frac{UNDISTURBED\ SHEAR\ STRENGTH}{REMOLDED\ SHEAR\ STRENGTH}$	

*HIERARCHY OF SOIL STRENGTH PREDICTION: **1)** LABORATORY TRIAXIAL TESTING. **2)** FIELD INSITU VANE TESTING. **3)** LABORATORY VANE TESTING. **4)** SPT VALUES. **5)** POCKET PENETROMETER.

A P P E N D I X ‘ C ‘

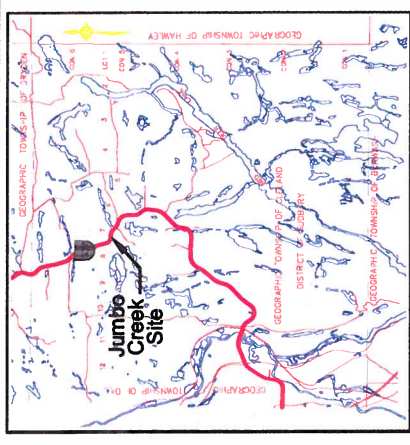
D R A W I N G S

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METERS

CONT No 5279-03-00
GWP No
WP No
Site No
GeoCres No 421-286

ROAD ALIGNMENT
AT JUMBO CREEK
Hwy 537 - Cleland Twp.
Borehole Locations

SHEET



0 8
SCALE IN KILOMETRES

- LEGEND**
- Borehole/Hand Auger
 - Borehole with DCPT
 - Dynamic Cone Penetration Test (DCPT)
 - Rock Probe
 - 'N' Blows/0.3m (Std. Pen Test, 475 J/Blow)
 - Water level at time of investigation
 - Benchmark
 - Fill
 - Organics
 - Topsoil
 - Till
 - Bedrock
 - Sand
 - Silt
 - Clay
 - Sand & Gravel
 - Boulders

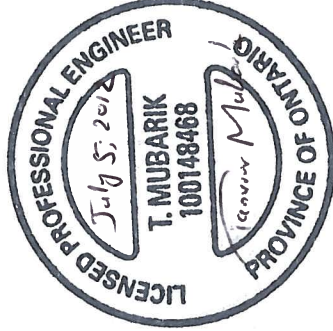
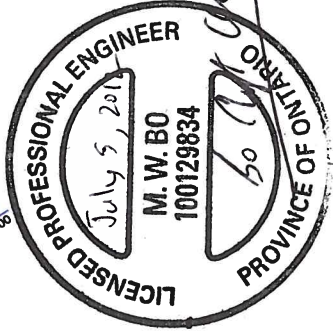
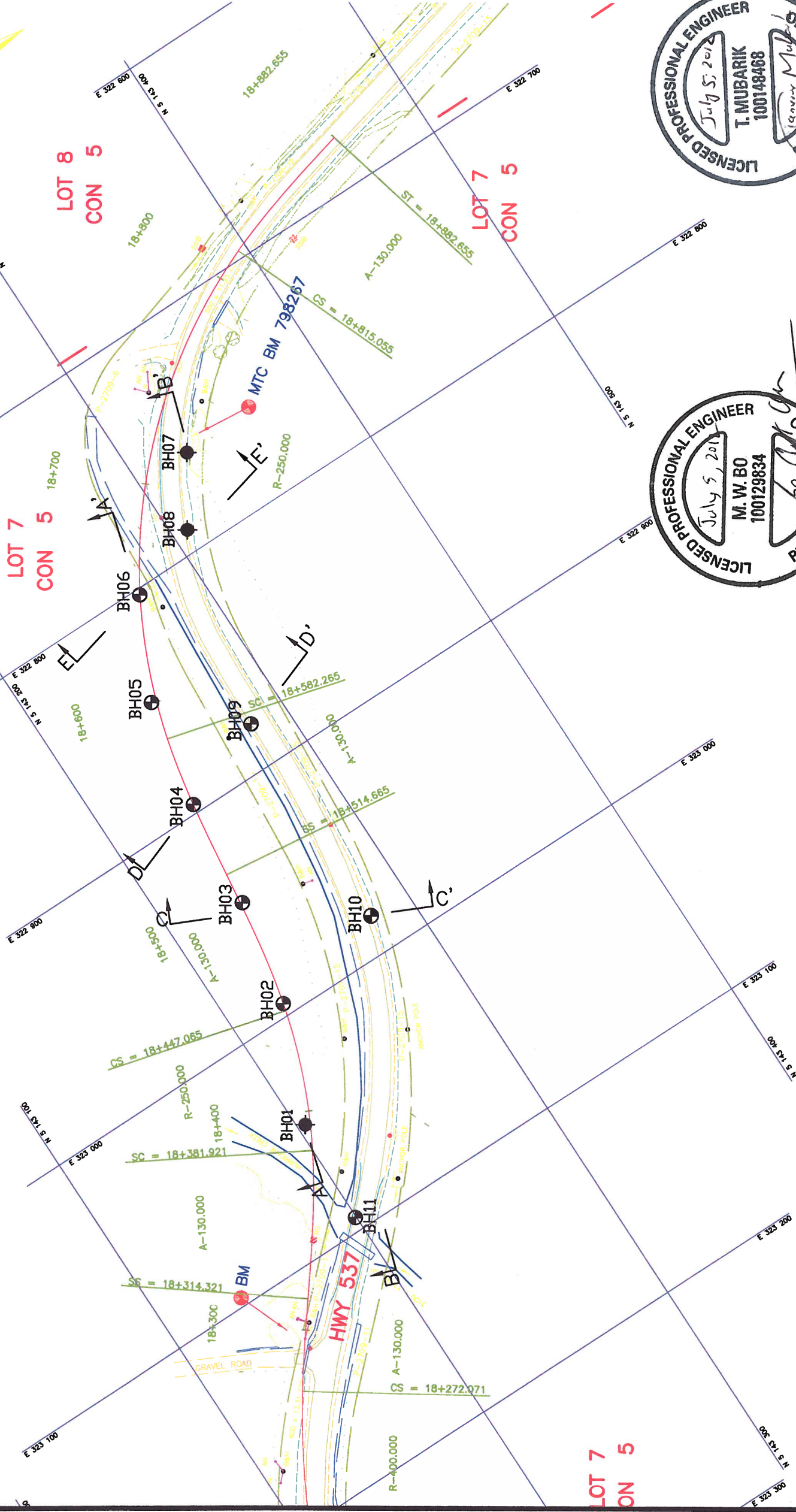
No.	Elevation	Northing	Easting	Station	Offset
BH1	221.761	5141673	518228	18+412	2.2 m LT
BH2	221.841	5141688	518167	18+450	CL
BH3	221.836	5141684	518133	18+500	0.9 m RT
BH4	221.970	5141689	518090	18+550	CL
BH5	221.888	5141712	518046	18+600	2.3 m LT
BH6	221.815	5141731	517988	18+650	CL
BH7	223.300	5141782	517947	18+715	3.0 m RT
BH8	222.806	5141782	517932	18+875	4.0 m RT
BH9	221.832	5141738	518037	18+875	4.0 m LT
BH10	221.874	5141731	518189	18+475	4.8 m RT
BH11	222.130	5141682	518233	18+350	3.0 m LT

NOTE:
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed by interpolation and may not represent actual conditions.

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consulting engineers Email: thunderbay@dstgroup.com

DRAWING 1

GEOGRAPHIC TOWNSHIP OF CLELAND
DISTRICT OF SUDBURY

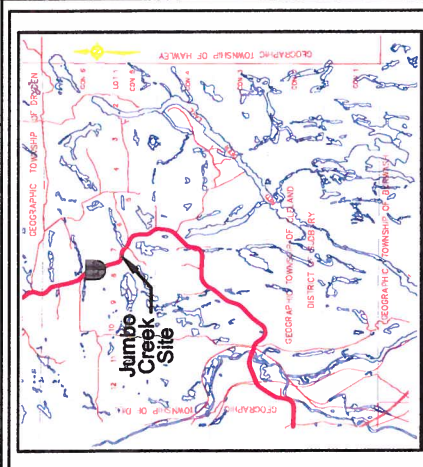


0 25 50 75 100
Scale in Metres

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

CONT	No	No
GWP	No	5279-03-00
WP	No	
Site	No	
GeoCres	No	421-286

PROPOSED ROAD ALIGNMENT AT JUMBO CREEK Hwy 537 - Cleland Twp. Borehole Locations & Soil Strata	SHEET
---	-------



0 8
SCALE IN KILOMETRES

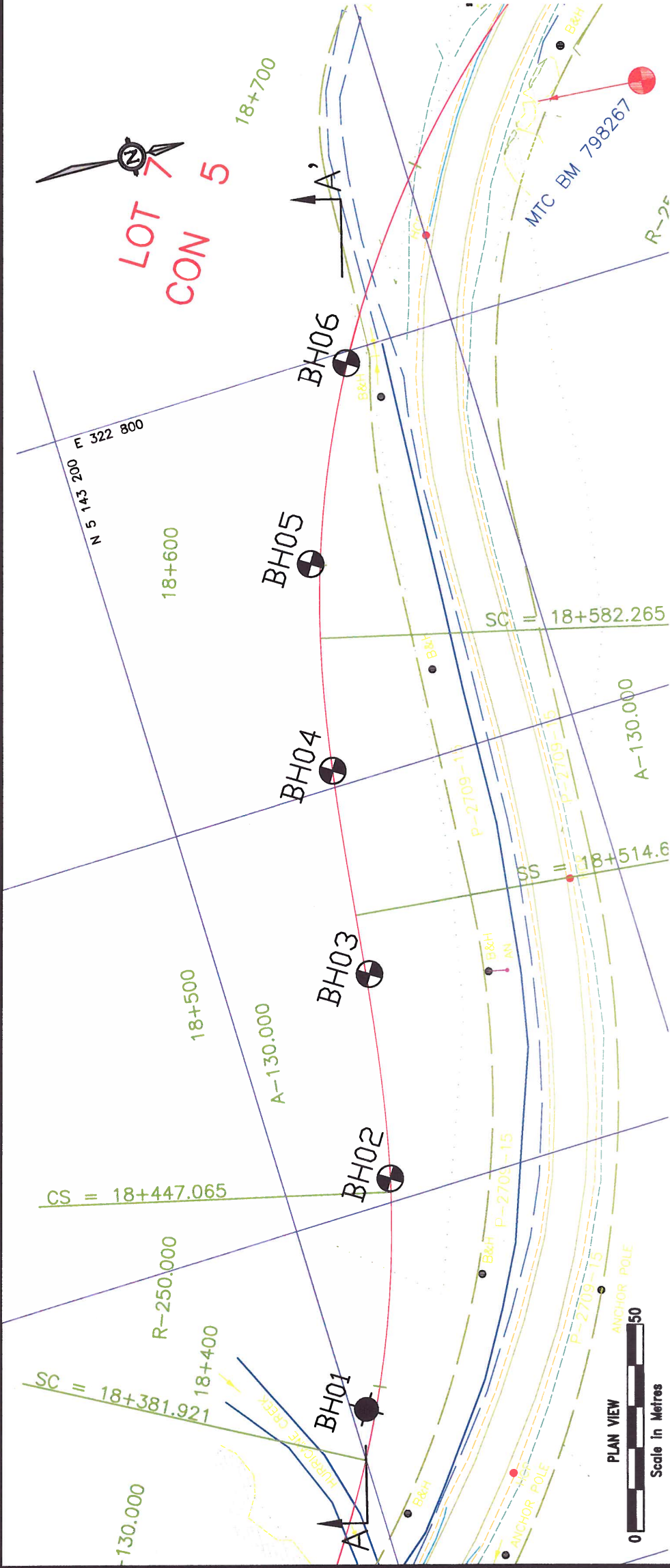
LEGEND	
	Borehole/Hand Auger
	Borehole with DCPT
	Dynamic Cone Penetration Test (DCPT)
	Rock Probe
	Blows/0.3m (Std. Pen Test, 475 J/Blow)
	Water level at time of investigation.
	Benchmark
	Fill
	Organics
	Topsoil
	Till
	Bedrock
	Sand
	Silt
	Clay
	Sand & Gravel
	Boulders

No.	Elevation	Northing	Eastings	Station	Offset
BH1	221.761	5141673	514228	18+412	2.2 m LT
BH2	221.041	5141686	514167	18+450	CL
BH3	221.636	5141684	514136	18+500	0.9 m RT
BH4	221.970	5141689	514090	18+550	CL
BH5	221.889	5141712	514046	18+600	2.3 m LT
BH6	221.516	5141762	517698	18+650	CL
BH7	223.300	5141731	517647	18+715	3.0 m RT
BH8	222.506	5141762	517683	18+675	4.0 m RT
BH9	221.832	5141738	518087	18+675	4.0 m LT
BH10	221.974	5141731	518189	18+475	4.8 m RT
BH11	222.130	5141652	518253	18+350	3.0 m LT

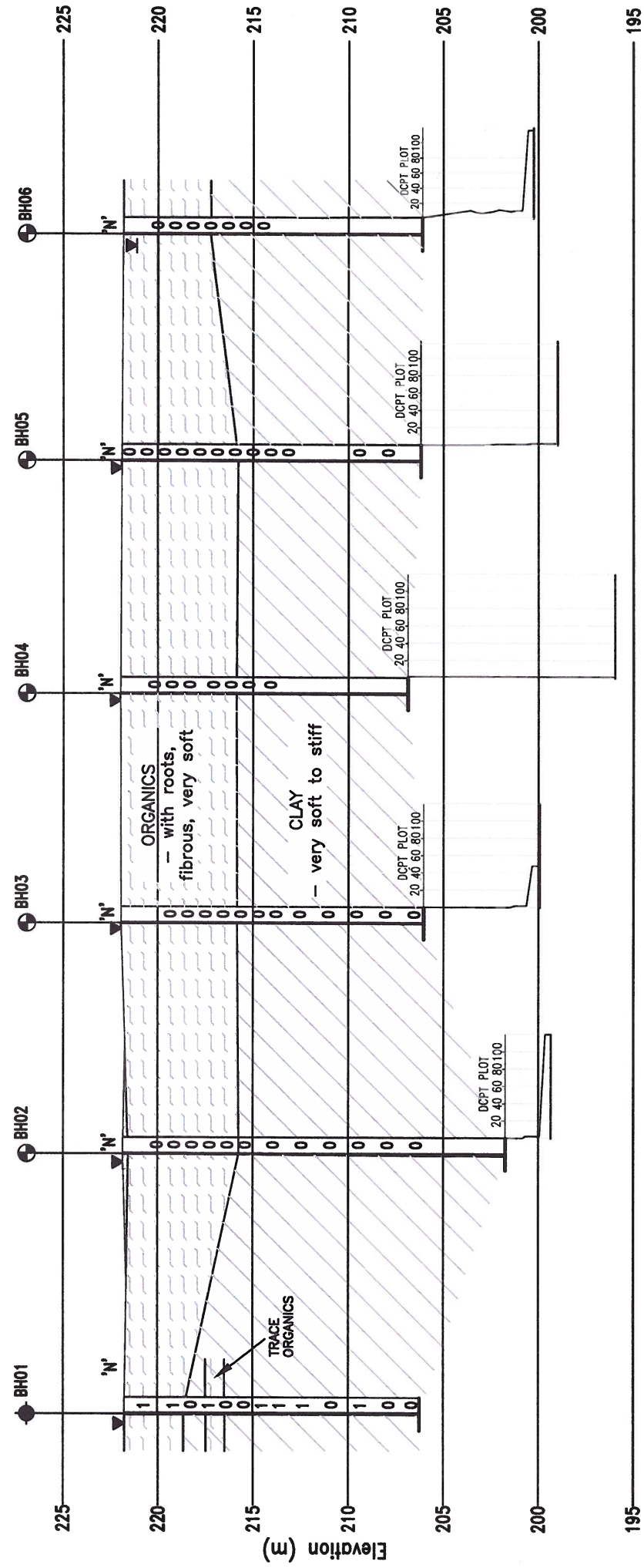
Vertical Scale in Metres
0 5
Horizontal Scale in Metres
0 25

NOTE:
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PROFILE ALONG THE PROPOSED ALIGNMENT



CONT No 5279-03-00

GWP No

WP No

Site No

GeoCres No 421-286

METRIC

MEASUREMENTS ARE IN METRES

AND/OR MILLIMETRES UNLESS

OTHERWISE SHOWN. STATIONS

IN KILOMETRES + METERS

0 8

SCALE IN KILOMETRES

EXISTING ROAD ALIGNMENT AT JUMBO CREEK

Hwy 537 - Cleland Twp.

Borehole Locations & Soil Strata

0 8

SCALE IN KILOMETRES

LEGEND			
	Borehole/Hand Auger		Sand
	Borehole with DCPT		Silt
	Dynamic Cone Penetration Test (DCPT)		Clay
	Rock Probe		Sand & Gravel
	Blows/0.3m (Std. Pen Test, 475 J/Blow)		Boulders
	Water level at time of investigation.		
	Benchmark		
	Fill		Organics
	Topsoil		Bedrock
	Till		
	Bedrock		

No.	Elevation	Northing	Eastings	Station	Offset
BH1	221.761	5141673	518228	18+412	2.2 m LT
BH2	221.841	5141688	518197	18+450	CL
BH3	221.536	5141684	518136	18+500	0.9 m RT
BH4	221.970	5141689	518060	18+550	CL
BH5	221.939	5141712	518046	18+500	2.3 m LT
BH6	221.815	5141731	517988	18+650	CL
BH7	225.300	5141762	517947	18+715	3.0 m RT
BH8	222.806	5141762	517852	18+675	4.0 m RT
BH9	221.532	5141738	518087	18+675	4.0 m LT
BH10	221.974	5141731	518169	18+475	4.8 m RT
BH11	222.130	5141652	518293	18+350	3.0 m LT

PROFILE ALONG THE EXISTING ALIGNMENT

Profile view showing soil strata and elevation data for boreholes BH07 through BH11. The profile includes labels for various soil types like 'SANDY GRAVEL', 'SILT', 'WOOD CHIPS', 'ORGANICS', 'CLAY', and 'BEDROCK'. It also shows DCPT plots for each borehole.

NOTE:

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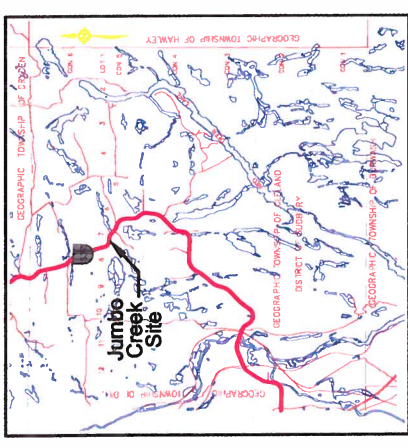
Email: thunderbay@dstgroup.com

DRAWING 3

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METERS

CONT No 5279-03-00
GWP No
WP No
Site No
GeoCres No 421-286

CROSS SECTION
AT JUMBO CREEK
Hwy 537 - Cleland Twp.
Borehole Locations & Soil Strata



KEY PLAN
0 8
SCALE IN KILOMETRES

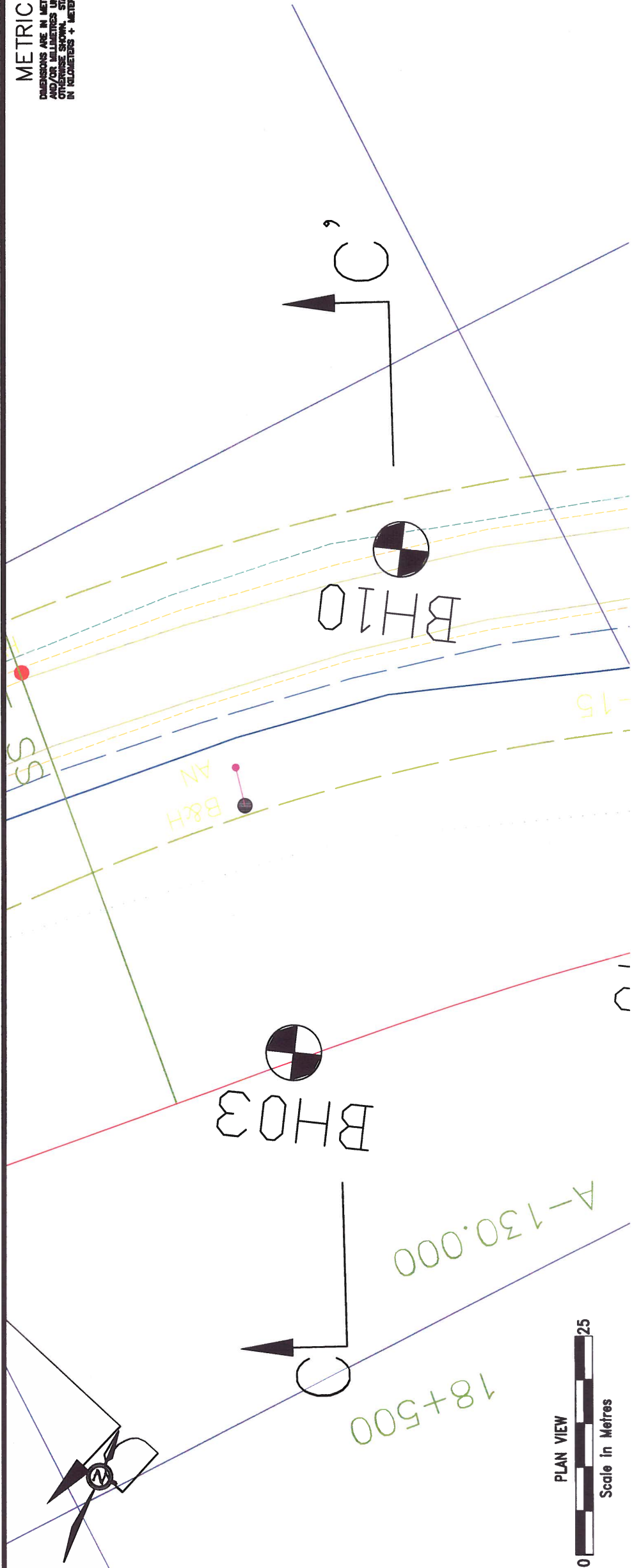
LEGEND	
	Borehole/Hand Auger
	Borehole with DCPT
	Dynamic Cone Penetration Test (DCPT)
	Rock Probe
	Blows/0.3m (Std. Pen Test, 475 J/Blow)
	Water level at time of investigation.
	Benchmark
	Fill
	Organics
	Topsoil
	Till
	Bedrock
	Sand
	Silt
	Clay
	Sand & Gravel
	Boulders

No.	Elevation	Northing	Eastings	Station	Offset
BH1	221.761	5141673	516228	18+412	2.2 m LT
BH2	221.841	5141686	516187	18+450	CL
BH3	221.836	5141684	516138	18+500	0.9 m RT
BH4	221.970	5141689	516090	18+550	CL
BH5	221.889	5141712	516046	18+600	2.3 m LT
BH6	221.816	5141731	517888	18+650	CL
BH7	223.300	5141762	517847	18+715	3.0 m RT
BH8	222.806	5141762	517682	18+715	4.0 m RT
BH9	221.832	5141738	516087	18+875	4.0 m LT
BH10	221.874	5141731	516189	18+875	4.8 m RT
BH11	222.130	5141652	516293	18+350	3.0 m LT

NOTE:
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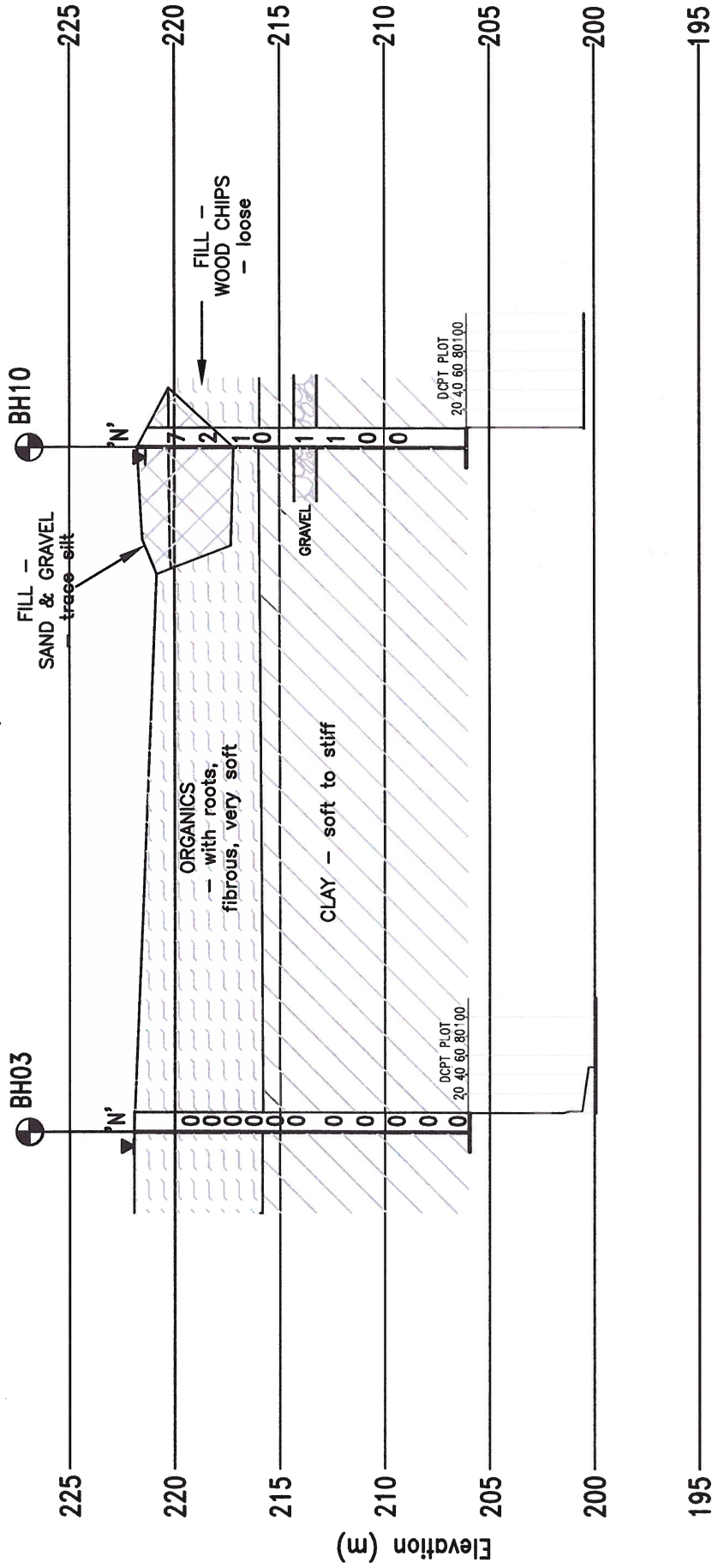
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DRAWING 4

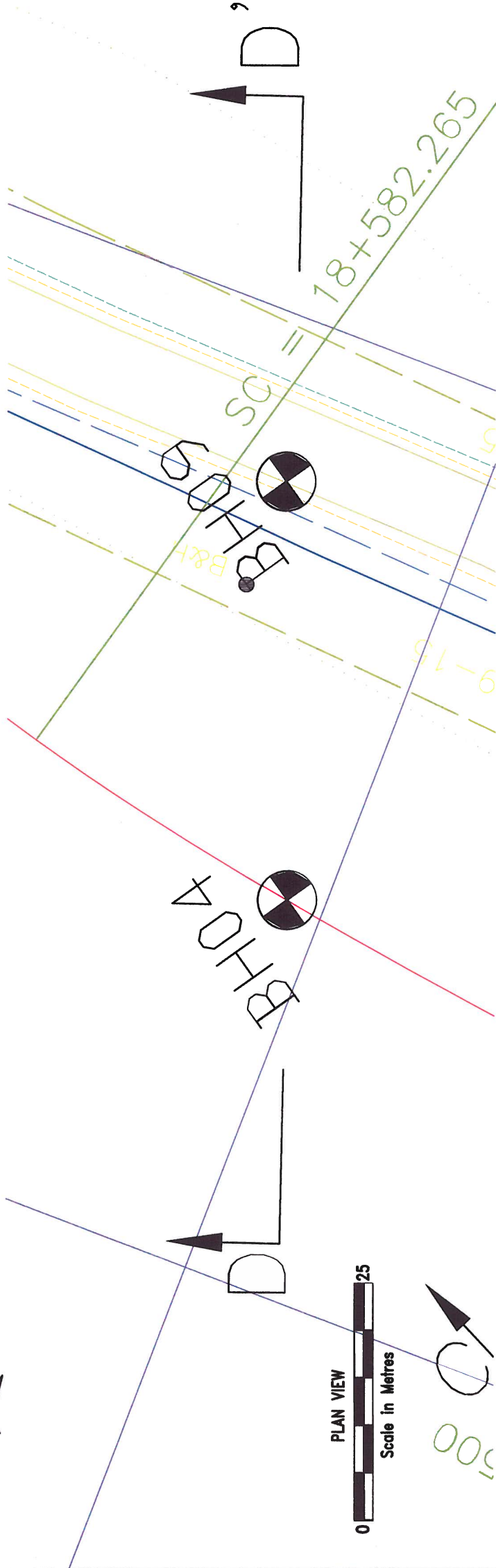
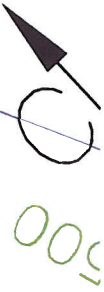


PLAN VIEW
0 25
Scale in Metres

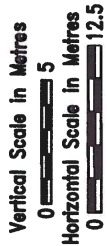
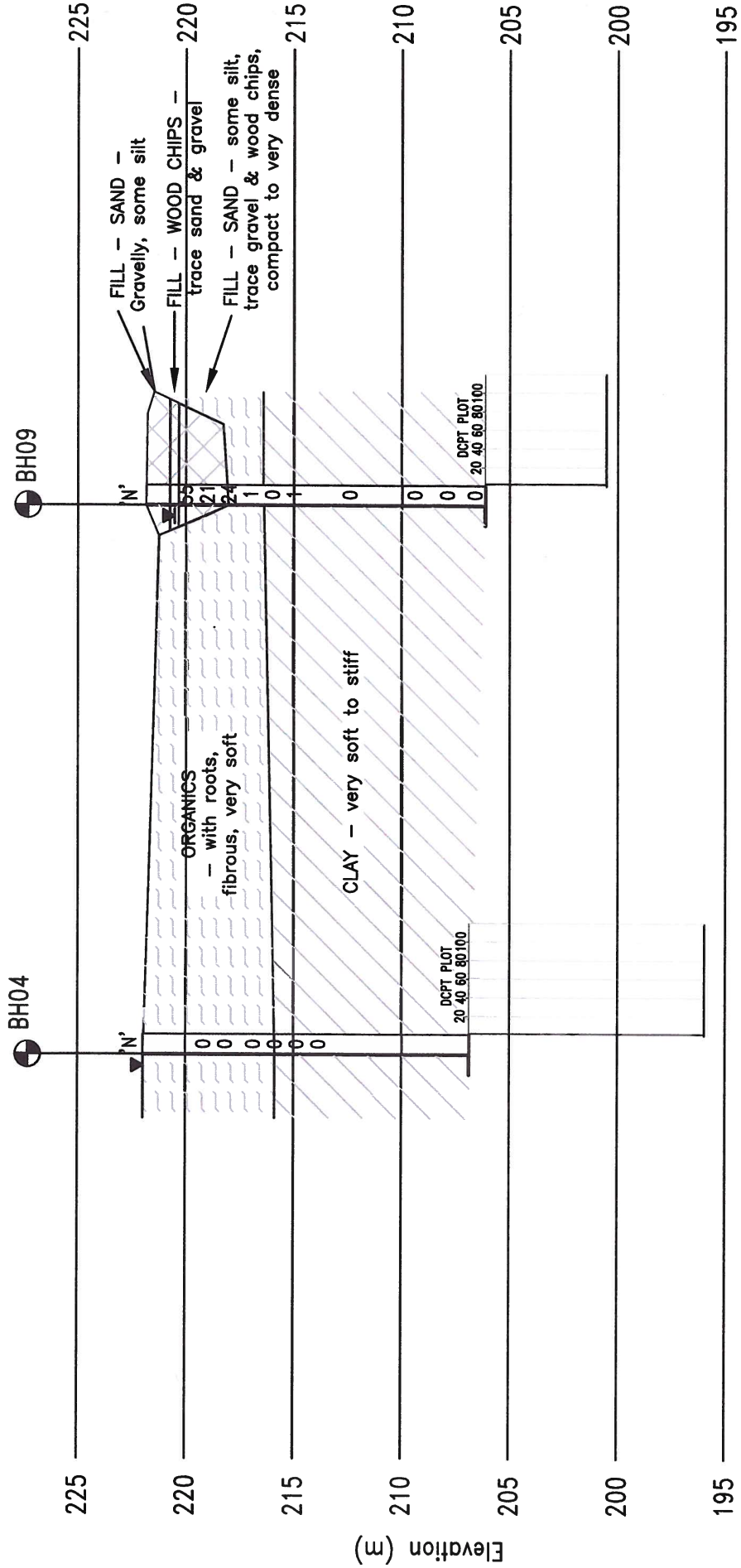
CROSS SECTION AT THE PROPOSED/EXISTING ALIGNMENT



Vertical Scale in Metres
0 5
Horizontal Scale in Metres
0 12.5



CROSS SECTION AT THE PROPOSED/EXISTING ALIGNMENT



METRIC

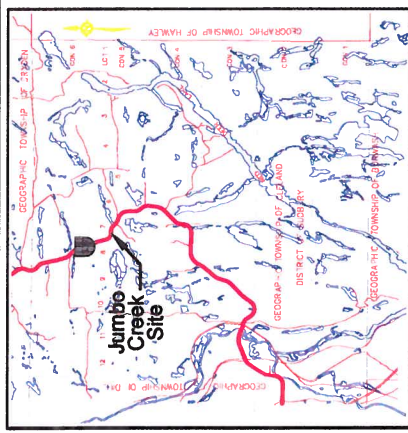
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETERS + METERS

CONT No 5279-03-00
GWP No
WP No
Site No
GeoCres No 421-286



CROSS SECTION
AT JUMBO CREEK
Hwy 537 - Cleland Twp.
Borehole Locations & Soil Strata

SHEET



LEGEND

- Borehole/Hand Auger
- Borehole with DCPT
- Dynamic Cone Penetration Test (DCPT)
- Rock Probe
- 'N' Blows/0.3m (Std. Pen Test, 475 J/Blow)
- Water level at time of investigation.
- Benchmark



No.	Elevation	Northing	Eastings	Station	Offset
BH1	221.761	5141673	518228	18+412	2.2 m LT
BH2	221.841	5141686	518187	18+450	CL
BH3	221.336	5141684	518133	18+500	0.9 m RT
BH4	221.970	5141689	518080	18+550	CL
BH5	221.689	5141712	519046	18+600	2.3 m LT
BH6	221.815	5141731	517883	18+650	CL
BH7	223.300	5141762	517947	18+715	3.0 m RT
BH8	222.806	5141762	517982	18+675	4.0 m RT
BH9	221.532	5141738	519087	18+575	4.0 m LT
BH10	221.974	5141731	518189	18+475	4.8 m RT
BH11	222.130	5141682	518293	18+350	3.0 m LT

NOTE:
The boundaries between soil strata have been established only at borehole
locations. Between boreholes the boundaries are assumed by interpolation
and may not represent actual conditions.

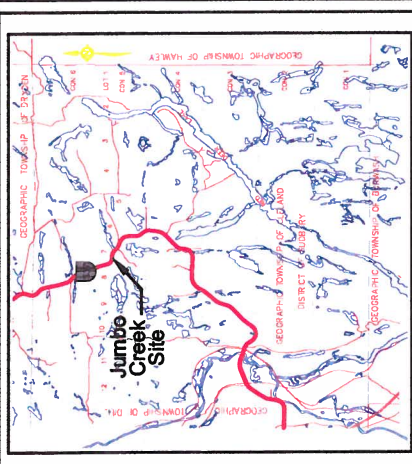


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METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETERS + METERS

CONT	No
GWP	No 5279-03-00
WP	No
Site	No
GeoCres	No 421-286

CROSS SECTION AT JUMBO CREEK Hwy 537 - Cleland Twp. Borehole Locations & Soil Strata	SHEET
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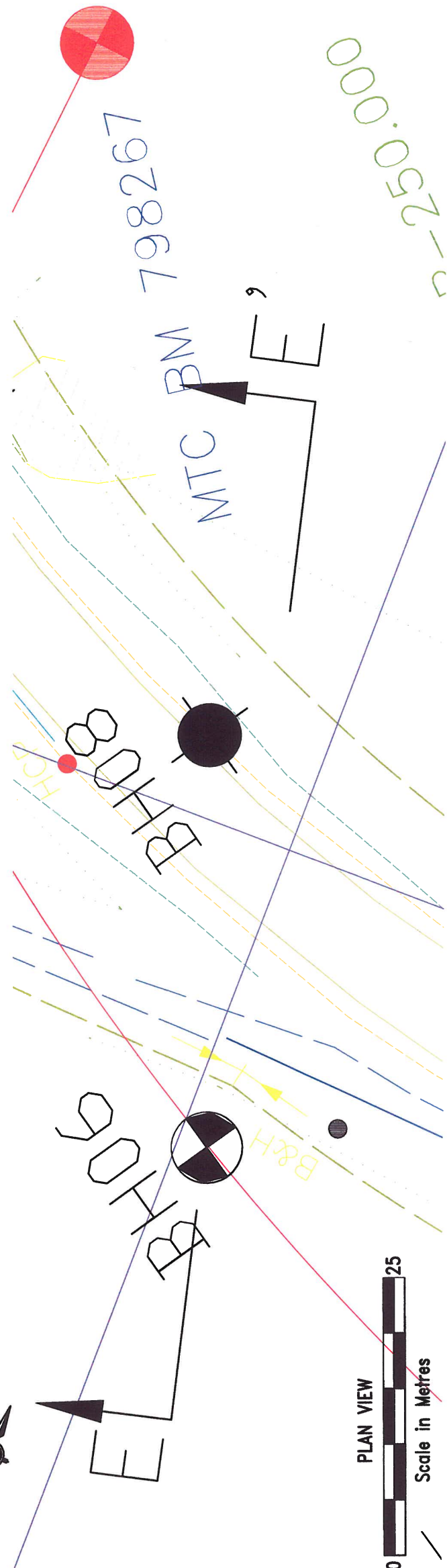
LEGEND	
	Borehole/Hand Auger
	Borehole with DCPT
	Dynamic Cone Penetration Test (DCPT)
	Rock Probe
	Blows/0.3m (Std. Pen Test, 475 J/Blow)
	Water level at time of investigation.
	Benchmark
	Fill
	Organics
	Topsoil
	Till
	Bedrock
	Sand
	Silt
	Clay
	Sand & Gravel
	Boulders

No.	Elevation	Northing	Eastings	Station	Offset
BH1	221.761	5141673	516226	18+412	2.2 m LT
BH2	221.941	5141688	516167	18+450	CL
BH3	221.636	5141684	516138	18+500	0.9 m RT
BH4	221.970	5141689	516090	18+520	CL
BH5	221.686	5141712	516046	18+600	2.3 m LT
BH6	221.815	5141731	517898	18+650	CL
BH7	225.300	5141762	517947	18+715	3.0 m RT
BH8	222.606	5141762	517932	18+875	4.0 m RT
BH9	221.632	5141738	516087	18+975	4.0 m LT
BH10	221.874	5141731	516189	18+475	4.8 m RT
BH11	222.130	5141652	516233	18+350	3.0 m LT

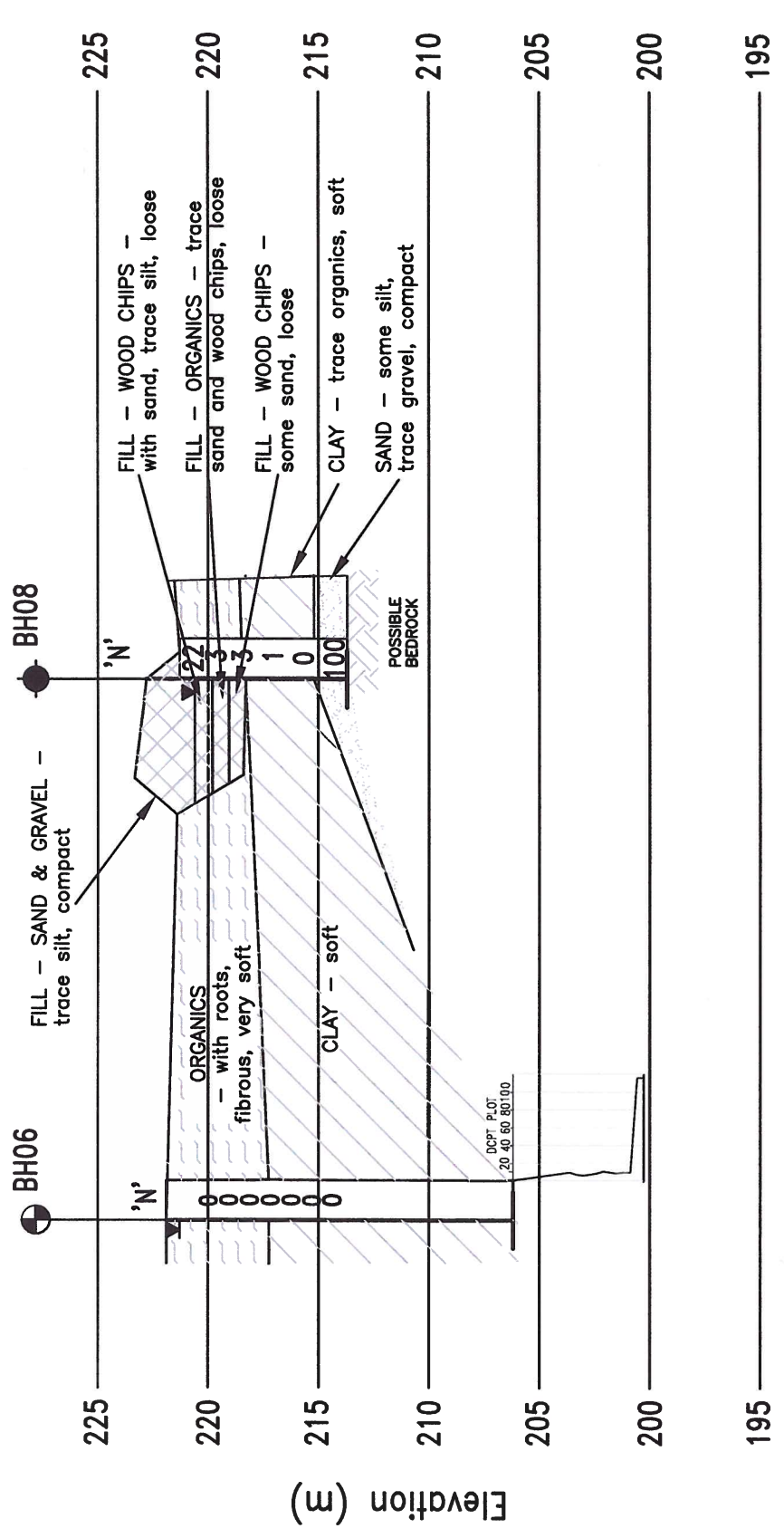


NOTE:
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Email: thunderbay@dstgroup.com



CROSS SECTION AT THE PROPOSED/EXISTING ALIGNMENT

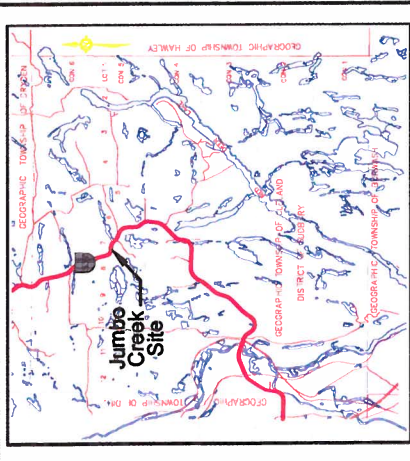
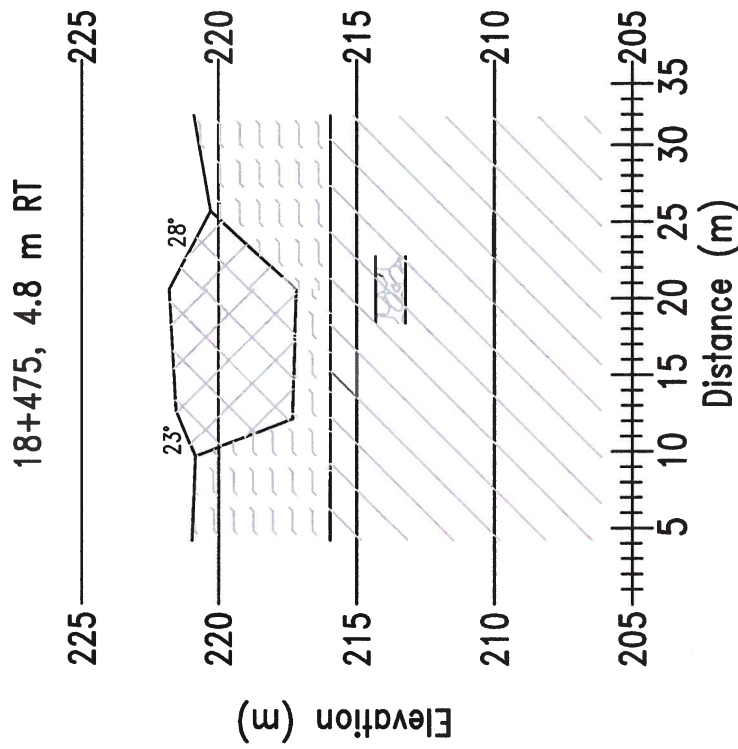
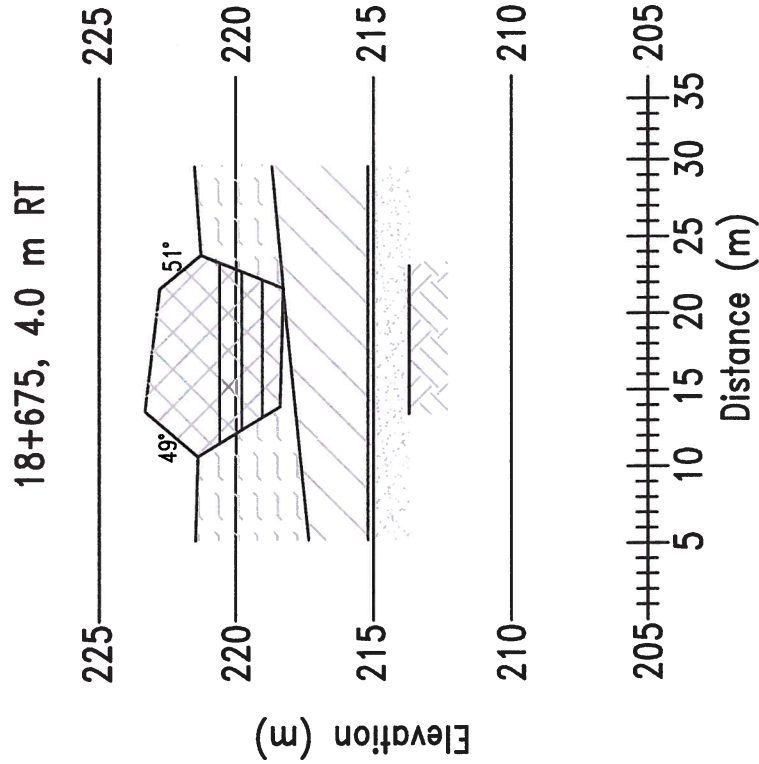
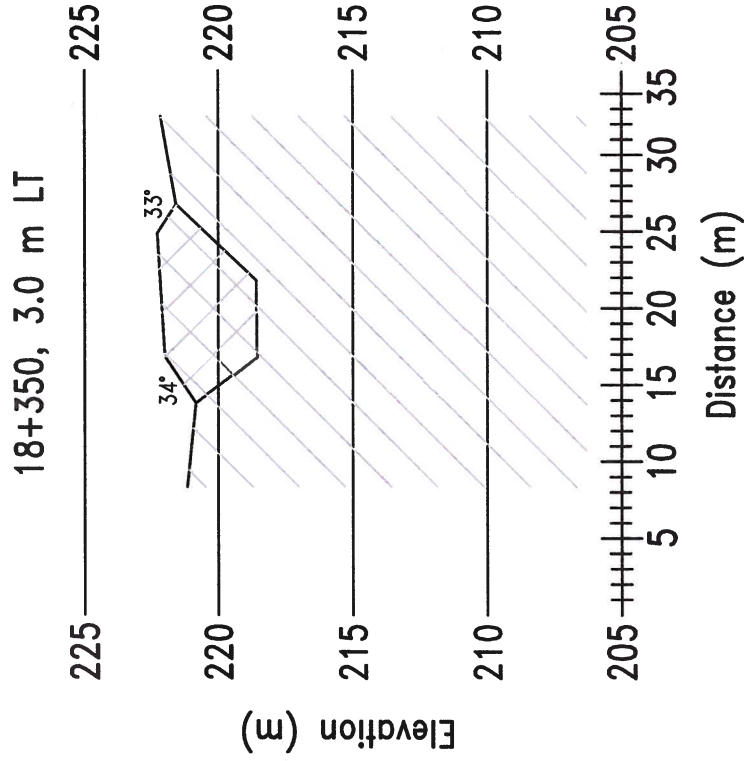
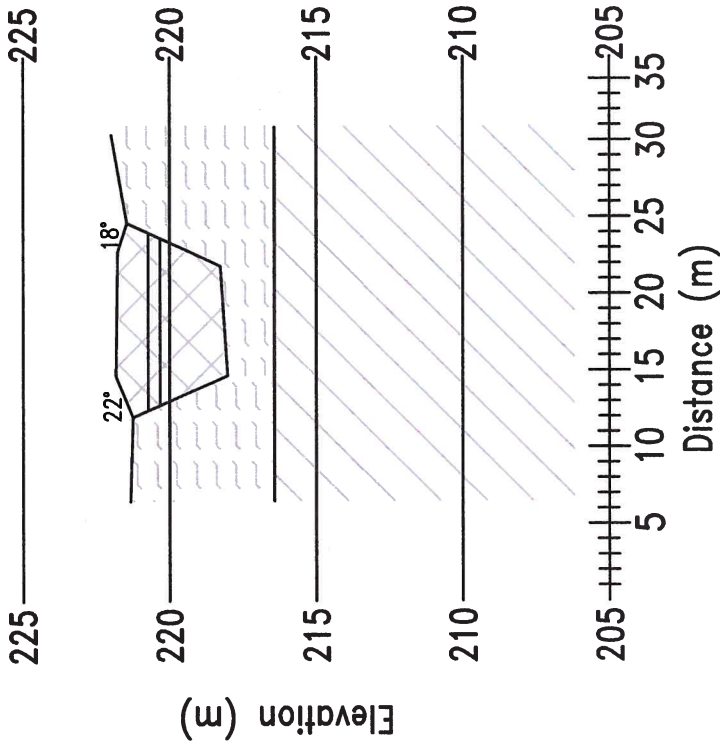


METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SPECIFIED
CONVERSIONS TO SI UNITS
IN PARENTHESES + METERS

CONT No 5279-03-00
GWP No
WP No
Site No
GeoCres No 421-286

EXISTING TYPICALS ALONG ROAD
ALIGNMENT AT JUMBO CREEK
Hwy 537 - Cleland Twp.
Existing Section Drawings

18+575, 4.0 m LT



KEY PLAN
SCALE IN KILOMETRES
0 8

- LEGEND
- Borehole/Hand Auger
 - Borehole with DCPT
 - Dynamic Cone Penetration Test (DCPT)
 - Rock Probe
 - Blows/0.3m (Std. Pen Test, 475 J/Blow)
 - Water level at time of investigation.
 - Benchmark
 - Fill
 - Organics
 - Topsoil
 - Till
 - Bedrock
 - Sand
 - Silt
 - Clay
 - Sand & Gravel
 - Boulders

No.	Elevation	Station	Offset
BH1	221.761	5141673	18+412 2.2 m LT
BH2	221.841	5141686	18+450 CL
BH3	221.596	5141684	18+500 0.9 m RT
BH4	221.670	5141689	18+550 CL
BH5	221.889	5141712	18+600 2.3 m LT
BH6	221.815	5141731	18+650 CL
BH7	225.300	5141762	18+715 3.0 m RT
BH8	222.806	5141762	18+675 4.0 m RT
BH9	221.832	5141738	18+675 4.0 m LT
BH10	221.974	5141731	18+475 4.8 m RT
BH11	222.130	5141652	18+350 3.0 m LT

Vertical Scale in Metres
0 5
Horizontal Scale in Metres
0 10

NOTE:
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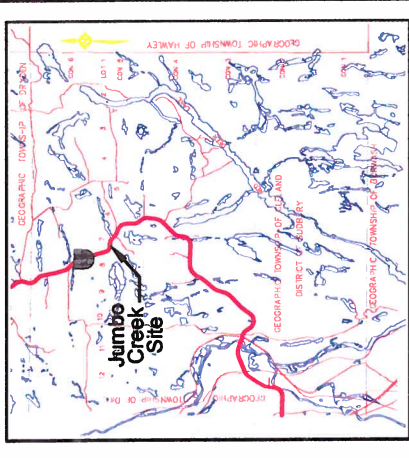
DRAWING 7

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METERS

CONT No 5279-03-00
GWP No
WP No
Site No
GeoCres No 421-286

OPTION 1 - TYPICAL PROFILES
OF GRADE RAISES ON
EXISTING ROAD ALIGNMENT
Hwy 537 - Cleland Twp.

SHEET



KEY PLAN
SCALE IN KILOMETRES
0 8

LEGEND	
	Borehole/Hand Auger
	Borehole with DCPT
	Dynamic Cone Penetration Test (DCPT)
	Rock Probe
	Blows/0.3m (Std. Pen Test, 475 J/Blow)
	Water level at time of investigation.
	Benchmark
	Fill
	Organics
	Topsoil
	Till
	Bedrock
	Sand
	Silt
	Clay
	Sand & Gravel
	Boulders

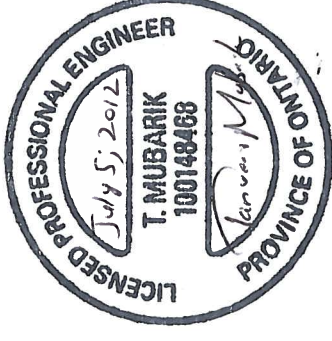
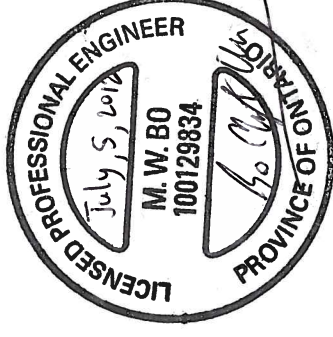
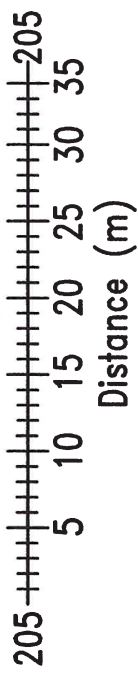
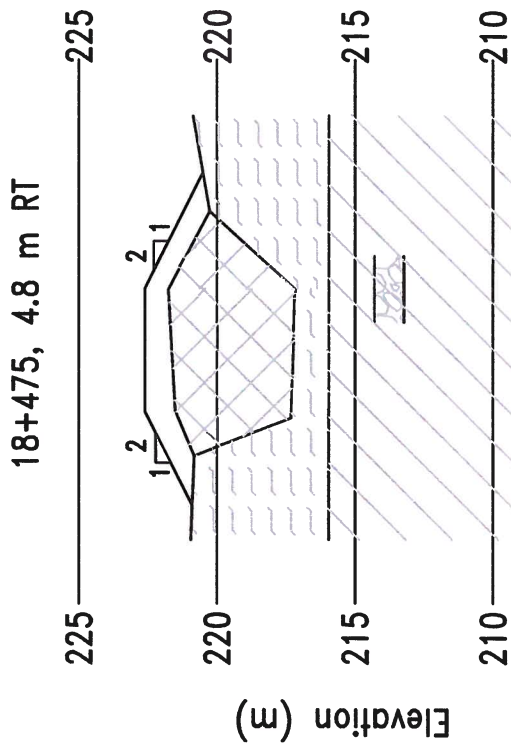
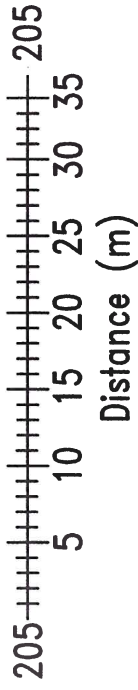
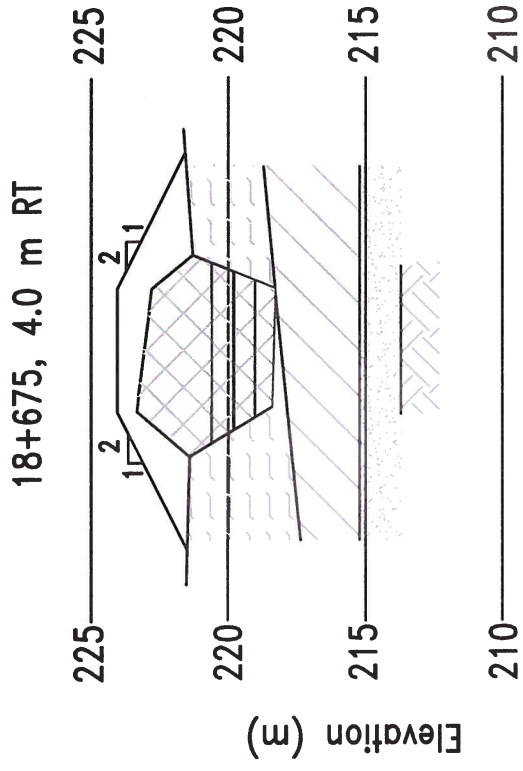
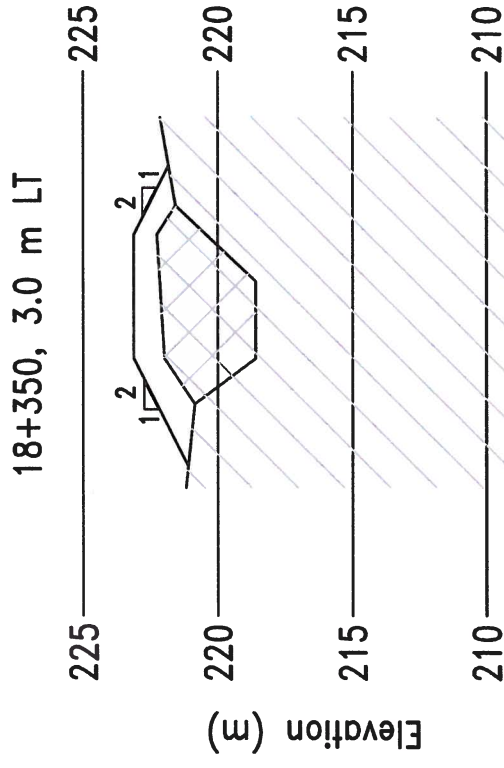
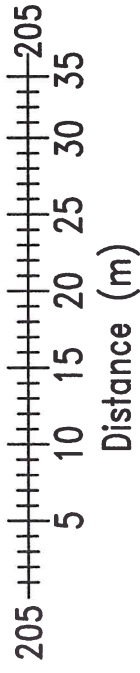
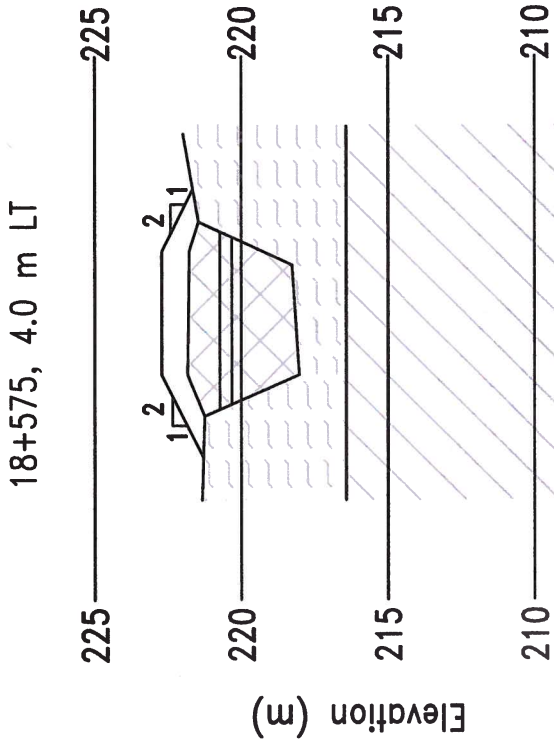
No.	Elevation	Northing	Eastings	Station	Offset
BH1	221.761	5141673	516228	18+412	2.2 m LT
BH2	221.841	5141686	516128	18+450	CL
BH3	221.536	5141694	516138	18+500	0.9 m RT
BH4	221.870	5141689	516090	18+550	CL
BH5	221.888	5141712	516048	18+600	2.3 m LT
BH6	221.815	5141731	517668	18+650	CL
BH7	225.300	5141762	517947	18+715	3.0 m RT
BH8	222.806	5141762	517962	18+75	4.0 m RT
BH9	221.832	5141736	516007	18+575	4.0 m LT
BH10	221.574	5141731	516189	18+475	4.8 m RT
BH11	222.130	5141662	516263	18+350	3.0 m LT

Vertical Scale in Metres
0 5
Horizontal Scale in Metres
0 10

NOTE:
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and may not represent actual conditions.

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DRAWING 8



APPENDIX ‘D’ ENCLOSURES

RECORD OF BOREHOLE No BH01

1 OF 1

METRIC

W.P. 5279-03-00 LOCATION STA. 18+412, 2.2 m LT (5141673 m N, 518228 m E) ORIGINATED BY JF
DIST 400 m HWY 537 BOREHOLE TYPE Hollow Stem Auger (100 mm ID) COMPILED BY ML
DATUM Geodetic DATE 2012 02 27 CHECKED BY TM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _P	W	W _L			WATER CONTENT (%)
								20 40 60 80 100	20 40 60						
221.8	GROUND SURFACE		AS1	AS											
	ORGANICS - with roots, fibrous, humification (H9), very soft, black		NR	SS	1										
218.7	Von Post Test at 2.3 m: H9, B3, F2, R0, W1, N0		SS2	SS	1										
3.1	CLAY - grey, wet, soft to firm ---- - trace organics ----		SS3	SS	0										
			SS4	SS	1										
			SS5	SS	0										
			SS6	SS	0										
			SS7	SS	1										
			SS8	SS	1										
			SS9	SS	1										
			SS10	SS	0										
			SS11	SS	1										
			SS12	SS	0										
206.3			SS13	SS	0										
15.5	End of Borehole at 15.5 m														

NR = NO RECOVERY

+³, X³: Numbers refer to
Sensitivity

O 3% STRAIN AT FAILURE

ENCLOSURE 1

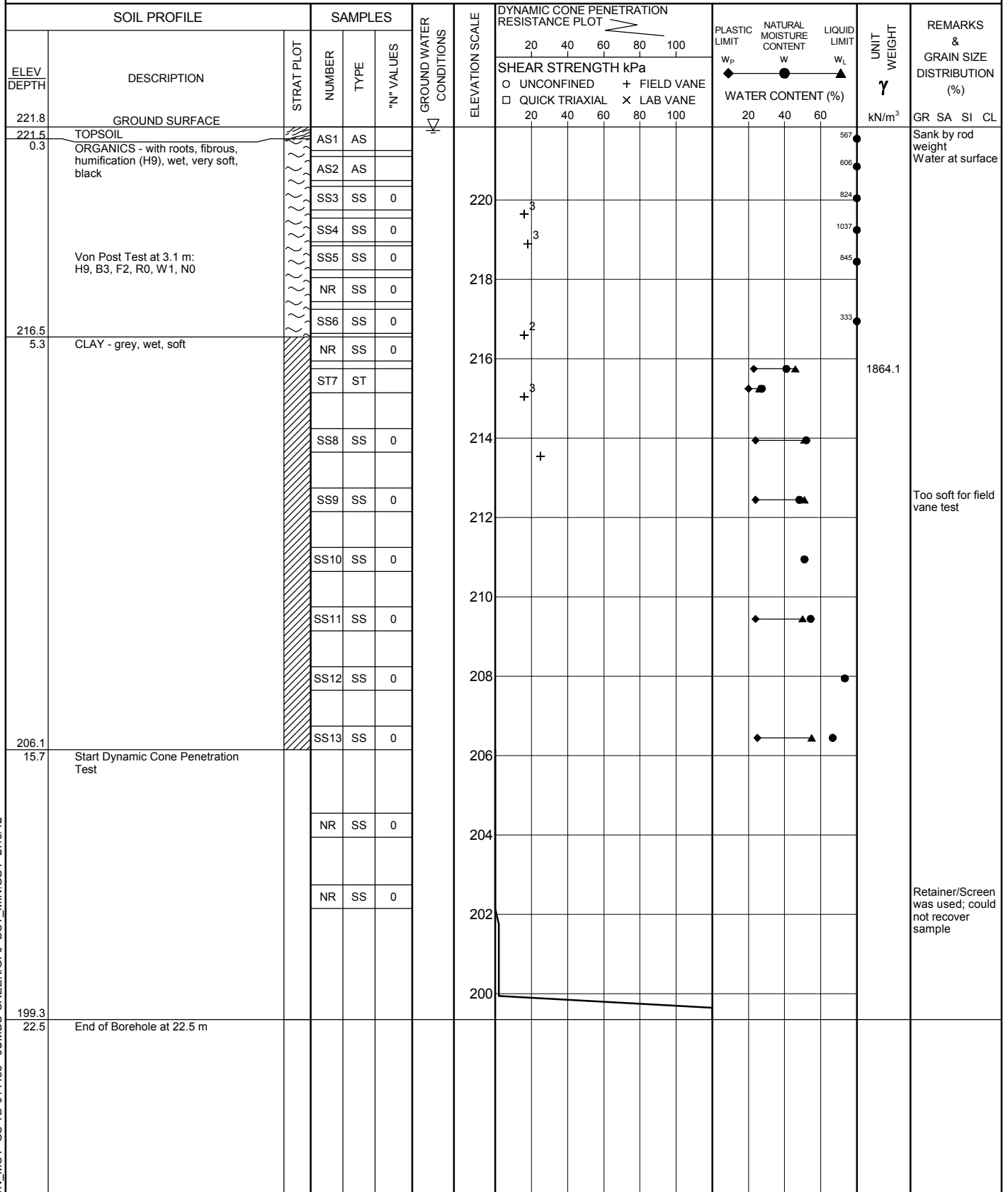
ON_MOT_CS-TB-014485 - JUMBO CREEK.GPJ DST_MIN.GDT 27/6/12

RECORD OF BOREHOLE No BH02

1 OF 1

METRIC

W.P. 5279-03-00 LOCATION STA. 18+450, CL (5141686 m N, 518187 m E) ORIGINATED BY JF
 DIST 400 m HWY 537 BOREHOLE TYPE Hollow Stem Auger (100 mm ID) COMPILED BY ML
 DATUM Geodetic DATE 2012 02 29 CHECKED BY TM



NR = NO RECOVERY

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH03

1 OF 1

METRIC

W.P. 5279-03-00 LOCATION STA. 18+500, 0.9 m RT (5141694 m N, 518138 m E) ORIGINATED BY JF
DIST 400 m HWY 537 BOREHOLE TYPE Hollow Stem Auger (100 mm ID) COMPILED BY ML
DATUM Geodetic DATE 2012 03 01 CHECKED BY TM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
221.9	GROUND SURFACE							20 40 60 80 100		W _P W W _L				
	ORGANICS - with roots, fibrous, humification (H10), wet, very soft, black		AS1	AS				○ UNCONFINED + FIELD VANE					386	Sank by rod weight
			AS2	AS				□ QUICK TRIAXIAL × LAB VANE					449	Water at surface
			SS3	SS	0								629	
			SS4	SS	0								774	
			SS5	SS	0									
	Von Post Test at 4.6 m: H10, B3, F1, R0, W0, N0		SS6	SS	0								952	
			SS7	SS	0								785	
215.8													714	
6.1	CLAY - grey, wet, stiff		SS8	SS	0									
			NR	ST										Too soft for field vane test
			SS9	SS	0									
			SS10	SS	0									
			SS11	SS	0									
			SS12	SS	0									
			SS13	SS	0									
206.0	Start Dynamic Cone Penetration Test													Retainer/Screen was used; could not recover sample
15.9														

NR = NO RECOVERY + 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ENCLOSURE 3

ON_MOT_CS-TB-014485 - JUMBO CREEK.GPJ DST_MIN.GDT 27/6/12

RECORD OF BOREHOLE No BH04

1 OF 1

METRIC

W.P.	5279-03-00	LOCATION	STA. 18+550, CL (5141699 m N, 518090 m E)	ORIGINATED BY	JF
DIST	400 m	HWY	537	BOREHOLE TYPE	Hollow Stem Auger (100 mm ID)
DATUM	Geodetic	DATE	2012 03 02	CHECKED BY	TM

[illegible]

ON MOT GS-TB-014485 - JUMBO CREEK.GPJ DST_MIN.GDT 27/6/12

NR = NO RECOVERY +³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ENCLOSURE 4

RECORD OF BOREHOLE No BH05

1 OF 1

METRIC

W.P.	5279-03-00	LOCATION	STA. 18+600, 2.3 m LT (5141712 m N, 518046 m E)	ORIGINATED BY	JF
DIST	400 m	HWY	537	BOREHOLE TYPE	Hollow Stem Auger (100 mm ID)
DATUM	Geodetic	DATE	2012 03 04	COMPILED BY	ML
				CHECKED BY	TM

[illegible]

NR = NO RECOVERY +³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ENCLOSURE 5

ON MOT GS-TB-014485 - JUMBO CREEK.GPJ DST_MIN.GDT 27/6/12

METRIC

NR = NO RECOVERY +³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE






ON_MOT GS-TB-014485 - JUMBO CREEK.GPJ DST_MIN.GDT 27/6/12

RECORD OF BOREHOLE No BH07

1 OF 1

METRIC

W.P. 5279-03-00 LOCATION STA. 18+715, 3.0 m RT (5141762 m N, 517947m E) ORIGINATED BY JF
DIST 400 m HWY 537 BOREHOLE TYPE Hollow Stem Auger (100 mm ID) COMPILED BY ML
DATUM Geodetic DATE 2012 03 06 CHECKED BY TM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
								○ UNCONFINED + FIELD VANE □ QUICK TRIAXIAL x LAB VANE											
225.3	GROUND SURFACE							20	40	60	80	100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		GR SA SI CL		
	FILL - SAND - Gravelly, some silt, brown, dry, loose to dense		AS1	AS			224										Water level at 222.450 m 27 62 (11)		
			AS2	AS															
			SS3	SS	47														
			SS4	SS	9														
222.4	FILL - GRAVEL - Sandy, trace silt, some organics and wood, brown, compact		SS5	SS	13			222											29 61 (11)
2.9																			
221.5	FILL - SILT - some sand, some organics, trace clay, brown/grey, firm		SS6	SS	5														
3.8																			
220.7	End of Borehole at 4.6 m Refusal on possible bedrock		SS7	SS	100+														0 20 70 9
4.6																			

NR = NO RECOVERY +³, X³: Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

ENCLOSURE 7

RECORD OF BOREHOLE No BH08

1 OF 1

METRIC

W.P. 5279-03-00 LOCATION STA. 18+675, 4.0 m RT (5141762 m N, 517982 m E) ORIGINATED BY JF
DIST 400 m HWY 537 BOREHOLE TYPE Hollow Stem Auger (100 mm ID) COMPILED BY ML
DATUM Geodetic DATE 2012 03 06 CHECKED BY TM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED + FIELD VANE □ QUICK TRIAXIAL x LAB VANE								
222.8	GROUND SURFACE						20 40 60 80 100	20 40 60 80 100	20 40 60							
	FILL - SAND & GRAVEL - trace silt, brown, compact		AS1	AS			222								45 49 (6) Water level at 221.856 m	
			AS2	AS												
			SS3	SS	22											
220.6																
2.2	FILL - WOOD CHIPS - with sand, trace silt, grey, loose wet		SS4	SS	3		220							499		
219.8	Von Post Test at 2.3 m: H1, B2, F3, R3, W3, N3															
3.0			SS5	SS	3									114		
219.1	FILL - ORGANICS - trace sand and wood chips, black, loose		SS6	SS	3									96		
3.8																
218.3	FILL - WOOD CHIPS - some sand, loose, wet		SS7	SS	1		218									
4.5	CLAY - trace organics, grey, wet, soft		ST8	ST												
			SS9	SS	0	216								Sank by rod weight		
215.2																
7.6	SAND - some silt, trace gravel, grey, compact		ST10	ST												
213.7			SS11	SS	100+		214									
9.1	End of Borehole at 9.1 m Refusal on possible bedrock															

NR = NO RECOVERY

+³, X³: Numbers refer to
Sensitivity

O 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH09

1 OF 1

METRIC

W.P. 5279-03-00 LOCATION STA. 18+575.4.0 m LT (5141738 m N, 518087 m E) ORIGINATED BY JF
 DIST 400 m HWY 537 BOREHOLE TYPE Hollow Stem Auger (100 mm ID) COMPILED BY ML
 DATUM Geodetic DATE 2012 03 07 CHECKED BY TM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE □ QUICK TRIAXIAL × LAB VANE								WATER CONTENT (%)
221.8	GROUND SURFACE														GR SA SI CL	
220.7	FILL - SAND - Gravelly, some silt, grey, wet		AS1	AS											24 65 (11) Water level at 220.832 m	
220.3			AS2	AS												
220.3	FILL - WOOD CHIPS - trace sand and gravel		AS3	AS												
1.5	FILL - SAND - some silt, trace gravel and wood chips, grey, wet, compact to very dense		SS4	SS	55											
			SS5	SS	21											
			SS6	SS	24											
218.0																
3.8	ORGANICS - fibrous, brown Von Post Test at 3.8 m: H2, B2, F2, R3, W1, N1		SS7	SS	1											
			SS8	SS	0											
216.4	CLAY - grey, wet, firm to stiff		SS9	SS	1											
5.4			ST10	ST												
			ST11	ST												
			SS12	SS	0											
			ST13	ST												
			SS14	SS	0											
		SS15	SS	0												
		SS16	SS	0												
206.1	Start Dynamic Cone Penetration Test															
15.7																

NR = NO RECOVERY

+³, X³: Numbers refer to Sensitivity

O 3% STRAIN AT FAILURE

METRIC

NR = NO RECOVERY +³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

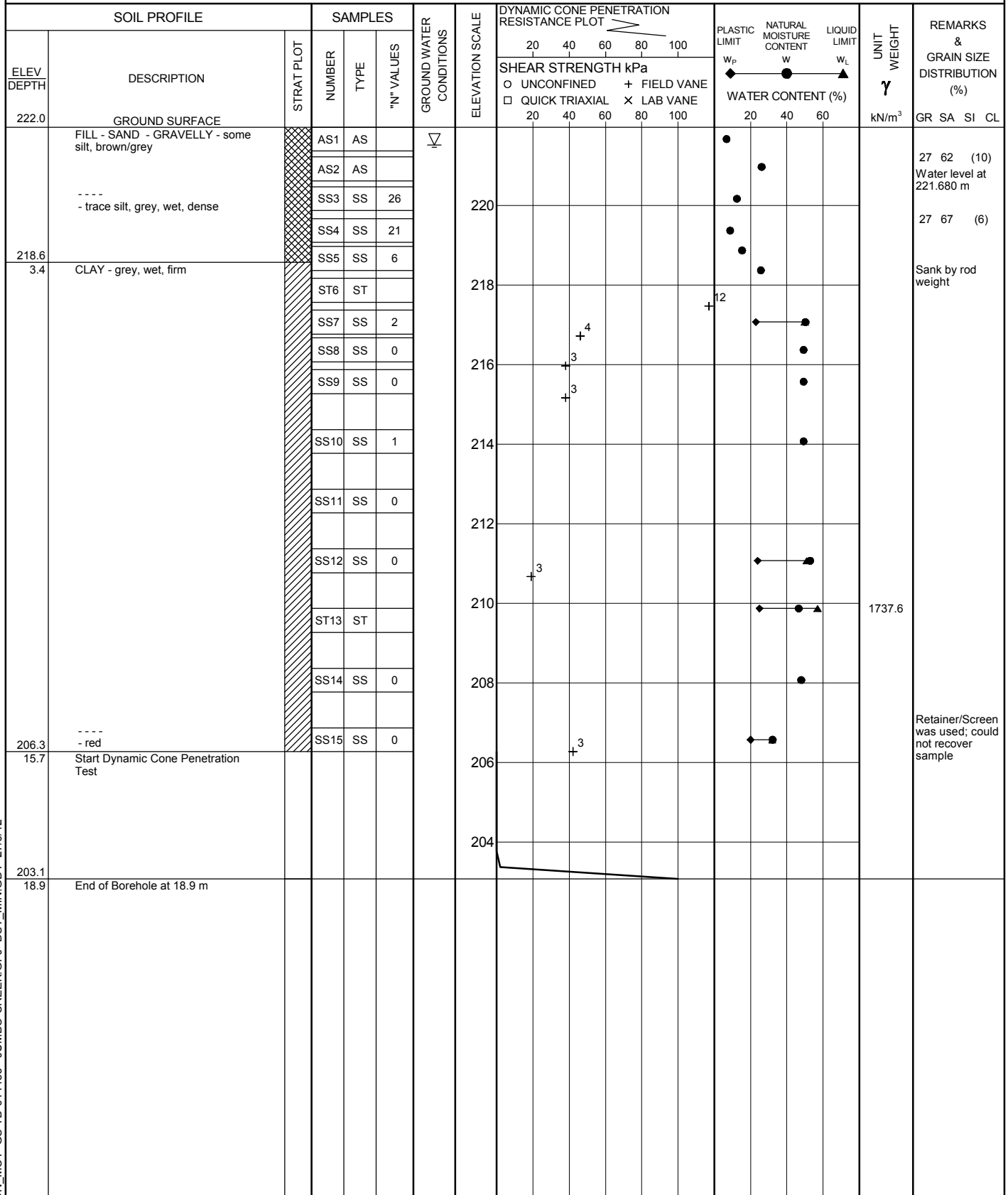
ON_MOT GS-TB-014485 - JUMBO CREEK.GPJ DST_MIN.GDT 27/6/12

RECORD OF BOREHOLE No BH11

1 OF 1

METRIC

W.P. 5279-03-00 LOCATION STA. 18+350, 3.0 m LT (5141652 m N, 518293 m E) ORIGINATED BY JF
DIST 400 m HWY 537 BOREHOLE TYPE Hollow Stem Auger (100 mm ID) COMPILED BY ML
DATUM Geodetic DATE 2012 03 09 CHECKED BY TM



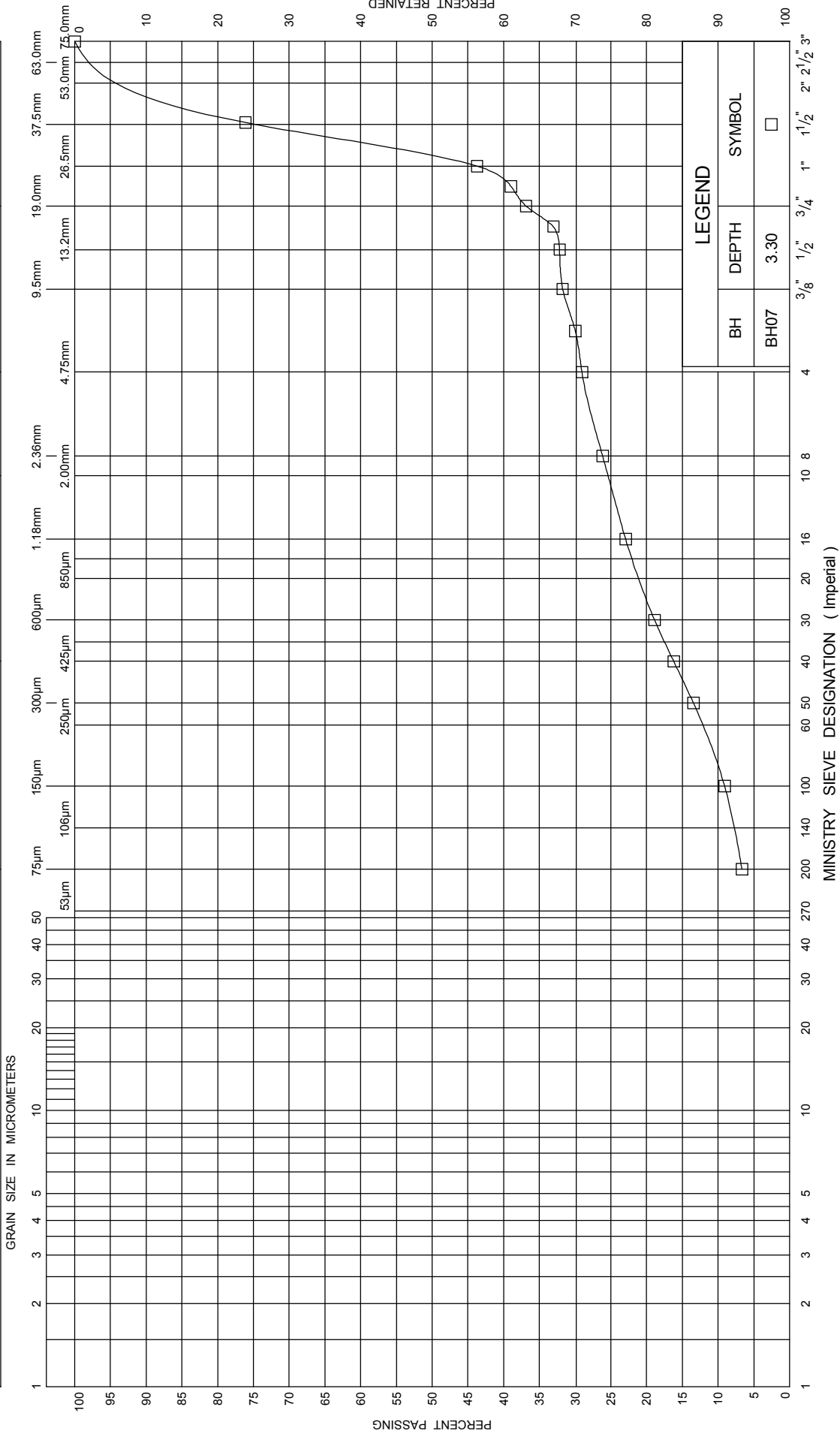
NR = NO RECOVERY

+³, ×³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND				GRAVEL	
		Fine		Medium	Coarse	Fine	Coarse



ENCLOSURE 12

GRAIN SIZE DISTRIBUTION

SANDY GRAVEL - Existing

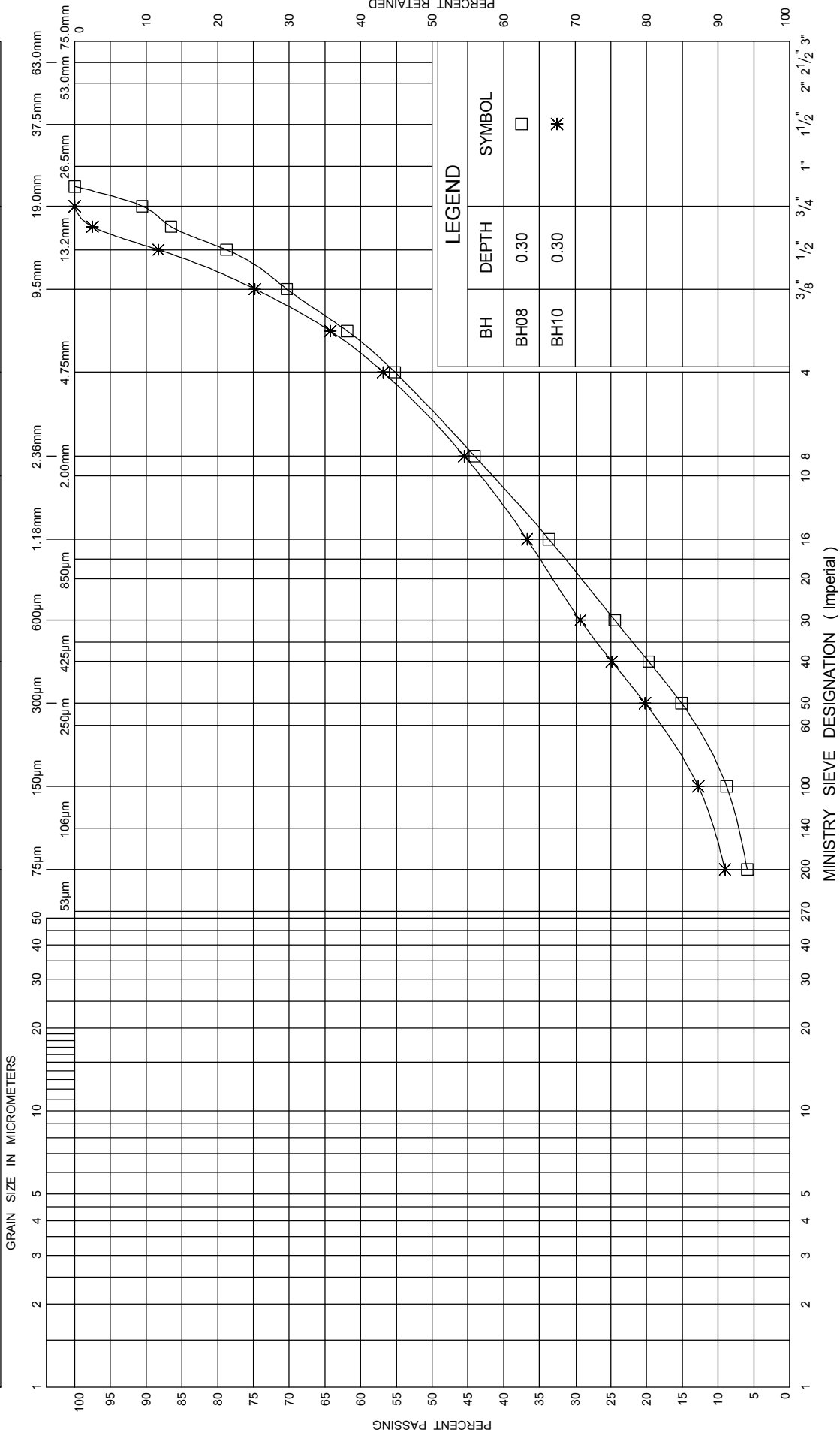


W P 5009-E-0061

HIGHWAY 537

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine		Medium	Coarse	Fine	Coarse



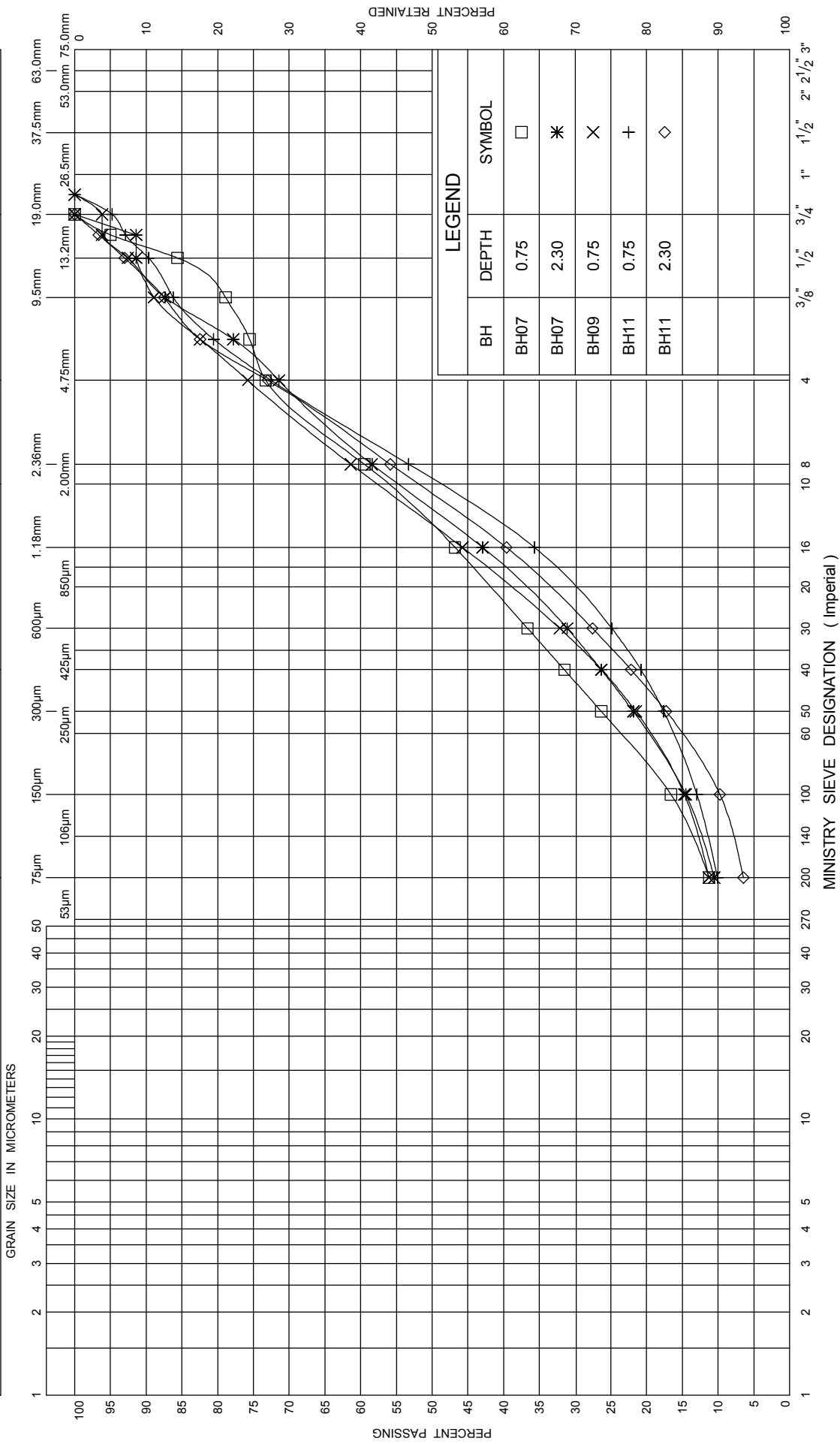
ENCLOSURE 13

W P 5009-E-0061

HIGHWAY 537

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine		Medium	Coarse	Fine	Coarse



ENCLOSURE 14

GRAIN SIZE DISTRIBUTION

GRAVELLY SAND - Existing

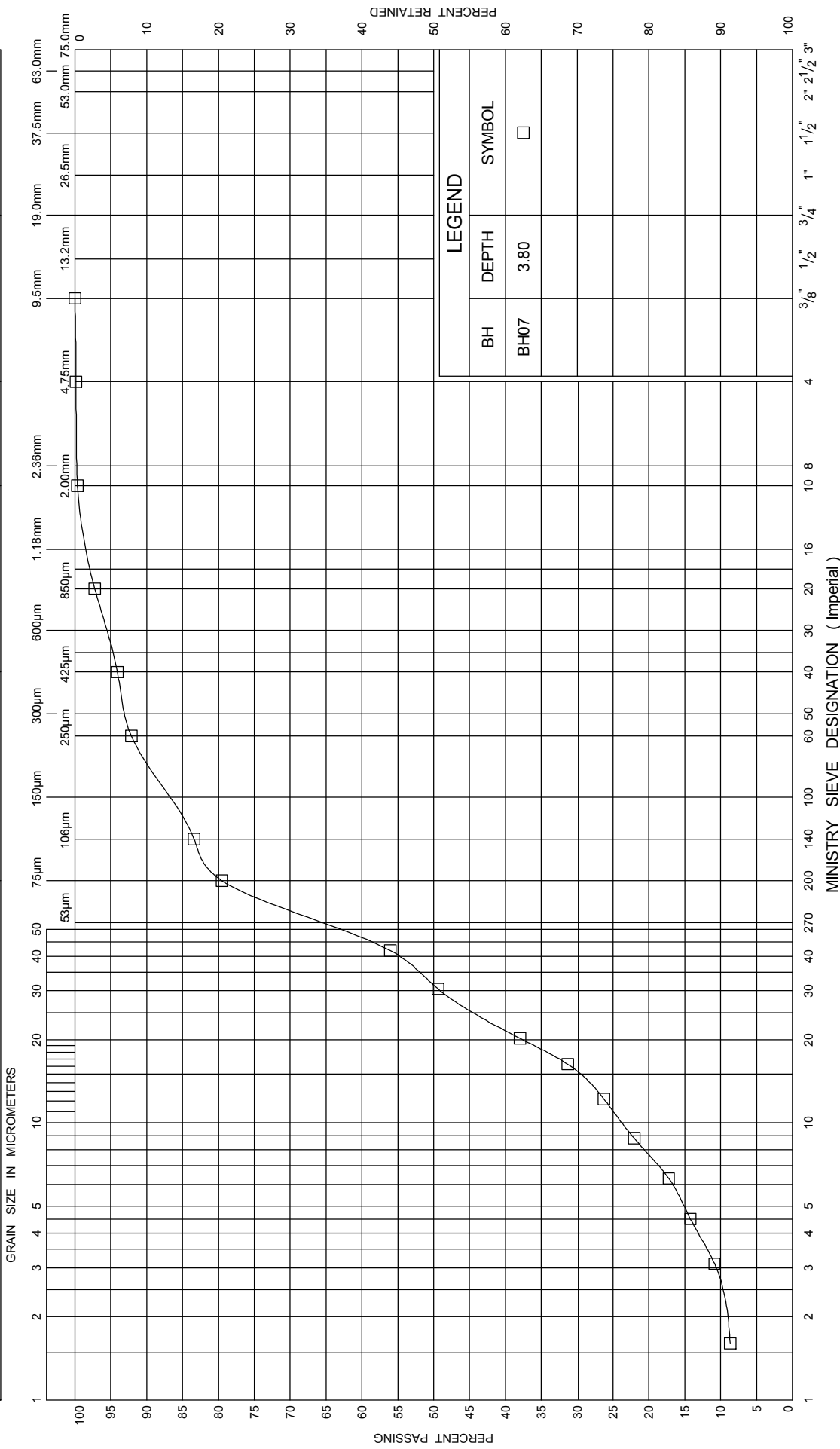


W P 5009-E-0061

HIGHWAY 537

UNIFIED SOIL CLASSIFICATION SYSTEM

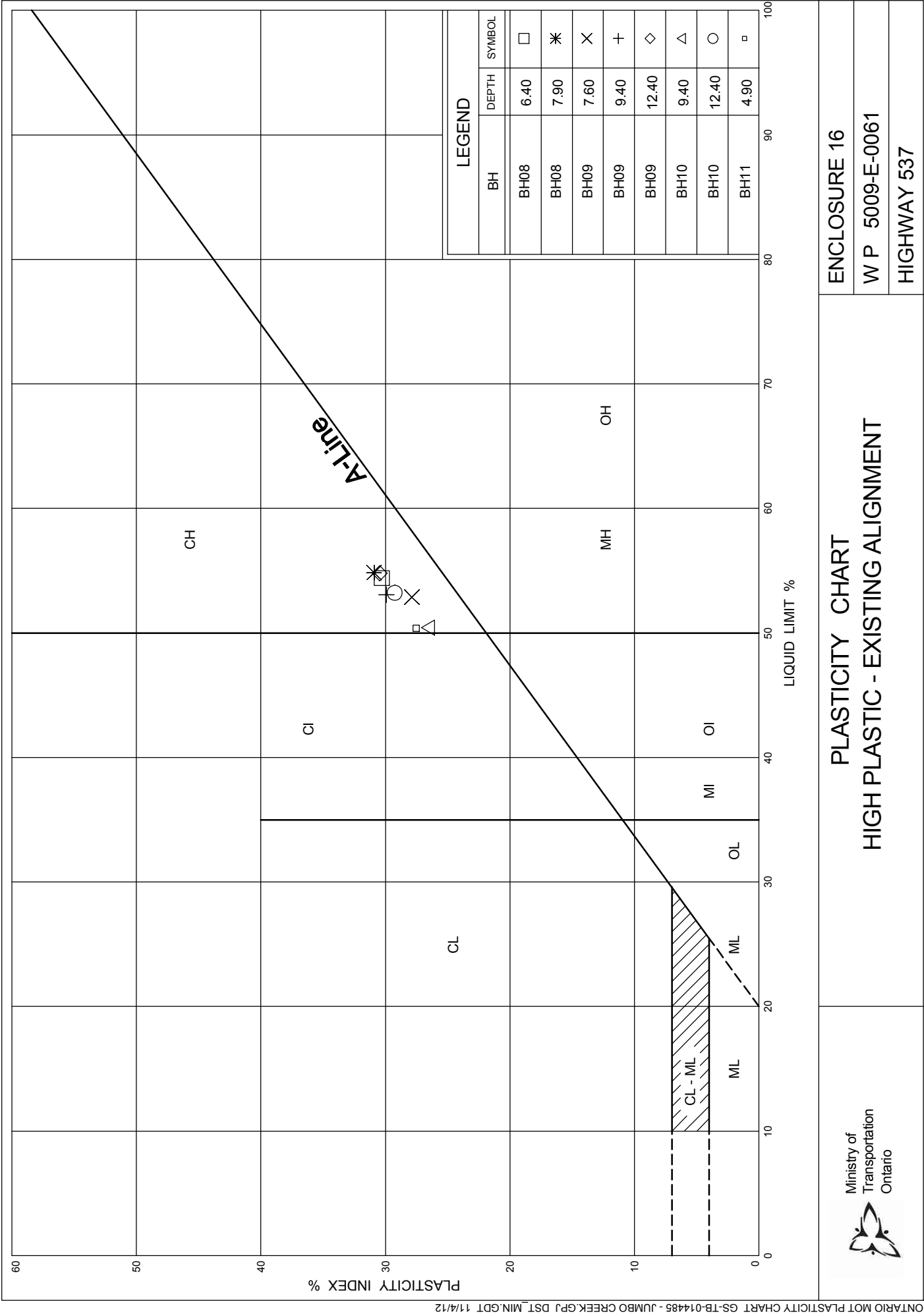
CLAY & SILT		SAND			GRAVEL	
		Fine		Medium	Coarse	Coarse

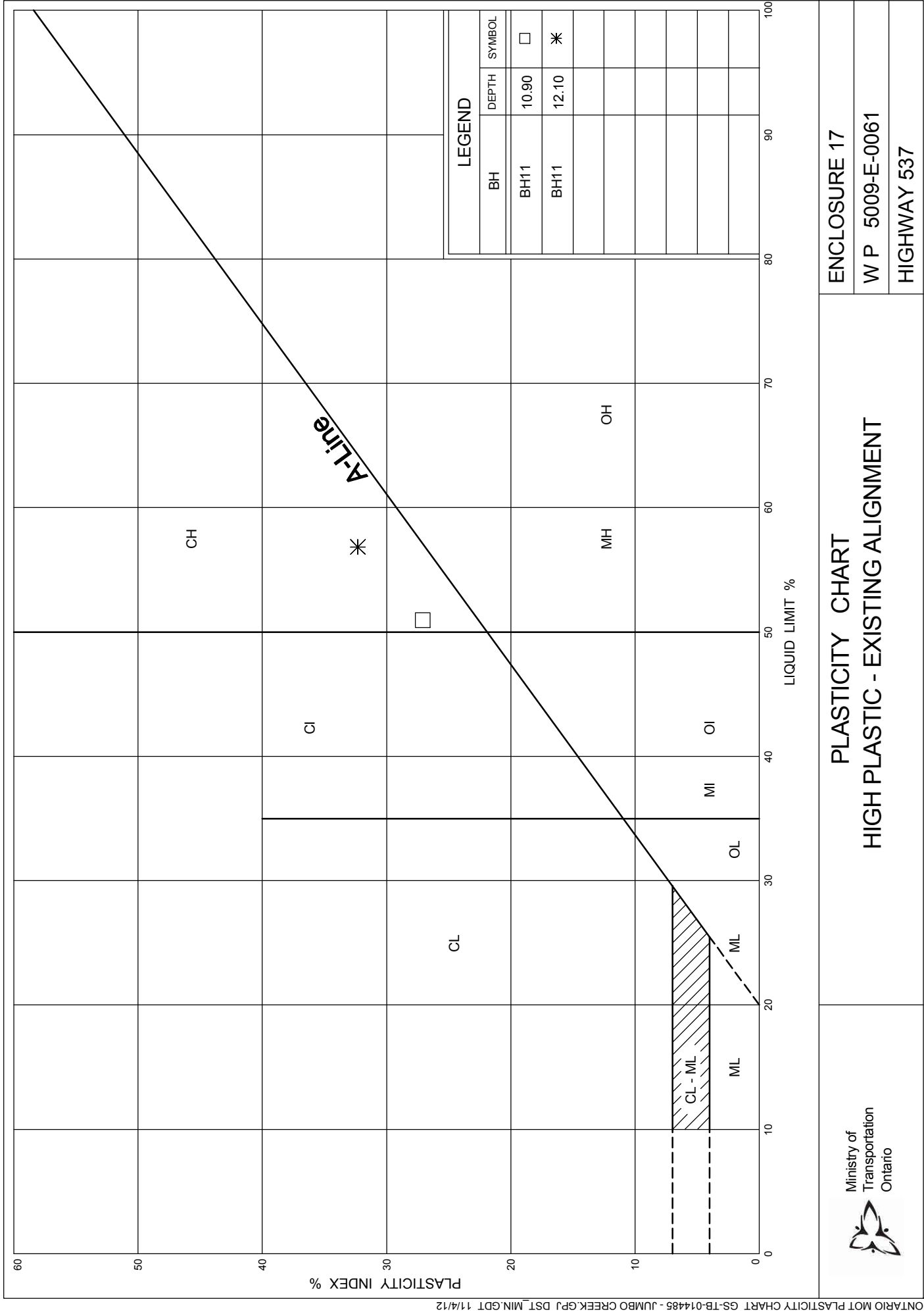


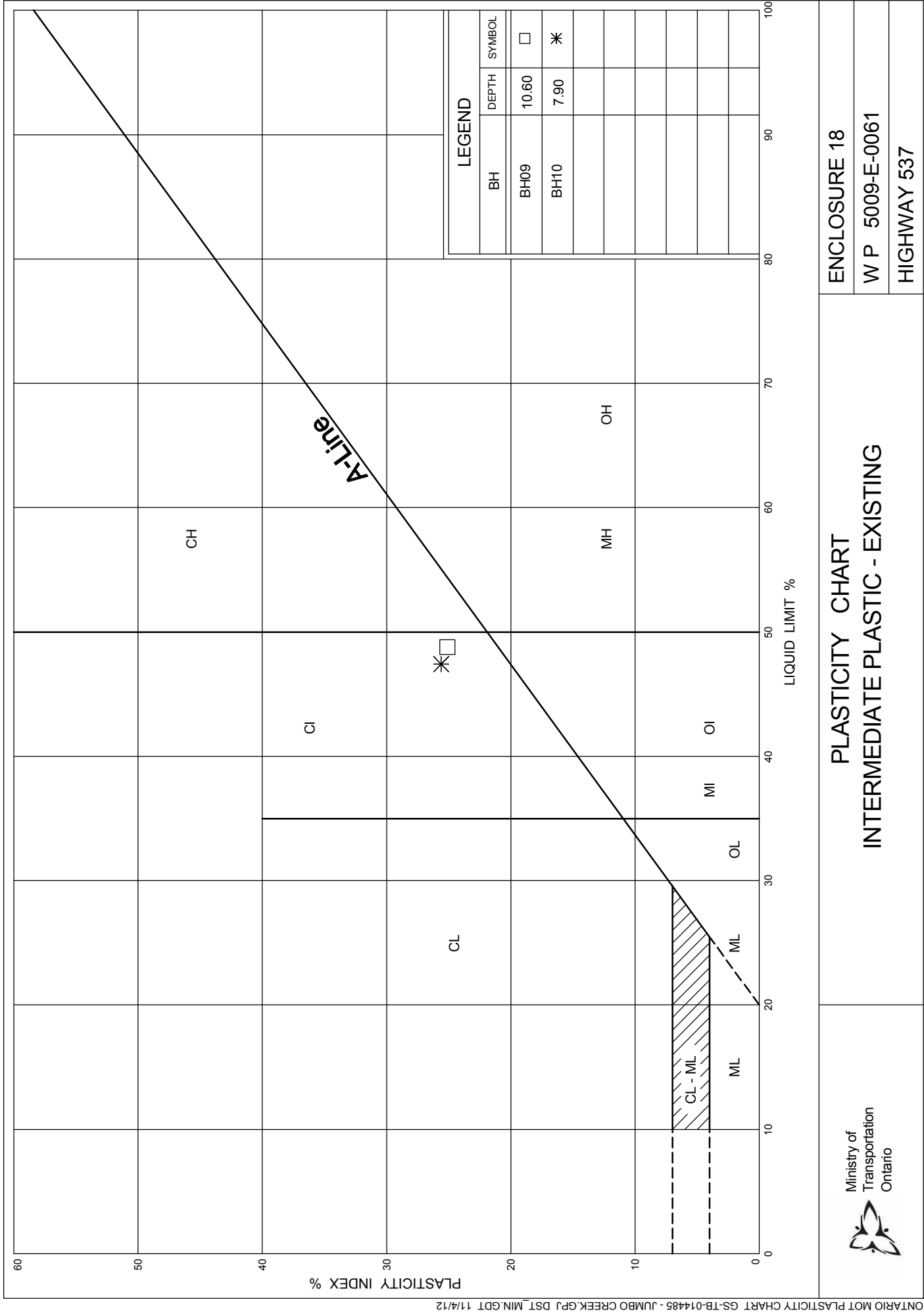
GRAIN SIZE DISTRIBUTION
SILT - SOME SAND - Existing

ENCLOSURE 15
W P 5009-E-0061
HIGHWAY 537









PLASTICITY CHART
INTERMEDIATE PLASTIC - EXISTING

ENCLOSURE 18
W P 5009-E-0061
HIGHWAY 537



