G.I.-30 SEPT. 1976

GEOCRES No. 30M13-142

DIST. CR REGION

W.P. No. 475-91-00

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 400

LOCATION Hwy 400 from N of Langstaff Rd. N'ly to S of

No. of PAGES - Major Mackenzie Rd

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

GEOCRES No
30M13-142

STRATA ENGINEERING CORP.

20 Trudy Road, Suite B
North York, Ontario M2J 2Y9

Tel: 416-494-9079
Fax: 416-493-9369

FOUNDATION INVESTIGATION REPORT

for

Proposed High Mast Lighting
Highway 400

From north of Langstaff Road northerly to just south of Major Mackenzie Drive

Station 15+000 - 17+800

and

Rutherford Road Interchange Area

W.P. 475-91-00 Site No. N/A

Ministry of Transportation, Ontario

Central Region

Geotechnical Engineering Section

Strata File: S-98-417F
Report Date: December 1998

STRATA

TABLE OF CONTENTS

LIST OF TABLES

FOUNDATION INVESTIGATION REPORT

for

Proposed High Mast Lighting

Highway 400

From North of Langstaff Road northerly

to just south of Major Mackenzie Drive

W.P. 475-91-00 Site No. N/A

Ministry of Transportation, Ontario, Central Region

1. INTRODUCTION

Strata Engineering Corp. has been retained by the Geotechnical Engineering Section, Central Region, Ministry of Transportation, to investigate the foundation conditions for proposed high mast lighting along the centreline of Highway 400, from north of Langstaff Road to south of the Major Mackenzie Drive Interchange. High mast lighting presently exists along the centreline median of Highway 400 to a few hundred metres north of Langstaff Road. The proposed high mast lighting will continue northerly from the present termination of the existing high mast lighting standards. Generally, the existing standards are spaced ~150 m apart. It is presumed that the proposed high mast lighting standards for the current project will also be spaced at roughly 150 m. For this reason, boreholes were drilled at 300 m spacing, to provide a wide coverage of existing subsurface conditions, since the exact location of each proposed high mast lighting standard was not known at the time of the field investigation, and remains unknown at the time of submission of this report.

This report contains the factual information obtained from a number of boreholes drilled between Stations 15+000 and 17+800, centreline chainage, Highway 400 existing. Subsurface information from other foundation investigations within the project area was obtained from the GEOCRES data base files of the Pavements and Foundations Section, Engineering Materials Office, MTO, and is referenced in this report.

Subsurface information from previous investigations by the Ministry and others should be included in any contractual documents provided to potential bidders, so as to avoid the appearance of withholding available information.

2.0 DESCRIPTION OF SITE AND GEOLOGY

The site is located along Highway 400 in the Town of Vaughan, Regional Municipality of York. The project location extends from Station 15+000 northerly to Station 17+800. The topography of the area is generally flat to gently undulating on either side of the highway. The profile grade of the highway increases by ~ 17 m from south to north within the project limits. Drainage is generally towards the southeast.

The subject section of highway is located within the Peel Plain physiographic region of southern Ontario (Chapman and Putnam, 1984, 3rd edition, Special Volume 2, Ministry of Natural Resources), which consists of level to undulating tracts of clayey glacial till soils. Such soils cover major portions of land within the Regional Municipalities of York, Peel and Halton. The clayey glacial tills are presumed to have been derived from moraines, interspersed with non-cohesive silts and sands from interstadial stages of Wisconsinan glaciation. The bedrock in this area is mapped as the Dundas-Meaford shale of Paleozoic age, and occurs at depths of over 70 m below prevailing ground level.

Highway 400 through the project area is a basic six lane divided urban freeway. The multi-lane core-collector system of Highway 400, from its south junction with Highway 401 terminates just north of Langstaff Road. North from this location, Highway 400 is a basic divided six lane facility with an urban cross-section. The southern portion, south of the southern limit of this project, has a tall wall concrete median barrier with which are associated the existing high mast lighting standards. Northwards, the median has a steel box beam guiderail. It is presumed that the box beam guiderail will be replaced with a tall wall median concrete barrier in conjunction with the erection of the proposed high mast lighting standards.

3.0 PROCEDURES

The field work for this project was carried out on 1998 09 03 and 04. Field work was not permitted on weekends and within designated timings on weekdays. Full traffic protection was provided to close off the inside lane (Lane 1) in the northbound direction for work performed on 1998 09 03 and Lane 1 in the southbound direction on 1998 09 04. Crash trucks were provided, as required by Ministry protocol for such work. No incidents occurred, and the public was never placed in danger.

Boreholes were drilled at locations indicated in Table 1 using a truck mounted CME 55 drill, equipped with solid stem augers. Upon completion of drilling and sampling, and after observation of groundwater conditions, each hole was backfilled with the native soil cuttings, which were compacted with the hydraulic power of the machine. Final capping off consisted of cold mix asphalt, placed and compacted flush with the existing pavement surface.

Table 1 - Location of Boreholes and Final Depths

BH No.	Station	CL offset	Coordinates		Depth (m)
		Main Lanes			
1	15+000	1.4 m Rt.	N: 4 853 011	E: 301 161	11.1
2	15+300	1.5 m Rt.	N: 4 853 310	E: 301 141	9.6
3	15+600	1.4 m Rt.	N: 4 853 609	E: 301 120	8.1
4	15+900	1.5 m Rt.	N: 4 853 909	E: 301 099	8.1
5	16+600	1.5 m Rt.	N: 4 854 606	E: 301 052	9.6
6	16+900	1.5 m Rt.	N: 4 854 906	E: 301 030	7.7
7	17+200	1.5 m Lt.	N: 4 855 205	E: 301 008	8.1
8	17+500	1.5 m Lt.	N: 4 855 504	E: 300 986	8.1
9	17+800	1.5 m Lt.	N: 4 855 804	E: 300 969	8.1
		Rutherford Road Interchange			
10	10+375 Ramp W-N, inside shoulder		N: 4 854 138	E: 301 188	8.1
11	10+380 Ramp E-S, inside shoulder		N: 4 854 342	E: 300 986	9.6

* CL Offset refers to offset from the median centreline of Highway 400.

Groundwater observations were made in the boreholes during sampling and immediately after completion.

The station chainages were the same as those used for a pavement widening investigation within the project limits, where the stations were marked off by Strata personnel using known stations at structure locations.

Borehole locations with respect to north and east coordinates were determined by scaling off a "Preliminary Only" 1000:1 scale plan, supplied by the Ministry. Ground elevations at borehole locations were interpreted from contour lines shown on the same plan.

Sampling was performed in each borehole at depth intervals ranging from 0.75 m to 1.5 m, in the Standard Penetration Test (ASTM D 1586), with the accompanying N values being noted in blows/0.3 m. No soft cohesive soils were encountered which required the taking of relatively undisturbed thin walled tube samples, or which required in situ vane shear device measurements of the undrained shear strength.

Recovered samples were classified in the field in accordance with the Unified Soil Classification System (ASTM D 2487) and placed in moisture proof zip-lock bags for subsequent visual examination under controlled conditions in the laboratory. Based on the visual laboratory examination, some samples were assigned testing for moisture content, grain size distribution, Atterberg Limits and unit weight determinations. All samples designated for such testing were delivered to the Agra Earth and Environmental Laboratory in Scarborough, a Ministry approved laboratory for such testing. The results of testing by Agra Earth and Environmental are appended.

Borehole logs have been prepared in accordance with Ministry protocol, and are also appended, along with pertinent figures.

4.0 SUBSURFACE CONDITIONS

4.1 Summary

The subsurface stratigraphy consists of asphaltic concrete pavement of the paved shoulders, over sand and gravel (or granular base and sub-base), followed by a generally cohesive fill and topsoil, overlying the natural soil which is a clayey silt glacial till, interspersed at depth with silt and silty sand to sandy silt layers.

Details follow.

4.2 Bituminous Pavement

The thickness of asphaltic concrete encountered in the holes drilled along the inside shoulder of Highway 400 varied from 50 mm to 280 mm, depending on where the hole was drilled with respect to the full depth partially paved shoulder which extends out from the inside main lane, Lane 1. The thicker asphalt was encountered in holes which were drilled closer to the inside edge of Lane 1.

4.3 Fill Material

The asphaltic concrete is underlain by a sand and gravel (or base and sub-base material) whose thickness varies from 0.4 m to 2.0 m. Some sandy materials encountered in some hole may be backfill to a centreline storm sewer. The sand and gravel fill material was found to be generally loose to compact, as evidenced by N values of 8 to 29 blows/0.3 m, with one value of 47 blows/0.3 m being observed in Borehole 10, which indicated a dense state. The grain size distribution curves for some samples from this stratum are provided in the appendix, and are noted as per cent gravel, sand, silt and clay in the Remarks column of the appended log sheets.

Below the sand and gravel fill, more fill material was encountered to depths between 2.4 and 4.3 m below prevailing ground level. This fill generally consists of clayey silt, similar to the natural soil in this area. The presence of topsoil below or within this material indicated it to be fill. Based on the observed N values, the cohesive fill is considered to be generally firm to very stiff. Atterberg limits for the fill material are shown in Figure 1, appended. The cohesive fill below the sand and gravel is classified as a clayey silt of low plasticity (CL), with some zones being a silty clay of intermediate plasticity (CI).

4.4 Clayey Silt (Glacial Till)

The predominant natural soil within the study limits is a clayey silt glacial till containing some sand and occasional gravel (CL), as shown by the Atterberg Limits of Figure 2. Clayey silt to silty clay soils were encountered in Boreholes 5 and 11. The glacial till natural soil was encountered generally at depths of 2.4 m to 4.0 m below existing inside shoulder surface along the centreline of Highway 400 and at depths of slightly over 4 m in the loop ramps of the Rutherford Road interchange.

The clayey silt glacial till natural soil is interspersed with silt and fine sand seams which appear to be discontinuous over the distances at which the boreholes were drilled.

4.5 Silty Sand to Sandy Silt

In Borehole 4 below elevation 217.4 m, and in Borehole 5 below elevation 215.9 m, a sandy silt to silty sand deposit of glacial origin was encountered. Similar soil was encountered in Boreholes 10 and 11 at the Rutherford Road Interchange. On the basis of the N values observed in these fine grained but non-cohesive materials, the deposit is considered to be generally dense to very dense.

4.6 Groundwater Conditions

Observations of groundwater conditions were made during augering and sampling, and upon completion of drilling and auger withdrawal. Free water was observed in Boreholes 1, 2, 5, and 7 immediately after completion of boring and withdrawal of the auger flights. These are shown on the appended logs of boreholes. However, they are not stabilized water levels. Had time permitted longer duration observation at each hole, or had piezometers been installed for continued monitoring over a period of time, the prevailing groundwater levels might have been noted as being quite different from those indicated on the log sheets.

Previous borings and piezometer installations within the study area indicate that the long term groundwater level may be close to the natural ground surface prior to filling to construct the highway. Hence, groundwater levels may be present within 3 m to 4 m of existing pavement surface.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

It is proposed to install high mast lighting standards between about Stations 15+000 and 17+800 along the median centreline of Highway 400. The precise locations of such standards are not known. However, it is assumed that they will be spaced 150 m apart. Hence, for specific pole design purposes, reference may be made to the logs of holes nearest to the proposed lighting standard location.

5.2 Previous Investigations

The following foundation reports, available through the Ministry's GEOCRES data base, are considered relevant to the present study:

GEOCRES No. 30M13-127 Foundation design reports for W.P. 527-91-01(B) for concrete culverts between Stations 14+938 and 15+349 (Langstaff Road to Rutherford Road).

GEOCRES No. 30M13-128 Foundation investigation for a proposed triple cell culvert, 110 m north of Langstaff Road, W.P. 527-91-01(A).

GEOCRES No. 30M13-109A Foundation investigation for proposed high mast lighting at the Highway 400 and Rutherford Road Interchange, W.P. 632-89-00.

GEOCRES No. 30M13-137 Foundation investigation for high mast lighting standards installed under Contract 93-072 (W.P. 528-91-01), between Highway 7 to north of Langstaff Road.

Further subsurface information is also available from foundation studies performed in conjunction with W.P. 164-79-04/05 (1985) and Foundations Section W.O. 89-11001 (1989).

A review of the subsurface conditions encountered in the above cited documents confirms the general site stratigraphy inferred from the present investigation.

5.3 Design

Loads from high mast lighting standards may be transferred to the subsoil by means of cast in place concrete caissons taken down to the elevation required to provide the design lateral resistance. The foundation design should be in accordance with the method outlined in the following technical publications, for both cohesive and non-cohesive soils:

Brohms, B. B. 1964. Lateral resistance of piles in cohesive soil. ASCE Journal of the Soil Mechanics and Foundations Division, vol. 90, SM 2, Paper 3285, March.

Brohms, B. B. 1964. Lateral resistance of piles in cohesionless soil. ASCE Journal of the Soil Mechanics and Foundations Division, vol. 90, SM 3, Paper 3285, May.

Based on the current investigation, and a review of the available previous data, the calculated parameters to be used for design of the proposed high mast lighting standards are indicated in Table 2, which also provides values of the effective angle of internal friction, ϕ', in degrees, for the cohesionless natural soils; q_u, the unconfined compressive strength of the cohesive soils, in kN/m^2; and, the unit weight of the soils, γ, in kN/m^3.

Note that below the prevailing water table, the buoyant unit weight, γ', may apply, where $\gamma' = \gamma - \gamma_w$, where $\gamma_w = 9.8\ kN/m^3$ = unit weight of water.

For design purposes, the top 1.2 m of soil support should be discounted completely, as the soil in this zone is subject to freezing and subsequent loss of lateral resistance when thawed.

If some high mast lighting standards are to be placed in areas where grade raises are proposed, the following parameters may be applied to granular fill materials, placed and compacted to minimum 95 per cent Standard Proctor density: $\phi' = 28°$, and $\gamma = 20.0\ kN/m^3$.

Table 2R - Revised[a] Design Parameters - Caisson Foundations, Proposed High Mast Lighting, Hwy. 400

BH	Exist. GL[b]	Max. Elev.[c]	Soil Type	ϕ' deg.	q_u - kN/m^2	γ - kN/m^3
1	210.2	209.0	Cohesive Fill		80	19.5
		206.7	Cohesive		200	20.0
2	211.1	209.9	Cohsive Fill		150	20.0
		207.8	Cohesive		400	22.5
3	215.9	214.7	Cohesive Fill		120	20.0
		212.9	Cohesive		600	23.0
4	222.4	221.2	Cohesive Fill		120	20.0
		218.8	Cohesive		600	23.0
		217.4	Non-Cohesive	36.0		21.0
5	224.4	223.2	Cohesive Fill		80	19.5
		220.4	Cohesive		200	21.0
		215.9	Non-Cohesive	36.0		22.0
6	223.0	221.8	Cohesive Fill		120	20.0
		220.4	Cohesive		600	23.0
7	222.2	221.0	Cohesive Fill		120	20.0
		219.2	Cohesive		500	22.0
8	224.5	223.3	Cohesive Fill		80	19.5
		222.1	Cohesive		600	23.0
9	227.1	225.9	Non-Cohesive Fill	28.0		19.5
		223.9	Cohesive		600	23.0
10	226.5	225.3	Cohesive Fill		120	20.0
		222.4	Non-Cohesive	36.0		22.0
11	229.0	227.8	Cohesive Fill		120	20.0
		224.7	Cohesive		100	21.0
		223.5	Non-Cohesive	36.0		22.0

a. Revised, per comments, MTO Foundations Section - includes fill design parameters (see accompanying letter, 1999 02 15).
b. Existing ground Level (Geodetic, m). c. Maximum elevation above which no lateral support may be assumed.

SPECIAL NOTES WHEN USING FILL FOR DESIGN:

1. The design q_u values shown above for cohesive fills should be reduced by 50 % for determination of lateral support.

2. The existing fill is not suitable for end bearing. In no case should a foundation unit be terminated within the fill, regardless of the value of support obtained from the design parameters provided above.

3. The design parameters shown for the fill materials are applicable ONLY at the locations drilled. The fill can not be relied upon to be present or to provide the required support at locations other than those drilled and for which this table (Table 2R) is applicable.

4. High mast lighting standards located on sloping ground may need additional design information not included in the Foundation Investigation Report or in this response to comments offered by the Foundations Section, MTO. For standards located on sloping ground, use the lowest ground line surrounding the light standard as the ground elevation, and deduct 1.2 m for frost protection from that elevation, before using any design parameters.

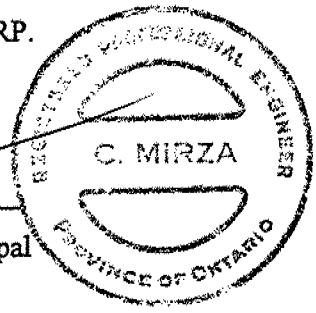
6.0 CLOSURE

The foundation investigation was performed under the overall guidance of C. Mirza, P. Eng. The field work was supervized by Gordon Lo, P. Eng., under the periodic supervision of C. Mirza. Drilling services were provided by Master Soil Investigation Limited, Weston, Ontario. Traffic protection services were provided by Trademark Safety Inc., Aurora, Ontario.

The subsurface conditions described in this report have been determined from borings and infrequent sampling within each borehole. We assume no responsibility or liability for ground conditions which may be different from those described at the locations drilled. Should changed ground conditions be encountered at the locations drilled, we should be advised immediately so that we may assess the impact of such changed conditions on the design parameters and construction.

Respectfully submitted:

STRATA ENGINEERING CORP.



C. Mirza, P. Eng., Senior Principal

Gordon Lo, P. Eng., Field Engineer

Report Distribution:

MTO Central Region Geotechnical Engineering Section - 6 copies

Strata File: S-98-417F - 2 copies

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:

R Q D (%)	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

STRESS AND STRAIN

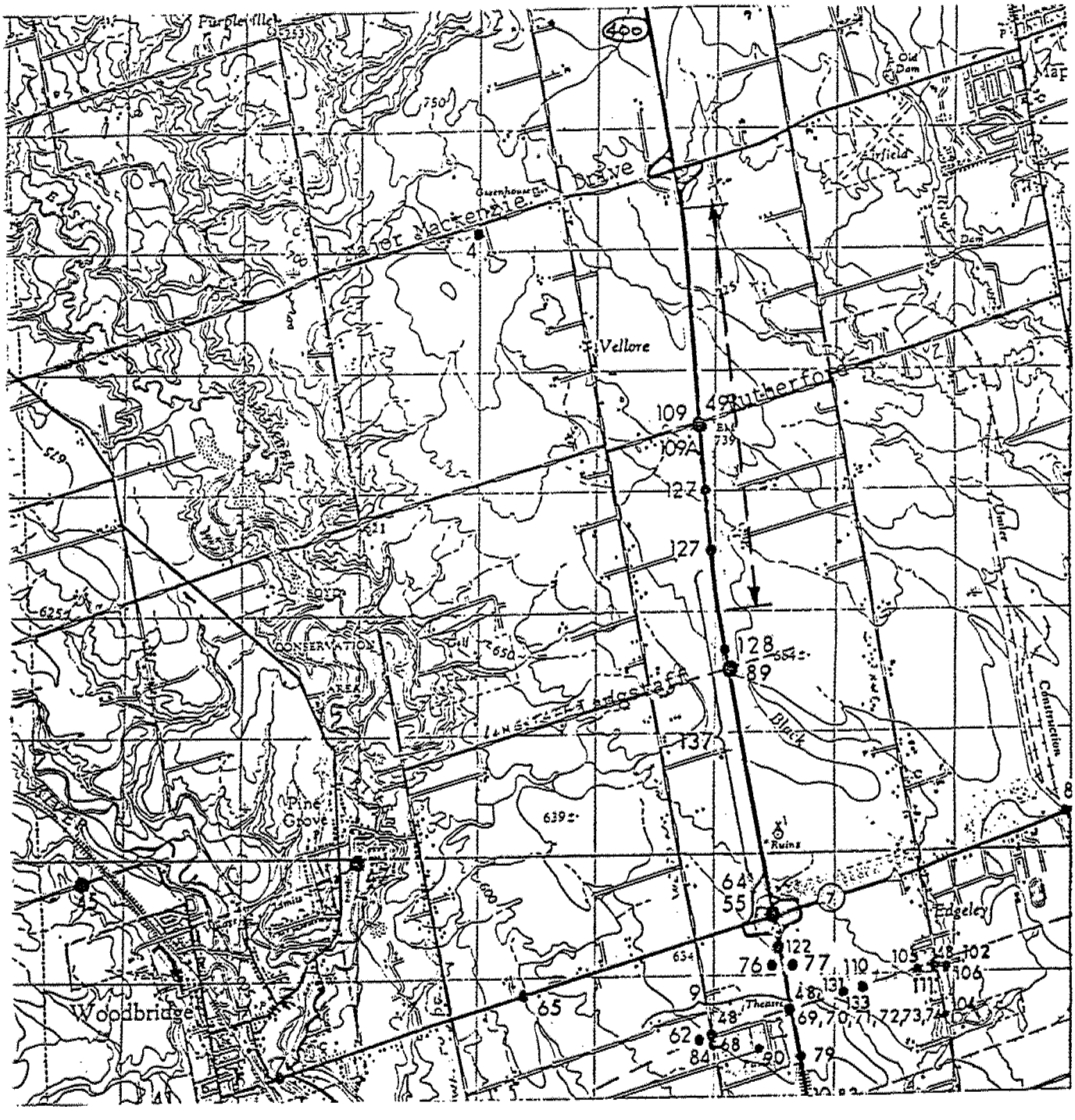
u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa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

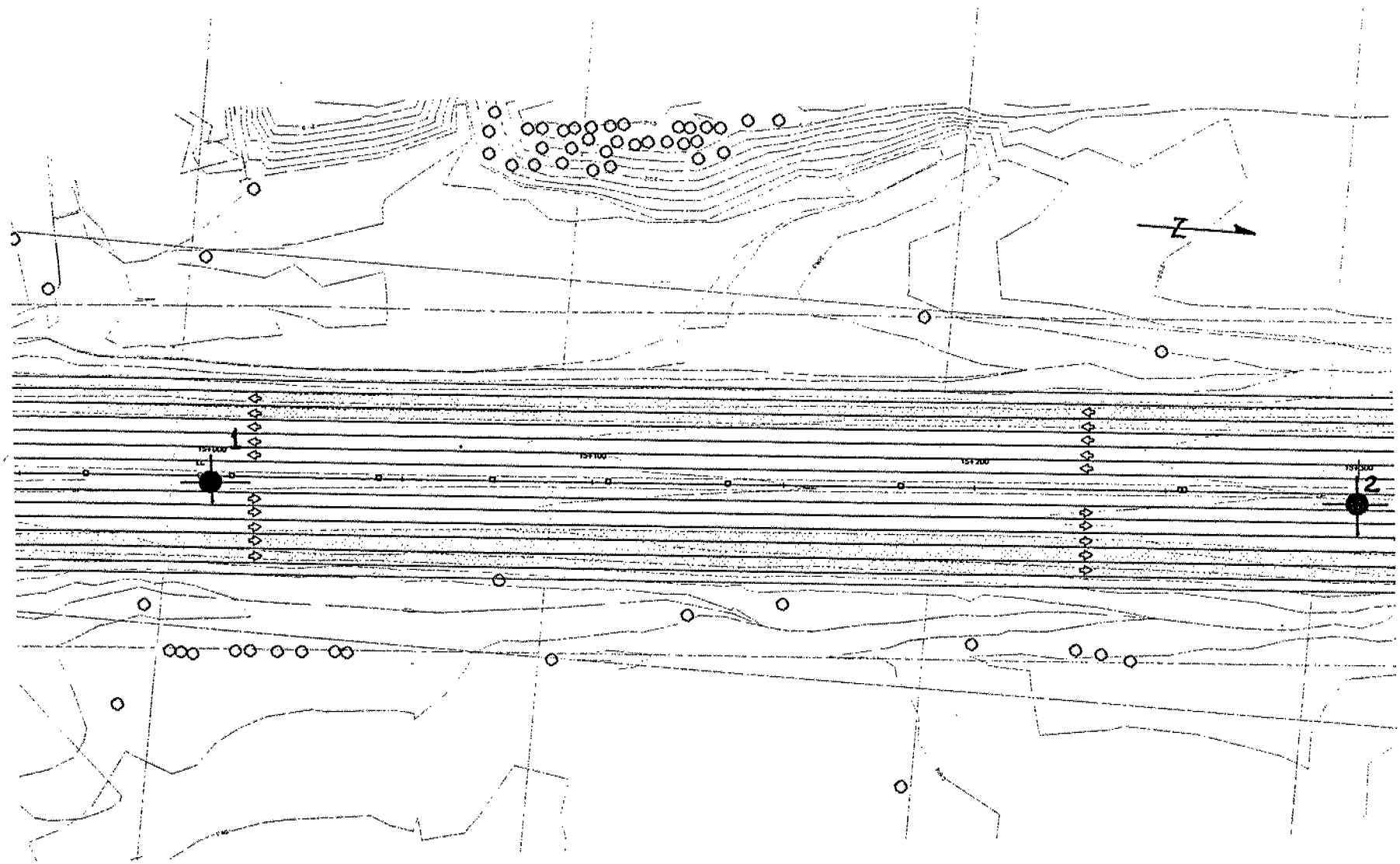
ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
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 = $\frac{w_L - w}{I_p}$
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



PROJECT LOCATION MAP

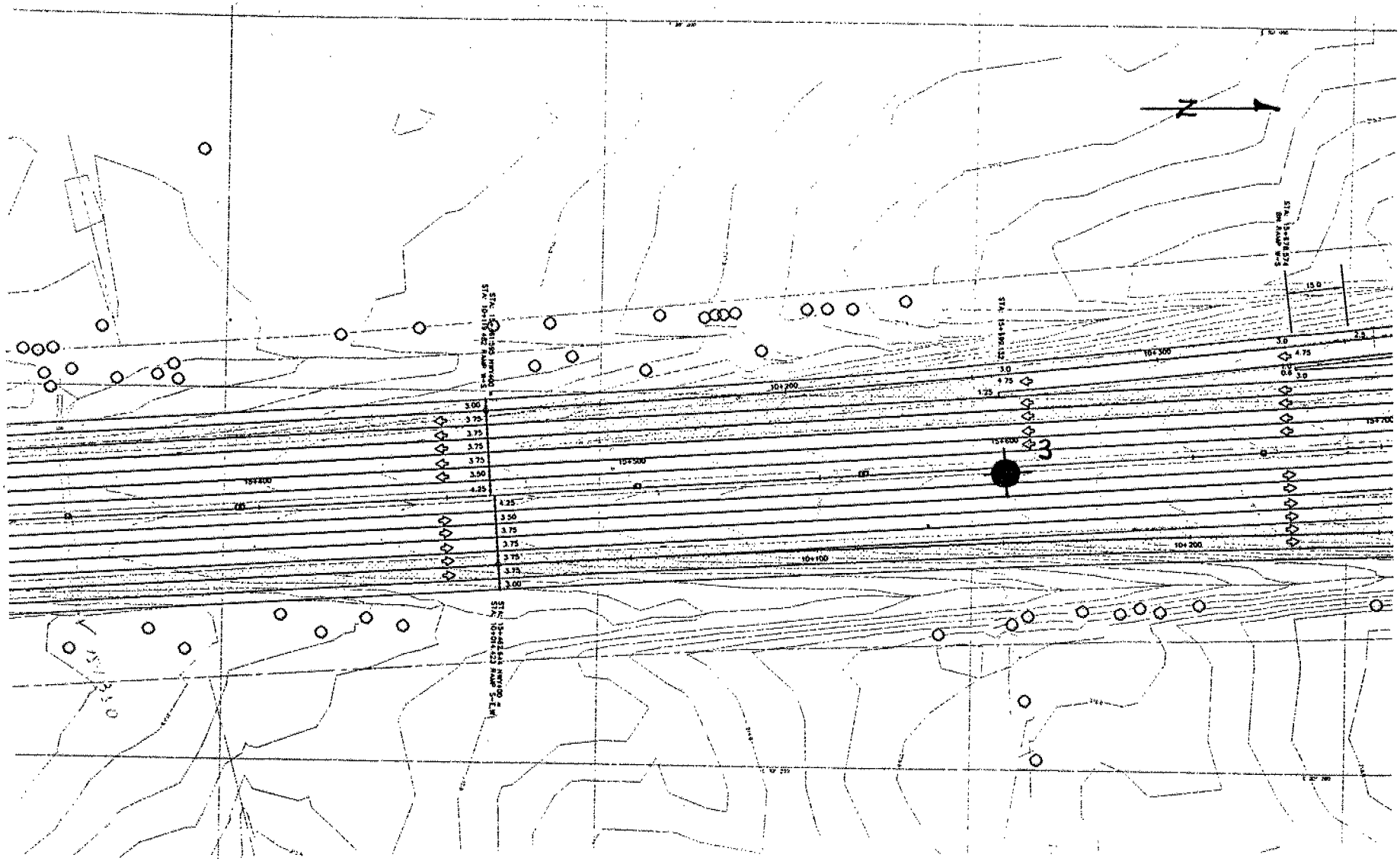
Highway 400 High Mast Lighting
Langstaff Road to Major Mackenzie Drive
W.P. 475-91-00

Numbers next to full circles indicate GEOCRES file number.



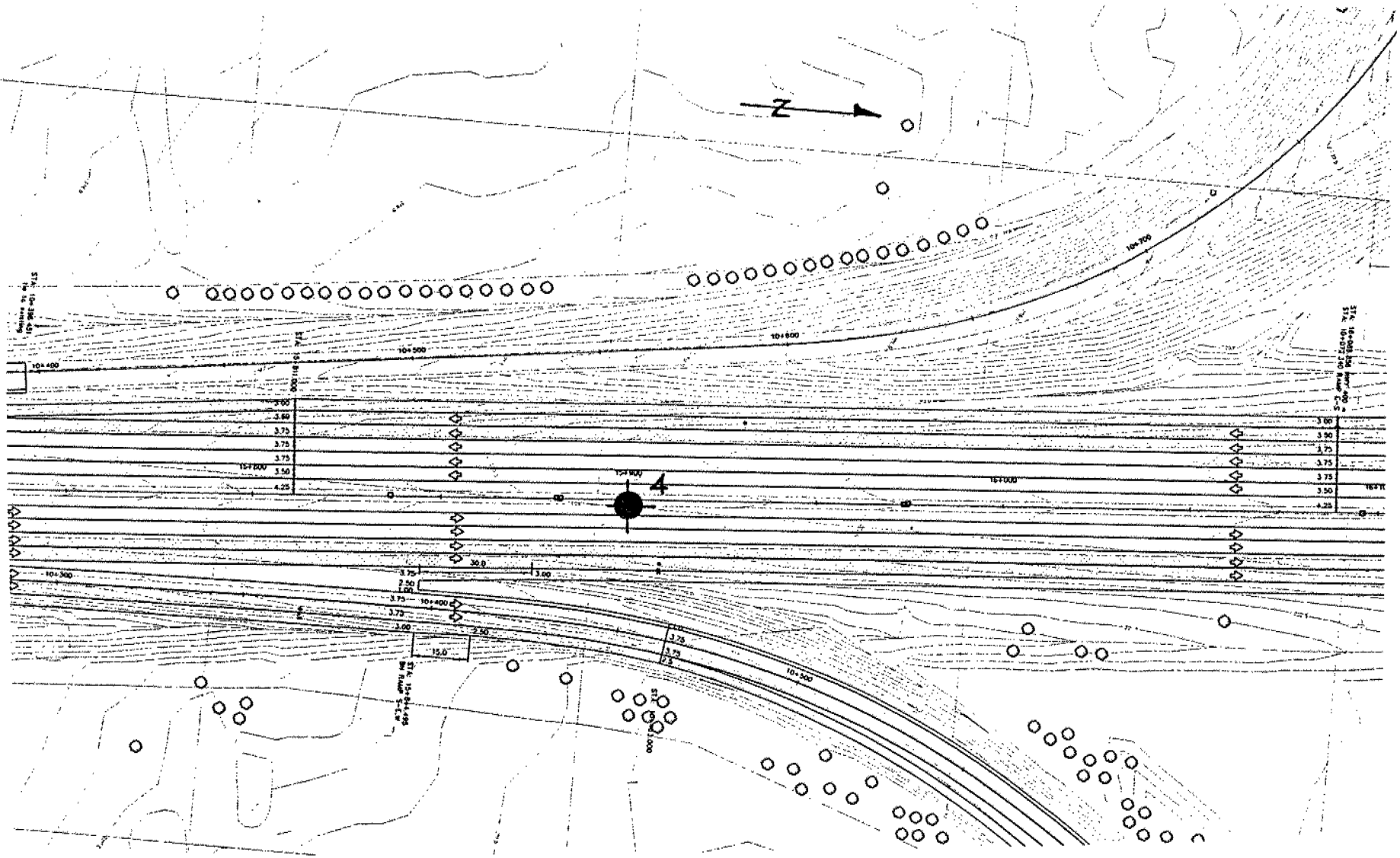
STRATA ENGINEERING CORPORATION		
W.P. 475-91-00 HIGHWAY 400 - HIGH MAST LIGHTING **Location of Boreholes**		
MS-CM 1998 12 22	Drawing No.	4759100-1

Reference: Peliminay Plan dated June 15, 1998, MTO Central Region



STRATA ENGINEERING CORPORATION		
W.P. 475-91-00 HIGHWAY 400 - HIGH MAST LIGHTING **Location of Boreholes**		
MS-CM 1998 12 22	Drawing No.	4759100-1

Reference: Peliminay Plan dated June 15, 1998, MTO Central Region



STRATA ENGINEERING CORPORATION

W.P. 475-91-00

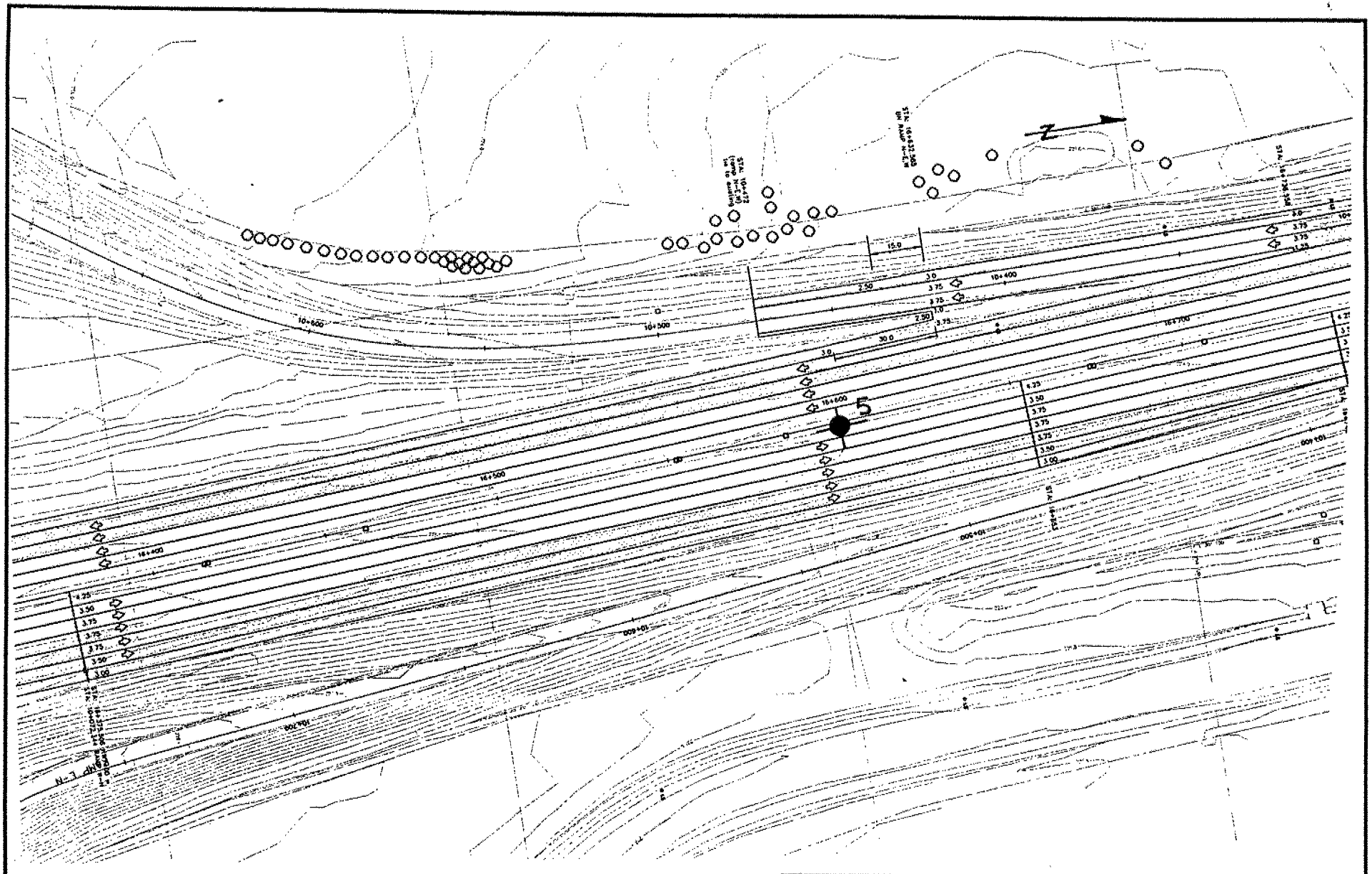
HIGHWAY 400 - HIGH MASK LIGHTING

Location of Boreholes

MS-CM 1998 12 22	Drawing No.	4759100-1

Reference: Peliminay Plan dated June 15, 1998, MTO Central Region

Sheet 3 of 9



STRATA ENGINEERING CORPORATION

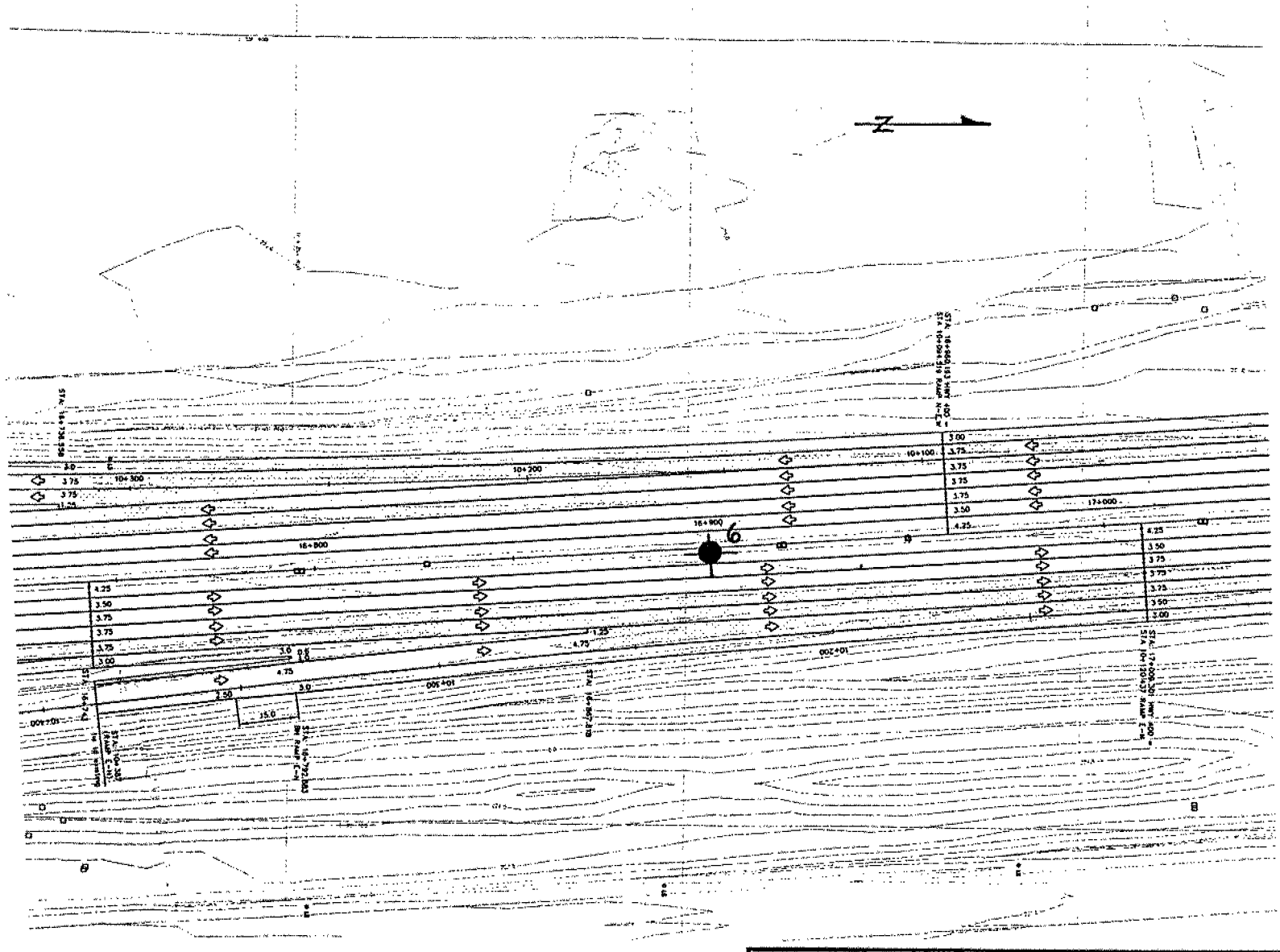
W.P. 475-91-00

HIGHWAY 400 - HIGH MAST LIGHTING

Location of Boreholes

MS-CM 1998 12 22	Drawing No.	4759100-1

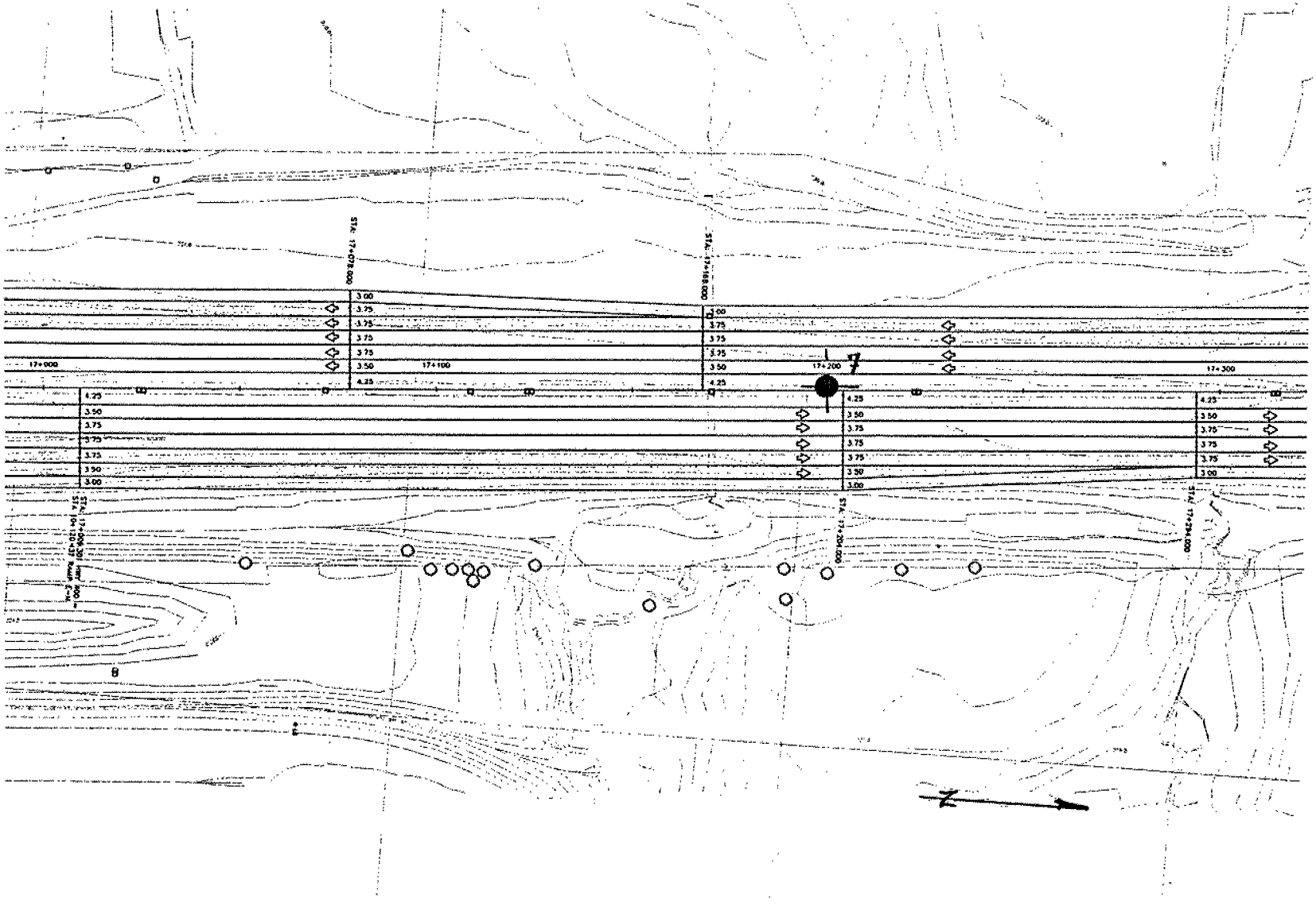
Reference: Peliminay Plan dated June 15, 1998, MTO Central Region



STRATA ENGINEERING CORPORATION		
W.P. 475-91-00 HIGHWAY 400 - HIGH MAST LIGHTING **Location of Boreholes**		
MS-CM 1998 12 22	Drawing No.	4759100-1

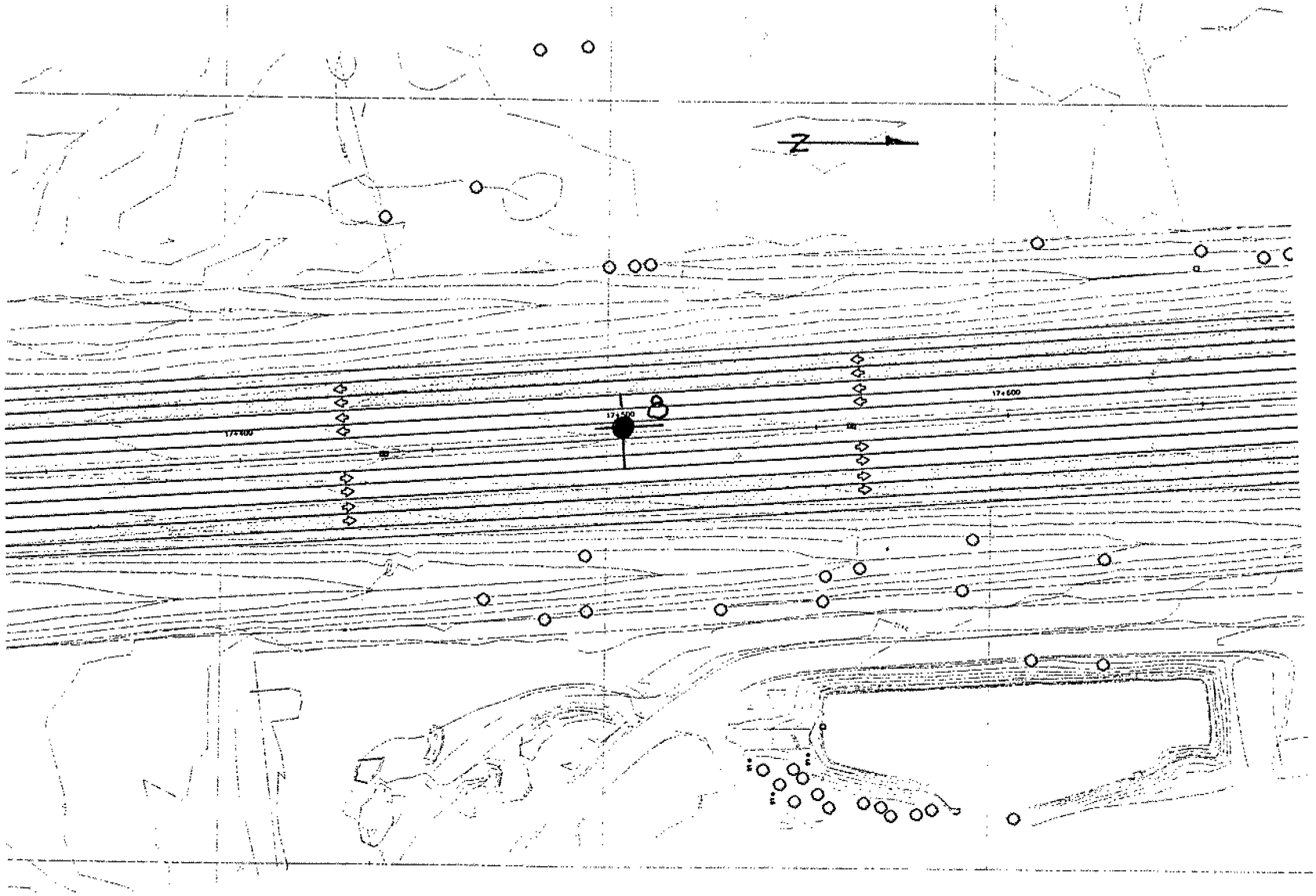
Reference: Peliminay Plan dated June 15, 1998, MTO Central Region

Sheet 5 of 9



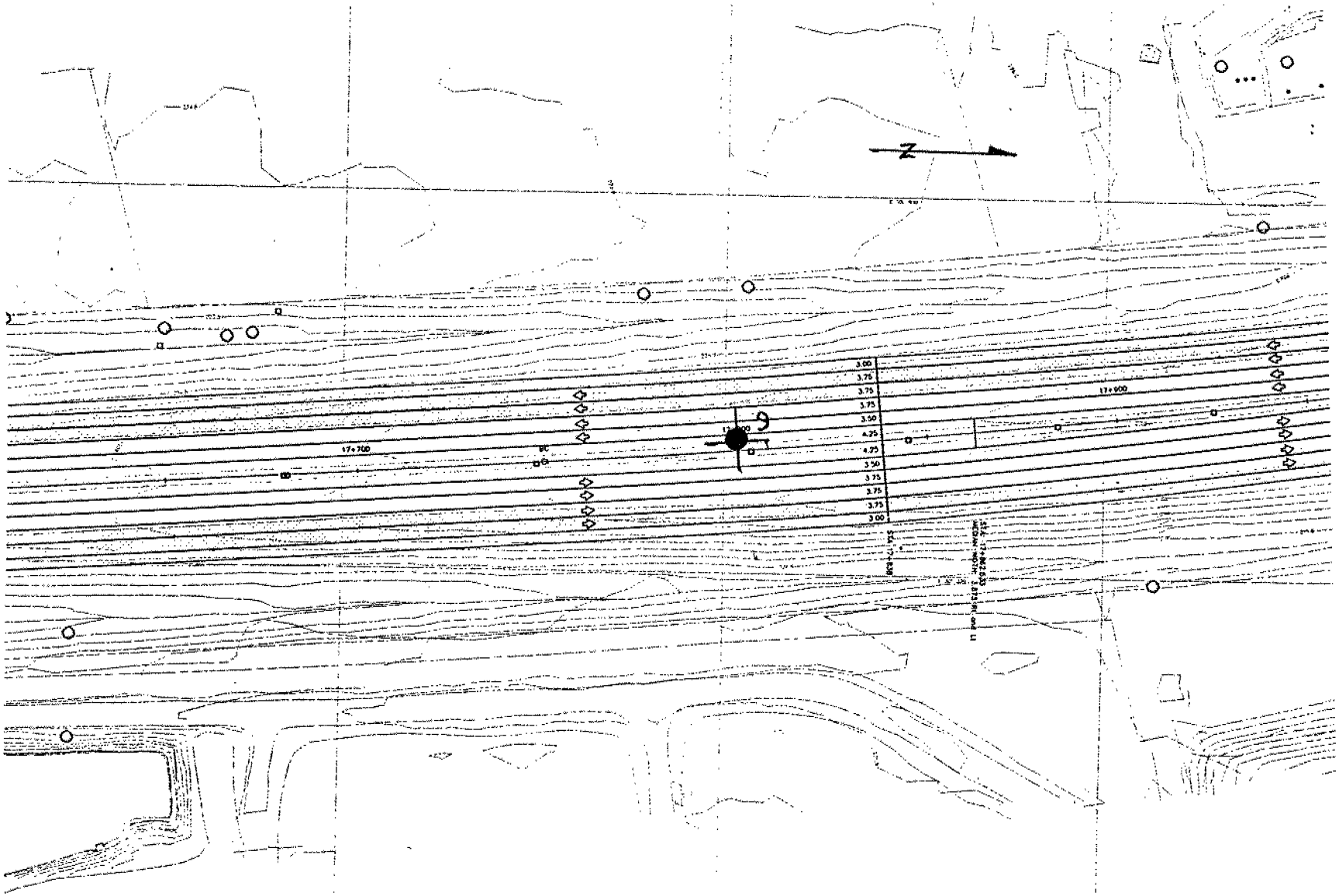
STRATA ENGINEERING CORPORATION		
W.P. 475-91-00 HIGHWAY 400 - HIGH MAST LIGHTING **Location of Boreholes**		
MS-CM 1998 12 22	Drawing No.	4759100-1

Reference: Poliminay Plan dated June 15, 1998, MTO Central Region



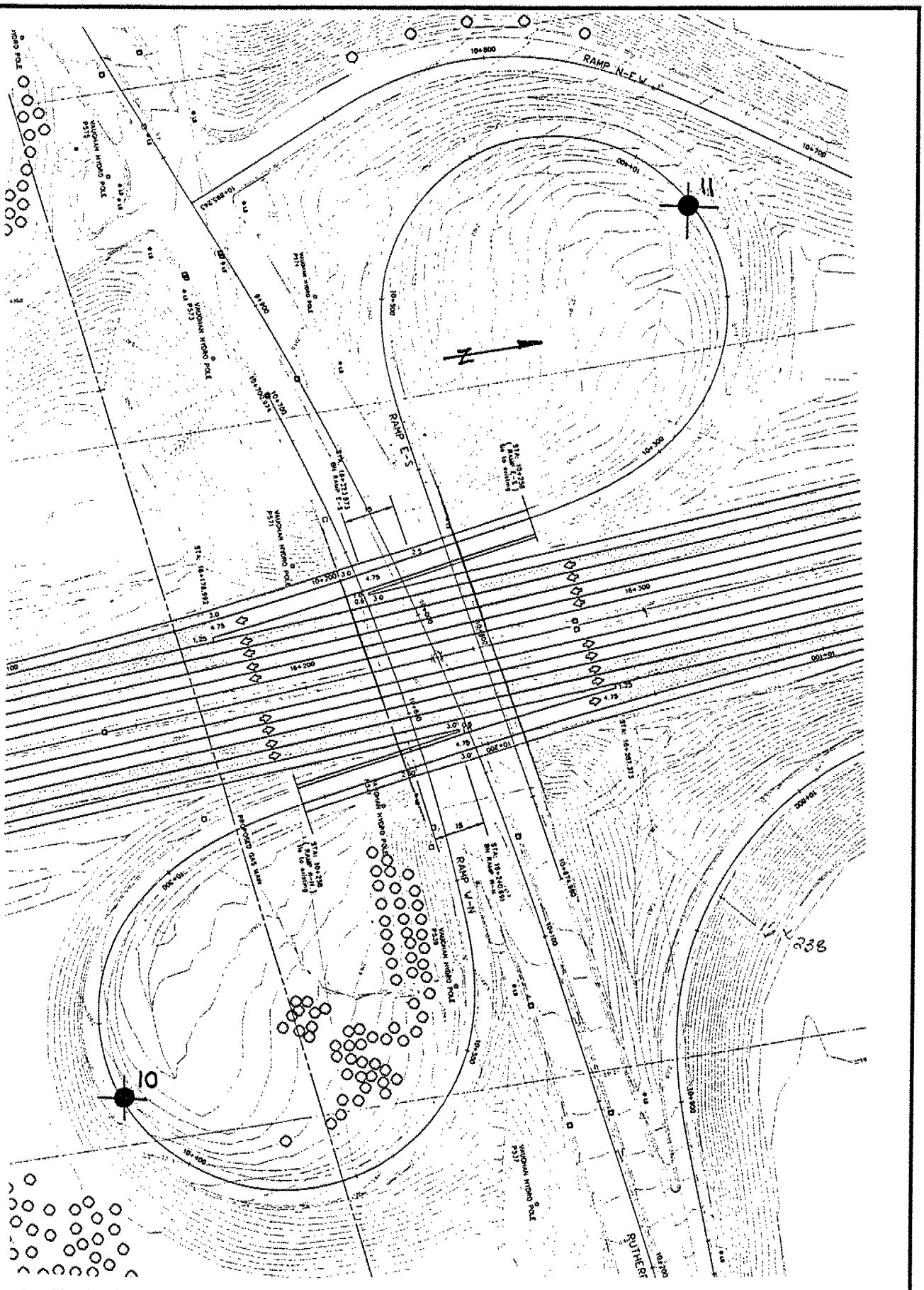
STRATA ENGINEERING CORPORATION		
W.P. 475-91-00 HIGHWAY 400 - HIGH MAST LIGHTING **Location of Boreholes**		
MS-CM 1998 12 22	Drawing No.	4759100-1

Reference: Peliminay Plan dated June 15, 1998, MTO Central Region



STRATA ENGINEERING CORPORATION		
W.P. 475-91-00 HIGHWAY 400 - HIGH MAST LIGHTING **Location of Boreholes**		
MS-CM 1998 12 22	Drawing No.	4759100-1

Reference: Peliminay Plan dated June 15, 1998, MTO Central Region



HIGHWAY 400 - HIGH MAST LIGHTING - **Location of Boreholes**		Drawing No.
STRATA ENGINEERING CORPORATION	*Ref: Prelim. Plan June 15/98 MTO Central Region*	4759100-1

Ministry of Transportation, Ontario

RECORD OF BOREHOLE No 1

METRIC

W P 475-91-00 LOCATION Sta.15+000 1.4 m Rt. N:4 853 011; E: 301 161 ORIGINATED BY GL

DIST CR HWY 400 BOREHOLE TYPE Truck Mount Solid Stem Auger COMPILED BY JP

DATUM Geodetic DATE 1998 09 03 CHECKED BY CM

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 (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
210.2	Paved Shoulder						210				
0.0	230 mm Asphalt										
209.8	Sand and Gravel										
0.4			1	SS	25						
	FILL										
			2	SS	10		208				
	Brown clayey silt with some sand, gravel										
	Stiff - V. Stiff										
	Firm Topsoil		3	SS	6	*					
206.7							206				
3.5			4	SS	22					19.9	
	Brown Clayey Silt with some sand, occ. gravel (Glacial Till)										
	Stiff - Hard		5	SS	9		204			20.0	
	Grey-Brown Sandy Silt, Dense		6	SS	35				NP		1 26 60 13
	Hard						202				
			7	SS	33					22.9	
							200				
199.1			8	SS	30					21.9	
11.1	End of Borehole										

* Water level on 1998 09 03.

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No 2 METRIC

W P 475-91-00 LOCATION Sta. 15+300 1.5 m Rt. N: 4 853 310; E: 301 141 ORIGINATED BY GL
DIST CR HWY 400 BOREHOLE TYPE Truck Mount Solid Stem Auger COMPILED BY JP
DATUM Geodetic DATE 1998 09 03 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
211.1	Paved Shoulder								
0.0	280 mm Asphalt								
	Brown Silty sand, Tr. Gravel		1	SS	20		210		3 73 (24)
209.9									
1.2	FILL		2	SS	18				
	Brown Clayey Silt and Silt, some sand Compact or V. Stiff		3	SS	57	▼*	208		1 14 78 7
207.8									
3.3	Brown								
	Grey		4	SS	29		206	23.2	
	Clayey Silt with some sand, occ. gravel (Glacial Till)		5	SS	38				
	Very Stiff - Hard		6	SS	36		204		4 25 55 16
			7	SS	42		202		
201.5									
9.6	End of Borehole								

* Water Level on 1998 09 03

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100
SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT W_p NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L
WATER CONTENT (%) 10 20 30

NP

+³, ×⁵ : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation
Ontario

REVISED

RECORD OF BOREHOLE No 3

METRIC

W P 475-91-00 LOCATION Sta. 15+600 1.4 m Rt. N: 4 853 609; E: 301 120 ORIGINATED BY GL

DIST CR HWY 400 BOREHOLE TYPE Truck Mount Solid Stem Auger COMPILED BY JP

DATUM Geodetic DATE 1998 09 03 CHECKED BY CM

ELEV / DEPTH	SOIL PROFILE 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 (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
215.9	Paved Shoulder										
0.0	200 mm Asphalt					*					
215.4	Sand and Gravel										
0.5	Brwon Fine Sand										
214.9	Loose		1	SS	12						
1.0	FILL										
	150 mm Topsoil		2	SS	16		214				
	Brown Clayey Silt to Silt, with sand, occ. gravel Stiff - V. Stiff										
212.9											
3.0	Brown Clayey Silt to Silt, with some sand, occ. gravel (Glacial Till)		3	SS	40		212				
	Hard		4	SS	78					22.6	
	Grey		5	SS	77		210				0 16 69 15
	occ. wet sand seams		6	SS	87		208			23.3	
207.8											
8.1	End of Borehole										

* Borehole wet upon completion. No free standing water.

+³, ×⁵ : Numbers refer to Sensitivity

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

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation Ontario

REVISED

RECORD OF BOREHOLE No 4

METRIC

W P 475.91-00 LOCATION Sta. 15+900 1.5 Rt. N: 4 853 909; E: 301 099 ORIGINATED BY GL

DIST CR HWY 400 BOREHOLE TYPE Truck Mount Solid Stem Auger COMPILED BY JP

DATUM Geodetic DATE 1998 09 03 CHECKED BY CM

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 (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
222.4	Paved Shoulder										
0.0	250 mm Asphalt/Gravel					*	222				
	FILL Brown Fine Sand, Tr. Gravel, Compact		1	SS	18						
221.0											
1.4	Topsoil		2	SS	15					20.2	
	Brown Clayey Silt (Fill Material) Stiff mixed with some sand trace organics						220				
218.8			3	SS	11					21.0	
3.6	Hard Brown Clayey Silt to Silt, Tr. Sand (Glacial Till) Very Dense		4	SS	50/8 cm		218				0 6 80 14
217.4											
5.0	Brown Sandy Silt occ. fine sand seams Very Dense		5	SS	50/13 cm		216				
			6	SS	63						0 77 18 5
214.3											
8.1	End of Borehole * Borehole dry upon completion										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

REVISED

RECORD OF BOREHOLE No 5

METRIC

W P 475-91-00 LOCATION Sta. 16+600 1.5 m Rt. N: 4 854 606; E: 301 052 ORIGINATED BY GL

DIST CR HWY 400 BOREHOLE TYPE Truck Mount Solid Stem Auger COMPILED BY JP

DATUM Geodetic DATE 1998 09 04 CHECKED BY CM

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 (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
224.4	Paved Shoulder										
0.0	50 mm Asphalt						224				
224.0	Sand and Gravel										
0.4	Brown Fine Sand										
223.3	Loose		1	SS	8						
1.1	100 mm Topsoil										
	FILL		2	SS	12						
	Brown Clayey silt with sand, mixed with occ. topsoil		3	SS	9		222				
	Firm - Stiff		4	SS	7						
220.4											
4.0	Brown						220				
	Grey		5	SS	28					20.9	
	Clayey Silt with some sand, occ. gravel (Glacial Till)		6	SS	12		218			21.3	
	Stiff to V. Stiff		7	SS	26	*					
215.9							216				
8.5	Grey Sandy Silt to Silty Sand, Dense		8	SS	43						2 38 45 15
214.8											
9.6	End of Borehole										

* Water level on 1998 09 04

+3, ×5 : Numbers refer to Sensitivity

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

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation Ontario

RECORD OF BOREHOLE No 6

METRIC

W P 475-91-00 LOCATION Sta. 16+900 1.5 m Rt. N: 4 854 906; E: 301 030 ORIGINATED BY GL

DIST CR HWY 400 BOREHOLE TYPE Truck Mount Solid Stem Auger COMPILED BY IP

DATUM Geodetic DATE 1998 09 04 CHECKED BY CM

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 (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) / WATER CONTENT (%) PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT Wl (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
223.0	Paved Shoulder									
0.0 / 222.6	200 mm Asphalt / Sand and Gravel					*				
0.4 / 222.0	Brown Silty Sand Loose		1	SS	9		222			2 58 32 8
1.0	FILL									
	Brown Clayey Silt with mixed topsoil		2	SS	15					
220.4	Firm - Stiff		3	SS	10		220			
2.6	Brown Clayey Silt with some sand, occ. gravel (Glacial Till)		4	SS	36					
			5	SS	103		218			
	Grey Hard		6	SS	67					
215.3			7	SS	50/ cm		216			
7.7	End of Borehole									

* Borehole dry upon completion

+3, ×5 : Numbers refer to Sensitivity

15 20/10 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation
Ontario

REVISED

RECORD OF BOREHOLE No 7

METRIC

W P 475-91-00 LOCATION Sta. 17+200 1.5 m Lt. N: 4 855 205; E: 301 008 ORIGINATED BY GI

DIST CR HWY 400 BOREHOLE TYPE Truck Mount Solid Stem Auger COMPILED BY JP

DATUM Geodetic DATE 1998 09 03 CHECKED BY CM

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 (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
222.2	Paved Shoulder										
0.0 / 221.7	250 mm Asphalt Sand and Gravel						222				
0.5 / 221.0	Brown Fine Sand		1	SS	13						
1.2	FILL Topsoil		2	SS	17						
219.2	Brown Clayey Silt Very Stiff						220				
3.0	Brown Clayey Silt with some sand, occ. gravel (Glacial Till)		3	SS	34				o	22.2	
			4	SS	61	*	218		o——	22.1	
	Very Hard Grey		5	SS	50/15 cm		216		o		
214.1			6	SS	91				o—	21.8	
8.1	End of Borehole * Water level on 1998 09 03										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

REVISED

RECORD OF BOREHOLE No 8

METRIC

W P 475-91-00 LOCATION Sta. 17+500 1.5 m Lt. N: 4 855 504; E: 300 986 ORIGINATED BY GL

DIST CR HWY 400 BOREHOLE TYPE Truck Mount Soil Stem Auger COMPILED BY JP

DATUM Geodetic DATE 1998 09 03 CHECKED BY CM

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 (o UNCONFINED, + FIELD VANE, • QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
224.5	Paved Shoulder										
0.0	200 mm Asphalt					*	224				
	Loose to Compact FILL Sand & Gravel		1	SS	12						0 84 (16)
223.3 / 1.2	Clayey Silt occ. Topsoil incl. Firm		2	SS	7				o		
222.1 / 2.4	Brown Clayey Silt with some sand, occ. gravel (Glacial Till)		3	SS	59		222		o—	22.6	
	Hard		4	SS	82		220		o	22.4	
	Grey		5	SS	43		218		o—	23.0	
216.7 / 7.8	Grey Silt, V. Dense		6	SS	87				o		0 10 80 10
216.4 / 8.1	End of Borehole * Borehole dry upon completion										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

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

Ministry of Transportation Ontario

REVISED

RECORD OF BOREHOLE No 9

METRIC

W P 475-91-00 LOCATION Sta. 17+800 1.5 m Lt. N: 4 855 804; E: 300 966 ORIGINATED BY GL

DIST CR HWY 400 BOREHOLE TYPE Truck Mount Solid Stem Auger COMPILED BY JP

DATUM Geodetic DATE 1998 09 03 CHECKED BY CM

ELEV / DEPTH	SOIL PROFILE 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 (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
227.1	Paved Shoulder										
0.0	75 mm Asphalt										
226.5	Sand and Gravel					*					
0.6	FILL Brown Sand Compact		1	SS	29		226				
	Topsoil										
	Brown Clayey silt		2	SS	13						
	Brown Silty Sand, occ. fine gravel Compact - Dense										
223.9			3	SS	42		224			23.3	
3.2	Brown Clayey Silt with some sand, occ. gravel (Glacial Till)		4	SS	50/15 cm		222				
	Hard Grey		5	SS	63					22.9	
							220				
219.0			6	SS	82					23.2	
8.1	End of Borehole * Borehole dry upon completion										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

REVISED

RECORD OF BOREHOLE No 10

METRIC

W P 475-91-00 LOCATION Sta. 10+375 E/PS Ramp W-N, Rutherford Rd. Interchange ORIGINATED BY GL

DIST CR HWY 400 BOREHOLE TYPE Truck Mount Solid Stem N: 4 854 138; E: 301 188 COMPILED BY JP

DATUM Geodetic DATE 1998 09 04 CHECKED BY CM

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 (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
226.5	Inside Gravel Shoulder										
0.0	Dense Granular A Crushed gravel with some sand					*	226				
225.4			1	SS	47						
1.1	Brown Clayey Silt FILL		2	SS	10				o		
			3	SS	18		224		o		
	Stiff		4	SS	12				o —		
222.4											
4.1	Light Brown Silt Dense		5	SS	34		222		o		0 3 89 8
221.0											
5.5	Light Brown Silty Sand to Sandy Silt (Glacial Till) Very Dense		6	SS	60		220		o		
218.4			7	SS	72				o		0 40 55 5
8.1	End of Borehole										

* Borehole wet upon completion at base. No free standing water.

+3, ×5 : Numbers refer to Sensitivity

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

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No. 11 METRIC

W P 475-91-00 LOCATION Sta. 10+380 E/P Ramp E-S, Rutherford Road Interchange N: 4 854 342; E: 300 986 ORIGINATED BY GL

DIST CR HWY 400 BOREHOLE TYPE Truck Mount Solid Stem Auger COMPILED BY JP

DATUM Geodetic DATE 1998 09 04 CHECKED BY CM

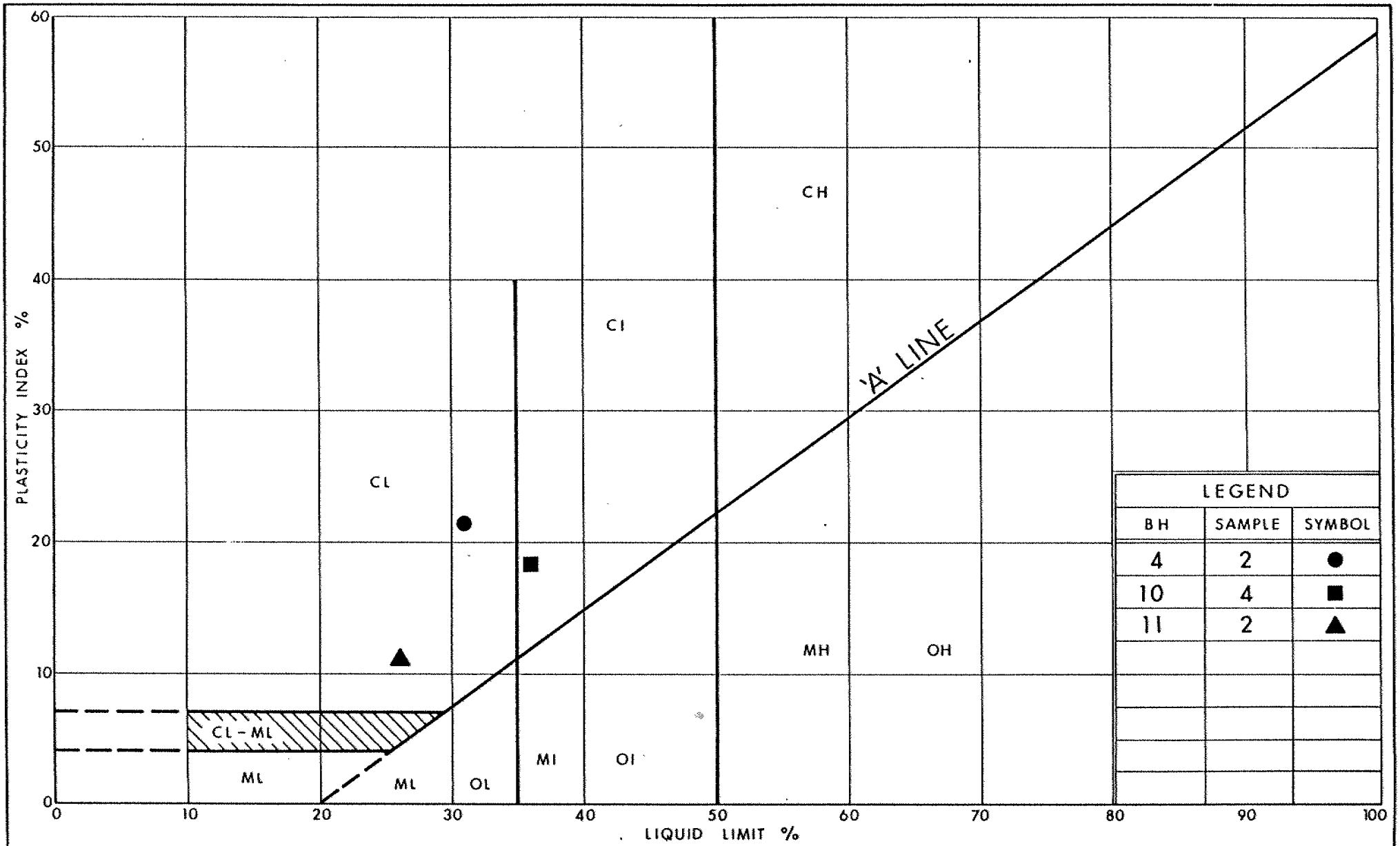
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
229.0	Inside Partial Paved Shldr										
0.0	200 mm Asphalt					*					
228.2	Granular A Crushed gravel & sand										
0.8	FILL		1	SS	14		228				
	Brown Clayey silt		2	SS	17						
	occ. topsoil inclusions		3	SS	16						
			4	SS	13		226				
224.7	Stiff										
4.3	Brown Silty Clay (Glacial Till)		5	SS	19		224				
223.5	Very Stiff										
5.5	Light Brown Silt Tr. Fine Sand		6	SS	33						0 5 85 10
			7	SS	79		222				0 6 89 5
	Dense - V. Dense										
219.4			8	SS	90		220				
9.6	End of Borehole										
	* Borehole bottom wet - no free standing water										

+3, x5 : Numbers refer to Sensitivity

20
15 ⊹ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

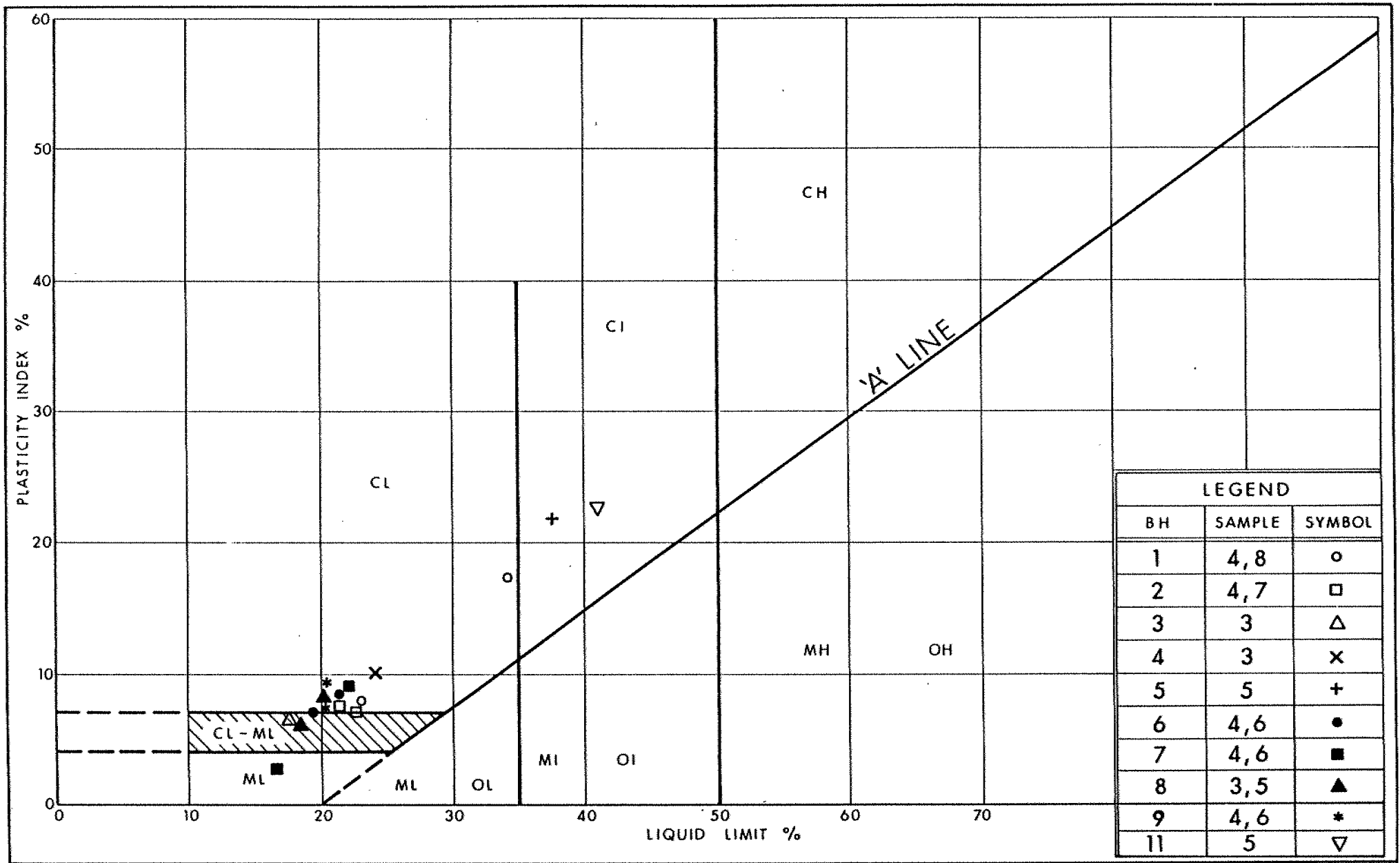
Oct 75, FF-S-21



Ministry of Transportation
Ontario

PLASTICITY CHART
CLAYEY SILT (Fill)

FIG No 1
W P 475-91-00
Hwy 400 HML



LEGEND		
BH	SAMPLE	SYMBOL
1	4, 8	o
2	4, 7	□
3	3	△
4	3	×
5	5	+
6	4, 6	●
7	4, 6	■
8	3, 5	▲
9	4, 6	*
11	5	▽

Ministry of Transportation
Ontario

PLASTICITY CHART
CLAYEY SILT TO SILTY CLAY (Glacial Till)

FIG No 2
W P 475-91-00
Hwy 400 HML

NOTE REGARDING AGRA LABORATORY TEST RESULTS

Agra Earth and Environmental have identified Borehole 10 as being at Station 16+100 and Borehole 11 as being at Station 16+400. These are the main lane chainages which were used to identify samples in the field at the time of drilling, The hole locations were tied into the appropriate ramp chainages after the field drilling program was completed. There are no log sheets in this report for Station 16+100 and Station 16+400. There are log sheets for Borehole 10 (identified in Agra test report as Station 16+100) and Borehole 11 (identified in Agra test report as Station 16+400).

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental Limited
104 Crockford Blvd.
Scarborough, Ontario
Canada M1R 3C6
Tel (416) 751-6565
Fax (416) 751-7592

Client:- Strata Engineering **Job# :-** TT 98250

Project:- Hwy 400, High Mast Lightings- Laboratory analysis of soil samples.

Sample Identification		Moisture Content (%)	Unit Weight (kN/m3)	Atterberg Limits			
Location	Sample No.			Plastic Limit(%)	Liquid Limit(%)	Plasticity Index(%)	Remarks
Sta.15+000	2	16.2	-	-	-	-	-
Sta.15+000	3	24.0	-	-	-	-	-
Sta.15+000	4	23.5	19.9	16.8	34.3	17.5	CL
Sta.15+000	5	23.7	20.0	-	-	-	-
Sta.15+000	6	10.8	-	Non Plastic			-
Sta.15+000	7	10.5	22.9	-	-	-	-
Sta.15+000	8	15.8	21.9	14.9	22.9	8.0	CL
Sta.15+300	2	12.3	-	-	-	-	-
Sta.15+300	3	17.4	-	Non Plastic			-
Sta.15+300	4	9.5	23.2	13.3	20.9	7.6	CL
Sta.15+300	5	12.9	-	-	-	-	-
Sta.15+300	6	9.7	-	-	-	-	-
Sta.15+300	7	17.3	-	15.7	22.6	6.9	CL-ML
Sta.15+600	2	20.8	-	-	-	-	-
Sta.15+600	3	9.6	-	11.0	17.4	6.4	CL-ML
Sta.15+600	4	9.9	22.6	-	-	-	-
Sta.15+600	5	14.6	-	-	-	-	-
Sta.15+600	6	8.3	23.3	-	-	-	-
Sta.15+900	2	20.8	20.2	18.4	30.8	21.4	CL
Sta.15+900	3	16.9	21.0	13.8	24.0	10.2	CL
Sta.15+900	4	18.5	-	-	-	-	-
Sta.15+900	5	11.5	-	-	-	-	-
Sta.16+100	2	19.3	-	-	-	-	-
Sta.16+100	3	10.5	-	-	-	-	-

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental Limited
104 Crockford Blvd.
Scarborough, Ontario
Canada M1R 3C6
Tel (416) 751-6565
Fax (416) 751-7592

Client:- Strata Engineering

Job# :- TT 98250

Project:- Hwy 400, High Mast Lightings- Laboratory analysis of soil samples.

Sample Identification		Moisture Content (%)	Unit Weight (kN/m3)	Atterberg Limits			
Location	No.			Plastic Limit(%)	Liquid Limit(%)	Plasticity Index(%)	Remarks
Sta.16+100	4	11.1	-	17.6	36.0	18.4	CI
Sta.16+100	5	20.3	-	-	-	-	-
Sta.16+100	6	19.3	-	-	-	-	-
Sta.16+100	7	21.3	-	-	-	-	-
Sta.16+400	2	13.2	-	14.7	25.9	11.2	CL
Sta.16+400	3	20.1	-	-	-	-	-
Sta.16+400	4	12.4	-	-	-	-	-
Sta.16+400	5	19.3	-	18.2	40.9	22.7	CI
Sta.16+400	6	17.5	-	-	-	-	-
Sta.16+400	7	18.7	-	-	-	-	-
Sta.16+400	8	16.8	-	-	-	-	-
Sta.16+600	1	35.2	-	-	-	-	-
Sta.16+600	2A	14.0	-	-	-	-	-
Sta.16+600	2B	21.1	-	-	-	-	-
Sta.16+600	3	25.5	-	-	-	-	-
Sta.16+600	4	29.4	-	-	-	-	-
Sta.16+600	5	16.3	20.9	15.8	37.5	21.7	CI
Sta.16+600	6	10.6	21.3	-	-	-	-
Sta.16+600	7	18.3	-	-	-	-	-
Sta.16+600	8	17.0	-	-	-	-	-
Sta.16+900	2	15.1	-	-	-	-	-
Sta.16+900	3	10.4	-	-	-	-	-
Sta.16+900	4	9.6	-	12.5	19.4	6.9	CL-ML
Sta.16+900	5	9.3	-	-	-	-	-

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

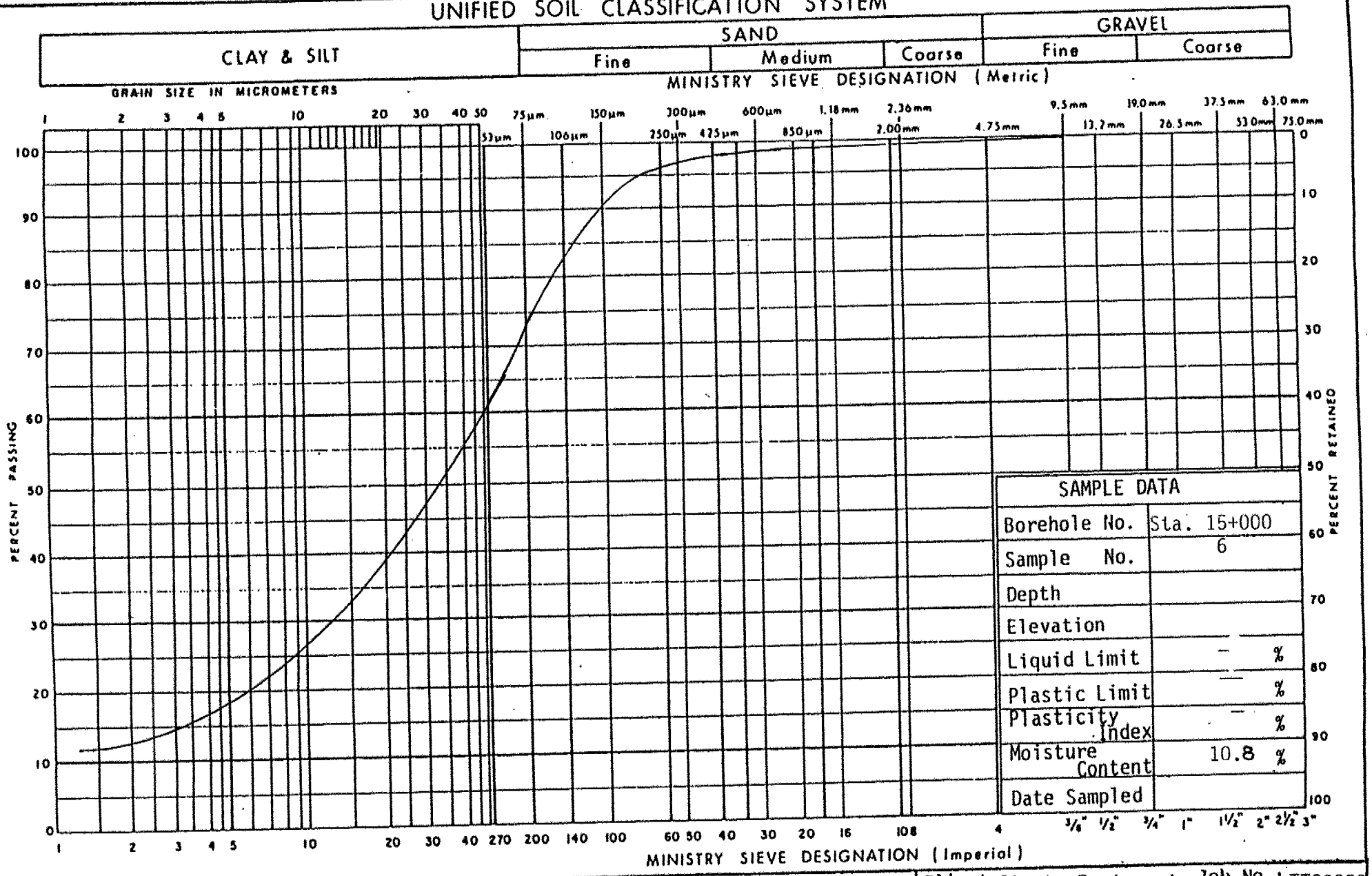
AGRA Earth &
Environmental Limited
104 Crockford Blvd.
Scarborough, Ontario
Canada M1R 3C6
Tel (416) 751-6565
Fax (416) 751-7592

Client:- Strata Engineering **Job# :-** TT 98250

Project:- Hwy 400, High Mast Lightings- Laboratory analysis of soil sampl

Sample Identification		Moisture Content (%)	Unit Weight (kN/m3)	Atterberg Limits			
Location	No.			Plastic Limit(%)	Liquid Limit(%)	Plasticity Index(%)	Remarks
Sta.16+900	6	9.1	-	12.9	21.2	8.3	CL
Sta.17+200	3	11.4	22.2	-	-	-	-
Sta.17+200	4	10.8	22.1	12.8	22.0	9.2	CL
Sta.17+200	5	9.0	-	-	-	-	-
Sta.17+200	6	10.5	21.8	13.9	16.6	2.7	ML
Sta.17+500	2	17.5	-	-	-	-	-
Sta.17+500	3	10.3	22.6	11.9	18.1	6.2	CL-ML
Sta.17+500	4	10.0	22.4	-	-	-	-
Sta.17+500	5	11.6	23.0	12.3	20.1	7.8	CL
Sta.17+500	6	15.1	-	-	-	-	-
Sta.17+800	3	11.1	23.3	-	-	-	-
Sta.17+800	4	10.7	-	12.8	20.1	7.3	CL
Sta.17+800	5	8.9	22.9	-	-	-	-
Sta.17+800	6	7.5	23.2	11.0	20.2	9.2	CL

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA	
Borehole No.	Sta. 15+000
Sample No.	6
Depth	
Elevation	
Liquid Limit	— %
Plastic Limit	— %
Plasticity Index	— %
Moisture Content	10.8 %
Date Sampled	

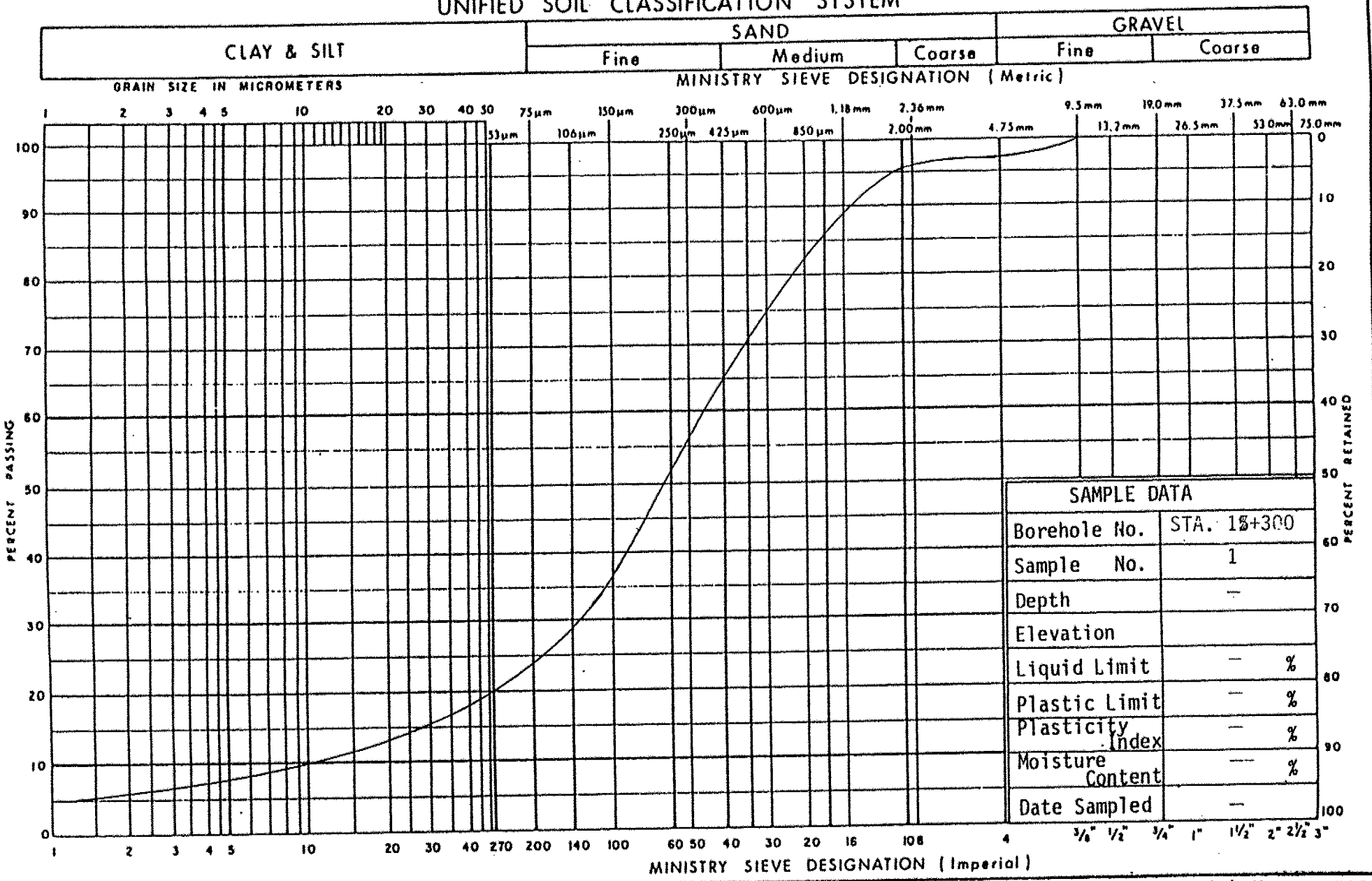
AGRA
Earth & Environmental

GRAIN SIZE DISTRIBUTION

Sandy Silt, Some Clay

Client: Strata Engineering
Job No.: TT98250
Project: Hwy 400, High Mast Lighting
Location: STATION 15+000
Test date: Sep.17,1998

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA	
Borehole No.	STA. 15+300
Sample No.	1
Depth	—
Elevation	
Liquid Limit	— %
Plastic Limit	— %
Plasticity Index	— %
Moisture Content	— %
Date Sampled	—

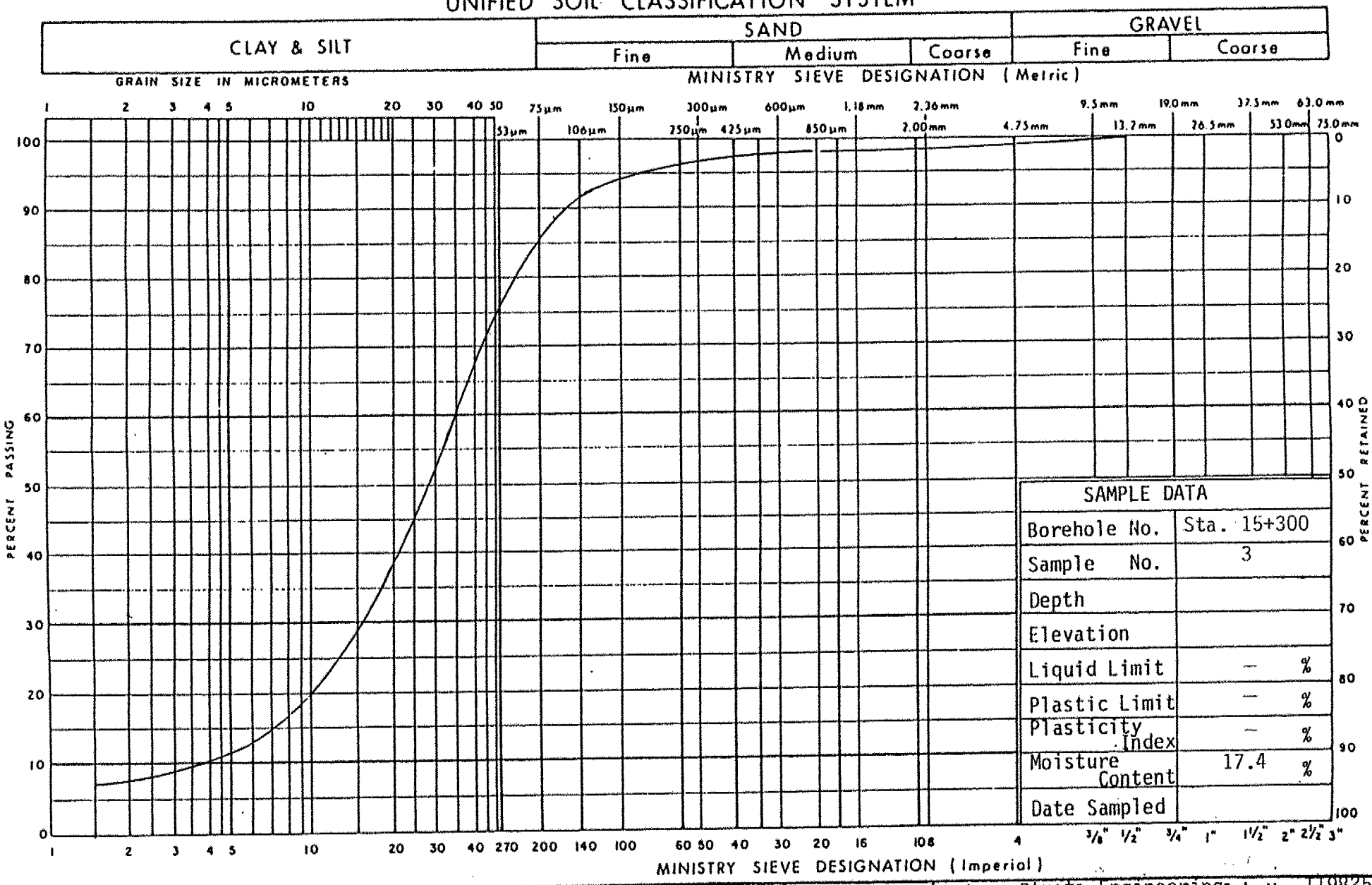
AGRA
Earth & Environmental

GRAIN SIZE DISTRIBUTION

Sand Some Silt, traces of gravel and clay

Client: STRATA ENGINEERING Job No.: TT98250
Project: Hwy 400 High Mast Lighting
Location: Station 15+300
Test date: Sep 22, 1998

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA	
Borehole No.	Sta. 15+300
Sample No.	3
Depth	
Elevation	
Liquid Limit	— %
Plastic Limit	— %
Plasticity Index	— %
Moisture Content	17.4 %
Date Sampled	

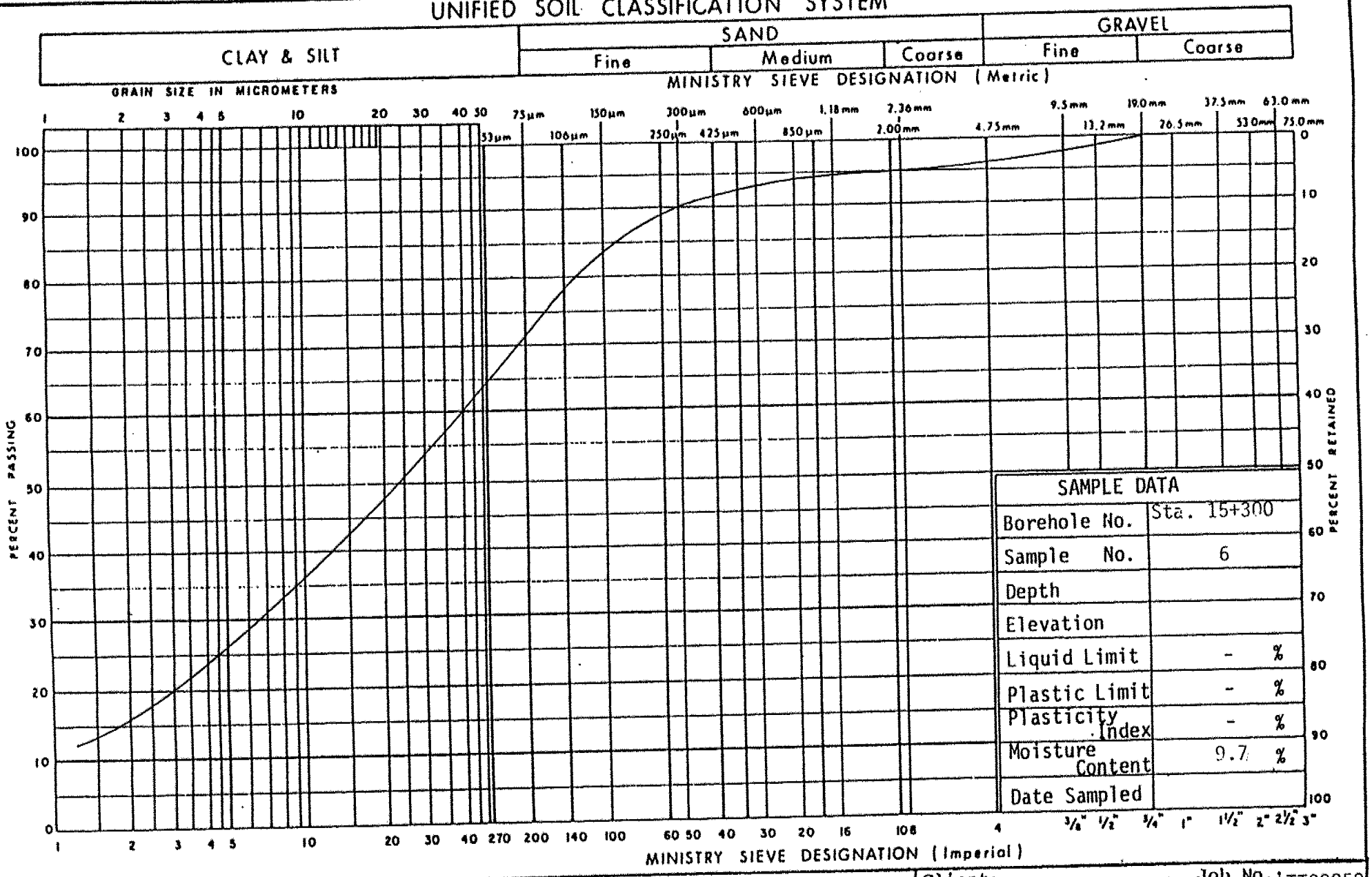
AGRA
Earth & Environmental

GRAIN SIZE DISTRIBUTION

Silt some Sand , Traces of clay & gravel

Client: Strata Engineering Job No.: 1198250
Project: Hwy 400, High Mast Lighting
Location: Station 15+300
Test date: Oct.02, 1998

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA	
Borehole No.	Sta. 15+300
Sample No.	6
Depth	
Elevation	
Liquid Limit	- %
Plastic Limit	- %
Plasticity Index	- %
Moisture Content	9.7 %
Date Sampled	

AGRA
Earth & Environmental

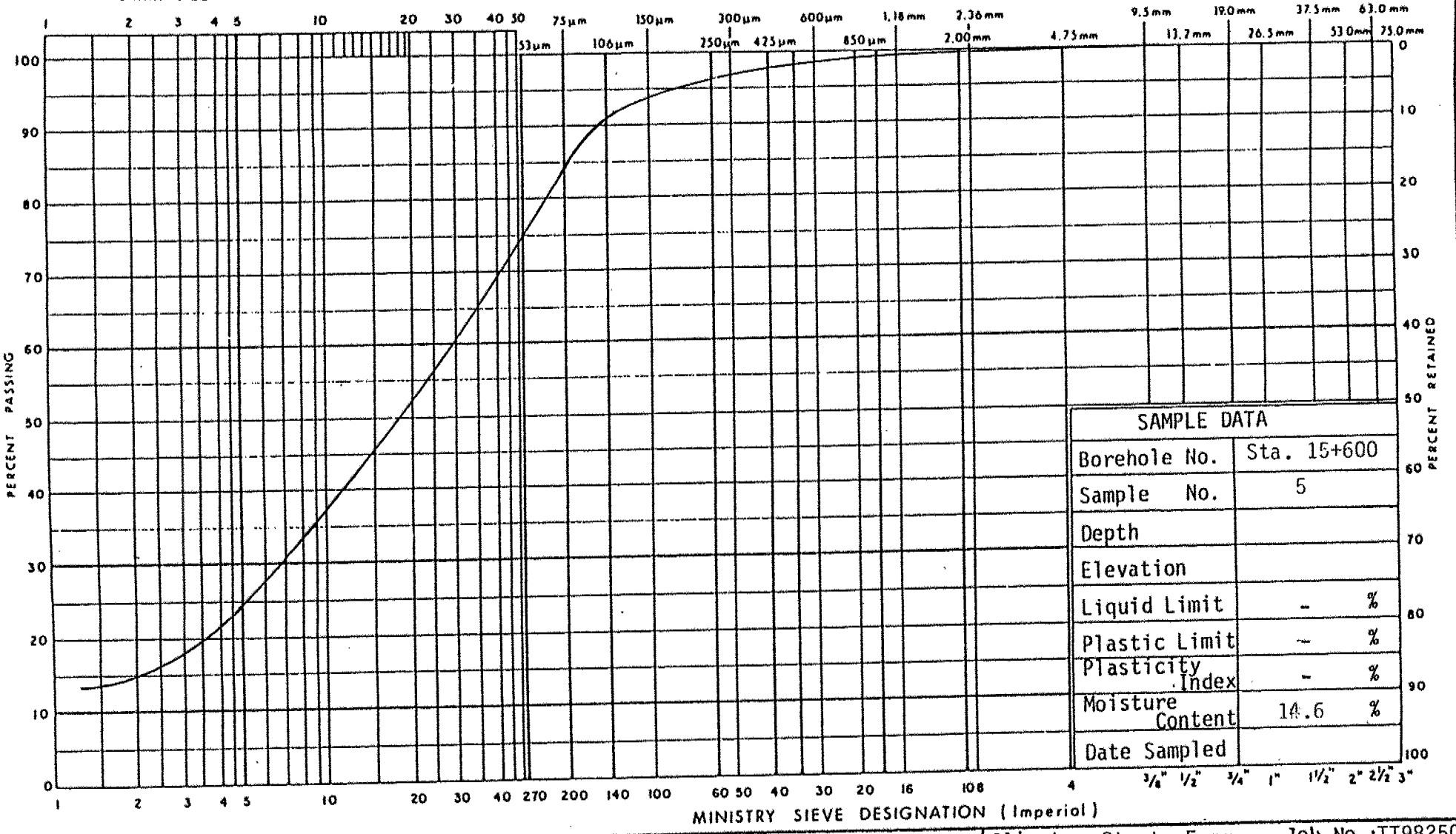
GRAIN SIZE DISTRIBUTION

Clayey Silt, some Sand and traces of Gravel

Client: Strata Engineering Job No.: TT98250
Project: Hwy400, Highmast Lighting
Location: Station 15+300
Test date: Sep.23, 1998

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



SAMPLE DATA		
Borehole No.	Sta. 15+600	
Sample No.	5	
Depth		
Elevation		
Liquid Limit	-	%
Plastic Limit	-	%
Plasticity Index	-	%
Moisture Content	14.6	%
Date Sampled		

AGRA
Earth & Environmental

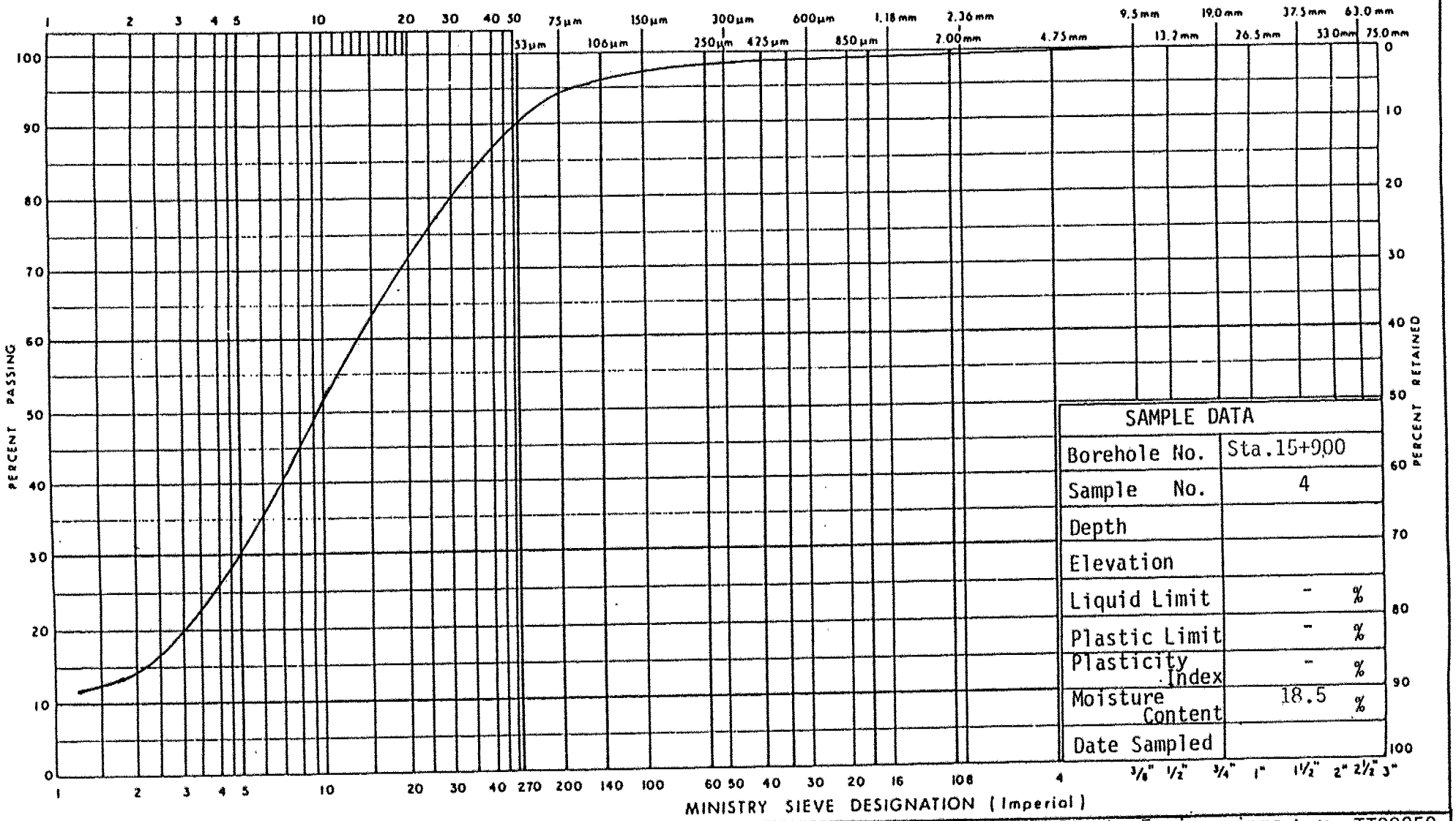
GRAIN SIZE DISTRIBUTION

Clayey Silt, some Sand

Client: Strata Engg. Job No.:TT98250
Project: Hwy 400, Highmast Lighting
Location: Station 15+600
Test date: Sep.23, 1998.

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



SAMPLE DATA	
Borehole No.	Sta.15+900
Sample No.	4
Depth	
Elevation	
Liquid Limit	- %
Plastic Limit	- %
Plasticity Index	- %
Moisture Content	18.5 %
Date Sampled	

AGRA
Earth & Environmental

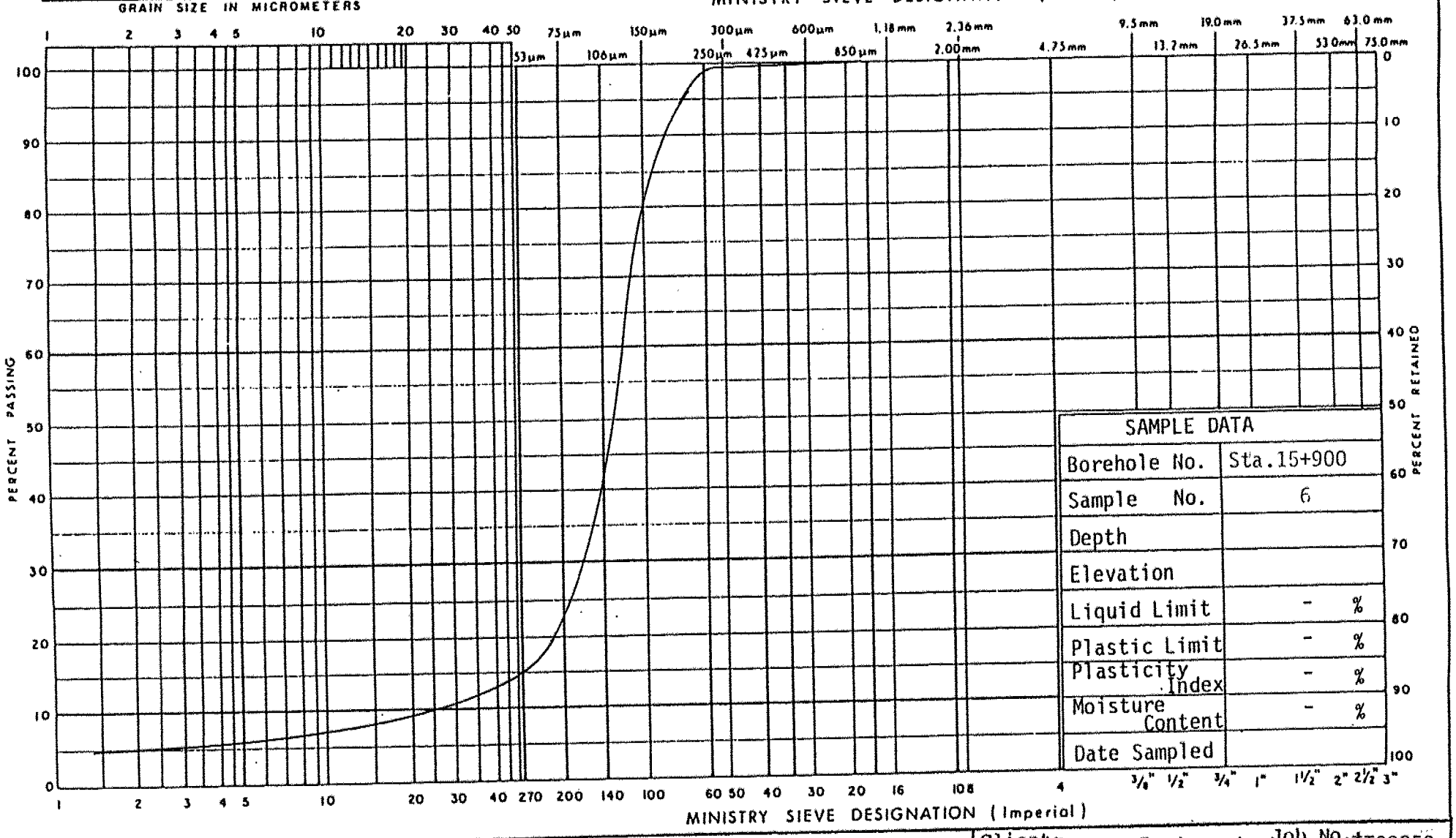
GRAIN SIZE DISTRIBUTION

Silt, Some Clay, traces of Sand

Client: Strata Engineering Job No. T98250
Project: Hwy 400, High Mast Lighting
Location: Station 15+900
Test date: Sep.23, 98.

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



SAMPLE DATA	
Borehole No.	Sta.15+900
Sample No.	6
Depth	
Elevation	
Liquid Limit	- %
Plastic Limit	- %
Plasticity Index	- %
Moisture Content	- %
Date Sampled	

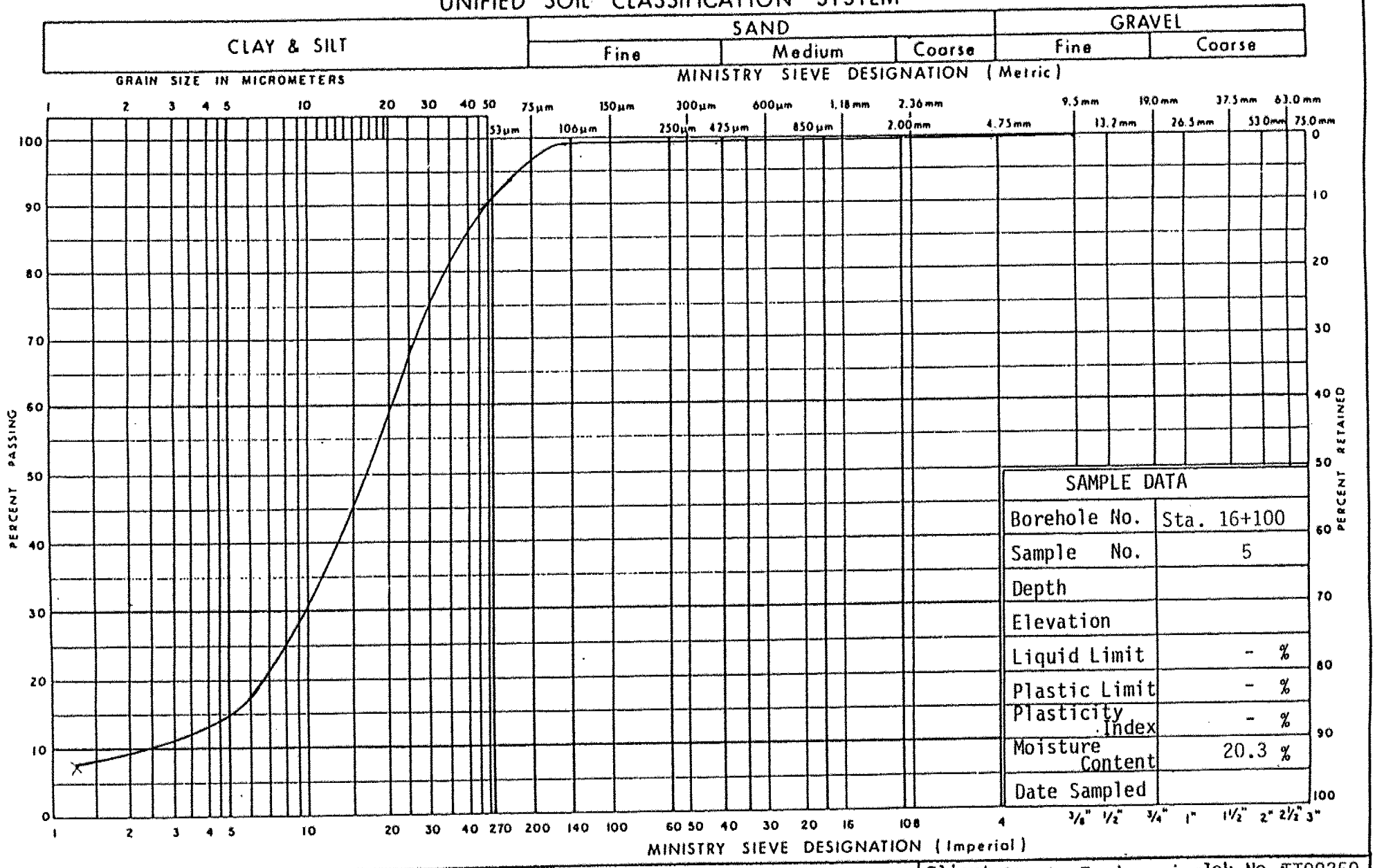
AGRA
Earth & Environmental

GRAIN SIZE DISTRIBUTION

Silty Sand traces of clay

Client: Strata Engineering Job No. TT98250
Project: Hwy 400, High Mast Lighting
Location: Station 15+900
Test date: Sep.22, 1998.

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA	
Borehole No.	Sta. 16+100
Sample No.	5
Depth	
Elevation	
Liquid Limit	- %
Plastic Limit	- %
Plasticity Index	- %
Moisture Content	20.3 %
Date Sampled	

AGRA
Earth & Environmental

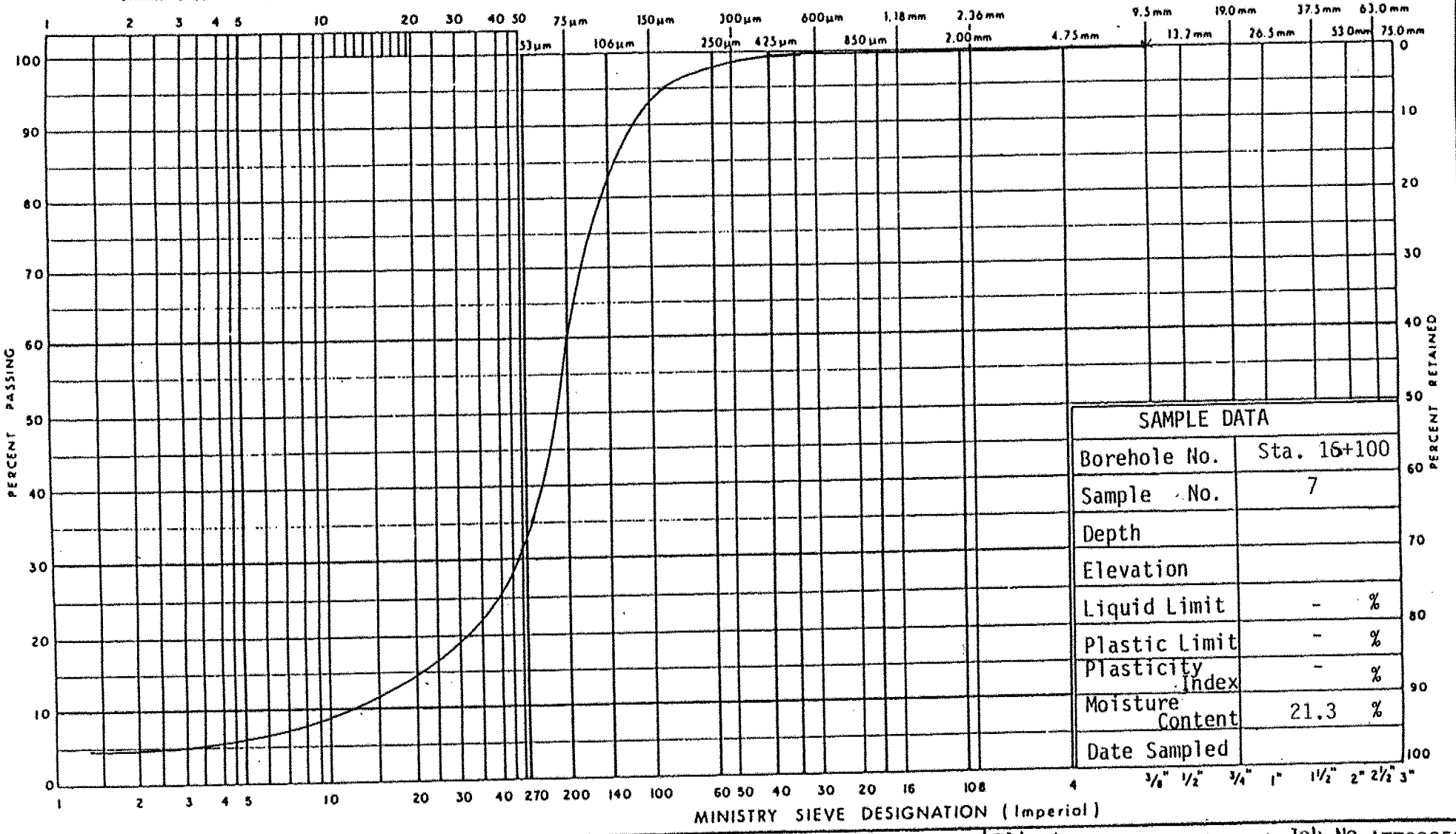
GRAIN SIZE DISTRIBUTION

Silt traces of Clay.

Client: Strata Engineering Job No. TT98250
Project: Hwy.400, High Mast Lighting
Location: Station 16+100
Test date: Sep. 23, 1998.

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



SAMPLE DATA	
Borehole No.	Sta. 16+100
Sample No.	7
Depth	
Elevation	
Liquid Limit	- %
Plastic Limit	- %
Plasticity Index	- %
Moisture Content	21.3 %
Date Sampled	

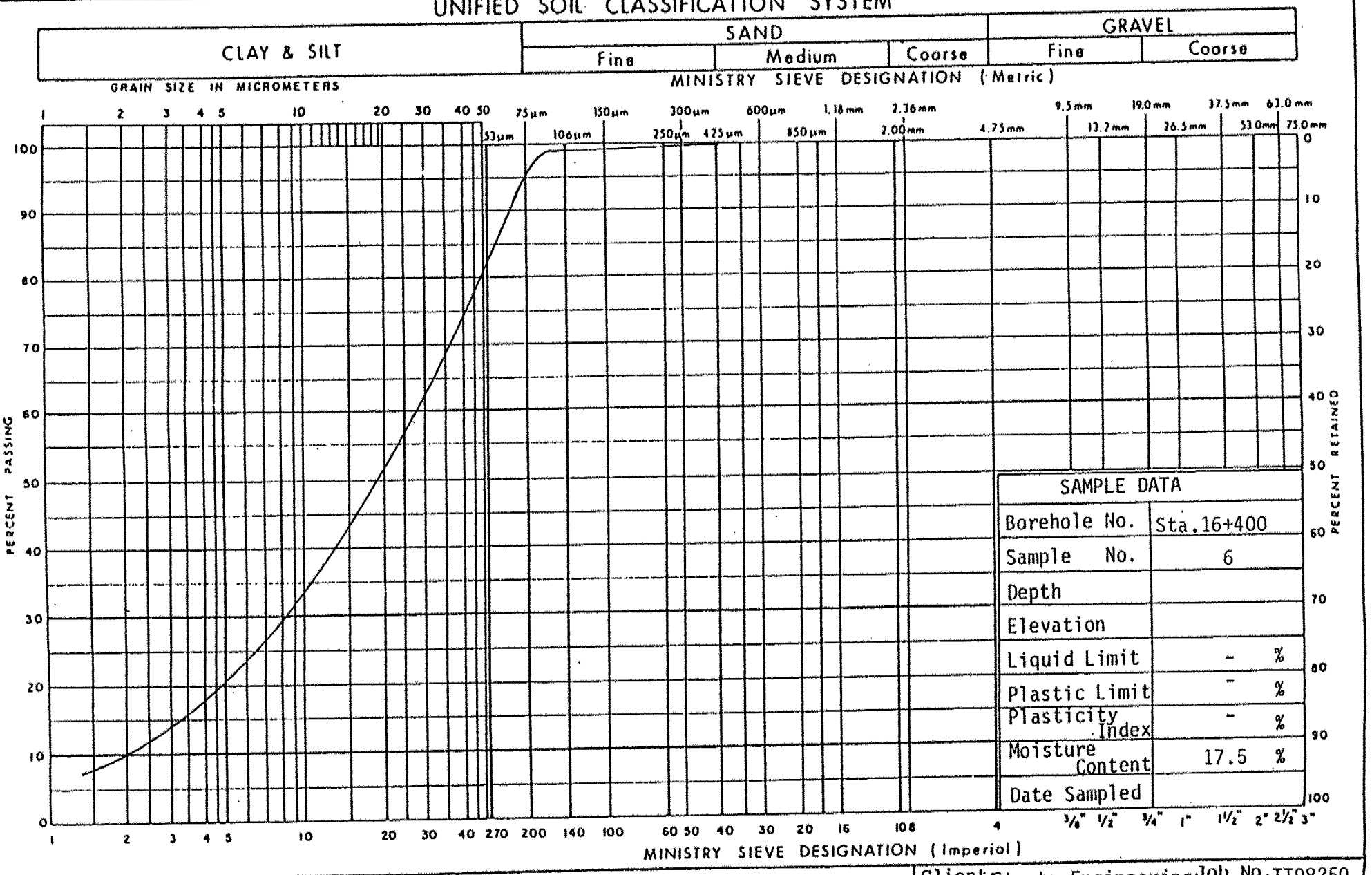
AGRA
Earth & Environmental

GRAIN SIZE DISTRIBUTION

Silt and Sand traces of Clay

Client: Strata Engineering
Job No.: TT98250
Project: Hwy 400, High Mast Lightings
Location: Station 16+100
Test date: m Sep 23, 1998

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA	
Borehole No.	Sta.16+400
Sample No.	6
Depth	
Elevation	
Liquid Limit	- %
Plastic Limit	- %
Plasticity Index	- %
Moisture Content	17.5 %
Date Sampled	

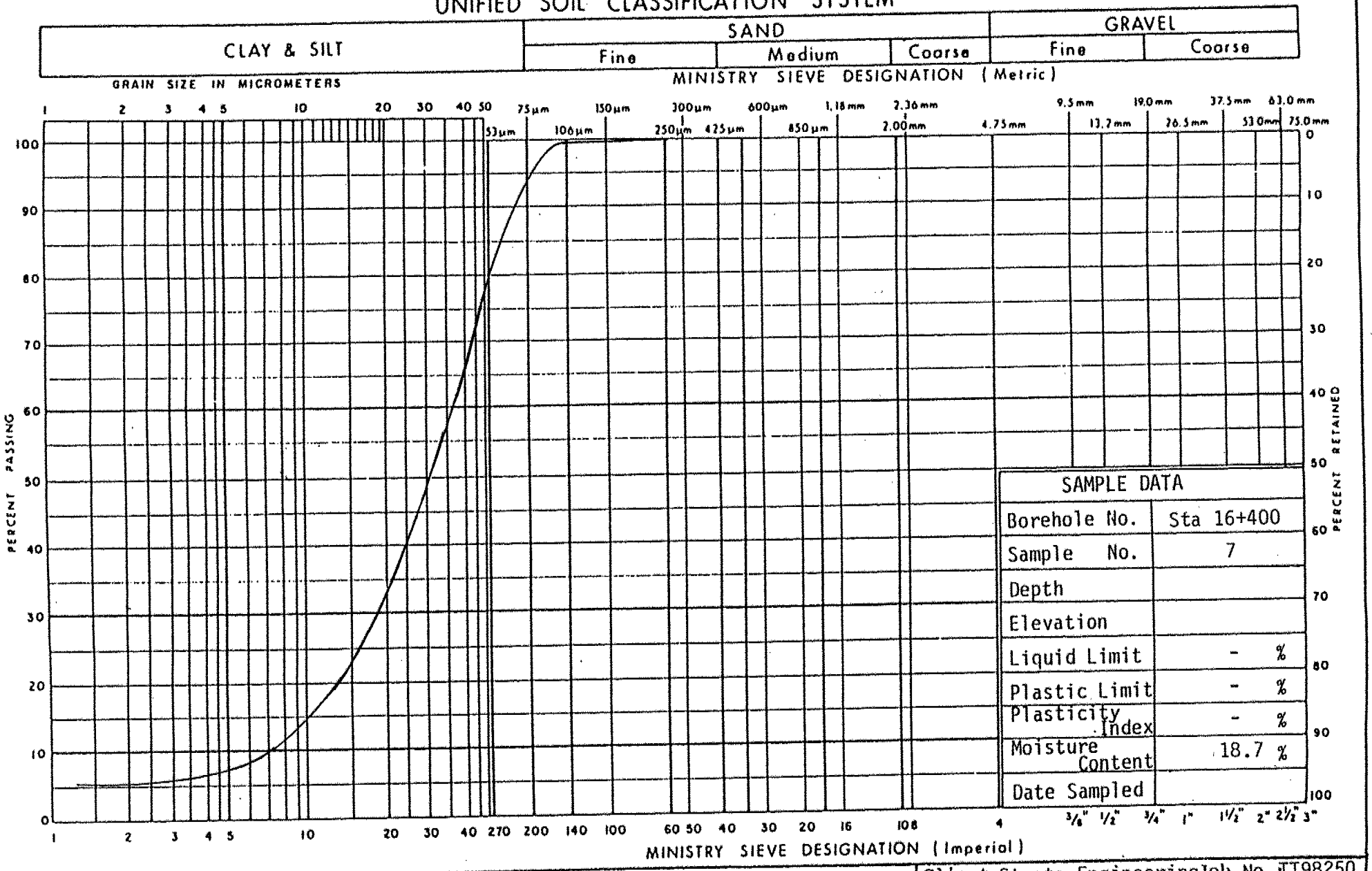
AGRA
Earth & Environmental

GRAIN SIZE DISTRIBUTION

Silt some Clay, Traces of Gravel

Client: Strata Engineering Job No. TT98250
Project: Hwy 400, High Mast Lightings
Location: Station 16+400
Test date: Sep.22,1998.

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA	
Borehole No.	Sta 16+400
Sample No.	7
Depth	
Elevation	
Liquid Limit	- %
Plastic Limit	- %
Plasticity Index	- %
Moisture Content	18.7 %
Date Sampled	

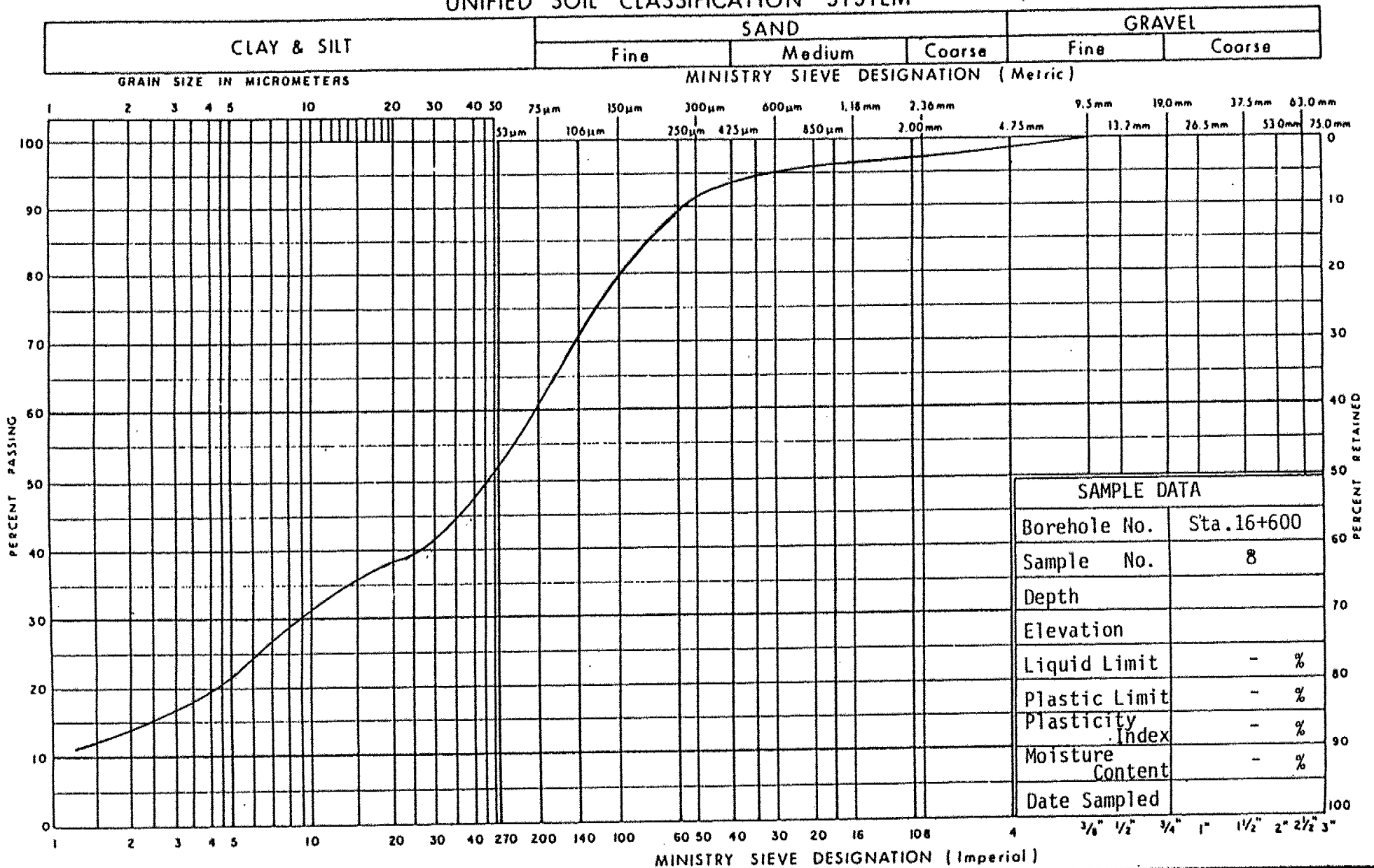
AGRA
Earth & Environmental

GRAIN SIZE DISTRIBUTION

Silt, traces of Clay

Client: Strata Engineering Job No.: TT98250
Project: Hwy 400, High Mast Lightings.
Location: Station 16+400
Test date: Sep.22, 1998.

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA	
Borehole No.	Sta.16+600
Sample No.	8
Depth	
Elevation	
Liquid Limit	- %
Plastic Limit	- %
Plasticity Index	- %
Moisture Content	- %
Date Sampled	

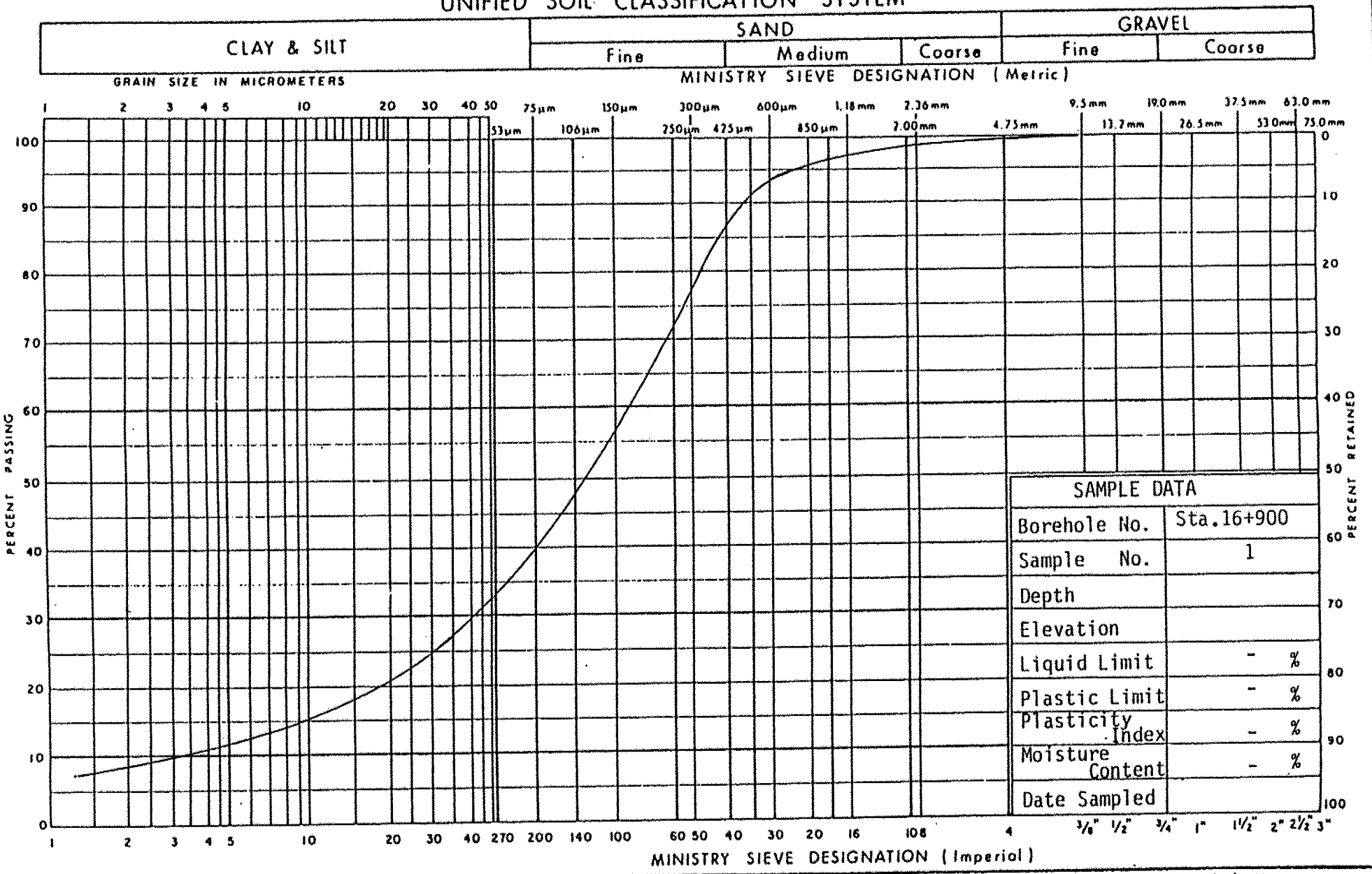
AGRA
Earth & Environmental

GRAIN SIZE DISTRIBUTION

Silt and Sand some Clay, traces of gravel

Client: Strata Engineering
Job No.: TT98250
Project: Hwy.400, High Mast Lightings
Location: Station 16+600
Test date: Sep.23, 1998

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA	
Borehole No.	Sta.16+900
Sample No.	1
Depth	
Elevation	
Liquid Limit	- %
Plastic Limit	- %
Plasticity Index	- %
Moisture Content	- %
Date Sampled	

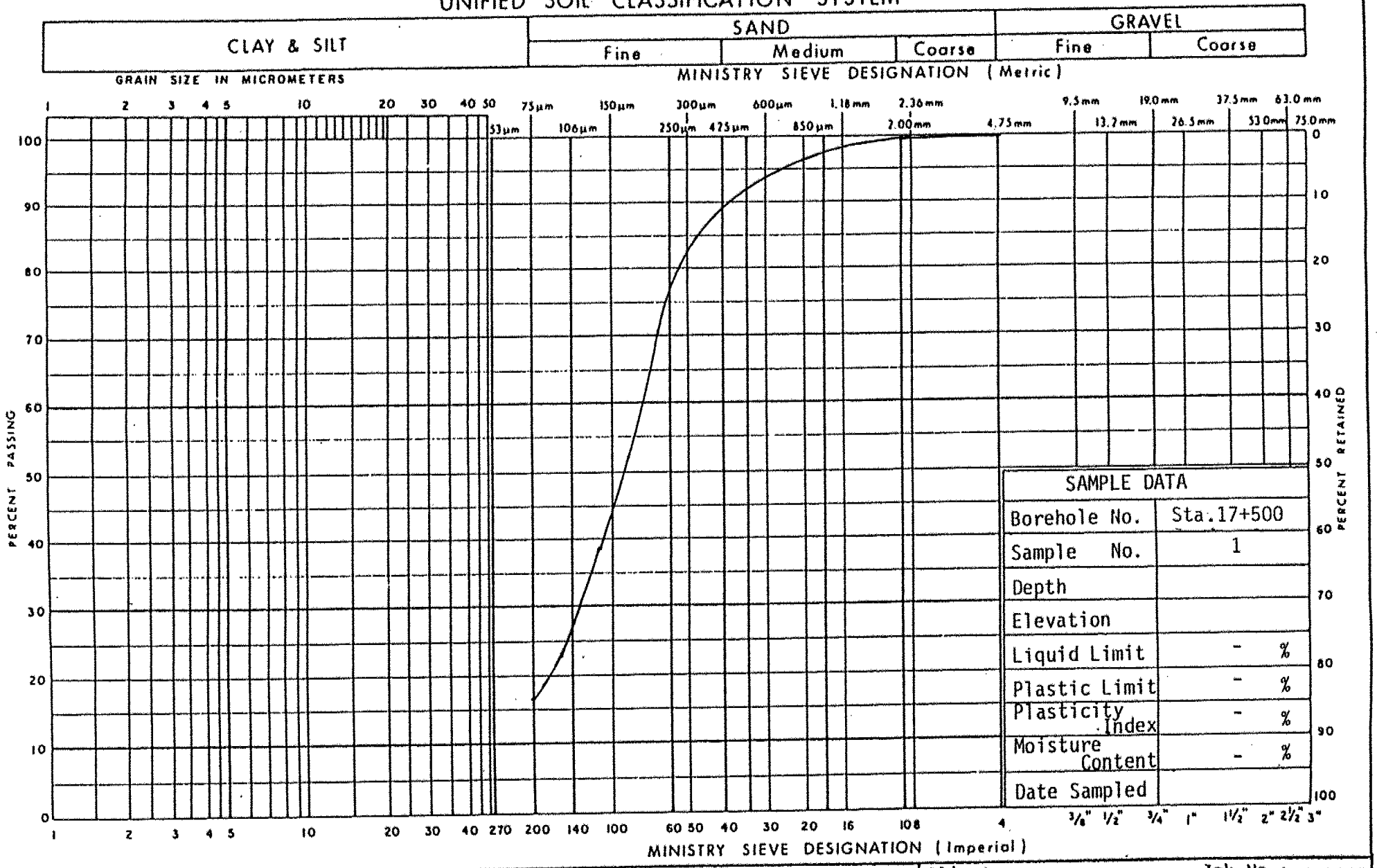
AGRA
Earth & Environmental

GRAIN SIZE DISTRIBUTION

Silty Sand, Traces of Gravel and Clay

Client: Strata Engineering Job No.: TT98250
Project: Hwy 400, High Mast Lightings
Location: Station 16+900
Test date: Sep.22, 1998.

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA	
Borehole No.	Sta.17+500
Sample No.	1
Depth	
Elevation	
Liquid Limit	- %
Plastic Limit	- %
Plasticity Index	- %
Moisture Content	- %
Date Sampled	

AGRA
Earth & Environmental

GRAIN SIZE DISTRIBUTION

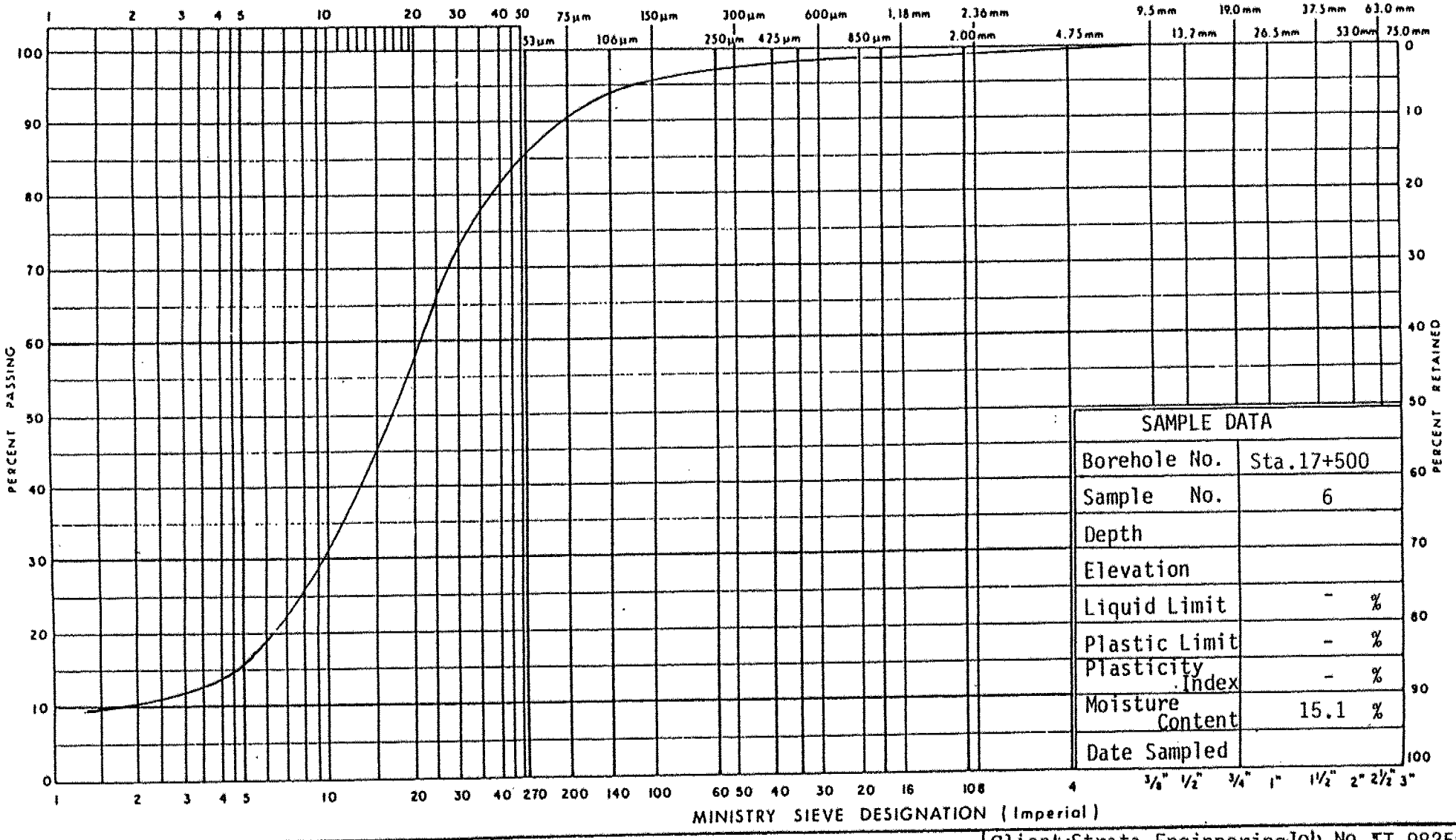
Sand, some Silt.

Client: Strata Engineering Job No.: TT98250
Project: Hwy. 400, High Mast Lightings
Location: Station 17+500
Test date: Sep.22, 1998.

78 12 M

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



SAMPLE DATA	
Borehole No.	Sta.17+500
Sample No.	6
Depth	
Elevation	
Liquid Limit	- %
Plastic Limit	- %
Plasticity Index	- %
Moisture Content	15.1 %
Date Sampled	

AGRA
Earth & Environmental

GRAIN SIZE DISTRIBUTION

Silt some Sand and Clay

Client: Strata Engineering Job No. FT 98250
Project: Hwy400, High Mast Lightings
Location: Station 17+500
Test date: Sep. 22, 1998.