Appendix F

Geotechnical Surveys

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EDISON
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FOUNDATION DESIGN RECOMMENDATIONS
SANTA CLARA-CARPINTERIA 66 KV T/L
SANTA CLARA SUBSTATION TO CASITAS SUBSTATION
VENTURA COUNTY, CALIFORNIA

PREPARED BY: SOUTHERN CALIFORNIA EDISON COMPANY
ENGINEERING & TECHNICAL SERVICES
CIVIL/STRUCTURAL/ GEOTECHNICAL GROUP

June 29, 2000

June 29, 2000

Mr. Bill Sasse

Subject: Foundation Design Recommendations
Santa Clara-Carpinteria 66 kV T/L
Santa Clara Substation to Casitas Substation
Ventura County, California

References:

1. Report No. 144
No. 4 Santa Clara-Casitas 66 kV Transmission Line
Tower Footing Design Data
Prepared by the Engineering Department
Dated July 18, 1956

2. Report No. 200
Santa Clara-Goleta 220 kV Transmission Line
Soil Investigation
Prepared by the Engineering Department
Dated September 1966

INTRODUCTION

At your request, we are herein submitting results of our field investigation of the soil and geologic conditions at the proposed new pole/tower sites along the subject transmission line. Recommended drilled pier foundation design parameters for use in the "BIPILE" program are listed on the attached tables. The recommendations are based upon a site visit performed during May 15 to May 18, 2000; and a review of the referenced reports and the local geology.

It is our understanding that the existing lattice towers of Santa Clara-Carpinteria 66 kV T/L and portion of the Santa Clara-Getty-PS 85 66 kV T/L will be replaced by tubular steel poles (TSP) with few exceptions that lattice towers will still be used. This phase of the study is for the transmission line between Santa Clara and Casitas Substations, existing towers numbered from M0T1A to M9T3. Section of the subject alignment is depicted on the Figure 1, Site Plan.

Based on the provided information, the section of line will be approximately 9.5 miles long. Most poles will be on or near ridge tops. The diameters of the pole footings will approximately range from 56 to 84 inches and the proposed pole heights will be range from 60 to 100 feet.

FIELD INVESTIGATION AND LABORATORY TESTING

Field investigation consisted of site visit to each proposed pole location, and was performed during May 15 to May 18, 2000. Purpose of our site reconnaissance is to evaluate any visible geotechnical and geological conditions at each pole location along the alignment.

Five (5) disturbed and undisturbed near-surface samples were taken at selected locations on the transmission line. The samples were tested in the laboratory to determine soil strength parameters. Current laboratory testing results confirm earlier studies (Ref. 1 and 2).

The soil strength characteristics of the geologically-young sediments are similar. The design recommendation is for a single soil type for the entire Line. The soil type is designated as Soil Type A in the footing design table (Table 1). Table 2 includes special design and construction considerations which should be used accordingly in the foundation design. Laboratory test results are present on the Appendix.

GEOLOGY AND SITE CONDITIONS

The transmission line right-of-way starts at Santa Clara Substation on a site graded in alluvium and bedrock. The first towers leaving the Substation are in sandstone. Bedrock along the entire route consists of Pliocene and Pleistocene Age marine and non-marine sandstones, siltstones and shales. These geologically-young sediments have been folded and faulted by active east-west and northeasterly-trending faults.

Shallow landslides of less than 20-foot depths are common along the right-of-way. The landsliding is the result of recent uplift of the mountains and the light degree of consolidation and cementation in the sediments. Most of the shallow landslides do not appear to be the result of adverse bedding in shales. Some of the larger, north-facing slides may be the result of bedding plane failures.

In some areas, the towers are sited on the very peak of ridges with landslides both upline towards Casitas Substation and downline towards Santa Clara Substation. In these instances, we have recommended that the pole be relocated offline towards the edge of the right-of-way wherever is feasible.

When the towers are moved offline, they are moved down the ridge line and are below the towers which will be replaced. The existing towers will not be removed until the new poles are set and the new lines installed. This means that temporary access roads will have to be cut on the steep slopes below the existing towers. Each one of these cuts will require care to avoid activating landslides or undercutting the existing tower foundations.

In some cases, it may not be feasible to move offline. This means that poles will be constructed on the steep side slopes. The footing design data (Table 2) shows a recommended design for additional scour at these sites.

The major active Red Mountain Fault crosses the transmission line just west of Weldon Canyon in the vicinity of Pole M8-P3. This Fault will very likely move during the 40-50 year lifetime of the poles. If the movement is mostly vertical, the transmission line should not be impacted.

M8P1 and M8P2 are in areas where extremely difficult drilling has been reported in the past. The sandstones and conglomerates are well cemented. Coring and explosives may be required. This cementing is related to the active faulting.

ANTICIPATED CONSTRUCTION CONSIDERATIONS

Pile Drilling

Generally, the soil-weathered zone is 3 to 5 feet thick with rock getting gradually harder with depth. Drilling on the adjacent Santa Clara-Goleta 220 kV Transmission Line showed weathered rock ranging from 3 to 13 feet underlain by shale and sandstone.

In most cases, the rock could be drilled using a truck-mounted bucket auger or a relatively powerful large auger-type drill such as a Texoma or Watson-type rig. Some hard sandstone layers can be expected which may require core barrels or special tools or cutting teeth.

As indicated above, difficult drilling will be encountered near M8P1 and M8P2. The drilling conditions at almost all other poles should not be difficult with large flight augers.

Grading

Grading on steep slopes will be required to provide access for drilling equipment. It is our understanding that the new poles will be also built with helicopter if the slopes are too steep for equipment to reach there.

Temporary cut slopes should be made at slopes no steeper than 1:1. The top of the cut slope should be no closer than five feet from the edge of any existing footing. Temporary fill slopes will be made at the angle of repose are approximately 1:1. These fill slopes will be unstable when saturated. The fill material will turn to mudflow during periods of heavy rainfall. Care must be taken not to place fills above developed areas or areas where mudflows can inundate structures, livestock or producing orchards.

We have prepared idealized sections showing typical grading and setbacks (Figures 2 and 3). These details are designed to protect the existing towers from failure during construction of the new poles. After completion and the existing towers are removed, each site should be re-graded to divert drainage away from the new pole. In addition, all disturbed areas should be restored by filling to match original grade. All fill placed should be benched into the competent native materials and should be properly compacted. A typical side hill benching detail is attached as Figure 4.

RECOMMENDATIONS

We have provided ultimate soil design parameters for the foundations on Table 1. We recommend that these values be used with a factor of safety of at least 1.5 for final design.

The area where these poles are to be constructed is historically prone to landsliding and many of the sites have been damaged in 1969, 1978, 1983, and 1998. Consequently, special measurements are exercised to take this special subsurface and geologic conditions into consideration and provided on the attached Table 2. The design values are intended to take special subsurface and geological conditions into account.

In Table 2, additional lateral loads are recommended at the top of the some foundations to compensate for a landslide load on the side of the foundation. This load assumes that the soil on the hill below the tower slides away and the footing acts as a retaining wall supporting a 15-foot wide and 15-foot high soil face with an equivalent fluid load of 50 pound-per-square-foot (pcf) (up to 30° slope) (only three towers get this load).

To prevent excessive disturbing of the subsurface soils and to utilize them as an additional protection measurement on the slope, without obstructing the drilling of the new footing, we recommend that the existing lattice tower footings to be left in-place after towers are removed.

All sites will be properly graded. Berms and/or swales should be constructed as needed. Positive surface drainage should be provided to prevent water ponding at the TSP's foundations.

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The Geotechnical Group should review printouts of drilled pier computer design to verify compatibility with the above recommendations. If you have any questions or comments regarding this information, please call the undersign at PAX 47795.

ZAID AHMAD, P.E.
Lead Engineer
Civil/Structural/Geotechnical Group
Engineering & Technical Services
Southern California Edison Company

s/civil/geotech/mc/2000/santacarpin3.doc

Attachment

TABLE 1

JUNE 29, 2000
FOUNDATION DESIGN RECOMMENDATIONS
SANTA CLARA—CARPINTERIA, 66 kV T/L
VENTURA COUNTY
(SOIL TYPE A)

A. Drilled Pier Foundation Design Parameters with No Landslide Corrections

1.	Soil Density		
	a.	Moist	120 pcf
	b.	Saturated	132 pcf
	c.	Submerged	70 pcf
2.	Ultimate Bearing Capacity		
	a.	At surface—moist	3400 psf
	b.	Rate of increase per foot—moist	1680 psf
	c.	Rate of increase per foot—submerged	980 psf
	d.	Maximum not to exceed	35,000 psf
3.	Ultimate Moist Skin Friction at Depth of 10 Feet		750 psf
4.	Estimated Depth to Groundwater		>100 feet
5.	Friction Angle of Soil		30 degrees
6.	Ratio of Submerged to Moist Skin Friction		0.59
7.	Depth to Bedrock (Case by Case)		0-20 feet
8.	Passive Pressure Multiplier Factor (PPM)		2.5
9.	Ultimate Lateral Soil Pressure at a Depth of 10 Feet		9,000 psf
10.	Side Hill Slope		varies
11.	Minimum Length		30 feet
12.	Scour Depth (or projection)		varies
13.	Additional Lateral Load		Varies(See Table 2)

NOTES:

1. Minor to moderate caving should be expected during the drilling of the pier foundation excavations. The use of water during drilling of pier excavations should aid in control of caving. Casing, drilling mud, or other means to control caving should be made available if the use of water is found to be ineffective.

2. The soil parameters in this table represent ultimate values which require the use of appropriate factors of safety for design.

3. The area is subject to numerous landslides. We have attempted to provide design parameters to resist the landslide movement on Table 2.

TABLE 2
Special Considerations, Proposed M0-T1A to M9-P3
Santa Clara-Carpinteria 66 kV T/L
Santa Clara Substation to Casitas Substation
Ventura County, California

POLE	SOIL TYPE	SIDE HILL SLOPE (DEGREES)	ADDED LANDSLIDE LOAD AT TOP	DESIGN SCOUR[4] (FEET)	SPECIAL DESIGN CONSIDERATIONS & RECOMMENDED MOVEMENT FROM EXISTING TOWER
M0-T1A	A	8	N/A	0	Move pole 15 ft. north[1] or south[2] stay online.
M0-T1	A	15	N/A	**5**	See Note 3
M0-P2	A	15	N/A	0	Move pole 15 ft. north or south stay online.
M0-P3	A	**25**	N/A	0	Move pole 15 ft. **north** stay online.
M0-P4	A	**20**	N/A	0	See Note 3
M0-P5	A	30	N/A	**5**	Move pole 15 ft. south. Recommended to lower pad 10 ft.
M0-P6	A	18	N/A	5	Move pole 10-15 ft. north for scour.
M1-P1	A	25	28.1 kips	10	Move pole 15-30 ft. north.
M1-P2	A	20	N/A	5	Move pole north or south 15 feet stay online.
M1-P3	A	30	N/A	5	See Note 3. Steep slopes north & south. West access road will be a problem.
M2-P1	A	30	N/A	5	See Note 3. Steep slopes north and south. West access road will be a problem.
M2-P2	A	30	N/A	5	See Note 3. Access road will be a problem on steep ridge.
M2-P3	A	0	N/A	0	Move 15 ft. north (wood frame). Can also go offline to south towards Santa Clara

Table 2
(continued)

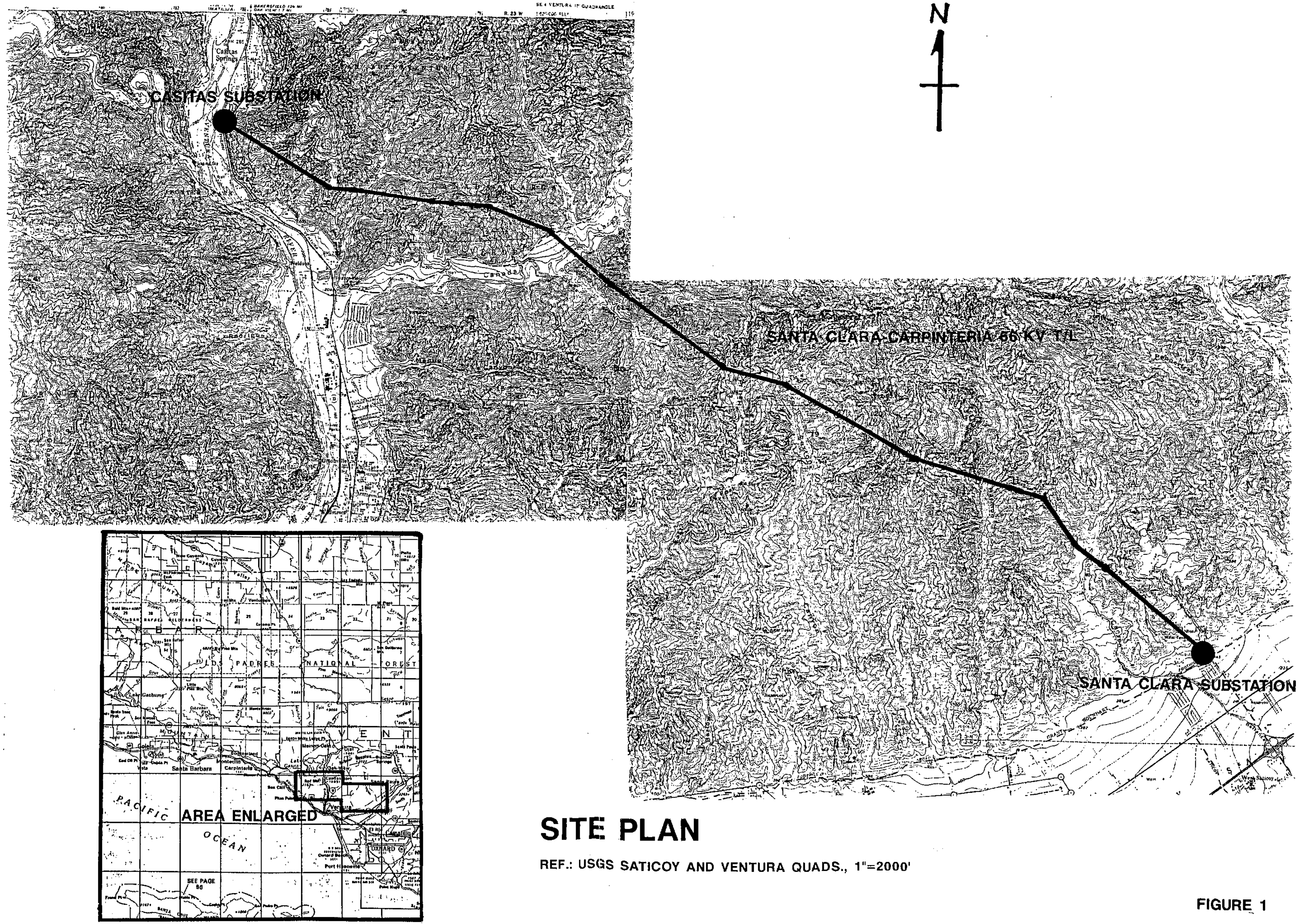
POLE	SOIL TYPE	SIDE HILL SLOPE (DEGREES)	ADDED LANDSLIDE LOAD AT TOP	DESIGN SCOUR[4] (FEET)	SPECIAL DESIGN CONSIDERATIONS & RECOMMENDED MOVEMENT FROM EXISTING TOWER
M3-P1	A	30	N/A	5	Move pole south toward Santa Clara or offline. If needed, west towards edge of R/W.
M3-P2	A	**20**	N/A	**0**	Move pole 15 ft. north. Slopes north and south.
M3-P3	A	**20**	N/A	**0**	Move pole 15 ft. north. Slopes north and south.
M3-P4	A	20	N/A	5	Move pole 15 ft. online north towards Casitas Substation.
M4-P1	A	15	N/A	20	See Note 3
M4-P2	A	30	28.1 kips	5	See Note 3. Active landslide below crib wall. Design for 15 ft. of landslide pressure. Use 5 ft. for scour.
M4-P4	A	**25**	N/A	**5**	Move pole 15 ft **north** along slope.
M5-P1	A	**26**	N/A	**0**	See Note 3
M5-P2	A	20	N/A	5	See Note 3
M5-P3	A	20	N/A	10	Existing pole not to be replaced.
M5-P4	A	**20**	N/A	**0**	Move pole up to 50 ft. to south.
M5-P5	A	**20**	28.1 kips	10	See Note 3. Big landslide below 220 kV tower.
M5-P6	A	16	N/A	5	Move pole north or south 15 ft. to 30 ft.
M6-T1	A	15	N/A	5	Move pole online 15 ft. south or north.
M6-T2	A	**20**	N/A	5	Move pole online 15 to 20 ft. north or south. Adjacent 220 kV tower experienced damages from landslide

Table 2
(continued)

POLE	SOIL TYPE	SIDE HILL SLOPE (DEGREES)	ADDED LANDSLIDE LOAD AT TOP	DESIGN SCOUR[4] (FEET)	SPECIAL DESIGN CONSIDERATIONS & RECOMMENDED MOVEMENT FROM EXISTING TOWER
M6-P3	A	30	N/A	5	See note 3. Landslide to north and south.
M6-P4	A	20	N/A	5	Move pole north or lower pad 15 ft.
M7-P2	A	15	N/A	5	Move pole 15 ft. **south**. Lower 5 ft. and design for scour.
M7-P3	A	20	N/A	10	Move pole 15 ft. north. Design for scour of 10 ft. and lower 10 ft.
M7-P4	A	22	N/A	8	Move pole 15 ft. north. Design for 8 ft. scour
M7-P5	A	**15**	N/A	**0**	Move pole 15 ft. north. Site has crib wall. **Recommend lowering pad 10 ft.**
M8-P1	A	35	N/A	0	Move pole 15 ft. north or south (north best).
M8-P2	A	30	N/A	0	Move pole 15 ft. north or south (south best).
M8-P3	A	25	N/A	**0**	Move pole 15 ft. north or south.
M9-P1	A	**27**	N/A	**0**	Move pole 15 ft. north or south.
M9-P2	A	25	N/A	5	Move pole 15 ft. north or south.
M9-P3	A	20	N/A	10	Move pole 15 ft. south. Road badly scoured. Some seepage.

Note:

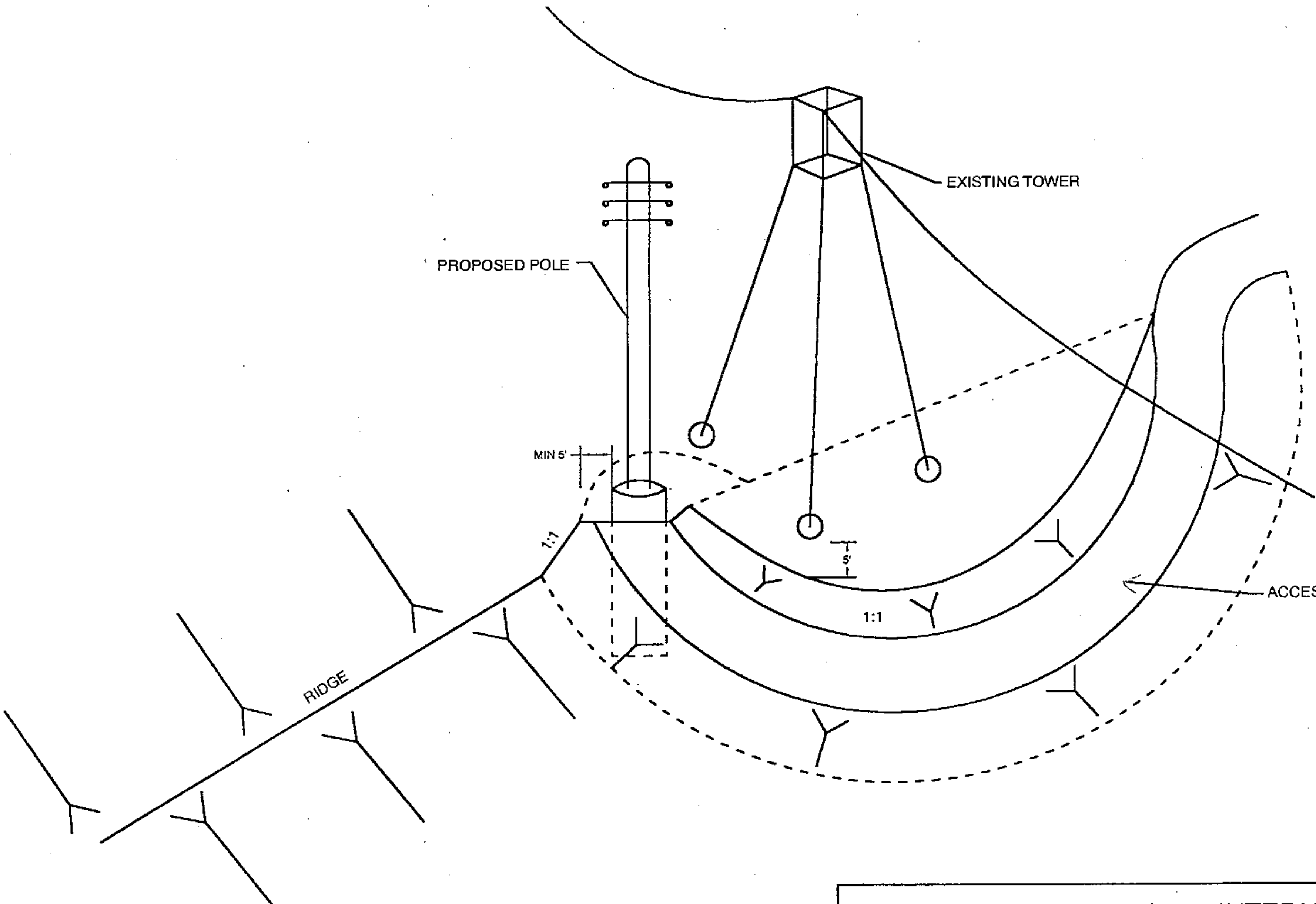
1. "North" is considered toward Casitas Substation online.
2. "South" is considered toward Santa Clara Substation online.
3. The new pole(s)/tower(s) will be constructed on the same existing tower location(s).
4. Denote a recommended additional length to be added to the program results.
5. All existing tower footings are recommended be left in-place, if feasible.



SITE PLAN

REF.: USGS SATICOY AND VENTURA QUADS., 1"=2000'

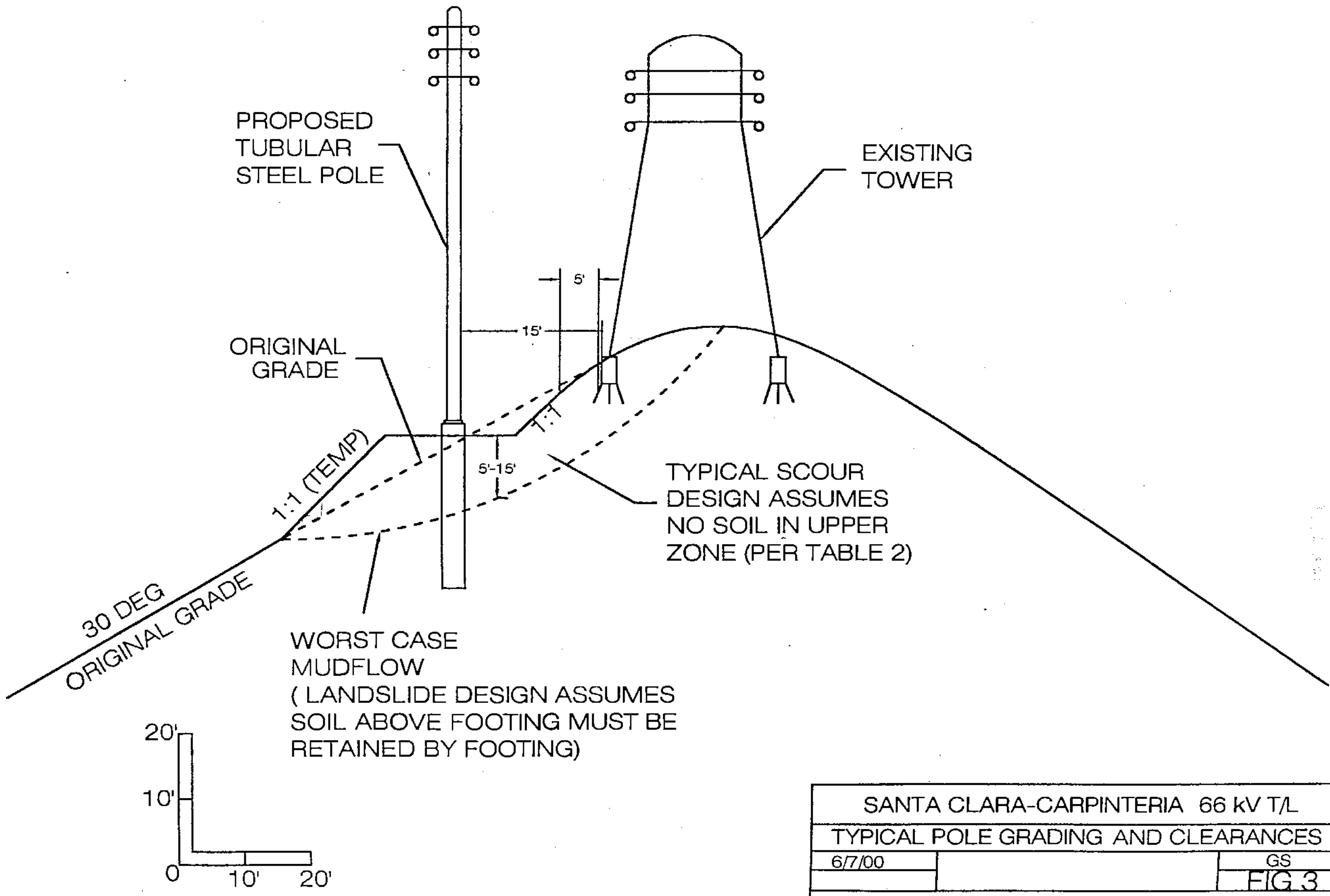
FIGURE 1



SANTA CLARA -CARPINTERIA

TEMP ACCESS ROAD GRADING

6/6/00		GS
		FIG 2



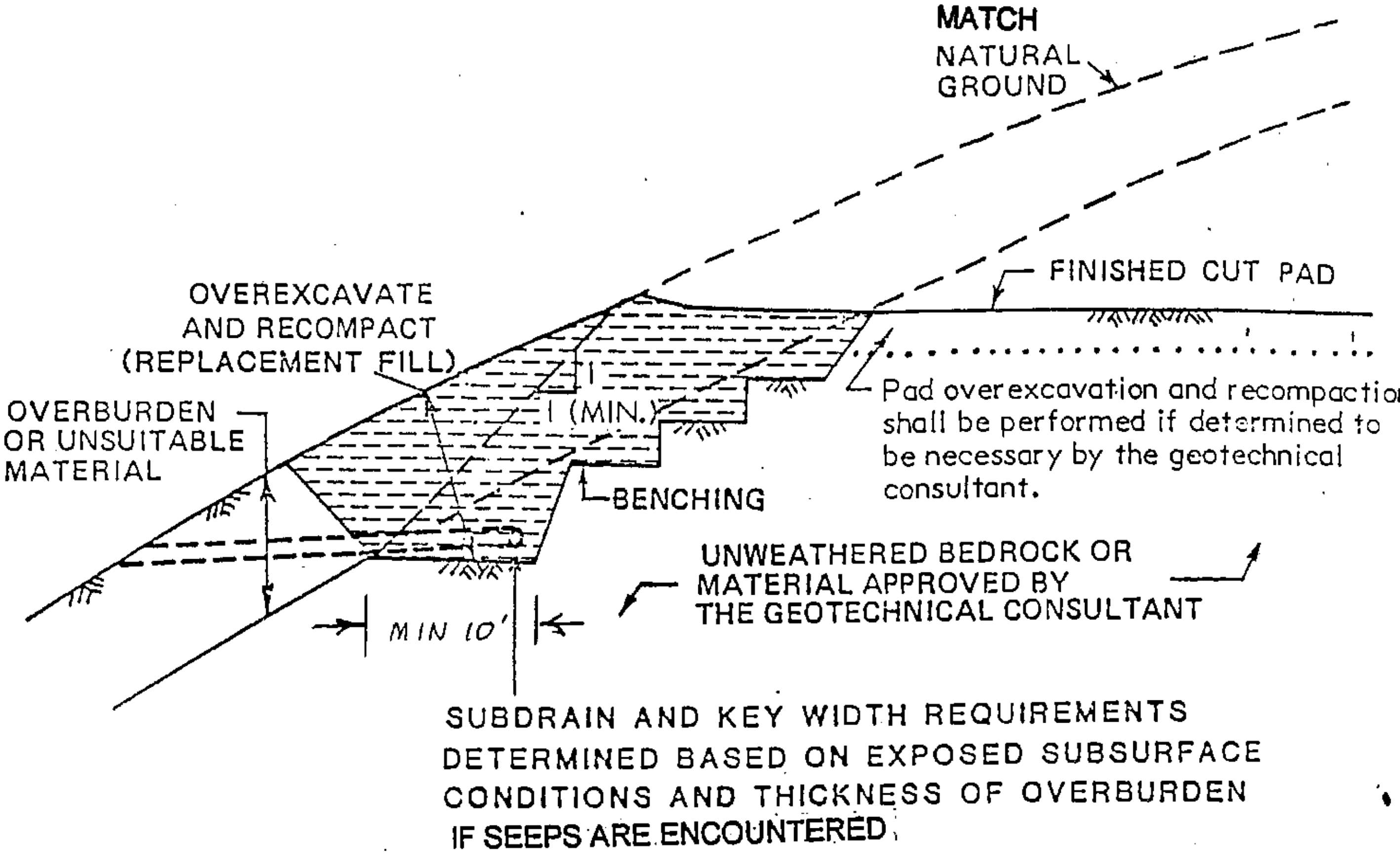
SANTA CLARA-CARPINTERIA 66 kV T/L

TYPICAL POLE GRADING AND CLEARANCES

6/7/00 GS

FIG 3

SIDE HILL
CUT PAD DETAIL



NOTE: All soil compaction should be performed to 90 percent of maximum Density as obtained by ASTM D1557-91 (5-layer) method of compaction.

FIGURE 4

APPENDIX

LABORATORY TEST RESULTS

SUMMARY OF TEST RESULTS
TABLE 1

Project: SANTA CLARA—CARPINTERIA 66 kV T/L

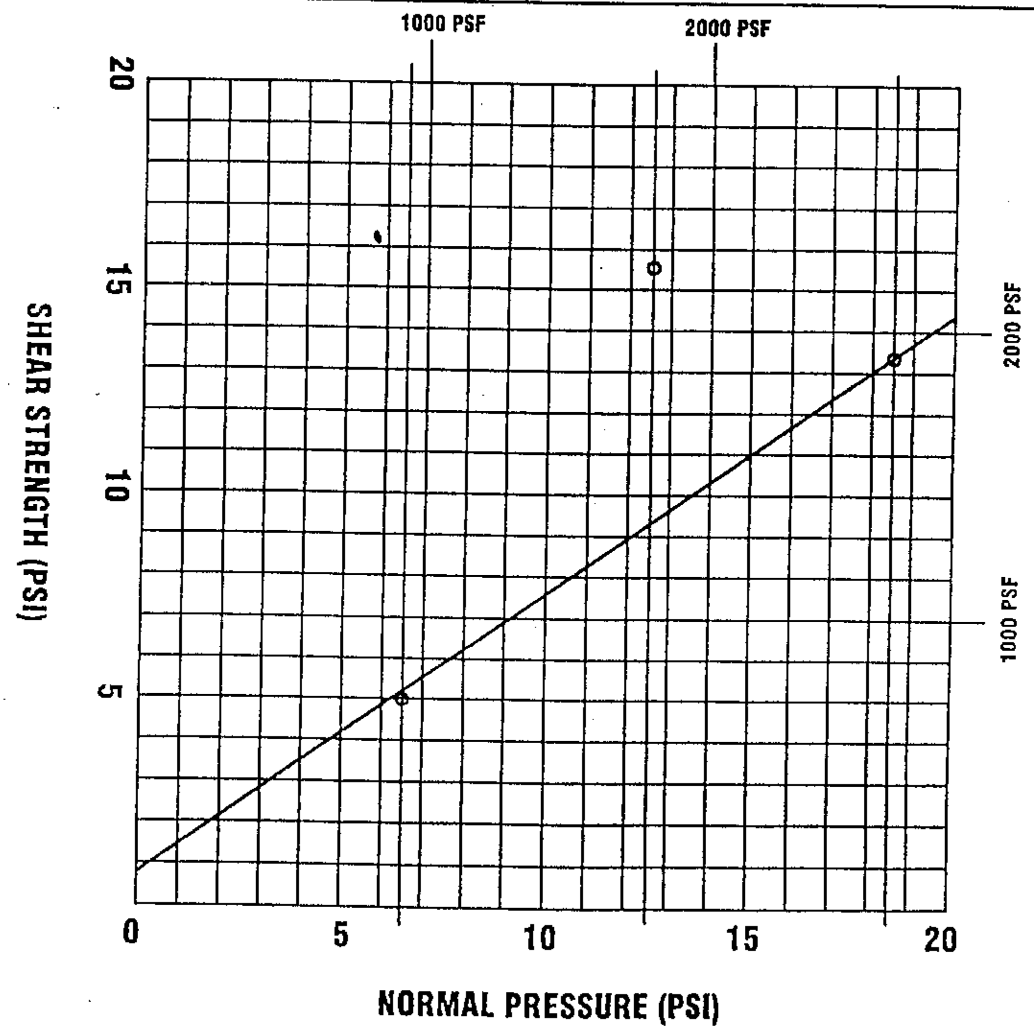
DALE HINKLE P. E. INC.

HOLE No.	Depth ft.	SAMPLE TYPE	Field Moisture %	FIELD DRY DENSITY lbs/cu. ft.	Gravel %	Sand %	Fines %	% CONSOLIDATION 2.5 psi	5.0 psi	10.0 psi	20.0 psi	40.0 psi	DEG. ϕ	Cohesion psf	Maximum pcf	Density %W	% Relative Compaction	ATTERBERG LIMITS LL	PL
M3T2	1	RING	3.9	113.1									34	100					
M3T3	1-2	RING	15.6	117.2									34	300					
M5T4	1	BAG	12.7	118.2		10.5	89.5						0	550	120.8	12.8			
M6T4	1-3	BAG	13.9	122.5	53	28	19						40	0	132.5	8.0			
M6T7	1	BAG	18.0	103.6	0	5	95						18	500	120.5	11.5			

DALE HINKLE P.E. INC.
15519 ROCKFIELD BLVD., SUITE B
IRVINE, CALIFORNIA 92618

Direct Shear Test Data

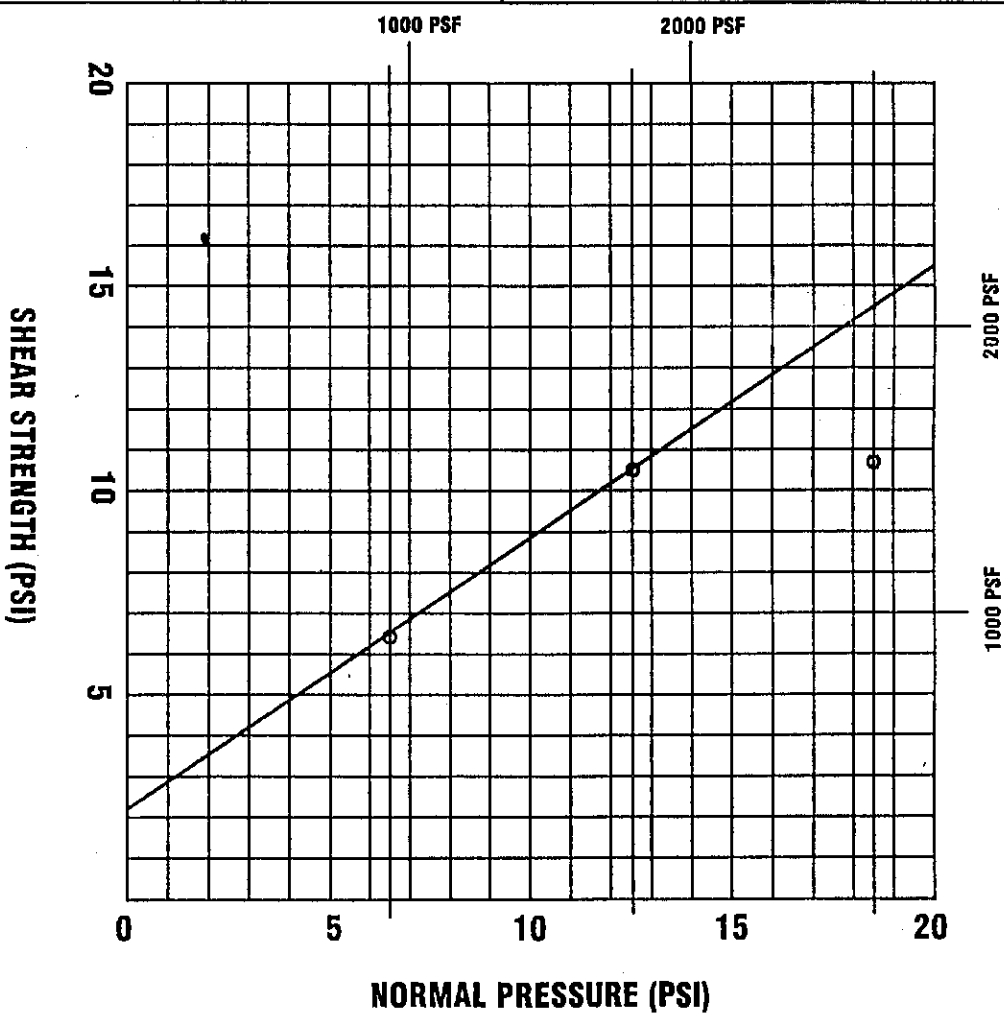
LOCATION	SANTA CLARA CARPINTERIA	SATURATED % W	
JOB NAME	66 kV T/L	ANGLE OF INTERNAL FRICTION	34 deg
HOLE NUMBER	M3-T2	COHESION	100 psf
HOLE DEPTH	1'	DRY DENSITY	113.1
SAMPLE TYPE:	UNDISTURBED	INITIAL FIELD MOISTURE	3.9
TESTED BY:	DRK	SATURATED DENSITY	



DALE HINKLE P.E. INC.
15519 ROCKFIELD BLVD., SUITE B
IRVINE, CALIFORNIA 92618

Direct Shear Test Data

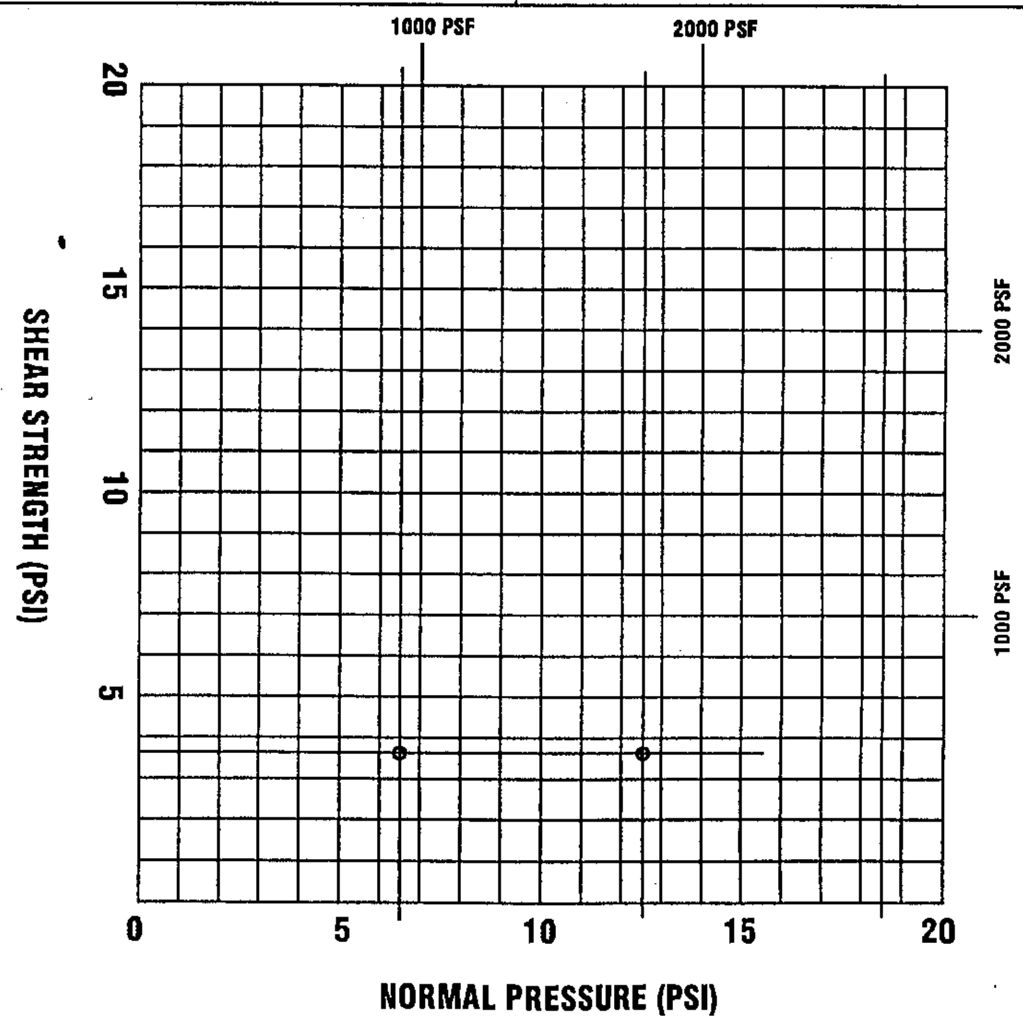
LOCATION: SANTA CLARA CARPINTERIA	SATURATED % W
JOB NAME: 66 kV T/L	ANGLE OF INTERNAL FRICTION: 34DEG
HOLE NUMBER: M3-T3	COHESION: 300 PSF
HOLE DEPTH: 1'-2'	DRY DENSITY: 117.2
SAMPLE TYPE: UNDISTURBED	INITIAL FIELD MOISTURE: 15.6
TESTED BY: DRK	SATURATED DENSITY



DALE HINKLE P.E. INC.
15519 ROCKFIELD BLVD., SUITE B
IRVINE, CALIFORNIA 92618

Direct Shear Test Data

LOCATION SANTA CLARA-CARPINTERIA	SATURATED % W
JOB NAME 66 kV T/L	ANGLE OF INTERNAL FRICTION 0
HOLE NUMBER M5-T4	COHESION 550 psf
HOLE DEPTH 1'	DRY DENSITY 118.2
SAMPLE TYPE: UNDISTURBED	INITIAL FIELD MOISTURE 12.7
TESTED BY: DRK	SATURATED DENSITY



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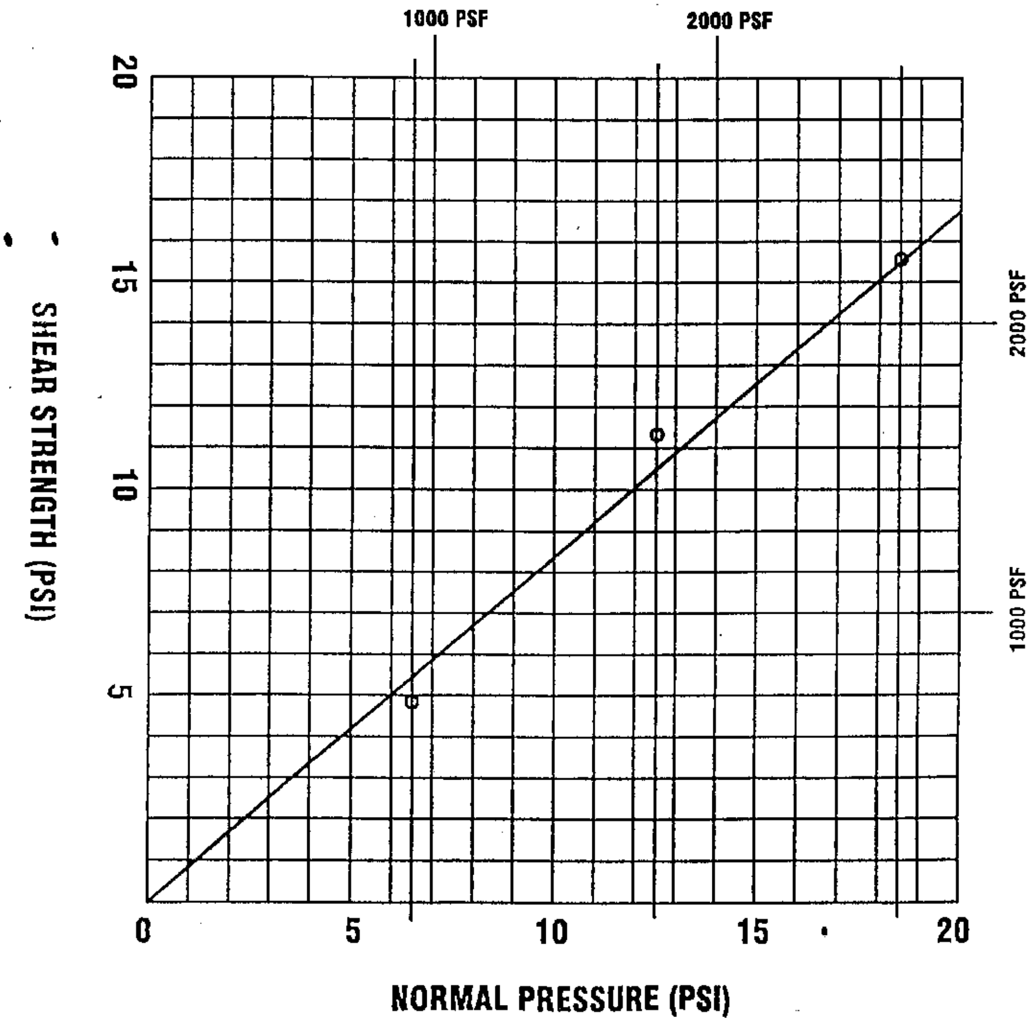
15519 ROCKFIELD BLVD., SUITE B
IRVINE, CALIFORNIA 92618

Direct Shear Test Data

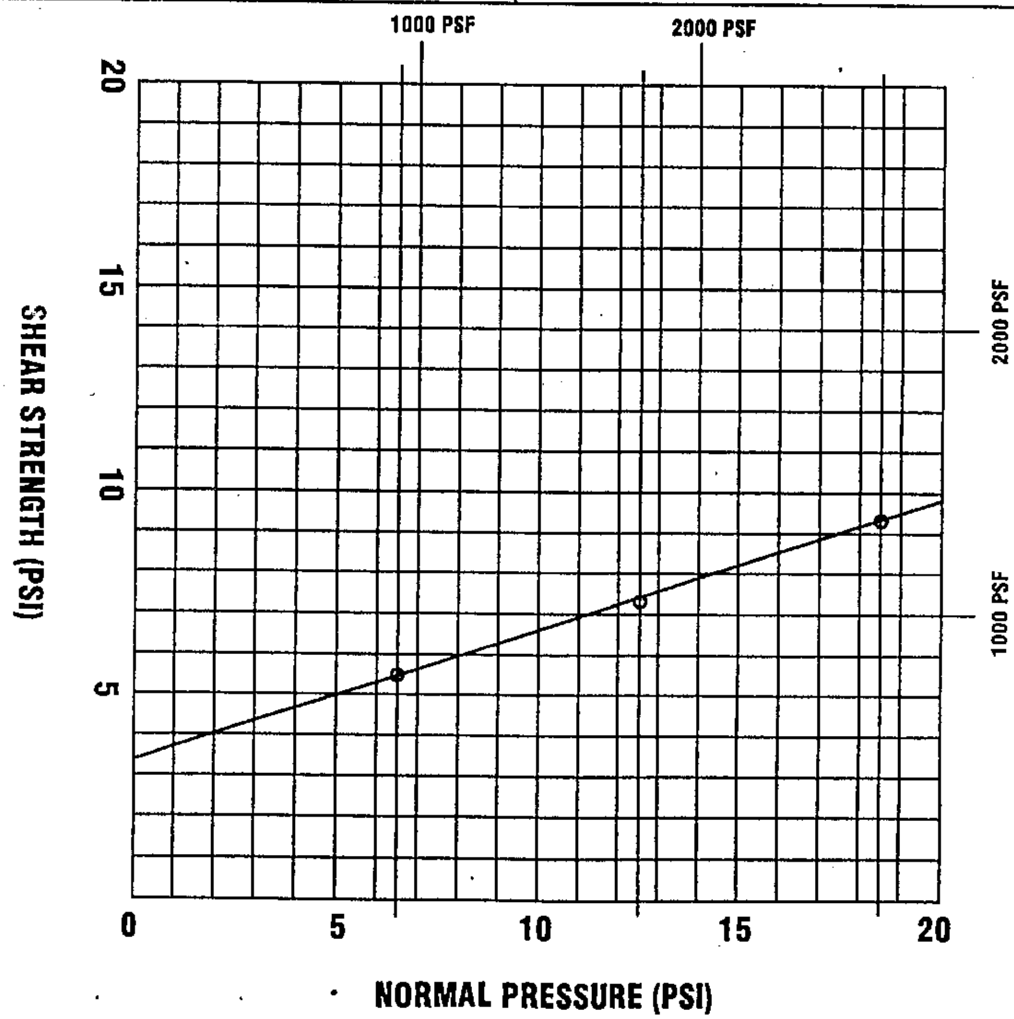
LOCATION: SANTA CLARA CARPINTERIA	SATURATED % W
JOB NAME: 66 kV T/L	ANGLE OF INTERNAL FRICTION: 40 deg
HOLE NUMBER: M6-T4	COHESION: 0
HOLE DEPTH: 1'-3'	DRY DENSITY: 122.5
SAMPLE TYPE: REMOLDED	INITIAL FIELD MOISTURE: 13.9
TESTED BY: DRK	SATURATED DENSITY



DALE HINKLE P.E. INC.
15519 ROCKFIELD BLVD., SUITE B
IRVINE, CALIFORNIA 92618

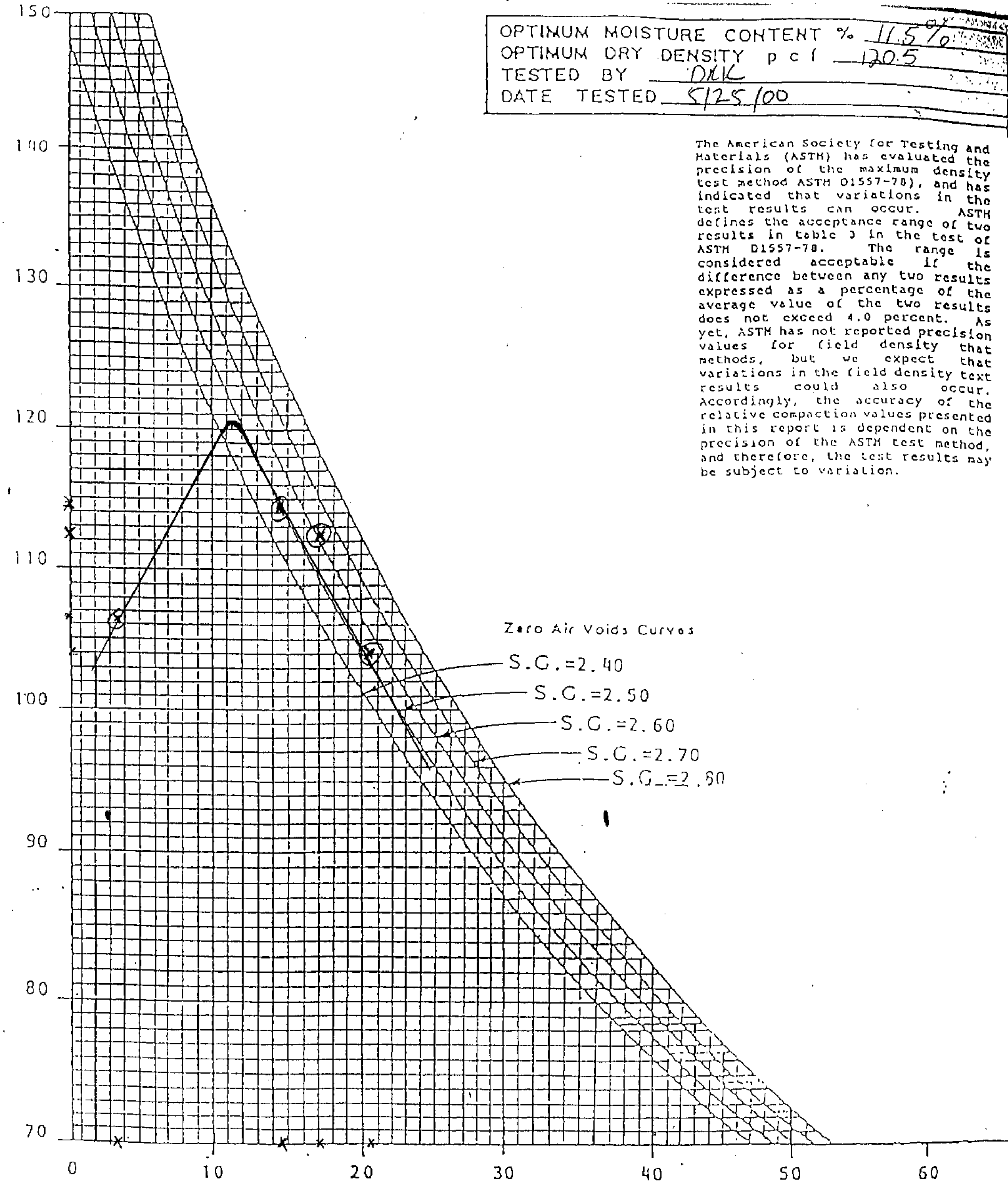
Direct Shear Test Data

LOCATION SANTA CLARA-CARPINTERIA	**SATURATED % W**
JOB NAME 66kV T/L	**ANGLE OF INTERNAL FRICTION** 18 DEG
HOLE NUMBER M6-T7	**COHESION** 500 PSF
HOLE DEPTH 1'	**DRY DENSITY** 103.6 PCF
SAMPLE TYPE: REMOLDED	**INITIAL FIELD MOISTURE** 18 %
TESTED BY: DRK	**SATURATED DENSITY**



OPTIMUM MOISTURE CONTENT %	11.5%
OPTIMUM DRY DENSITY p c f	120.5
TESTED BY	DKK
DATE TESTED	5/25/00

The American Society for Testing and Materials (ASTM) has evaluated the precision of the maximum density test method ASTM D1557-78), and has indicated that variations in the test results can occur. ASTM defines the acceptance range of two results in table 3 in the test of ASTM D1557-78. The range is considered acceptable if the difference between any two results expressed as a percentage of the average value of the two results does not exceed 4.0 percent. As yet, ASTM has not reported precision values for field density that methods, but we expect that variations in the field density text results could also occur. Accordingly, the accuracy of the relative compaction values presented in this report is dependent on the precision of the ASTM test method, and therefore, the test results may be subject to variation.



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D1557-78.

MAXIMUM DRY DENSITY

SCE Santa Clarita

ROJECT 66 KVT/L

OLE NO. U6T-7

EPTH ft. 1'

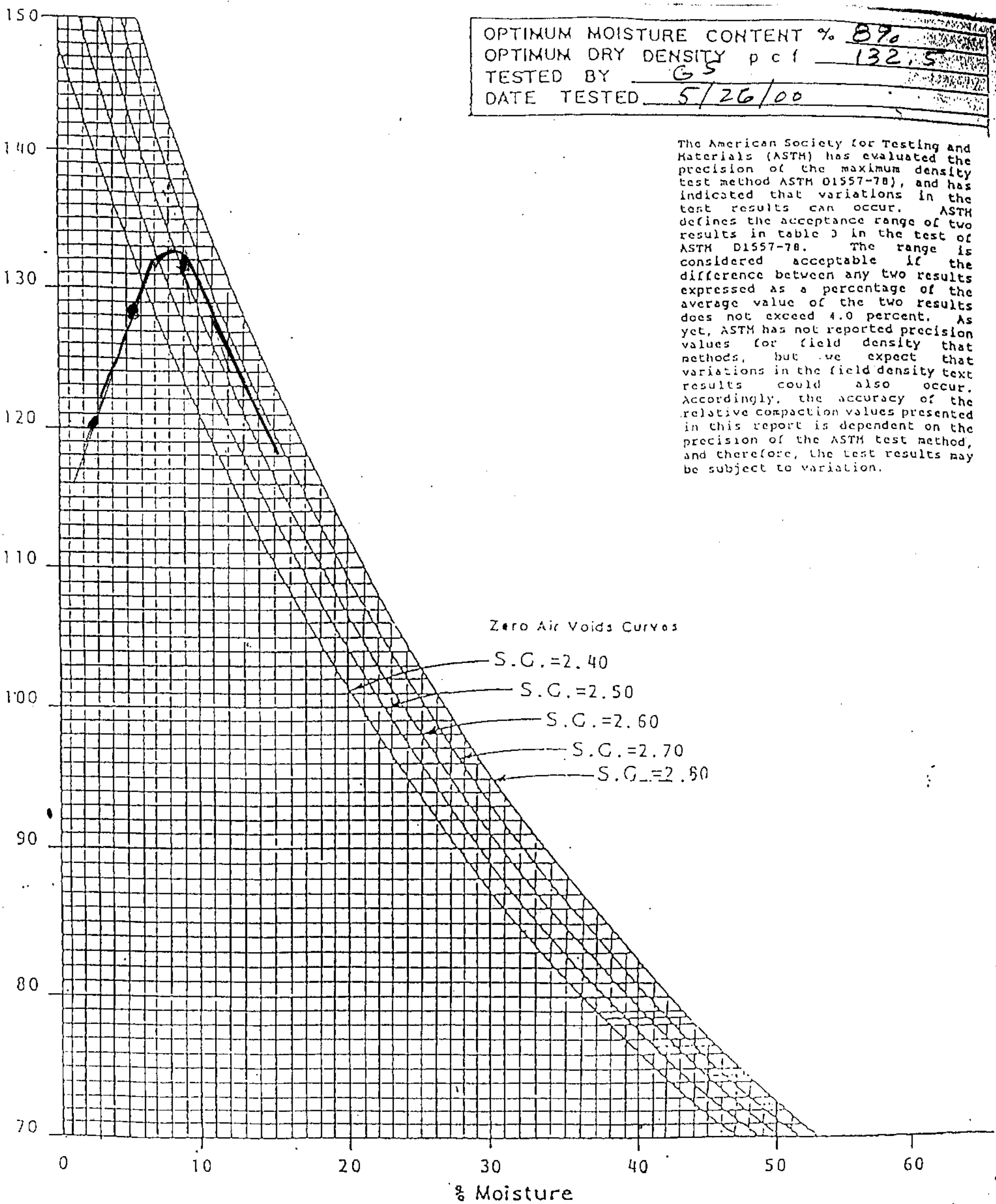
AMPLE NO.

SCALE	CHECKED BY	DRAWN BY
DATE		

DALE HINKLE P.E. INC.

OPTIMUM MOISTURE CONTENT % 8%
OPTIMUM DRY DENSITY pcf 132.5
TESTED BY GS
DATE TESTED 5/26/00

The American Society for Testing and Materials (ASTM) has evaluated the precision of the maximum density test method ASTM D1557-78), and has indicated that variations in the test results can occur. ASTM defines the acceptance range of two results in table 3 in the test of ASTM D1557-78. The range is considered acceptable if the difference between any two results expressed as a percentage of the average value of the two results does not exceed 4.0 percent. As yet, ASTM has not reported precision values for field density that methods, but we expect that variations in the field density text results could also occur. Accordingly, the accuracy of the relative compaction values presented in this report is dependent on the precision of the ASTM test method, and therefore, the test results may be subject to variation.



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D1557-78.

MAXIMUM DRY DENSITY

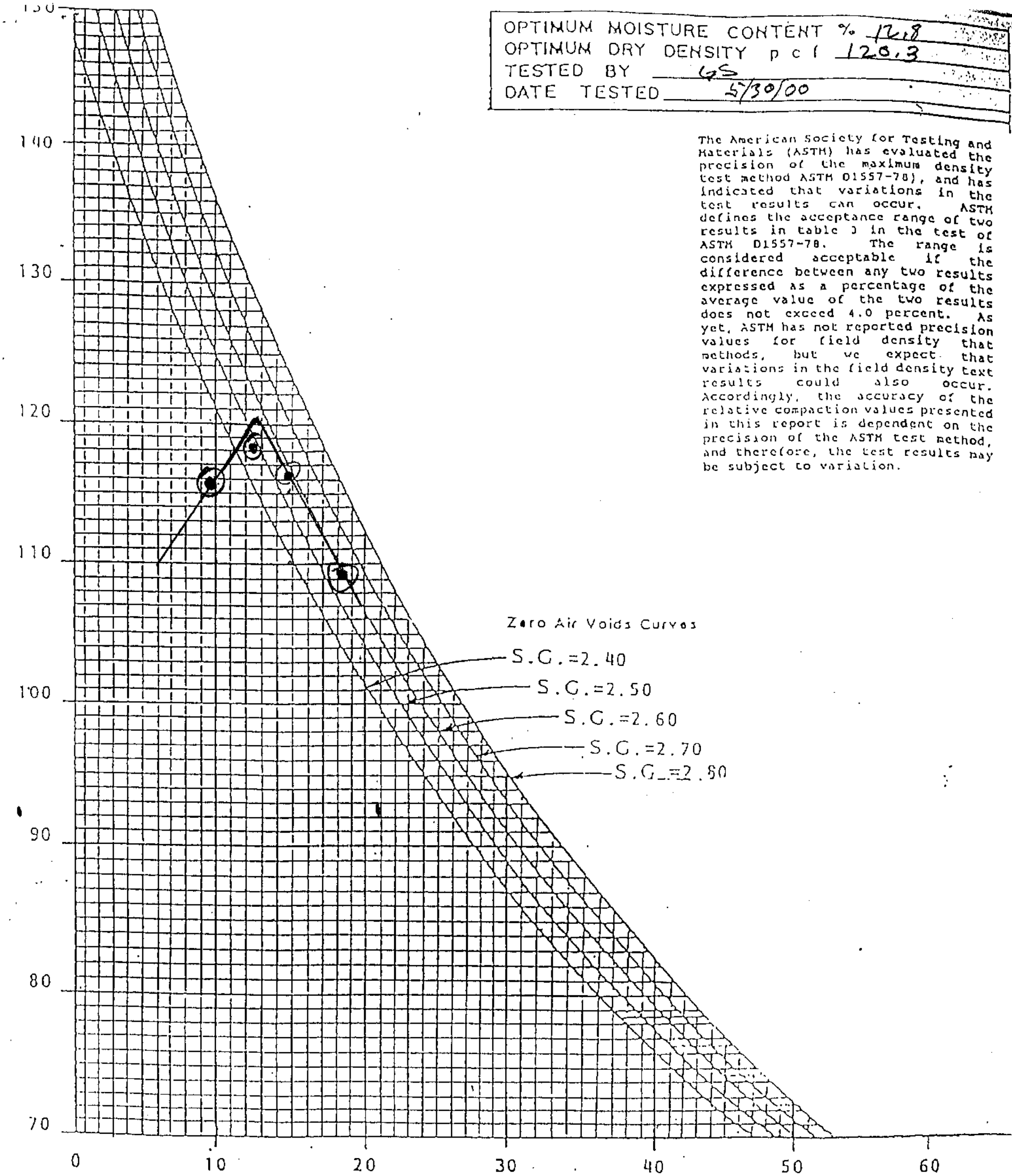
PROJECT Santa Clara Carpinteria
HOLE NO. M6T4
DEPTH ft. 1-3'
SAMPLE NO.

SCALE
DATE
CHECKED BY
DRAWN BY

DALE HINKLE P.E. INC.

OPTIMUM MOISTURE CONTENT % 12.8
OPTIMUM DRY DENSITY pcf 120.3
TESTED BY GS
DATE TESTED 5/30/00

The American Society for Testing and Materials (ASTM) has evaluated the precision of the maximum density test method ASTM D1557-78), and has indicated that variations in the test results can occur. ASTM defines the acceptance range of two results in table 3 in the test of ASTM D1557-78. The range is considered acceptable if the difference between any two results expressed as a percentage of the average value of the two results does not exceed 4.0 percent. As yet, ASTM has not reported precision values for field density that methods, but we expect that variations in the field density text results could also occur. Accordingly, the accuracy of the relative compaction values presented in this report is dependent on the precision of the ASTM test method, and therefore, the test results may be subject to variation.



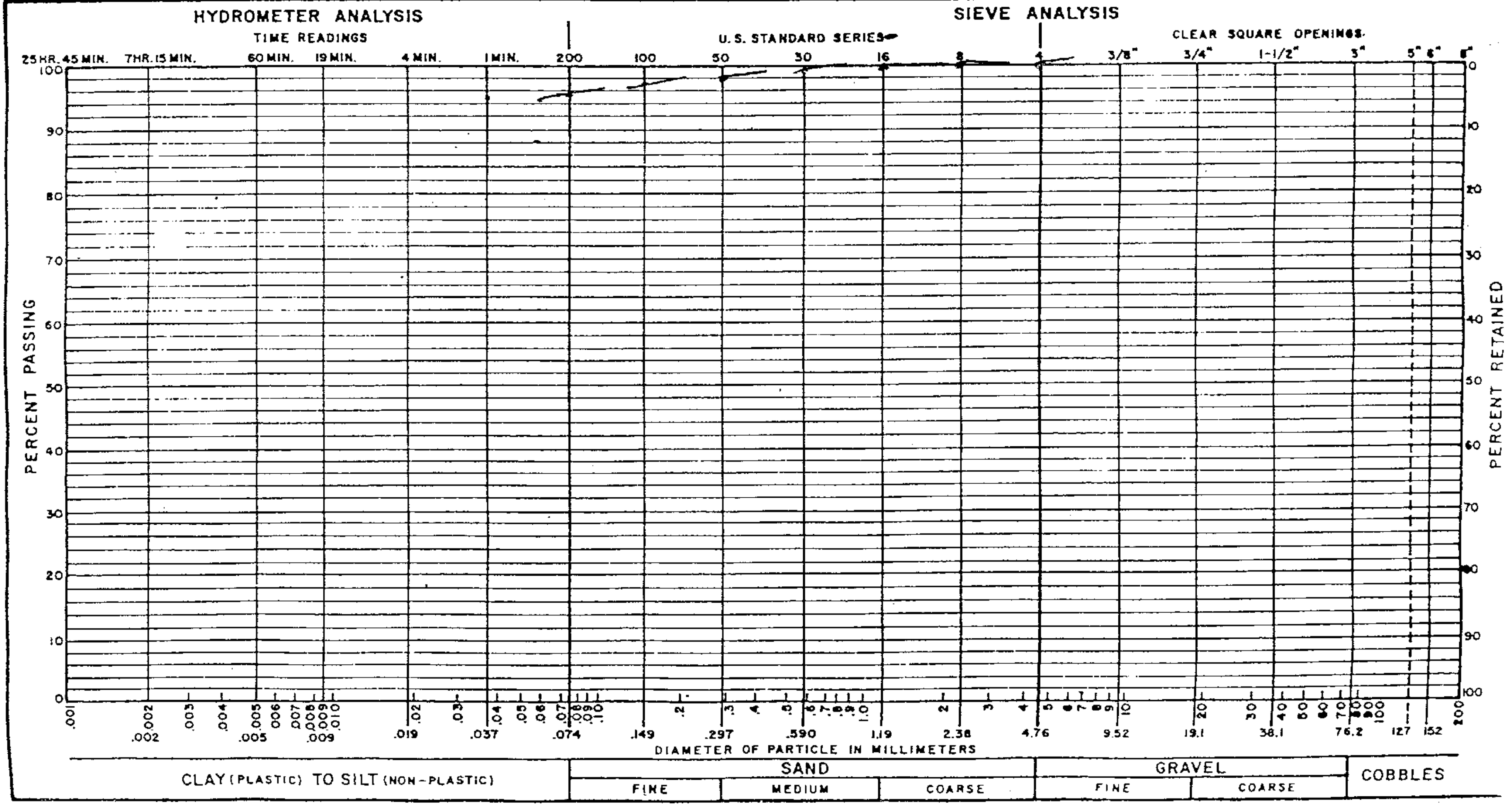
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D1557-78.

MAXIMUM DRY DENSITY

ROJECT Santa Clara Carpinteria	SCALE	CHECKED BY	DRAWN BY
OLE NO. M5-T4	DATE		
EPTH ft. 1'	DALE HINKLE P.E. INC.		
AMPLE NO.			

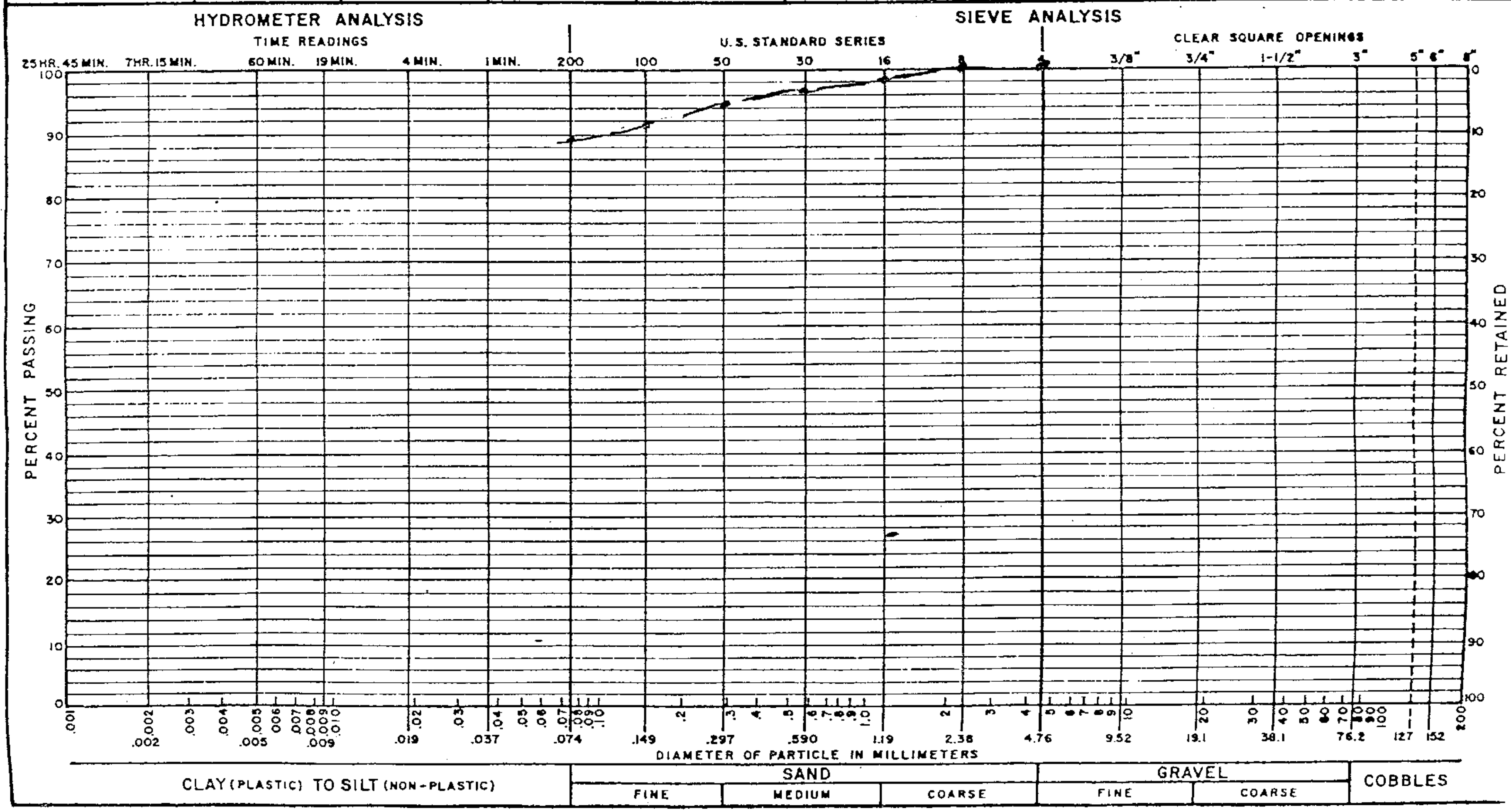
GRADATION TESTS

PROJECT Santa Clara Carpinteria				TESTED BY GS				DATE 5/25/00	
% GRAVEL	0								
% SAND	5								
% SILT & CLAY	95								
DEPTH FT.	1'								
HOLE NO.	M6-77								
SAMPLE NO.									



GRADATION TESTS

PROJECT	Santa Clara Carpinteria			TESTED BY	GS			DATE	5/26/80
% GRAVEL									
% SAND	10.5								
% SILT & CLAY	89.5								
DEPTH FT.	1'								
HOLE NO.	MST4								
SAMPLE NO.									

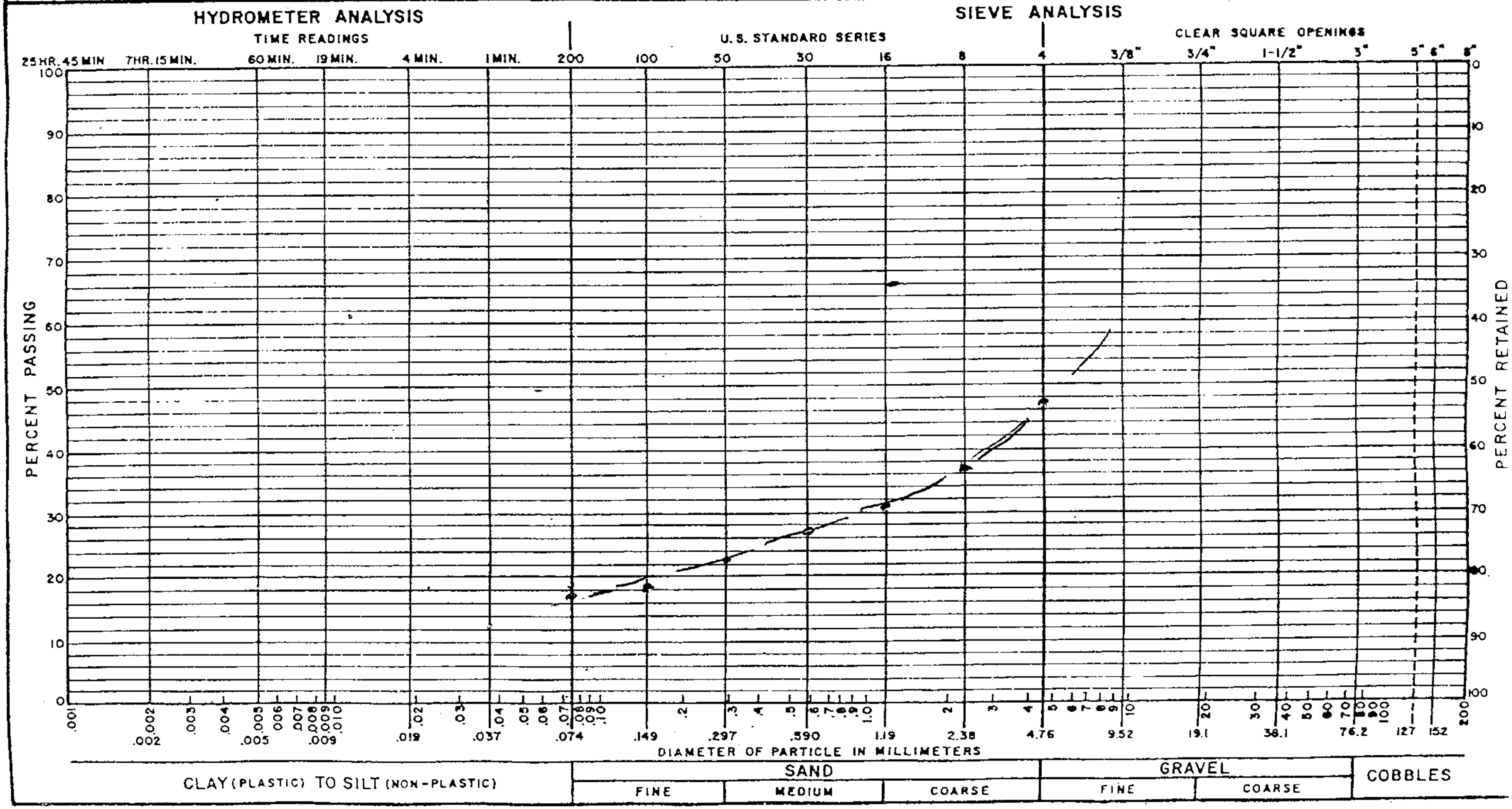


66 KV T/L

GRADATION TESTS

PROJECT Santa Clara Cornimenia	TESTED BY GS	DATE 3/26/00

% GRAVEL	53								
% SAND	28								
% SILT & CLAY	19								
DEPTH FT.	1-3'								
HOLE NO.	M6-T4								
SAMPLE NO.	SANDSTONE								



EDISON
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FOUNDATION DESIGN RECOMMENDATIONS
SANTA CLARA-CARPINTERIA 66 KV T/L
PROPOSED TSP SITES LOCATED WITHIN 5 MILES WEST FROM CASITAS SUBSTATION
EXISTING TOWERS M0T2 TO M4T1
VENTURA COUNTY, CALIFORNIA

PREPARED BY: SOUTHERN CALIFORNIA EDISON COMPANY
ENGINEERING & TECHNICAL SERVICES
CIVIL/STRUCTURAL/ GEOTECHNICAL GROUP

May 30, 2001

May 30, 2001

Mr. Bill Sasse

Subject: Foundation Design Recommendations
Proposed TSP Sites Located within 5 Miles West from Casitas Substation
Existing Towers M0T2 to M4T1
Santa Clara-Carpinteria 66 kV T/L
Ventura County, California

INTRODUCTION

At your request, we are herein submitting results of our field investigation of the soil and geologic conditions at the proposed new pole sites along the subject transmission line. Recommended drilled pier foundation design parameters for use in the "BIPILE" program are listed on the attached tables. The recommendations are based upon a site visit performed during May 1, 2001; a review of the referenced reports and the local geology; and a field note which depicted the tentative pole locations provided by yourself.

It is our understanding that the existing lattice towers of Santa Clara-Carpinteria 66 kV T/L and portion of the Santa Clara-Getty-PS 85 66 kV T/L will be replaced by tubular steel poles (TSP) with few exceptions that lattice towers will still be used. The first phase of the study for this subject project was performed during June 2000 which includes the T/L segment between the Santa Clara and the Casitas Substations. This phase of the study is starting from west side of the Ventura River opposite to the Casitas Substation (M0T2) and ending at approximately 5 miles west from the Casitas Substations (M4T1). Section of the subject alignment is depicted on the Figure 1, Site Plan.

Based on the site visit, most poles will be on or near ridge tops. Based on Phase I study for the subject project (Ref. 2), the diameters of the pole footings will approximately range from 56 to 84 inches and the proposed pole heights will be range from 60 to 100 feet.

GEOLOGICAL AND GEOTECHNICAL EVALUATIONS

Geological and geotechnical evaluations consisted of site visit to each proposed pole location was performed on May 1, 2001. Purpose of our site reconnaissance is to evaluate any visible geotechnical and geological conditions at each pole location along the alignment and to verify that the recommendations contained in the referenced reports are applicable to this project.

Results of this field reconnaissance confirm information contained on the referenced report (Ref. 1).

GEOLOGIAL CONDITIONS

This portion of southern California is controlled, geologically, by a series of roughly east-west trending faults and folds. The structure displays rather linear ridges composed of alternating sandstones, siltstones and shales.

The transmission corridor lies west of the Casitas Substation, which is situated on the eastern side of the Ventura River. The first few tower sites are situated in the Miocene-age Vaqueros Formation. This material is dominantly a massive to poorly bedded light gray to tan, fine-grained sandstone. Locally the sandstone is cemented with calcareous material. The formation is relatively free of landsliding.

Before crossing the Coyote Creek, below the Lake Casitas dam, the corridor enters an area underlain by the Oligocene-age Sespe Formation. This unit is composed of pinkish-gray to light brown, moderately hard arkosic sandstone, interbedded with maroon-red siltstone and claystone. The corridor trends through this material for nearly two miles. Along this area there are several large landslides noted by previous geologic reports.

At about two miles west of the dam, the corridor crosses into another formation – the Rincon Shale. This material is poorly bedded gray clay shale and siltstone. As noted in the field, it is very susceptible to landsliding and soil slumping. In addition, it forms a deep weathered soil.

Local Structure and Faulting

The major geologic features in this region include the Red Mountain Fault which trends east-west, south of the corridor and the Arroyo Parida Fault which trends east-west, north of the corridor. Intermittently, there are other smaller faults, which likewise trend roughly east-west. Between each of the larger faults, there are a series of fold axes that also trend east-west. These axes cause the rock to be folded in such a way that dipping beds are somewhat asymmetrical about the axis of the fold. This results in a somewhat unpredictable condition with respect to determine the likelihood of landsliding at a given site.

Local Seismicity

The level of seismic activity associated with these faults is considered low to moderate for southern California. There are no indications of high levels of earthquakes occurring within this region. Seismic factors should not play a significant role in design of the transmission structures within the region.

Landsliding/Slope Instability

Each site along the corridor was inspected for the existence or likelihood of future landsliding. In most cases, there were no indications (except as noted in the site notes) of the existence of landsliding or slope instability. The exceptions included site No's M1T1, M2T1, M2T4, M3T3, and M3T4. The area adjacent to M2T3 has been noted prior to this report as an area of major instability (adjacent to M12T1, Santa Clara-Goleta 220kV T/L). At this time, however, there is no indication that the landslide will impact the proposed TSP.

SUBSURFACE SOIL CONDITIONS

Subsurface soils in the vicinity along the subject alignment typically consist of clayey silt and silty clay with random sand layers. Cobbles and boulders were also noted at some locations. Groundwater is not anticipated within a depth that would affect design. Logs of boring from the referenced report (Ref. 1) which described the subsurface soil conditions in the project vicinity along the subject T/L are present in the Appendix.

Based on the site visit, the design recommendation is for a single soil type for the entire Line. The soil type is designated as Soil Type A in the footing design table (Table 1).

CONSTRUCTION CONSIDERATIONS

Drilling for Pier Foundation

In most cases, the rock can be drilled using a truck-mounted bucket auger or a relatively powerful large auger-type drill. Difficult drilling is expected if hard sandstone layers are encountered which may require core barrels or special tools such as cutting teeth. Possible locations to expect difficult drilling are believed at existing M2T2, M2T3, and M3T2B sites. Drilling conditions at other poles should not be difficult with large flight augers.

Grading

Grading on steep slopes will be required to provide access for drilling equipment. It is our understanding that the new poles will be also built with helicopter if the slopes are too steep for equipment to reach there.

Temporary cut slopes should be made at slopes no steeper than 1:1. The top of the cut slope should be no closer than five (5) feet from the edge of any existing footing. Temporary fill slopes will be made at the angle of repose of approximately 1:1. These fill slopes will be unstable when saturated. The fill material can turn to mudflow during periods of heavy rainfall. Care must be taken not to place fills above developed areas or areas where mudflows can inundate structures, livestock or producing orchards.

We have prepared idealized sections showing typical grading and setbacks (Figures 2 and 3). These details are designed to protect the existing towers from failure during construction of the new poles. After completion and the existing towers are removed, each site should be re-graded to divert drainage away from the new pole. In addition, all disturbed areas should be restored by filling to match original grade. All fill placed should be benched into the competent native materials and should be properly compacted. A typical side hill benching detail is attached as Figure 4.

During the site visit, rock flows were noted which could obstruct the service road between the towers M1T4 - M1T5 - M2T1. It is recommended that culverts with adequate diameter and/or wet crossings should be installed at these drainage-problem areas.

RECOMMENDATIONS

We have provided ultimate soil design parameters for the foundations on Table 1. The soil parameters in this table represent ultimate values which require the use of appropriate factors of safety for design.

Based on the referenced report and our understanding of the design, landslide load as provided on the last report is not recommended at this study since the assumed landslide load (approximately 30 kips) is negligible compared to the design lateral loading at average 1,500 kips.

To prevent excessive disturbance of the subsurface soils and to utilize them as an additional protection measurement on the slope, without obstructing the drilling of the new footing, we recommend that the existing lattice tower footings to be left in-place after towers are removed.

All sites should be properly graded. Berms and/or swales should be constructed as needed. Positive surface drainage should be provided to prevent water from ponding at the TSP's foundations.

The Geotechnical Group should review printouts of drilled pier computer design to verify compatibility with the above recommendations. If you have any questions or comments regarding this information, please call the undersign at PAX 47795.

H. Gene Hawkins
CEG #952, Consulting Geologist

ZAID AHMAD, P.E.
Lead Engineer
Civil/Structural/Geotechnical Group
Engineering & Technical Services
Southern California Edison Company

s/civil/geotech/mc/2001/santacarpin-II.doc
Attachment

References:

1. Report No. 200
   Santa Clara-Goleta 220 kV Transmission Line
   Soil Investigation
   Prepared by the Engineering Department
   Dated September 1966

2. Foundation Design Recommendations
   Santa Clara-Carpinteria 66 kV T/L
   Santa Clara Substation to Casitas Substation
   Ventura County, California
   Prepared by the Civil/Structural/ Geotechnical Group
   Dated June 29, 2000

TABLE 1

FOUNDATION DESIGN RECOMMENDATIONS
SANTA CLARA—CARPINTERIA, 66 KV T/L
POLES AT APPROXIMATELY 5 MILES WEST OF CASITAS SUBSTATION
VENTURA COUNTY
(SOIL TYPE A)

1.	Soil Density		
	a.	Moist	120 pcf
	b.	Saturated	132 pcf
	c.	Submerged	70 pcf
2.	Ultimate Bearing Capacity		
	a.	At surface—moist	3500 psf
	b.	Rate of increase per foot—moist	1200 psf
	c.	Rate of increase per foot—submerged	600 psf
	d.	Maximum not to exceed	30,000 psf
3.	Ultimate Moist Skin Friction at Depth of 10 Feet		750 psf
4.	Estimated Depth to Groundwater		>100 feet
5.	Friction Angle of Soil		30 degrees
6.	Ratio of Submerged to Moist Skin Friction		0.50
7.	Depth to Hard Bedrock		Varies (See Table 2)
8.	Passive Pressure Multiplier Factor (PPM)		2.5
9.	Ultimate Lateral Soil Pressure at a Depth of 10 Feet		8,000 psf
10.	Side Hill Slope		Varies (See Table 2)
11.	Minimum Length		30 feet
12.	Additional Drilled Pier Length to Add into Final Design		Varies (See Table 2)
13.	Additional Lateral Load		Varies (See Table 2)

NOTES:

1. Minor to moderate caving should be expected during the drilling of the pier foundation excavations. The use of water during drilling of pier excavations should aid in control of caving. Casing, drilling mud, or other means to control caving should be made available if the use of water is found to be ineffective.

2. The soil parameters in this table represent ultimate values which require the use of appropriate factors of safety for design.

Table-2 Special Considerations

Santa Clara-Carpinteria 66 kV T/L
Poles at Approximately 5 Miles West of Casitas Substation
Ventura County, California

Existing Location	SOIL TYPE	SIDE HILL SLOPE (DEGREES)	ADDITIONAL LENGTH TO ADD IN FINAL DESIGN [2] (FEET)	SPECIAL CONSTRUCTION CONDITIONS
M0-T2	A	Note 1	10	Neglect upper 10 feet of soils or add 10 feet to the result
M0-T3	A	Note 1	10	Upper soils may cave
M0-T4				No new pole is planned at this location
M1-T1	A	Note 1	20	Pole will be located approx. 12 feet to a very steep slope. Neglect upper 20 feet of soils or add 20 feet to the result
M1-T2	A	18	N/A	
M1-T3	A	N/A	5	Neglect upper 5 feet of soils or add 5 feet to the result
M1-T4	A	Note 1	10	Neglect upper 10 feet of soils or add 10 feet to the result
M1-T5	A	Note 1	15	Neglect upper 15 feet of soils or add 15 feet to the result; Need access road
M2-T1	A	17	5	Entire area is possible landslide May encounter groundwater (**See Note 5**)
M2-T2	A	25	N/A	Hard drilling may be encountered
M2-T3	A	Note 1	15	Neglect upper 15 feet of soils or add 15 feet to the result; Hard drilling may be encountered; Need access road
M2-T4				No new pole is planned at this location
M3-T1	A	Note 1	5	Neglect upper 5 feet of soils or add 5 feet to the result
M3-T2A	A	18	N/A	
M3-T2B	A	Note 1	5	Neglect upper 5 feet of soils or add 5 feet to the result; Hard drilling may be encountered
M3-T3	A	37	N/A	Landslide at new pole location Need grading on existing access road
M3-T4	A	29	N/A	See **Note 6**; Need access road
M4-T1	A	N/A	N/A	

Note:

1. Effects of nearby side hill slope is compensated by adding an additional pile length (column 4) to final results
2. Denote a recommended additional length for potential scour and/or other considerations.
3. The new pole(s)/tower(s) will be constructed near the same existing tower location(s).
4. All existing tower footings are recommended be left in-place, if feasible.
5. In addition to the side hill slope, it is recommended that additional 5 feet to be added into final pier length or a preliminary test boring should be performed to evaluate groundwater and slide plane conditions.
6. Ideal pole location is where the existing tower is.

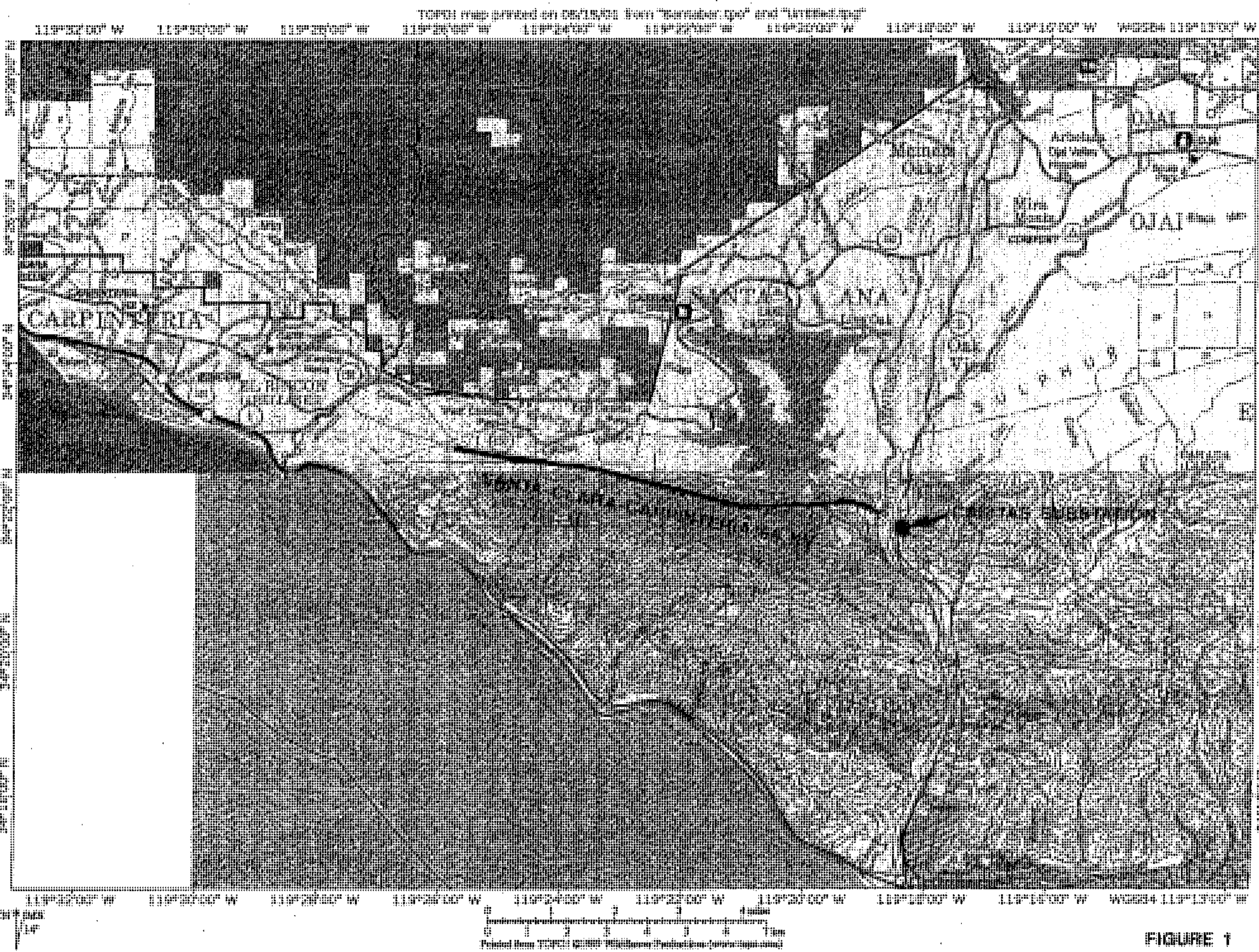
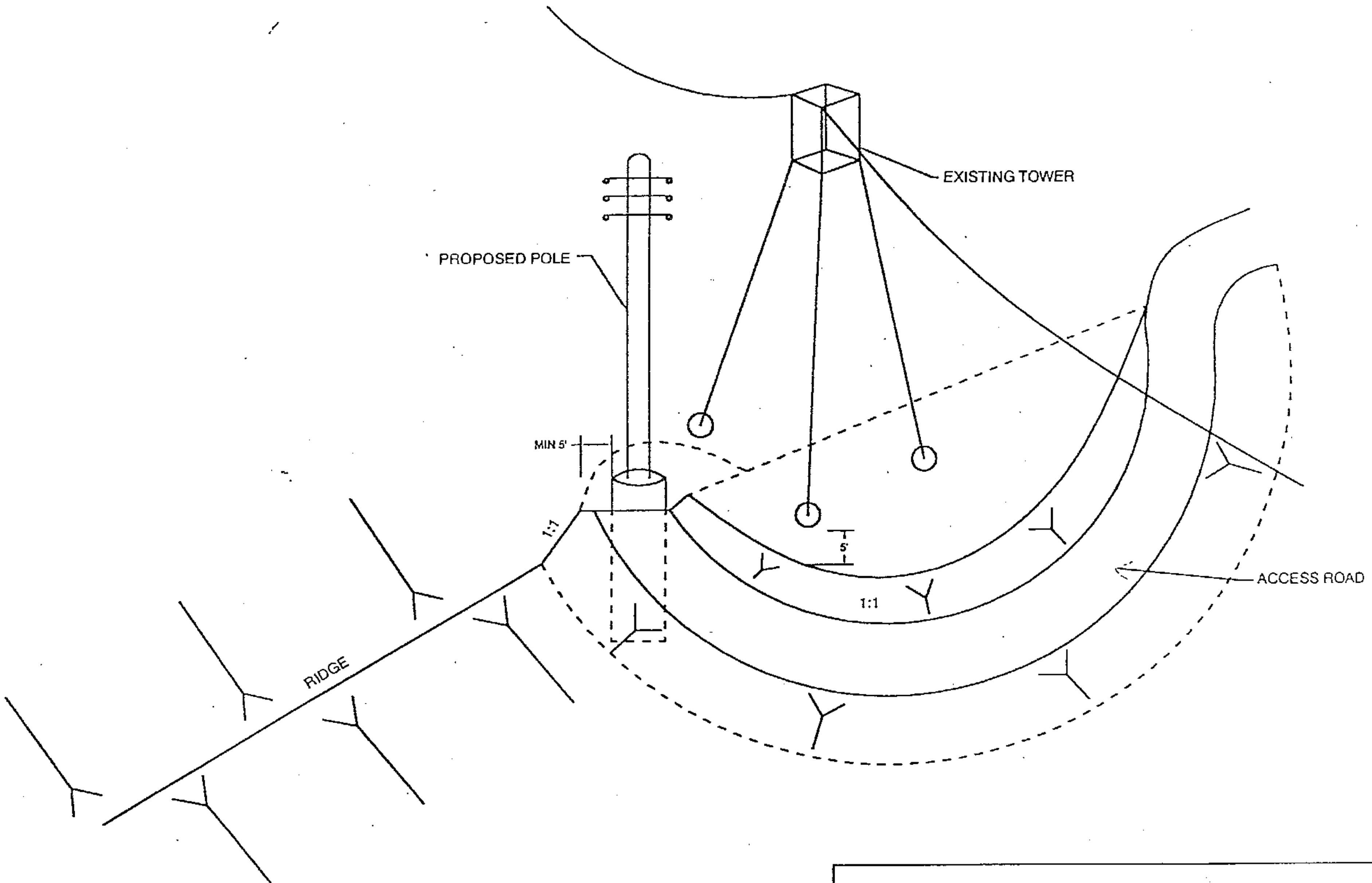


FIGURE 1



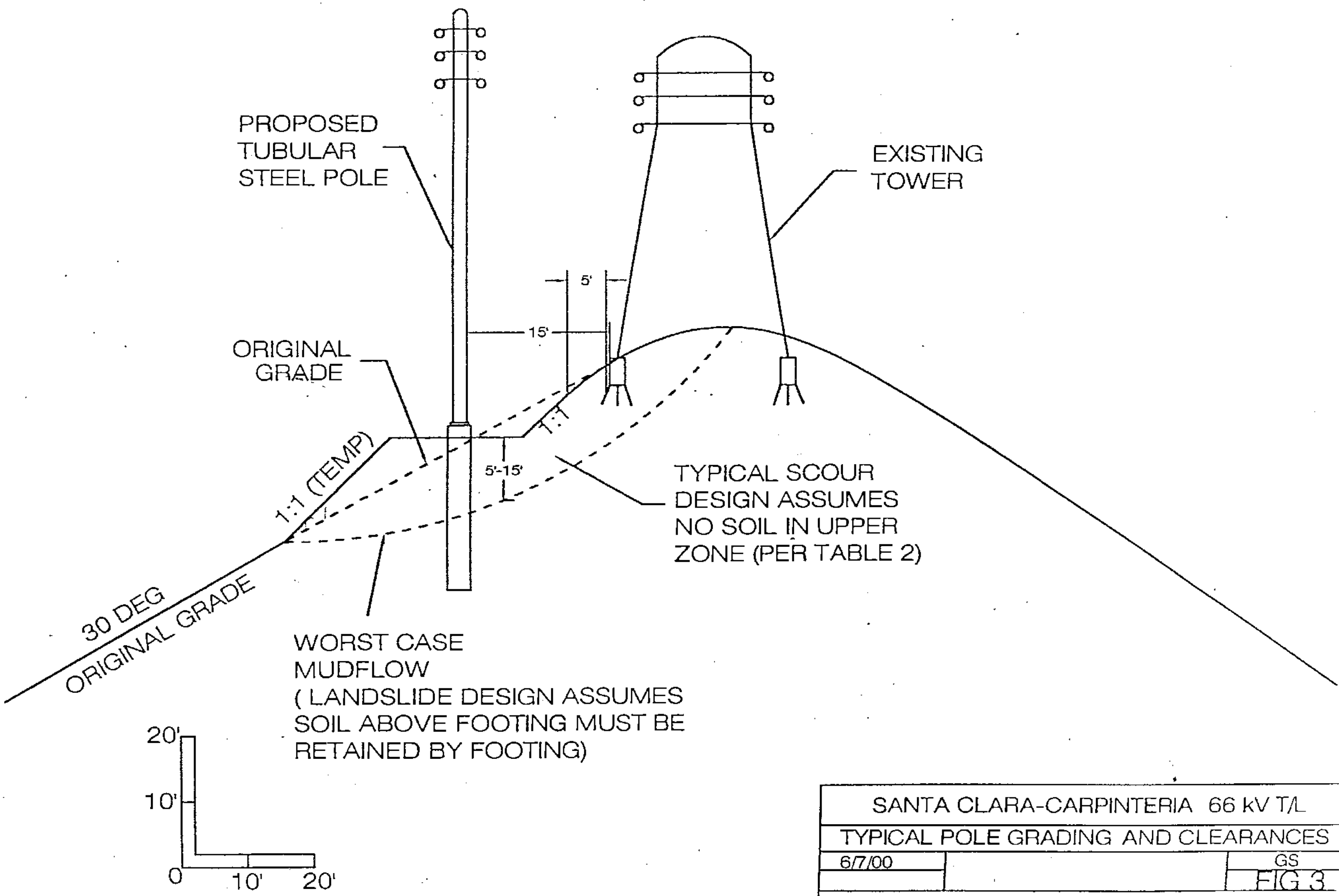
SANTA CLARA -CARPINTERIA

TEMP ACCESS ROAD GRADING

6/6/00

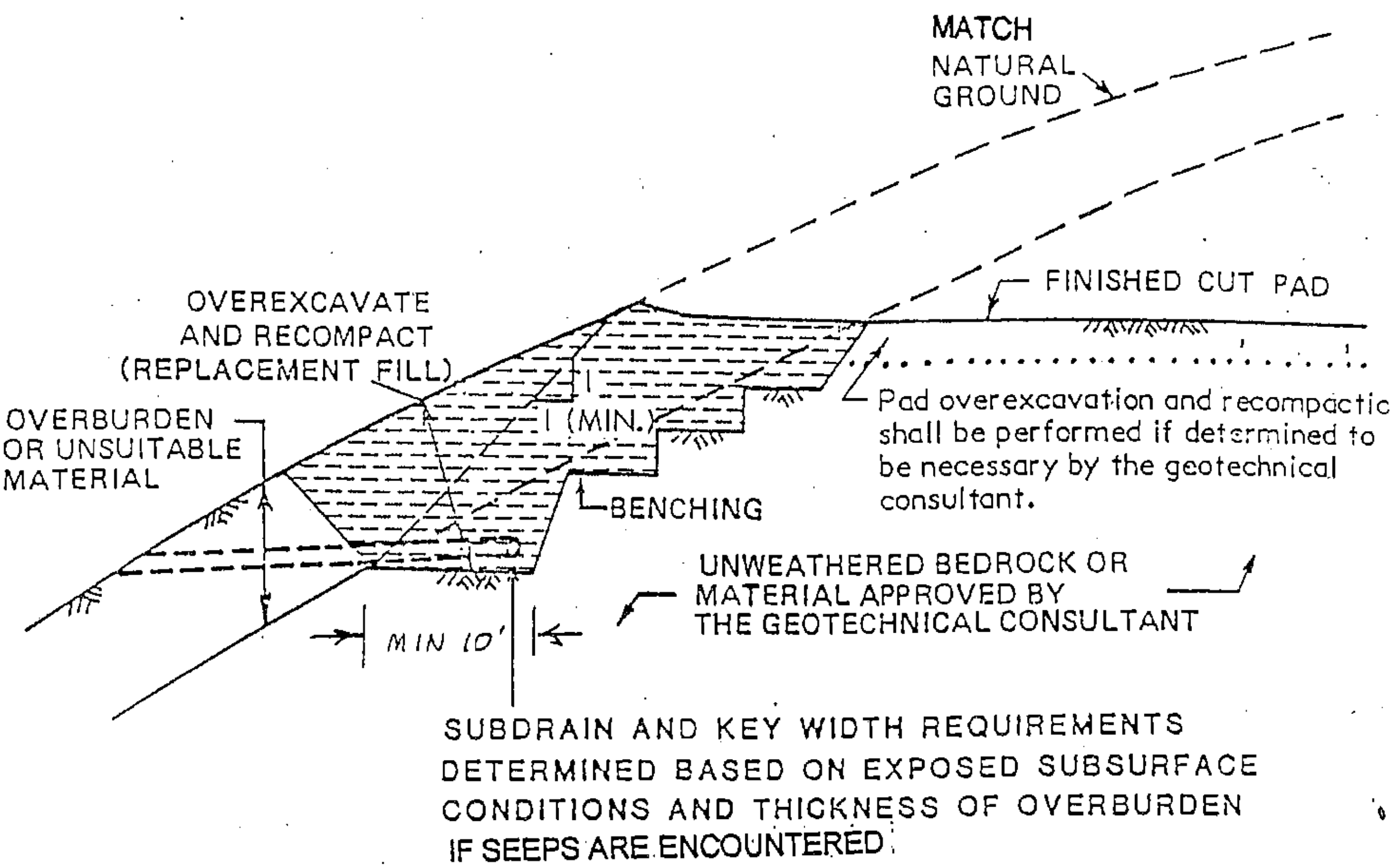
GS

FIG 2



SANTA CLARA-CARPINTERIA 66 kV T/L	
TYPICAL POLE GRADING AND CLEARANCES	
6/7/00	GS
	FIG 3

SIDE HILL
CUT PAD DETAIL

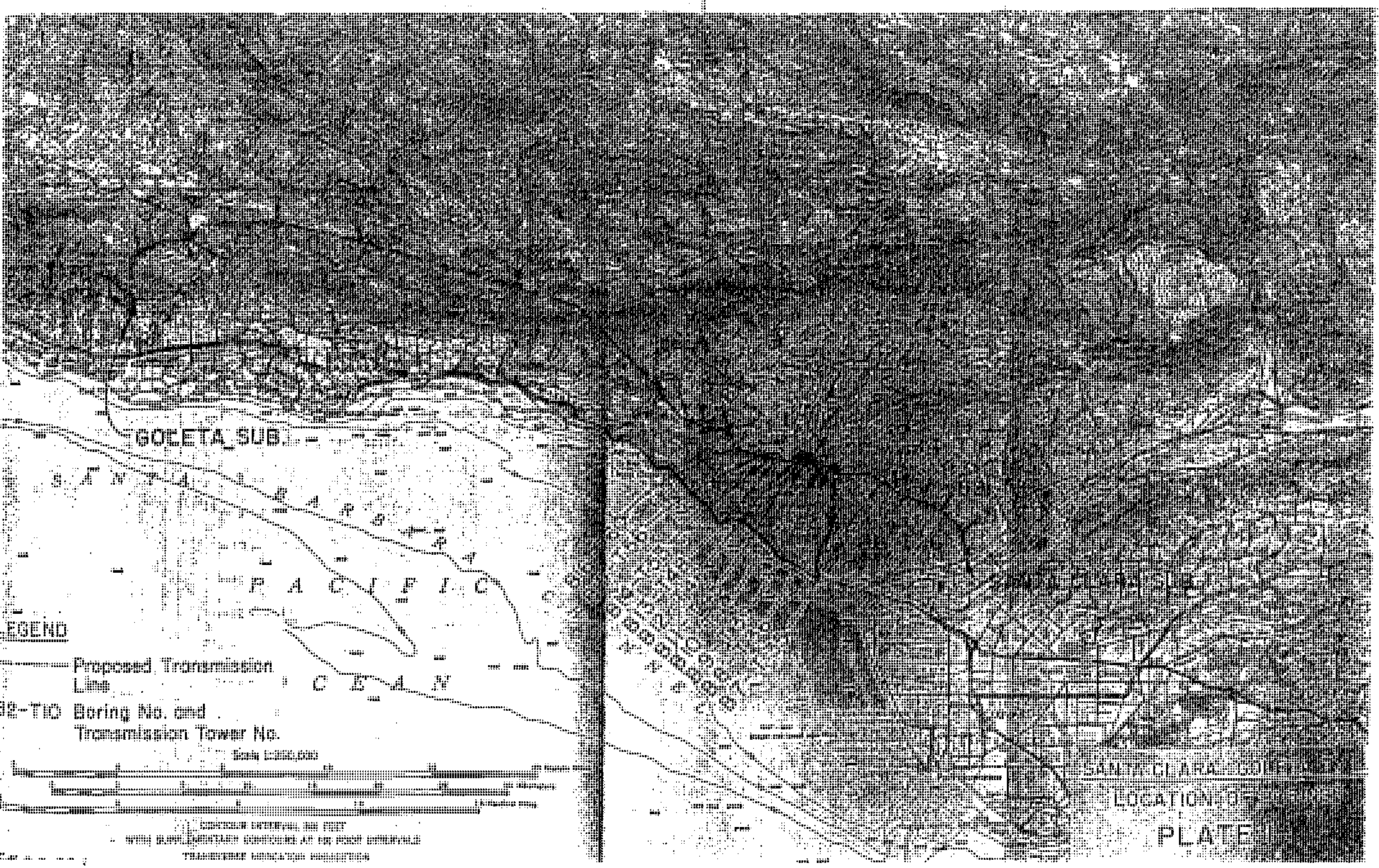


NOTE: All soil compaction should be performed to 90 percent of maximum Density as obtained by ASTM D1557-91 (5-layer) method of compaction.

FIGURE 4

APPENDIX

REFERENCED LOGS OF BORING


GOLETA SUB.
SANTA BARBARA
PACIFIC
OCEAN
LEGEND
Proposed Transmission Line
Boring No. and Transmission Tower No.
PLATE

LOG OF BORING

SOUTHERN CALIFORNIA EDISON COMPANY

ENGINEERING DEPARTMENT

HOLE NO. 10 DATE DRILLED 6-20-66

PROJECT Santa Clara-Goleta 220KVT/L

SHEET 1 OF 1

LOCATION At construction site no. 43

EXPLORATION METHOD Bucket Rig

GROUND ELEVATION

SIZE OF HOLE 18-inch diameter

DEPTH TO WATER TABLE *

CONTRACTOR Helton Drilling Co.

DEPTH TO TOP OF SOLID ROCK -

DRILLER Call-Lyons

INSPECTOR Wallace-Merritt-Bardin

UNDISTURBED SAMPLES				SAMPLES			DEPTH	FIELD DESCRIPTION
WEIGHT POUNDS	DROP INCHES	INCHES DRIVEN	TOTAL BLOWS	UNDIST.	BAG	JAR	FEET	
							0	River deposits, Fine sandy silt, brown, dry, stiff, approximately 25 percent rounded gravel and cobbles to 5 inches.
							1	
							2	
							3	Gravelly sand, compact, tan, dry, about 30 percent rounded cobbles and gravel to to 10 inches.
							4	
							5	Bottom
								Hole caves to 30 inches due to large cobbles.
							6	
							7	
							8	
							9	
							10	
							11	
							12	
							13	
							14	
							15	
							16	
							17	
							18	
							19	

REMARKS: * Ground water fluctuates from below 25 feet to as high as ground level.

LOG OF BORING

SOUTHERN CALIFORNIA EDISON COMPANY — ENGINEERING DEPARTMENT

HOLE NO. 11 DATE DRILLED 6-20-66 SHEET 1 OF 2

PROJECT Santa Clara-Goleta 220KV T/L EXPLORATION METHOD Bucket-Rig

LOCATION 150' N of construction site No. 45 SIZE OF HOLE 18-inch diameter

GROUND ELEVATION CONTRACTOR Helton Drilling Co.

DEPTH TO WATER TABLE - DRILLER Call-Lyons

DEPTH TO TOP OF SOLID ROCK - INSPECTOR Wallace-Bardin

UNDISTURBED SAMPLES WEIGHT POUNDS	DROP INCHES	INCHES DRIVEN	TOTAL BLOWS	SAMPLES UNDIST.	BAG	JAR	*	DEPTH FEET	FIELD DESCRIPTION
							7	0	Weathered shale, brown, dry, stiff,
							15	1	excavates as angular sand and gravel
							26		sized fragments which can easily be
							34	2	broken by hand.
									Damp
								3	
								4	
								5	Hard
					↕	↕	24		
							56	6	
								7	
								8	
								9	
						↕	19	10	
							63	11	
					↕			12	
								13	Gray
								14	
					↕	↕	7	15	Soft, wet, plastic.
							14	16	
							19		
							23	17	Streaks of brown clay
Ring Sampler								18	
1800	12	18	17	↕				19	Hard
								20	

REMARKS: * Standard penetration test.

LOG OF BORING

SOUTHERN CALIFORNIA EDISON COMPANY — ENGINEERING DEPARTMENT

HOLE NO. 11 DATE DRILLED 6-20-66 SHEET 2 OF 2

PROJECT Santa Clara-Goleta 220KV T/L EXPLORATION METHOD Bucket-Rig

LOCATION 150' N of construction site No. 45 SIZE OF HOLE 18-inch diameter

GROUND ELEVATION CONTRACTOR Helton Drilling Co.

DEPTH TO WATER TABLE - DRILLER Call-Lyons

DEPTH TO TOP OF SOLID ROCK - INSPECTOR Wallace-Bardin -

UNDISTURBED SAMPLES				SAMPLES				DEPTH	FIELD DESCRIPTION
WEIGHT POUNDS	DROP INCHES	INCHES DRIVEN	TOTAL BLOWS	UNDIST.	BAG	JAR	*	FEET	
						↕ (20–21)	26 / 60	20	Weathered shale, gray, wet, very stiff, excavates as angular sand and gravel sized fragments which can easily be broken by hand.
								21	
								22	
								23	
						↕ (24–25)		24	
							7 / 28 / 54	25	
								26	No caving, easy drilling
								27	Bottom
								28	
								29	
								30	
								31	
								32	
								33	
								34	
								35	
								36	
								37	
								38	
								39	
								40	

LOG OF BORING

SOUTHERN CALIFORNIA EDISON COMPANY — ENGINEERING DEPARTMENT

HOLE NO. 12 DATE DRILLED 6-20-66 SHEET 2 OF 2

PROJECT Santa Clara-Goleta 220KV T/L EXPLORATION METHOD Bucket-Rig

LOCATION 200' N of construction site No. 46 SIZE OF HOLE 18-inch diameter

GROUND ELEVATION CONTRACTOR Helton Drilling Co.

DEPTH TO WATER TABLE - DRILLER Call-Lyons

DEPTH TO TOP OF SOLID ROCK 25' INSPECTOR Wallace-Bardin

UNDISTURBED SAMPLES				SAMPLES			DEPTH	
WEIGHT POUNDS	DROP INCHES	INCHES DRIVEN	TOTAL BLOWS	UNDIST.	BAG	JAR	FEET	FIELD DESCRIPTION
							20	Weathered shale.
							21	Red-brown, slightly damp, hard, excavates as angular fragments
							22	which can be broken by hand.
							23	
							24	Hard drilling.
							25	Bottom
							26	Easy drilling from 0-24
							27	feet. No caving.
							28	
							29	
							30	
							31	
							32	
							33	
							34	
							35	
							36	
							37	
							38	
							39	

REMARKS:

LOG OF BORING

SOUTHERN CALIFORNIA EDISON COMPANY — ENGINEERING DEPARTMENT

HOLE NO. 13 DATE DRILLED 6-20-66 SHEET 1 OF 2

PROJECT Santa Clara-Goleta 220KV T/L EXPLORATION METHOD Bucket-Rig

LOCATION 75' W of construction site No. 49 SIZE OF HOLE 18-inch diameter

GROUND ELEVATION ______ CONTRACTOR Helton Drilling Co.

DEPTH TO WATER TABLE - DRILLER Call-Lyon

DEPTH TO TOP OF SOLID ROCK 23 INSPECTOR Wallace-Bardin

UNDISTURBED SAMPLES				SAMPLES					
WEIGHT POUNDS	DROP INCHES	INCHES DRIVEN	TOTAL BLOWS	UNDIST.	BAG	JAR	#	DEPTH FEET	FIELD DESCRIPTION
						↕ (0–2)	5	0	Highly weathered shale, reddish
							13	1	brown, damp, stiff.
							25		
							37	2	
								3	[illegible] not penetrate[illegible]
								4	[illegible]
Ring Sampler									[illegible] easy drilling
								5	
1800	12	18	8	↕ (5–6.5)				6	Weathered sand stone, reddish-brown, slightly damp, excavates as fine to
								7	medium sand, dense
								8	
								9	
						↕ (10–11.5)	15	10	
							40	11	Weathered shale, reddish brown, hard slightly damp, excavates as angular sand and gravel size fragments ~~which~~
							75	12	may be broken by hand with some difficulty.
								13	
								14	
						↕ (15)	50	15	
								16	
								17	
								18	Thin layer green sandy shale
								19	
								20	

LOG OF BORING

SOUTHERN CALIFORNIA EDISON COMPANY — ENGINEERING DEPARTMENT

HOLE NO. 13 DATE DRILLED 6-20-66 SHEET 2 OF 2

PROJECT Santa Clara-Galeta 220KV T/L EXPLORATION METHOD Bucket-Rig

LOCATION 75' W at construction site No. 49 SIZE OF HOLE 18-inch diameter

GROUND ELEVATION ______ CONTRACTOR Helton Drilling Co.

DEPTH TO WATER TABLE - DRILLER Call-Lyons

DEPTH TO TOP OF SOLID ROCK 23 INSPECTOR Wallace-Bardin-Merritt

UNDISTURBED SAMPLES: WEIGHT POUNDS	DROP INCHES	INCHES DRIVEN	TOTAL BLOWS	SAMPLES: UNDIST.	BAG	JAR		DEPTH FEET	FIELD DESCRIPTION
								20	
								21	Shale, reddish brown, slightly damp, hard excavates as angular sand and gravel.
								22	
								23	Bucket can not penetrate
									Bottom
								24	No caving, easy drilling.
								25	
								26	
								27	
								28	
								29	
								30	
								31	
								32	
								33	
								34	
								35	
								36	
								37	
								38	
								39	
								40	

REMARKS

LOG OF BORING

SOUTHERN CALIFORNIA EDISON COMPANY — ENGINEERING DEPARTMENT

HOLE NO. 14 DATE DRILLED 6-21-66 SHEET 1 OF 1

PROJECT Santa Clara-Goleta 220KV T/L EXPLORATION METHOD Bucket-Rig

LOCATION At construction site No. 53 SIZE OF HOLE 18-inch diameter

GROUND ELEVATION ______ CONTRACTOR Helton Drilling Co.

DEPTH TO WATER TABLE - DRILLER Call-Lyons

DEPTH TO TOP OF SOLID ROCK 16 INSPECTOR Wallace-Bardin-Merritt

UNDISTURBED SAMPLES WEIGHT POUNDS	DROP INCHES	INCHES DRIVEN	TOTAL BLOWS	SAMPLES UNDIST.	BAG	JAR	#	DEPTH FEET	FIELD DESCRIPTION
						↕	6	0	Weathered shale, reddish-brown, stiff, dry.
							14	1	
							28		
							37	2	
						↕		3	Sand stone, gray, hard, highly fractured, slightly damp.
								4	Weathered shale, reddish-brown, stiff, damp, highly decomposed, plastic
Split tube								5	
1800	12	24	15	↕				6	
						↕		7	
								8	Thin layer gray sand stone, hard.
								9	
						↕	7	10	
							17	11	
							31		
							60	12	
								13	
						↕		14	Sand stone, gray-brown, slightly damp, hard.
							60	15	Can not penetrate.
								16	Bottom
								17	Gad used in attempt to break up material. (1 inch in 60 blows)
								18	
								19	

REMARKS: # Standard penetrometer test.

LOG OF BORING

SOUTHERN CALIFORNIA EDISON COMPANY — ENGINEERING DEPARTMENT

HOLE NO. 15 DATE DRILLED 6-21-66 SHEET 1 OF 2

PROJECT Santa Clara-Goleta 220KV T/L EXPLORATION METHOD Bucket-Rig

LOCATION Construction site No. 56 SIZE OF HOLE 18-inch diameter

GROUND ELEVATION ______ CONTRACTOR Helton Drilling Co.

DEPTH TO WATER TABLE - DRILLER Call-Lyons

DEPTH TO TOP OF SOLID ROCK - INSPECTOR Wallace-Merritt-Bardin

UNDISTURBED SAMPLES: WEIGHT POUNDS	DROP INCHES	INCHES DRIVEN	TOTAL BLOWS	SAMPLES: UNDIST.	BAG	JAR	#	DEPTH FEET	FIELD DESCRIPTION
							11	0	Weathered shale, reddish brown, dry, stiff.
							23	1	
							36		
								2	
					↕			3	slightly damp
								4	
							11	5	
						↕	24	6	
						↕	39		
						↕	54	7	
								8	
								9	
						↕	16	10	Sand stone, light tan, slightly damp, dense
						↕	31	11	
						↕	48		
						↕	61	12	Weathered shale, brown, damp, stiff.
								13	
								14	Sand stone, tan, dense.
					↕		13	15	
					↕		29		
							34	16	Weathered shale, brown, damp, very stiff.
							47	17	
								18	Occasional thin layers sand stone.
								19	
								20	

REMARKS: Standard penetration test.

LOG OF BORING

SOUTHERN CALIFORNIA EDISON COMPANY — ENGINEERING DEPARTMENT

HOLE NO. 15 DATE DRILLED 6-21-66 SHEET 2 OF 2

PROJECT Santa Clara-Goleta 220KVT/L EXPLORATION METHOD Bucket-Rig

LOCATION Construction site no. 56 SIZE OF HOLE 18-inch diameter

GROUND ELEVATION CONTRACTOR Helton Drilling Co.

DEPTH TO WATER TABLE - DRILLER Call-Lyons

DEPTH TO TOP OF SOLID ROCK - INSPECTOR Wallace-Merritt-Bardin

UNDISTURBED SAMPLES				SAMPLES				DEPTH	
WEIGHT POUNDS	DROP INCHES	INCHES DRIVEN	TOTAL BLOWS	UNDIST.	BAG	JAR	*	FEET	FIELD DESCRIPTION
								20	Weatherd shale Brown, damp, very stiff, excavates in fragments which are easily broken by hand.
								21	
								22	
								23	
								24	Easy drilling, no caving
								25	Bottom
								26	
								27	
								28	
								29	
								30	
								31	
								32	
								33	
								34	
								35	
								36	
								37	
								38	
								39	

REMARKS: * See sheet 1.

LOG OF BORING

SOUTHERN CALIFORNIA EDISON COMPANY — ENGINEERING DEPARTMENT

HOLE NO. 16 DATE DRILLED 6-21-66 SHEET 1 OF 2

PROJECT Santa Clara-Goleta 220KV T/L EXPLORATION METHOD Bucket-Rig

LOCATION Construction site 60 SIZE OF HOLE 18-inch diameter

GROUND ELEVATION ____ CONTRACTOR Helton Drilling Co.

DEPTH TO WATER TABLE - DRILLER Call-Lyons

DEPTH TO TOP OF SOLID ROCK - INSPECTOR Wallace-Merritt-Bardin

UNDISTURBED SAMPLES				SAMPLES				DEPTH FEET	FIELD DESCRIPTION
WEIGHT POUNDS	DROP INCHES	INCHES DRIVEN	TOTAL BLOWS	UNDIST.	BAG	JAR	#		
								0	Weathered shale, Dark brown, dry, stiff.
								1	
Split Tube								2	
								3	Slightly damp
1800	12	24	12					4	
Lost Sample									
							10	5	
							18		
							26	6	
							34	7	
								8	
								9	
								10	Damp, soft, plastic.
							3		
							5	11	
							7		
							8	12	
							2		
							3	13	
							4		
							8	14	Medium
							17		
								15	
								16	Stiff
							10		
							24	17	
							48		Angular fragments, may be broken by hand.
							80	18	
								19	
								20	

LOG OF BORING

SOUTHERN CALIFORNIA EDISON COMPANY — ENGINEERING DEPARTMENT

HOLE NO. 16 DATE DRILLED 6-21-66 SHEET 2 OF 2
PROJECT Santa Clara-Goleta 220KV T/L EXPLORATION METHOD Bucket-Rig
LOCATION Construction site 60 SIZE OF HOLE 18-inch diameter
GROUND ELEVATION ____ CONTRACTOR Helton Drilling Co.
DEPTH TO WATER TABLE - DRILLER Call-Lyons
DEPTH TO TOP OF SOLID ROCK - INSPECTOR Wallace-Bardin-Merritt

UNDISTURBED SAMPLES						SAMPLES				DEPTH	
WEIGHT POUNDS	DROP INCHES	INCHES DRIVEN	TOTAL BLOWS			UNDIST.	BAG	JAR	*	FEET	FIELD DESCRIPTION
										20	Weathered shale, Tan, slightly damp, stiff.
										21	
										22	Gray, hard.
										23	
									20/60	24	Bottom
										25	No caving, easy drilling
										26	
										27	
										28	
										29	
										30	
										31	
										32	
										33	
										34	
										35	
										36	
										37	
										38	
										39	

REMARKS: * See sheet 1

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FOUNDATION DESIGN RECOMMENDATIONS FROM EAST CASITAS PASS TO RINCON ROAD SR-150 EXISTING TOWERS M4T2 TO M9T1 SANTA CLARA-CARPINTERIA 66 KV T/L VENTURA COUNTY, CALIFORNIA

PREPARED BY: SOUTHERN CALIFORNIA EDISON COMPANY
ENGINEERING & TECHNICAL SERVICES
CIVIL/STRUCTURAL/ GEOTECHNICAL GROUP

July 3, 2001

July 3, 2001

Mr. Bill Sasse

Subject: Foundation Design Recommendations
From East Casitas Pass to Rincon Road SR-150
Existing Towers M4T2 TO M9T1
Santa Clara-Carpinteria 66 kV T/L
Ventura County, California

INTRODUCTION

At your request, we are herein submitting results of our field investigation of the soil and geologic conditions at the proposed new pole sites along the subject transmission line. Recommended drilled pier foundation design parameters for use in the "BIPILE" program are listed on the attached tables. The recommendations are based upon a site visit performed during May 23 and 24, 2001; a review of the referenced reports and the local geology.

It is our understanding that the existing lattice towers of Santa Clara-Carpinteria 66 kV T/L and portion of the Santa Clara-Getty-PS 85 66 kV T/L will be replaced by tubular steel poles (TSP) with few exceptions that lattice towers will still be used. The first phase of the study for this subject project was performed during June 2000 which includes the T/L segment between the Santa Clara and the Casitas Substations.

The second phase of the study is starting from west side of the Ventura River opposite to the Casitas Substation (M0T2) and ending at approximately 5 miles west from the Casitas Substations (M4T1). The investigation for Phase 2 was performed and completed in May 2001.

The third phase of the project is starting from south of the East Casitas Pass to Rincon Road which starts from M4T2 to M7T1 along the Santa Clara-Carpinteria 66 kV T/L and continues to M7T2 through M9T1 along the Santa Clara-Getty 66 kV T/L. Section of the phase 3 alignment is depicted on the Figure 1, Site Plan.

Based on the site visit, most poles will be on or near ridge tops. Based on Phase I study for the subject project (Ref. 2), the diameters of the pole footings will approximately range from 56 to 84 inches and the proposed pole heights will be range from 60 to 100 feet.

GEOLOGICAL AND GEOTECHNICAL EVALUATIONS

Geological and geotechnical evaluations consisted of site visit to each proposed pole location was performed on May 23 to 24, 2001 with the presence of Mr. Jim Billingsley, SCE Construction Forces, regional T/L patrol crew, and yourself. Purpose of our visual inspection was to evaluate any visible geotechnical and geological conditions at each pole location along the alignment and to estimate the subsurface soil parameters to aid in the design of the new poles. No additional field and laboratory soil testing were conducted during this study.

Geological Conditions

This portion of southern California is controlled, geologically, by a series of roughly east-west trending faults and folds. The structure displays rather linear ridges composed of alternating sandstones, siltstones and shales. The rock units in this area are generally linear, trending approximately east-west.

This section of the transmission corridor lies west of Lake Casitas and south of East Casitas Pass, which is situated on the western side of the Ventura River and south of Highway 150. Approximately 3 miles of this portion of the line lies within the Miocene-age Rincon Shale. This material is poorly bedded gray clay shale and siltstone. As noted in the field, it is very susceptible to landsliding and soil slumping. In addition, it forms a deep weathered soil. Along this area there are several large landslides noted by previous geologic reports. Immediately west of West Casitas Pass, there is an impressively large landslide which has move northward from the northern edge of the outcrops of the Rincon Shale. This slide is about one mile in length and ½ mile in width. It is an active mass and tends to move, at least in part, each year.

As the corridor continues westerly, it passes into an area underlain by Miocene-age Monterey Formation. This material consists of marine shale units. They are composed of white-weathering soft, fissile to punky clay shale with interbeds of hard siliceous shales and thin limestone beds. Occasionally, there are large concretions up to 2-3 feet in diameter. The western portion of this material shows several small to moderate landslides within the geologic maps. However, these landslides do not appear to have an effect on towers within the transmission corridor.

Continuing toward the west, the corridor crosses into a small section of the Plio-Pleistocene – age Santa Barbara Formation. This unit consists of interbedded, shallow-marine, massive to poorly bedded, slightly consolidated, tan to yellow fossiliferous sandstones and siltstones. The material is generally not prone to landsliding.

The final geologic unit along this portion of the corridor is the Pleistocene-age Casitas Formation. This nonmarine unit is composed of weakly consolidated, massive to poorly bedded, gray to tan cobble-boulder gravels and gray to reddish sand and clay.

Local Structure and Faulting

The major geologic features in this region include the Red Mountain Fault which trends east-west, south of the corridor and the Arroyo Parida Fault which trends east-west, north of the corridor. Intermittently, there are other smaller faults such as the Shepard

Mesa and Rincon Creek faults, which likewise trend roughly east-west. Between each of the larger faults, there are a series of fold axes that also trend east-west. These axes cause the rock to be folded in such a way that dipping beds are somewhat asymmetrical about the axis of the fold. This results in a somewhat unpredictable condition with respect to determine the likelihood of landsliding at a given site.

Local Seismicity

The level of seismic activity associated with these faults is considered low to moderate for southern California. There are no indications of high levels of earthquakes occurring within this region. Seismic factors should not play a significant role in design of the transmission structures within the region.

Landsliding/Slope Instability

Each site along the corridor was inspected for the existence or likelihood of future landsliding. In most cases, there were no indications (except as noted in the site notes) of the existence of landsliding or slope instability. The exceptions included site No's M6T5, M6T6, and M7T1. The area to the west (and away from the proposed location) of M5T1 appears as a shallow soil failure.

Subsurface Soil Conditions

Subsurface soils in the vicinity along the subject alignment typically consist of clayey silt and silty clay with random sand layers, followed by bedrock consisted of sandstones, siltstones, and shales. Surficial cracks were observed during site visit at/near the tower Nos. M4T2 through M5T2, M6T2, M7T3 through M7T5, M8T1, and M8T6 which suggests that the subsurface soils have expansive potential.

As described on the Section, Geological Conditions, cobbles and boulders were also noted during the site visit near the end of the alignment which may cause caving during the drilled pier construction. Casing, drilling mud, or other means to control caving should be made available if the use of water is found to be ineffective. Groundwater is not anticipated within a depth that would affect design.

CONSTRUCTION CONSIDERATIONS

Drilling for Pier Foundation

In most cases, the rock can be drilled using a truck-mounted bucket auger or a relatively powerful large auger-type drill. Difficult drilling is expected if hard sandstone layers are encountered which may require core barrels or special tools such as cutting teeth. Possible locations to expect difficult drilling are believed at existing M8T3 site. Drilling conditions at other poles should not be difficult with large flight augers.

Grading

Grading on steep slopes will be required to provide access for drilling equipment. It is our understanding that the new poles will be also built with helicopter if the slopes are too steep for equipment to reach there.

Temporary cut slopes should be made at slopes no steeper than 1:1. The top of the cut slope should be no closer than five (5) feet from the edge of any existing footing. Temporary fill slopes will be made at the angle of repose of approximately 1:1. These fill slopes will be unstable when saturated. The fill material can turn to mudflow during periods of heavy rainfall. Care must be taken not to place fills above developed areas or areas where mudflows can inundate structures, livestock or producing orchards.

We have prepared idealized sections showing typical grading and setbacks (Figures 2 and 3). These details are designed to protect the existing towers from failure during construction of the new poles. After completion and the existing towers are removed, each site should be re-graded to divert drainage away from the new pole. In addition, all disturbed areas should be restored by filling to match original grade. All fill placed should be benched into the competent native materials and should be properly compacted. A typical side hill benching detail is attached as Figure 4.

During the site visit, running springs on the service road were noted near tower M5T3. It is recommended that culverts, wet crossings, water bars, McCarthy drains and/or other erosion control facilities should be installed to mitigate the roadway erosion.

RECOMMENDATIONS

We have provided ultimate soil design parameters for the foundations on Table 1. The soil parameters in this table represent ultimate values which require the use of appropriate factors of safety for design.

Based on the referenced report and our understanding of the design, landslide load as provided on the last report is not recommended at this study since the assumed landslide load (approximately 30 kips) is negligible compared to the design lateral loading at average 1,500 kips.

To prevent excessive disturbance of the subsurface soils and to utilize them as an additional protection measurement on the slope, without obstructing the drilling of the new footing, we recommend that the existing lattice tower footings to be left in-place after towers are removed.

All sites should be properly graded. Berms and/or swales should be constructed as needed. Positive surface drainage should be provided to prevent water from ponding at the TSP's foundations.

The Geotechnical Group should review printouts of drilled pier computer design to verify compatibility with the above recommendations. If you have any questions or comments regarding this information, please call the undersign at PAX 47795.

H. Gene Hawkins
CEG #952, Consulting Geologist

ZAID AHMAD, P.E.
Lead Engineer
Civil/Structural/Geotechnical Group
Engineering & Technical Services
Southern California Edison Company

s/civil/geotech/mc/2001/santacarpin-III.doc
Attachment

References:

1. Report No. 200
   Santa Clara-Goleta 220 kV Transmission Line
   Soil Investigation
   Prepared by the Engineering Department
   Dated September 1966

2. Foundation Design Recommendations
   Santa Clara-Carpinteria 66 kV T/L
   Santa Clara Substation to Casitas Substation
   Ventura County, California
   Prepared by the Civil/Structural/ Geotechnical Group
   Dated June 29, 2000

3. Foundation Design Recommendations
   Proposed TSP Sites Located within 5 Miles West from Casitas Substation
   Existing Towers M0T2 to M4T1
   Santa Clara-Carpinteria 66 kV T/L
   Ventura County, California
   Dated May 30, 2001

TABLE 1
FOUNDATION DESIGN RECOMMENDATIONS
FROM EAST CASITAS PASS TO RINCON ROAD SR-150
EXISTING TOWERS M4T2 TO M9T1
SANTA CLARA-CARPINTERIA 66 KV T/L
VENTURA COUNTY, CALIFORNIA

	Soil Type A	**Soil Type B**
1.Soil Density (pcf)		
a. Moist	120	120
b. Saturated	132	132
c. Submerged	70	70
2. Ultimate Bearing Capacity (psf)		
a. At surface—moist	5,000	10,000
b. Rate of increase per foot—moist	1,300	5000
c. Rate of increase per foot—submerged	800	3000
d. Maximum not to exceed	30,000	50,000
3. Ultimate Moist Skin Friction at Depth of 10 Feet (psf)	1,000	1,000
4. Estimated Depth to Groundwater (feet)	>100	>100
5. Friction Angle of Soil (degree)	27	30
6. Ratio of Submerged to Moist Skin Friction	0.55	0.55
7. Depth to Hard Bedrock (feet)	>50	>50
8. Passive Pressure Multiplier Factor (PPM)	3.0	3.0
9. Ultimate Lateral Soil Pressure at a Depth of 10 Feet (psf)	9,500	15,000
10. Side Hill Slope	Varies (See Table 2)	Varies (See Table 2)
11. Minimum Length (feet)	30	30
12. Additional Drilled Pier Length to Add into Final Design	Varies (See Table 2)	Varies (See Table 2)

NOTES:

1. Minor to moderate caving should be expected during the drilling of the pier foundation excavations. The use of water during drilling of pier excavations should aid in control of caving. Casing, drilling mud, or other means to control caving should be made available if the use of water is found to be ineffective.

2. The soil parameters in this table represent ultimate values which require the use of appropriate factors of safety for design.

Table-2 Special Considerations

Santa Clara-Carpinteria 66 kV T/L

Existing Location	SOIL TYPE	SIDE HILL SLOPE (DEGREES)	ADDITIONAL LENGTH TO ADD IN FINAL DESIGN [2] (FEET)	REMARKS AND SPECIAL CONSTRUCTION CONDITIONS
M4T2	A	-	10	Located on a 18° slope
M4T3	A	20	-	No access
M4T4	A	15	-	No access
M4T5	A	-	-	Existing pad will be lowered
M5T1	A	-	10	Slide at west side; new pole will on a future cut pad at the east (Casitas Sub) side.
M5T2	A	20	-	Adjacent to slide; no access
M5T3	B	20	-	No access; spring uphill of the tower (water in service roadway)
M5T4	B	-	5	Located at the bottom of the canyon in a heavy vegetated area.
M6T1	B	35	(use 35° or add 25 feet pile length to final result)	Not accessible; on a steep (35°) slope
M6T2	B	35	(use 35° or add 25 feet pile length to final result)	on a steep (35°) slope
M6T3	B	35	(use 35° or add 25 feet pile length to final result)	on a steep (35°) slope
M6T4	A	-	-	Pole will be located at the east (Casitas Sub) side
M6T5	A	-	10	Slide at north side
M6T6	A	20	-	Slide at west side
M7T1	A	10	-	Slide at north side
M7T2	B	-	5	On a gentle slope
M7T3	A	-	5	Neglect upper 5 feet of surficial disturbed soils
M7T4	A	10	-	
M7T5	A	18	-	
M7T6	B	27	-	
M8T1	A	15	-	
M8T2	B	20	-	
M8T3	B	15	-	Hard drilling should be anticipated
M8T4	B	45	(use 45° or add 25 feet pile length to final result)	on a steep (45°) slope
M8T5	B	20	-	
M8T6	A	28	-	
M9T1	A	-	-	Pole will be located at the east (Casitas Sub) side

Note:

1. Effects of adjoining side hill slope are compensated by either using the actual slopes (column 3) or adding an additional pile length (column 4) to final results.
2. Column 4 denotes a recommended additional length for potential scour and/or other considerations.
3. The new pole(s)/tower(s) will be constructed near the same existing tower location(s).
4. All existing tower footings are recommended be left in-place, if feasible.

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FOUNDATION DESIGN RECOMMENDATIONS (PHASE IV)
FROM EAST CASITAS PASS TO CARPINTERIA SUBSTATION
EXISTING TOWERS M13T2 TO CARPINTERIA SUBSTATION
SANTA CLARA-CARPINTERIA 66 KV T/L
VENTURA AND SANTA BARBARA COUNTIES, CALIFORNIA

**PREPARED BY: SOUTHERN CALIFORNIA EDISON COMPANY
ENGINEERING & TECHNICAL SERVICES
CIVIL/STRUCTURAL/ GEOTECHNICAL GROUP**

December 20, 2001

December 20, 2001

Mr. Bill Sasse

Subject: Foundation Design Recommendations (Phase IV)
From East Casitas Pass to Carpinteria Substation
Existing Towers M13T2 to Carpinteria Substation
Santa Clara-Carpinteria 66 kV T/L
Ventura and Santa Barbara Counties, California

INTRODUCTION

At your request, we are herein submitting results of our field investigation of the soil and geologic conditions at the proposed new pole sites along the subject transmission line. Recommended drilled pier foundation design parameters for use in the "BIPILE" program are listed on the attached tables. The recommendations are based upon a site visit performed during September 26 and 27; and October 4, 2001; a review of the referenced reports and the local geology.

It is our understanding that the existing lattice towers of Santa Clara-Carpinteria 66 kV T/L and portion of the Santa Clara-Getty-PS 85 66 kV T/L will be replaced by tubular steel poles (TSP) with few exceptions that lattice towers will still be used.

Phase 1 of the study for this subject project was performed during June 2000 which includes the T/L segment between the Santa Clara and the Casitas Substations. Phase 2 portion of the study was started from west side of the Ventura River opposite to the Casitas Substation (M0T2) and ended at approximately 5 miles west from the Casitas Substations (M4T1). The investigation for Phase 2 was performed and completed in May 2001. The third phase of the project was started from south of the East Casitas Pass to Rincon Road which starts from tower M4T2 to M7T1 along the Santa Clara-Carpinteria 66 kV T/L and continues to M7T2 through M9T1 along the Santa Clara-Getty 66 kV T/L.

This report covers the fourth phase of the project which starts from about ¼ mile south of East Casitas Pass (M13T2) and runs along the existing Goleta-Santa Clara 220 kV Nos. 1 and 2 till tower No. M6T4 for about 3.5 miles. After M6T4, the T/L goes along the Santa Clara-Ojai-Santa Barbara 66 kV T/L in the northwest direction for about 5.3 miles where it takes a right angle bend to the southwest toward the terminus of the project at Carpinteria Substation (existing towers M7T1 to Carpinteria Substation). Total length of the new T/L in phase 4 is approximately 11 miles. Section of the phase 4 alignment is depicted on the Figure 1, Site Map.

Based on the site visit, most of the proposed new poles will be located on or near the existing slopes or at ridge tops. Based on Phase I study for the subject project (Ref. 2), the diameters of the pole footings will approximately range from 56 to 84 inches and the proposed pole heights will range from 60 to 100 feet.

GEOLOGICAL AND GEOTECHNICAL EVALUATIONS

Geological and geotechnical evaluations consisted of site visits to each proposed pole location and were performed on September 26, 27 and October 4, 2001. Present during the job walk were Mr. Jim Billingsley, SCE Construction Forces, regional T/L patrol crew, yourself, and Zaid Ahamd, Gene Hawkins, Ming Chi from SCE Geotechnical Group. Purpose of our visual inspection was to evaluate any visible geotechnical and geological conditions at each pole location along the alignment and to estimate the subsurface soil parameters to aid in the design of the new poles. No additional field and laboratory soil testing were conducted during this study. Recommendations contained in this report were based on our visual observations of the site conditions, review of local geology and pertinent geotechnical and geological information contained in our files.

Geological Conditions

This portion of southern California is controlled, geologically, by a series of east-west trending faults and folds. The structure displays rather linear ridges composed of alternating sandstones, siltstones and shales.

This section of the transmission corridor lies about ¼ mile south of the East Casitas Pass area (Hwy 150 and the 'chlorinator station'). The terminus of the line is at the Carpinteria Substation. Total distance for this section is on the order of 11 miles.

The tower sites within the first 6 ½ miles (from East Casitas Pass to west of Gobernador Creek, Santa Barbara County) are situated in the Oligocene-age Sespe Formation. This material is dominantly maroon to reddish-brown silty shales with interbedded red sandstone. Locally the Sespe formation has conglomerate layers and lighter-colored sandstones. Drilling in this material should vary easy to moderately difficult. At many of the sites where this material is present, there are indications of expansive soils on the order of 3-4 feet deep.

The formation is relatively free of landsliding. However, at West Casitas Pass (Hwy 150), the corridor passes along the northern edge of a major landslide complex. The corridor passes to the north of the highway and away from the active landslide. Therefore, the slide should not impact the transmission corridor.

The transmission corridor next crosses into the Eocene-age Coldwater Sandstone. This sandstone is a hard, tan, bedded to massive material. Locally, it has thin beds of siltstone and shale. Drilling (esp. M10T6 to M11T2) in this material should be hard to difficult. The formation is relatively free of landslides. The corridor crosses this material for less than 1 mile.

After leaving the Coldwater Sandstone, the material again crosses into the Sespe Formation. The corridor trends northwest for about 1-½ miles where it takes a right angle bend to the southwest. The total length of this section within the Sespe formation is about two miles. No landslides were noted within this section of the corridor.

The corridor once again crosses into the Coldwater Sandstone for about ¼ mile and then into the Sespe Formation once again for about ¼ mile. When the corridor leaves this material, it crosses into younger alluvial deposits composed of unconsolidated floodplain materials of silt, sand, and gravel. Drilling within this material should be easy to moderate, depending on the size of cobbles encountered.

Local Structure and Faulting

The major geologic features in this region include the Arroyo Parida Fault which trends east-west, and crosses the corridor and the Shepard Mesa, Rincon Creek and Carpinteria Faults which trends east-west, and lie south of the corridor. Intermittently, there are other smaller faults, which likewise trend roughly east-west. Between each of the larger faults, there are a series of fold axes that also trend east-west. These axes cause the rock to be folded in such a way that dipping beds are somewhat asymmetrical about the axis of the fold. This results in a somewhat unpredictable condition with respect to determine the likelihood of landsliding at a given site.

Local Seismicity

The level of seismic activity associated with these faults is considered low to moderate for southern California. There are no indications of high levels of earthquakes occurring within this region. Seismic factors should not play a significant role in design of the transmission structures within the region.

Landsliding/Slope Instability

Each site along the corridor was inspected for the existence or likelihood of future landsliding. In most of the sites, there were no indications of the existence of landsliding or slope instability. However, between towers M13T4 and M13T5, there is an area of active soil slumping. This area should be monitored to insure that it does not encroach near the towers.

Subsurface Soil Conditions

Subsurface soils in the vicinity along the subject T/L alignment typically consist of clayey silt and silty clay with random sand layers, followed by bedrock consisted of sandstones, siltstones, and shales. Surficial cracks were observed during site visit at/near the tower which suggests that the subsurface soils have expansive potential.

Cobbles and boulders were also noted during the site visit at some new pole locations of the alignment which may cause caving during the drilled pier construction. Groundwater is not anticipated within a depth that would affect design.

CONSTRUCTION CONSIDERATIONS

Drilling for Pier Foundation

In most cases, the rock can be drilled using a truck-mounted bucket auger or a relatively powerful large auger-type drill. Difficult drilling is expected if hard sandstone layers are encountered which may require core barrels or special tools such as cutting teeth. As a minimum, possible locations to expect difficult drilling are believed at existing M10T6 to M11T2 sites.

At areas with the presence of cobbles and boulders, severe caving should be anticipated which could obstruct the construction of drilled pier foundations. Cobbles, boulders, and any loose soils should be removed from the bottom of the drilled hole prior to pouring concrete. For drilled pier foundations, the use of water (presoaking) and/or adequate size of drilling auger to remove oversized materials during the drilling may aid in the control of caving. Drilling mud (the slurry method), casing, or other means to control caving will be required if water is found ineffective. Alternative foundation recommendations, such as rock anchor and/or block footings, can be provided upon requested.

Drilling conditions at other poles should not be difficult with large flight augers.

Grading

Grading on steep slopes will be required to provide access for drilling equipment. It is our understanding that the new poles could be installed with helicopter if the slopes are too steep for equipment to reach there.

Temporary cut slopes should be made at slopes no steeper than 1:1. The top of the cut slope should be no closer than five (5) feet from the edge of any existing footing. Temporary fill slopes will be made at the angle of repose of approximately 1:1. These fill slopes will be unstable when saturated. The fill material can turn to mudflow during periods of heavy rainfall. Care must be taken not to place fills above developed areas or areas where mudflows can inundate structures, livestock or producing orchards.

We have prepared idealized sections showing typical grading and setbacks (Figures 2 and 3). These details are designed to protect the existing towers from failure during construction of the new poles. Each tower/TSP site should be re-graded to divert drainage away from the new pole. In addition, surficial drainage at all disturbed areas should be restored by filling to match original grade. All fill placed should be benched into the competent native materials and should be properly compacted. A typical side hill benching detail is attached as Figure 4.

RECOMMENDATIONS

Drilled pier foundation should be constructed in accordance with SCE's Construction Specification 3.2T, Drilled Pier Foundations. Recommended drilled pier foundation design parameters for use in SCE's "BIPILE" computer program are presented in Table 1. These parameters represent ultimate soil values which require the use of appropriate factors of safety.

As aforementioned, most of the towers and poles will be located on sloping ground and/or close to side hill slopes. Therefore, we recommend "Side Hill Slope" or "Scour Depth" to be used in the BIPILE computer program as shown on the attached Table-2 "Special Considerations".

To prevent excessive disturbance of the subsurface soils and to utilize them as an additional protection measurement on the slope, without obstructing the drilling of the new footing, we recommend that the existing lattice tower footings to be left in-place after towers are removed.

All sites should be properly graded. Berms and/or swales should be constructed as needed. Positive surface drainage should be provided to prevent water from ponding at the TSP's foundations.

The Geotechnical Group should review printouts of drilled pier computer design to verify compatibility with the above recommendations. If you have any questions or comments regarding this information, please call the undersign at PAX 47795.

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Southern California Edison Company

s/civil/geotech/mc/2001/SantaCarpin-IV.doc
Attachment

References:

1. Report No. 200
   Santa Clara-Goleta 220 kV Transmission Line
   Soil Investigation
   Prepared by the Engineering Department
   Dated September 1966

2. Foundation Design Recommendations (Phase 1)
   Santa Clara-Carpinteria 66 kV T/L
   Santa Clara Substation to Casitas Substation
   Ventura County, California
   Prepared by the Civil/Structural/ Geotechnical Group
   Dated June 29, 2000

3. Foundation Design Recommendations (Phase 2)
   Proposed TSP Sites Located within 5 Miles West from Casitas Substation
   Existing Towers M0T2 to M4T1
   Santa Clara-Carpinteria 66 kV T/L
   Ventura County, California
   Dated May 30, 2001

4. Foundation Design Recommendations (Phase 3)
   From East Casitas Pass to Rincon Road SR-150
   Existing Towers M4T2 To M9T1
   Santa Clara-Carpinteria 66 kV T/L
   Ventura County, California
   Dated July 3, 2001

TABLE 1
FOUNDATION DESIGN RECOMMENDATIONS
EXISTING TOWERS M13T2 TO CARPINTERIA SUB
SANTA CLARA-CARPINTERIA 66 KV T/L
VENTURA AND SANTA BARBARA COUNTIES, CALIFORNIA

	Soil Type A	Soil Type B	Soil Type C
1.Soil Density (pcf)			
a. Moist	115	125	120
b. Saturated	120	135	130
c. Submerged	58	73	68
2. Ultimate Bearing Capacity (psf)			
a. At surface—moist	5,000	10,000	7,500
b. Rate of increase per foot—moist	1,300	5000	1,500
c. Rate of increase per foot—submerged	800	3000	1,000
d. Maximum not to exceed	30,000	50,000	40,000
3. Ultimate Moist Skin Friction at Depth of 10 Feet (psf)	1,000	1,000	1,200
4. Estimated Depth to Groundwater (feet)	>100	>100	>100
5. Friction Angle of Soil (degree)	27	33	28
6. Ratio of Submerged to Moist Skin Friction	0.55	0.55	0.60
7. Depth to Hard Bedrock (feet)	>30*	>30*	>30*
8. Passive Pressure Multiplier Factor (PPM)	3.0	4.5	3.5
9. Ultimate Lateral Soil Pressure at a Depth of 10 Feet (psf)	9,500	20,000	15,000
10. Side Hill Slope	Varies (See Table 2)	Varies (See Table 2)	Varies (See Table 2)
11. Minimum Length (feet)	N/A	N/A	N/A
12. Additional Drilled Pier Length to Add into Final Design	Varies (See Table 2)	Varies (See Table 2)	Varies (See Table 2)

NOTES:

1. Minor to moderate caving should be expected during the drilling of the pier foundation excavations. The use of water during drilling of pier excavations should aid in control of caving. Casing, drilling mud, or other means to control caving should be made available if the use of water is found to be ineffective.

2. The soil parameters in this table represent ultimate values which require the use of appropriate factors of safety for design.

3. Hard drilling should be anticipated. Appropriate drilling equipment should be available to drill on hard foundation soils and rocks.

* For computer purpose ONLY, assuming rock is drillable.

Table-2 Special Considerations
M13T2 TO CARPINTERIA SUB
SANTA CLARA-CARPINTERIA 66 KV T/L
VENTURA AND SANTA BARBARA COUNTIES, CALIFORNIA

Existing Location	SOIL TYPE	SIDE HILL SLOPE (DEGREES)	ADDITIONAL LENGTH TO ADD IN FINAL DESIGN [2] (FEET)	REMARKS AND SPECIAL CONSTRUCTION CONDITIONS
M13T2	A	-	5	Crack on surface
M13T3	A	-	5	Crack on surface
M13T4	A	30	-	Adjacent to steep slope.
M13T5	A	-	5	Existing slope will be cut 5 feet down for future pole pad
M13T6	A	-	-	
M13T7	A	-	5	Steep Slope at Casitas Side
M14T1	B	-	-	Pole will be built on a cut pad
M-Frame	A	-	-	May be eliminated
M4T5	A	-	-	Will be moved about 200 feet toward Casitas side on a higher elevation level ground
M4T6	B	30	-	Steep slope on both sides. Need access to pad
M5T1	B	-	5	Pole will be built on a cut pad by lowering slope on Carpinteria side
M5T2	B	-	5	Pole will be built on a pad by leveling the slope on Casitas side
M5T3	B	-	-	
M5T4	B	-	-	
M6T1	C	-	5	Need access road
M6T2	B	-	-	Slope adjacent to existing tower on Carpinteria side will be lowered 5 feet for new pole
M6T3	B	-	-	Slope adjacent to existing tower on Casitas side will be lowered 5 feet for new pole
M6T4	C	-	10	Near washed out area. This site should be monitored regularly.
M7T1	B	-	5	
M7T2	C	15	-	Need access road. May be eliminated.
M7T3	C	-	5	Pole will be at the toe of the slope at Carpinteria Side
M7T4	B	-	10	Need access road. On steep slope.
M7T5	C	-	5	Pole will be on a gentle slope at Carpinteria Side

(Continued)

Table-2 Special Considerations
M13T2 TO CARPINTERIA SUB
SANTA CLARA-CARPINTERIA 66 KV T/L
VENTURA AND SANTA BARBARA COUNTIES, CALIFORNIA

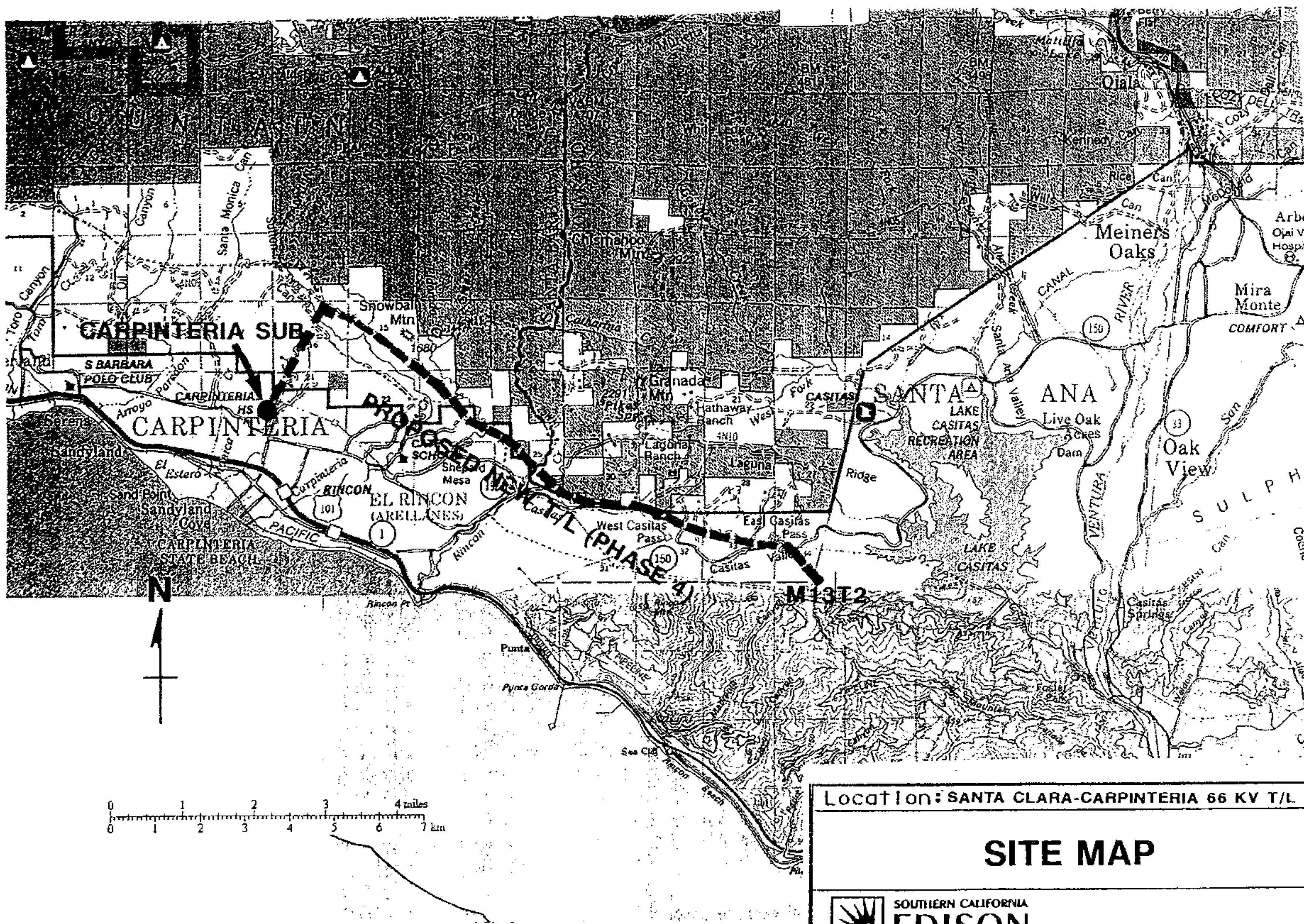
Existing Location	SOIL TYPE	SIDE HILL SLOPE (DEGREES)	ADDITIONAL LENGTH TO ADD IN FINAL DESIGN [2] (FEET)	REMARKS AND SPECIAL CONSTRUCTION CONDITIONS
M17T4	C	-	10	Need access road.
M17T5	C	-	5 feet for M8T2 10 feet for M17T5	
M17T6	C	-	5	Need access road
M18T1	C	-	-	Need access road
M18T2	C	-	5	Need access road. Pole will at Carpinteria side.
M18T3	C	-	5	Pole location was not visited. Values are provided based on assumptions.
M18T4	C	-	5	Need access road
M18T5	C	-	-	
M19T1	B	-	5	Need access road
M19T2	B	-	5	
M19T3	B	-	-	
M19T4	B	-	-	
M19T5	B	-	5	
M10T5	C	-	5	Need access road.
M10T6	B	-	5	Need access road. Soils eroded in the vicinity.
M11T1	B	-	-	
M11T2	B	-	5	Cracks on surface.
M11T3	C	-	5	On a gentle slope. Cracks on surface.
M11T4	B	-	5	On a gentle slope.
M11T5	B	-	5	Need access road. On a gentle slope.
M11T6	B	-	5	Need pad for the new pole. On a gentle slope.
M11T7	C	-	5	Need pad for the new pole. On a gentle slope.
M11T8	C	-	-	
M11T9	B	-	5	Need access road. Located adjacent to slopes.
M12T1	B	-	5	Need access road. Located adjacent to slopes.
M12T2	C	-	-	

(continued)

Table-2 Special Considerations
M13T2 TO CARPINTERIA SUB
SANTA CLARA-CARPINTERIA 66 KV T/L
VENTURA AND SANTA BARBARA COUNTIES, CALIFORNIA

Existing Location	SOIL TYPE	SIDE HILL SLOPE (DEGREES)	ADDITIONAL LENGTH TO ADD IN FINAL DESIGN [2] (FEET)	REMARKS AND SPECIAL CONSTRUCTION CONDITIONS
M12T3	C	-	-	
M12T4	C	-	5	Cracks on surface.
M12T5	C	-	5	Need access road. On a gentle slope.
Proposed TSP's	C	-	5	Cracks on surface.
M1T3	C	-	10	Called M1T6 in job walk. New pole will be located on the road instead of setting on the existing tower location.
M1T4	C	-	5	Called M1T5 in job walk. Need access road. On a gentle slope.
Cons. 42	C	20	-	Called M1T4 in job walk. Located adjacent to slopes
Cons. 43	C	-	10	Called M1T3 in job walk. Located adjacent to slopes.
M1T2	C	-	5	On a gentle slope.
M1T1	B	-	-	Set pole at Casitas side.
M0T6	B	-	5	Called M0T9 in job walk.
M0T5	C	20	-	Called M0T8 in job walk. Pole location was not accessible during site visit. Values are provided based on assumptions.
M0T4A	B	-	5	Called M0T7 in job walk. On a gentle slope.
M0T4	C	-	-	Called M0T6 in job walk.
M0T3	C	-	5	Called M0T5 in job walk. Located adjacent to a storm drain.
M0T2	C	-	-	Called M0T4 in job walk.
M0T1	C	-	-	Called M0T3 in job walk.

Note:
1. Effects of adjoining side hill slope of each pole are compensated by either using the actual slopes (column 3) or using a scour depth (column 4) in computer program.
2. Column 4 denotes a recommended additional length for potential scour and/or other considerations.
3. The new pole(s)/tower(s) will be constructed near the same existing tower location(s).
4. All existing tower footings are recommended be left in-place, if feasible.

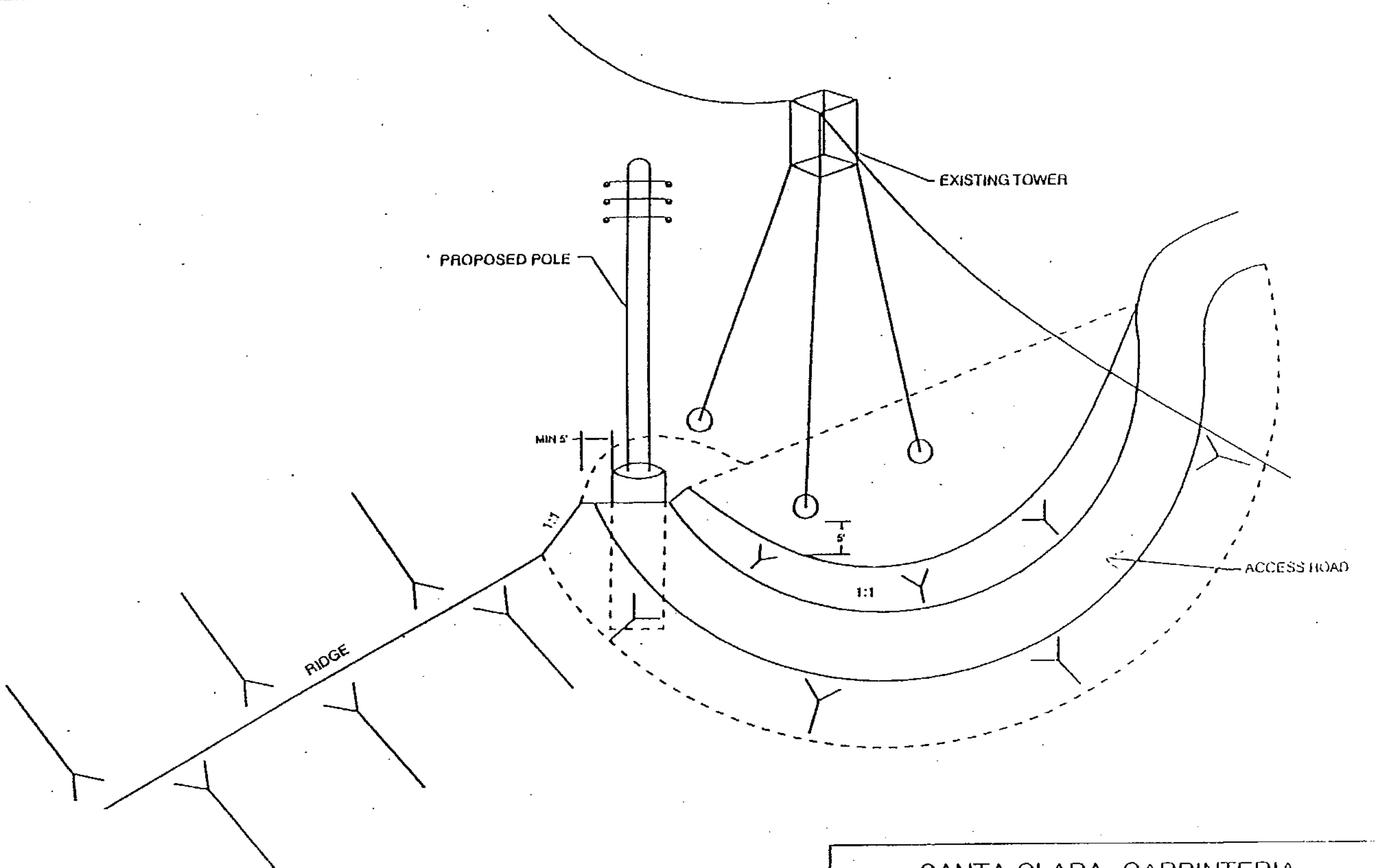


Location: SANTA CLARA-CARPINTERIA 66 KV T/L

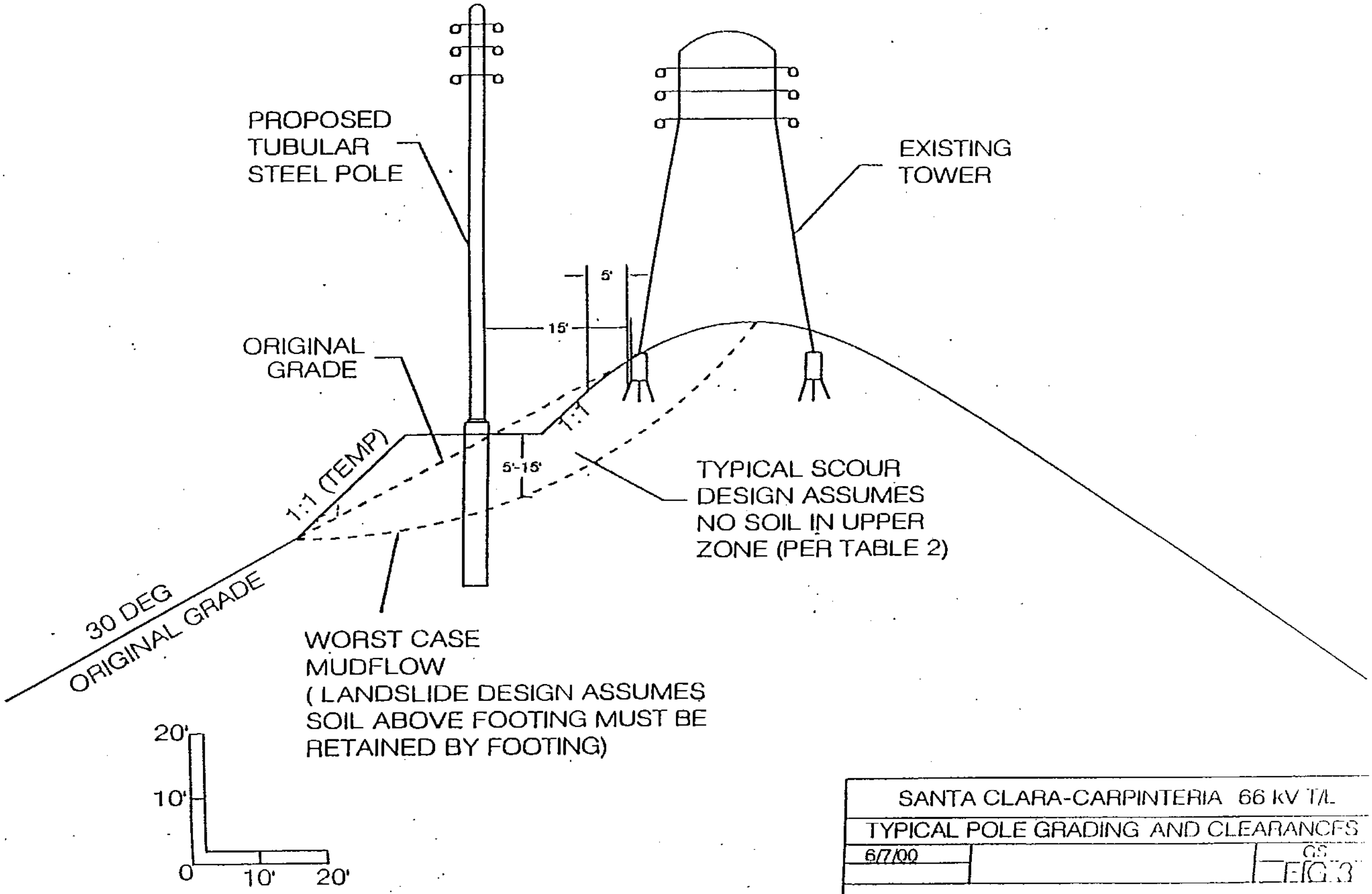
SITE MAP

SOUTHERN CALIFORNIA EDISON An EDISON INTERNATIONAL Company

FIGURE 1



SANTA CLARA -CARPINTERIA		
TEMP ACCESS ROAD GRADING		
6/6/00		GS
		FIG 2



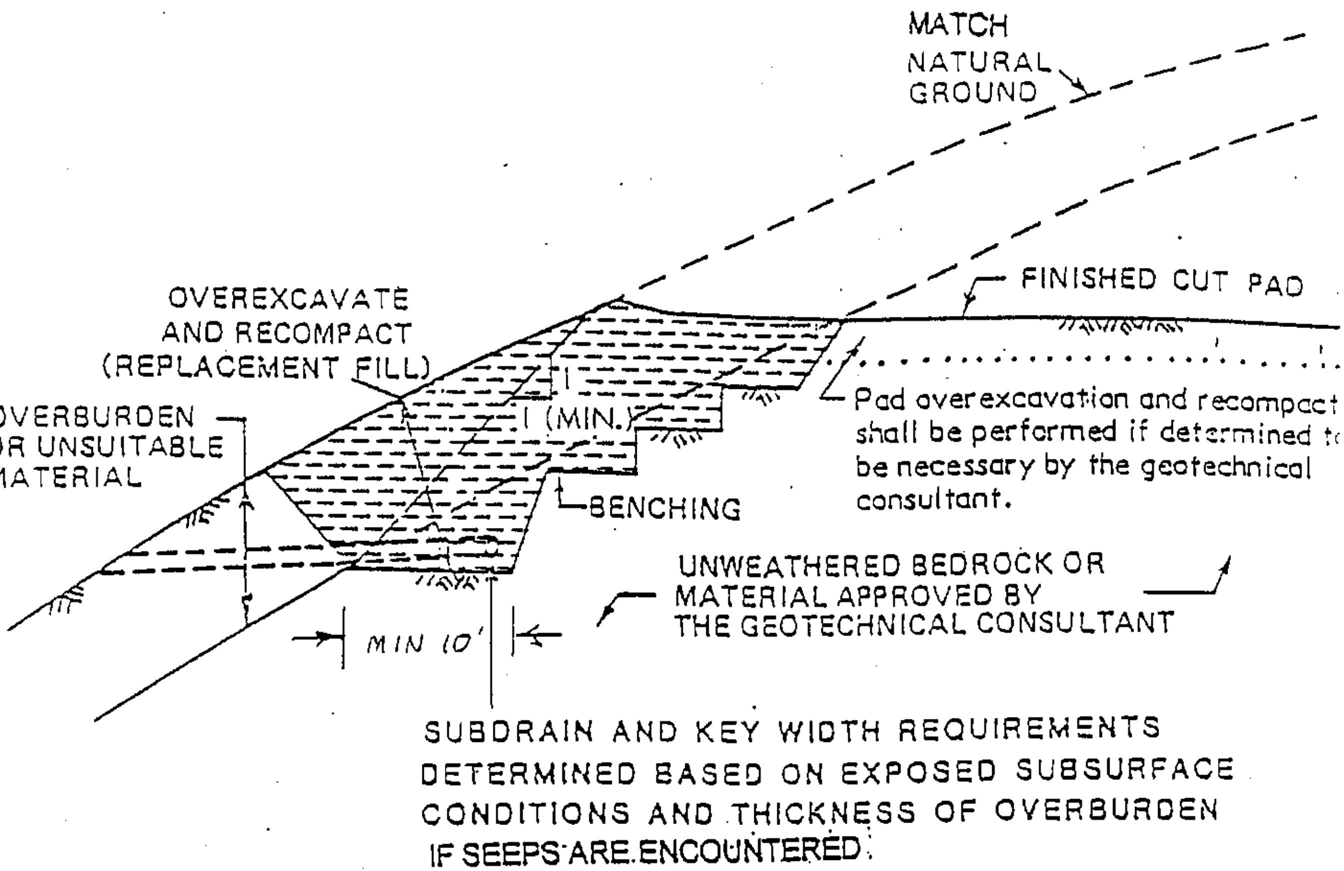
SANTA CLARA-CARPINTERIA 66 kV T/L

TYPICAL POLE GRADING AND CLEARANCES

6/7/00

FIG. 3

SIDE HILL
CUT PAD DETAIL



NOTE: All soil compaction should be performed to 90 percent of maximum Density as obtained by ASTM D1557-91 (5-layer) method of compaction.

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