FOR CONTRACT NO.: 07-4L2204

INFORMATION HANDOUT

MATERIALS INFORMATION

GEOTECHNICAL DESIGN REPORT

ROUTE: 07-LA-1-PM 82.8/83.3

REVISED PER ADDENDUM No. 3 DATED SEPTEMBER 7, 2011

Memorandum

Flex your power!
Be energy efficient!

To: MR. O. C. LEE– 07
Sr. Transportation Engineer

Attention: Mr. Hoa Luu

Date: November 18, 2005

File: 07-LA-01-PM51.6/KP83.07
EA 07-4L2201
Escondido Beach Landslide

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design - South

Subject: Geotechnical Design Report

Introduction

This report is to provides geotechnical data and analysis for remediation of an unstable slope located approximately at Post Mile 51.6 on the Pacific Coast Highway (Inter State Route 01). A site location plan is shown on Figure 1. The affected area is approximately 225 m long and 66 m to 100 m wide. The slope appears to be part of an older and larger landslide prone area (Figure 2, Feature 1).

Aerial photos of the area taken in 2003 were obtained from the Caltrans Photogrammetry Archives (Figure 2).

Previously (as described in the Preliminary Geotechnical Report dated August 23, 2002), the primary area of concern was the down slope on the south side of the highway (Figure 2, Feature 2). During the severe winter storms of December 2004 to February 2005 a localized slope failure (Figure 2, Feature 4) occurred upslope on the north side of the highway. The failure was triggered by surface flow and infiltration of storm water. Figure 3a shows the localized slope failure on the up slope side. The down-slope area is densely vegetated and highly uneven, typical of a slope that has undergone past movement. In addition, new movement at depth was triggered on the south side of the highway as a result of the 2004-2005 winter storms. This report presents data and analysis for both slopes (hereinafter called Escondido Beach Landslide).

Cracks on highway pavement were observed during a February, 2005 inspection, as shown in the attached photographs (Figure 3a and 3b). These photographs show that a series of curvilinear cracks have developed at the top of the slope primarily in Lane No. 2 of the eastbound Pacific Coast Highway (Figure 2, Feature 2). A distinct curvilinear scarp has formed and a maximum vertical separation of about 50 mm across the scarp was measured during the site inspection. The vertical separation was only 6 to 10 mm in July 2002.

Minor cracking in Lanes 1 and 2, which was observed in early 2002 at the eastern end of the affected area has propagated further towards the east. In addition, minor cracks crossing Lanes 1 and 2 of the westbound highway were also observed in the same area during the site inspection in February 2005.

Geology and Seismicity

The geology in the area of the Escondido Beach Landslide consists of Late Pleistocene age landslide debris and Pleistocene age alluvium consisting of gravel sand and clay, overlying the Miocene age Trancas and Modelo Formations consisting primarily of siliceous and clay shales (Figure 4a). The alluvium is of high permeability and consists of all sizes from silty clay to cobbles. The shales of Trancas and Modelo Formations are characterized by stiff clay to silty clay interbedded with silty fine sands [4]. The clay and sands occur as separate thin laminae but at some locations the sands are massive enough to be distinguished as a separate unit. The materials are extensively folded and faulted. Numerous small slickensided fractures cut across the bedding. These structural imperfections are not revealed until the material is failed in shear tests [3]. The surface geology has been modified as a result of relocation of the Pacific Coast Highway in 1940-47 [3] and placement of fill whenever emergency repair work was done in the past. Probably the excavated, dried slide mass (landslide debris) was compacted and placed as fill during the past emergency repair work [2].

The nearest seismic source is Malibu Coast-Santa Monica-Hollywood-Raymond (MMR) Fault (Figure 4b). Based on the 1996 Caltrans Seismic Hazard Map (CSHM), this reverse/oblique fault is located about 0.7 km north from the project site. The Malibu Coast Fault is a reverse/oblique fault with probable magnitudes of 7.5 (Mw) and slip rate of 0.3 mm/y. Based on the Caltrans' current policy of taking the Peak Bedrock Acceleration (PBA) from Reverse/Oblique fault as equal to 110% of that from Strike Slip (ST) fault with the same MCE and distance, and in accordance with the attenuation by Sadigh et al (1997), the design PBA at the site should be taken as 0.8g.

The site is not located within any Alquist Priolo Earthquake Fault Zone as defined by the California Geological Survey [5]. Because the minimum site to fault distance is 0.7 km, susceptibility to ground rupture hazard is considered low. The site is not susceptible to liquefaction based on the subsurface information available. The potential for other secondary seismic hazards including lateral spreading are considered to be very low.

Site History

The history of slope movements in the project area has been well documented [2]. Movement in eastbound lanes was first noticed in February 1978. By early March, 1978 a scarp about 1.2 m high had developed along the median and movement was continuing. The highway fill as well as the adjacent Garvey property to which it was keyed moved out on Malibu Cove Colony Road. The movement was generally along an S30^{o}W alignment [2].

During mid March 1978 a drilled pile system was installed on the North side of the median to protect the northbound lanes (Figure 5). The system consisted of 250 mm x 250 mm H beams in 600 mm diameter drilled holes at 3 m centers and filled with concrete. The pile tip elevation was about 10.7 m below highway grade. Wood lagging was placed between the piles. During late March 1978, six 40 mm diameter slotted PVC horizontal drains were installed into the slide mass from Malibu Cove Colony Road. These drains initially drained at 20,000 gallons per day and by mid April 1978 the flow rate had decreased to 2300 gallons per day (last reported May 16, 1978). Two slope indicators were installed during mid April 1978. These were read weekly upto May 12, 1978. The slope indicator readings along with observations on survey stakes indicated that movement had slowed with no gross change during the three-week period ending May 5, 1978 [2].

A drainage gallery was also installed after the 1978 failure (exact construction date unknown). The gallery was placed 6 m north of the centerline (the actual location is probably closer to the median within the No. 1 westbound lane) as described in the landslide repair recommendations [2]. The drainage gallery was constructed with a row of 0.9 m diameter, 15 m deep holes backfilled with Class 2 permeable material. The gallery appears to be functional to this day and a submersible pump is being used to pump out the water collected in a collection well located on the freeway median.

In 1993 due to reactivation of the slide emergency repair work was carried out [1]. The following chronological information relating to this work was compiled from discussions with Caltrans staff:

(i) 6 horizontal drains were installed from the toe of the slope along Malibu Colony Road. These are still operational.
(ii) In September 1993, 5 slope indicators and 3 wells were installed. Two of the slope indicators were installed at highway level near the hinge point, two along Malibu Cove Colony Road near the toe of slope and one at mid-slope location. The wells were installed at the top, mid-slope and toe locations.
(iv) In 1995 a reconstruction of the roadbed was carried out and in order to achieve the necessary width. A guardrail wall was built along the eastbound shoulder with a concrete

barrier on the top. The two slope indicators and a well at the top of the slope were paved over during the reconstruction.

During October 2001 the submersible pump installed for the drainage gallery was withdrawn and an attempt was made to clean the well and gallery by flushing water at high pressure. However, the submersible pump functioned only for about a week after the cleaning. Therefore, in March 2002, a 150 mm diameter water well was re-drilled at the same location and a new submersible pump was installed in the well. The new pump is reported to be working properly.

In April-June 2002, the Caltrans Ventura Regional Survey Office installed thirteen survey monuments. In addition, two slope indicators and one water level monitoring well were installed at the highway level in July 2002 (Table 1). In February 2005 two additional slope indicators were installed on the westbound shoulder of the highway. These were installed within the zone of the slope failure that occurred during the winter storms of December 2004 to February 2005. A location map of the existing instrumentation is shown on Figure 6.

Table 1: Instrumentation installed in July 2002 and February 2005

Instrument ID	Type	Location* (m)	Depth (m)	Installed
SI_07_02	Slope inclinometer	211+47 9.2 m RT CL RTE 01	19.8	July 2002
SI_08_02	Slope Inclinometer	211+48 8.2 m LT CL RTE 01	30.5	July 2002
W4_02	Monitoring well	211+75 8 m RT CL RTE 01	18	July 2002
SI_09_05	Slope inclinometer	211+87.8 m 6.3 m LT CL RTE 01	24.4	Feb. 2005
SI_10_05	Slope Inclinometer	212+35.9 m 6.5 m LT CL RTE 01	18.3	Feb. 2005

*Locations and elevations are approximate

Geotechnical Information

A study of landslides along Pacific Coast Highway from Colorado Avenue to Latigo Shore Drive is available [3]. The study was authorized by assembly Bill 4129 and was done during 1958-59. Relevant conclusions from this report are presented in Appendix B.

Geotechnical investigations have been conducted in the project vicinity by various agencies [3,6]. These reports contain information on the shear strength and other characteristics of the soils that may be similar to those present at the Escondido Beach Landslide location. A summary of this information is provided in Table 1 Appendix B.

During July 2002, Standard Penetration Tests (SPT) were conducted in three boreholes at selected depth intervals. The boreholes were drilled for installation of slope indicators and a monitoring well (Table 1). Undisturbed and disturbed soil samples were collected. The Caltrans Laboratory in Sacramento conducted classification and strength tests on the samples. Log of test borings (LOTBs) were prepared by the drafting department. The boring logs are attached for information (Appendix A).

During the severe winter storms of December 2004 to February 2005 a localized slope failure (Figure 2, Feature 4) occurred on the upslope north of the westbound highway. In order to determine if this movement signaled the development of a larger compound slide involving both sides of the highway, it was decided to conduct a drilling investigation and install two slope indicators (Table 1). During the drilling investigation punched core samples (114 mm diameter) were collected and preserved in core boxes. These samples are available for visual inspection at the Core Room inside the Caltrans facility located at 5900 Folsom Blvd., Sacramento 95819. Please contact the undersigned for arranging a viewing. Pictures of the core samples are included in Appendix A.

Bore Log Data

The boring records (SI_07_02 and SI_08_02) dated July 2002 indicate that the subsurface materials comprise about 8 to 9 m thick rusty brown mottled silty sand to clayey sand with isolated seams containing little to some (15 to 40%) gravel sized material. This is followed by about 5 m to 6 m thick clayey sand (SI_07_02) to sand (SI_08_02) with seams containing significant gravel and isolated cobble/boulder sized material. The upper 8 to 9 m of the mottled rusty brown strata may be filled materials consisting of weathered Modelo Formation materials. Unweathered Modelo Formation was encountered at 14 to 18 m depth below pavement level at SI_08_02. The interface between the weathered and unweathered material was characterized by alternating sequences of sandy and clayey materials. The sequences were relatively thinner at location SI_07_02.

Water level in monitoring well W4_02 fluctuated between 14.8 m, and 11.4 m below pavement level between July 2002 and May 2005. A cross section and idealized soil profile prepared on the basis of the survey data and boring logs is shown in Figure 7a and 7b

Historical Slope Indicator Data

As described above, slope indicators have been in place at the Escondido Beach Landslide since March 1978 [2]. Inclinometers were again installed during the emergency repair work of 1993. Previous records [7] indicate that two slope indicators installed during 1993 near the hinge point, indicated 4 mm movement in the N-S direction at 7.3 m depth. These readings were taken in March 1994. A field note dated 08/01/2001 reports that SI-3 located at mid-slope location was sheared at approximately 10.2 m depth. SI-4 and SI-5 are located at the toe of the slope, along Malibu Cove Colony Road (just north of house numbers 27044 and 27054). SI-4 was reported sheared at approximately 10.2 m and SI-5 reported no movement.

On April 18, 2002, readings were taken for slope indicators that were installed in 1993. The readings were taken by the Foundation Testing & Instrumentation (FT&I) group in Sacramento. Geotechnical Services Norwalk Office provided previous slope indicator readings and, field references to read the instruments. SI-3 showed about 114 mm movement since 10/19/93. No readings could be taken in SI-4 since it was sheared about 9.8 m below the top of the casing. No movement was detected in SI-5 since 10/18/93. A summary of the above-mentioned records is given in Table 2.

Table 2: Summary of Observed Cumulative Displacements

Inclinometer ID	Location on slope	Installed	Cum. Displacement* (mm) N-S				Depth of movement (m)
			03/94	10/95	08/97	04/02	
SI-1	Top	09/93	4	12	NA	NA	7.3
SI-2	Top	09/93	4	NA	30	NA	7.3-9.5
SI-3	Mid	09/93	0	NA	30	114	10
SI-4	Toe	09/93	0	NA	25	NA	9.8-10
SI-5	Toe	09/93	0	NA	NA	0	

*Cumulative displacement since 09-10/93

Recent Slope Indicator Data

<u>*Slope Indicator Data Analysis prior to December 2004*</u>: Based on the available data from SI_07_02 and SI_08_02 it appeared that movement was occurring along a planar surface with a steep head scarp at or just below the highway elevation (Figure 6a). The slope inclinometer data did not suggest deep-seated movement. The highway fill constructed during the emergency repair of March-April 1978 moved down and outwards along with the highly disturbed Modelo Formation materials on the down-slope side. Instability at the

interface of the weathered and unweathered Modelo Formation due to groundwater seepage may also have contributed to the observed movements. The location where the slide surface daylights cannot be determined, due to Right-of-Way restrictions and dense vegetation on the slope.

Slope Indicator Data Analysis after December 2004: Slope indicator data collected between December 2004 and March 2005 showed an increase in movement due to the winter storm (Figure 8). Readings of the two slope indicators, SI's 0702 and 0802, within the area of concern showed (1) significant increase of movement along the existing shallow shear zone at SI_0702, and (2) a newly detected deep-seated movement along a deeper shear zone at SI_0802 (Figures 9 and 10). According to the slope indicator readings, the shallow shear zone is about 5.2 m below the highway and the deep-seated shear zone is about 13.5 m below the highway

Approximately 20 mm additional movement along the shallow shear zone was observed due to the rainstorm, which resulted in a cumulative movement of 47 mm since the installation of the slope indicator. This shallow shear zone is affecting primarily the eastbound lanes and reflects the widening of the pre-existing pavement cracks (Figure 3a), and subsidence of eastbound lane No.2.

The deep-seated movement with shear zone at 13.5 m below the roadway surface, caused uniform movement of 5 mm at both slope indicators, SI's 0702 and 0802, after the rainstorm. The deep-seated shear zone was ascertained by the consistent displacement profiles of both SI's 07_02 and 08_02 at the depths near 13.5 m. This deep seated movement will affect the entire highway section and the slopes above and below the highway.

Two readings of the newly installed Slope Indicators SI_09_05 and SI_10_05 have not shown detectable movement after they were installed in February 2005. Based on currently available data it is inconclusive whether the disturbed soil masses on the north and south side of the highway are part of a single landslide zone.

Geotechnical Analyses

A series of stability analyses were performed to model the observed slope distress on both sides of the highway (Table 3, Case 1 and 2). A separate analysis was also run to analyze stability of the entire slope encompassing the affected area on both sides of the highway (Case 3). These analyses were performed using the SLOPE/W software (Geoslope Inc.). The first two runs (Case 1 and 2) were performed to back calculate soil properties with incipient failure (Factor of Safety (FOS) ≤ 1, along a failure surface defined approximately on the basis of the observed depths of movement and visible cracking on the eastbound and westbound sides of the highway (Figure 3a, 3b). Case 3 models the recent movement observed in SI_0802 at a depth of 13.5 m, using the back calculated soil properties from Case 1 and 2. A piezometric surface was entered into the models based on observed ground water table and data from previous explorations [6]. Case 3 indicates that the entire slope has a Factor of Safety close to unity.

Table 3: Summary of Stability Analyses Results

Case	Soil Parameters	Method	Min. FOS	Figure
1	Table 5	Spencer	0.962	7
2	Table 5	Spencer	0.971	8
3	Table 5	Spencer	1.071	9

Estimated Soil Properties

The estimated soil properties presented in the following table (Table 4) may be used for design purposes. The values presented were back calculated based on slope stability analyses results, field observations, and previous geotechnical data.

Table 4: Recommended Soil Strength Parameters

Soil Description	Depth (m)	Total Unit Wt. (kN/m^3)	Cohesion (kN/m^2)	Angle of internal friction (deg.)	Ka*	Kp
Fill	0-8	19	28.8	29	0.40	2.46
Weathered Modelo and Landslide debris	0-8	14.4	7	8	0.75	1.3
Unweathered Modelo Formation	>8	15.7	33.5	5	0.80	1.2
Pleistocene Alluvium (near the shore)	> 14	20.6	0	30	0.33	3

Ka, Kp: Coefficient of active, passive earth pressure

Recommendations

The following are our recommendations:

(1) Based on the slide geometry (possibility of a compound slide affecting both sides of the highway) and considering the existing field conditions and R/W constrains, we

recommend that a soldier pile wall in combination with tieback anchors, or a contiguous bored pile wall, or a micropile wall with tiebacks should be constructed. The proposed system (piles, tiebacks) may be designed and constructed within the State R/W. The length of the wall would be in the order of 220_meters, with height ranging from 5 m to 14 meters (Figure 3). The design should provide for the following improvements:

(i) Grading and restoration of recently failed slope (Feature 1 in Figure 3) on the westbound side of the highway. A geosynthetic-reinforced slope may be constructed. This office will provide a design if requested.
(ii) Improvement of the eastbound highway fill within the slope failure zone either by replacement, or other ground improvement procedures
(iii) subsurface drainage wells and pumps at the toe of the slope on the westbound side.

(2) Geotechnical staff from this office should be consulted during the design and construction phases. This office should be contacted if soil or groundwater conditions other than those described in this report are observed during any stage. The contractors should be made aware that cobbles/boulders, caving soils and groundwater problems are likely to be encountered during construction.

(3) Stability of the slopes will improve if surface water infiltration and subsurface water leakages above the slide area (likely from swimming pools, septic tanks etc.) are diverted, or prevented, and new horizontal drains are installed and/or the existing horizontal drains are cleaned and made more effective. This would require involvement of the City of Malibu and property owners.

(4) The need for a new drainage system may be imminent in the future once the gallery drain is clogged.

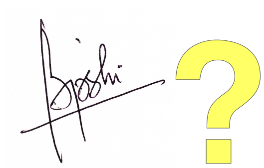
References

1 “Slope Review-LA-001 P.M. 51.6” Memorandum from Gustavo Ortega, Office of Geotechnical Design South to W. R. Sanborn, District 07, August 24, 2001.
2. “Report on Escondido Beach Landslide LA-1 Pacific Coast Highway P.M. 51.6 and Proposed Landslide Repair”, Memorandum from F. B. Correa, Chief Engineering Services to A. A. Smith Maintenance Branch, June 5, 1978.
3. “Final Report Pacific Pallisades Landslide Study” by Moran, Proctor, Mueser and Rutledge, July 1959.

4. Geologic Map of the Point Dume Quadrangle, Los Angeles and Ventura Counties, California", by T. W. Dibblee and H. E. Ehrenspeck, 1993, Dibblee Geological Foundation Map # DF48.
5. State of California Department of Conservation, Division of Mines and Geology, Special Publication 42, Fault-Rupture Hazard Zones in California, by Earl W. Hart and William A. Bryant, 1997.
6. "Response to Geologic Review Sheet and Geotechnical Review Sheet for proposed addition to an existing single family residence, 27120 Sea Vista Drive, City of Malibu", by Solus Geotechnical Corporation, Northridge CA, April 5, 1993.
7. Geotechnical Study for proposed addition, swimming pool, and Remodel of existing single family residence Portion of Lot 2, Tract RS 73-40-41, 27120 Sea Vista Drive, Malibu Area, County of Los Angeles, California", by Solus Geotechnical Corporation, Northridge CA, August 17, 1990.

Any questions or comments regarding this report should be addressed to Bhaskar Joshi, (916)-227-5241 of the Office of Geotechnical Design – South.

Prepared by: Date:11/18/05



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Bhaskar Joshi, Ph.D, P.E. (C66350)
Transportation Engineer Civil, Branch A
Office of Geotechnical Design - South

cc: Gustavo Ortega D07 Norwalk
(RGES 30)

APPENDIX A

Figure 1: Site Location Map

Figure 2: Aerial Photo of the Project Area

Figure 3a: Showing pavement cracks aligned with the east flank of the recently reactivated old landslide (February 2005).

Figure 3b: Pre-existing cracks on the eastbound side of the highway that have widened (February 2005)

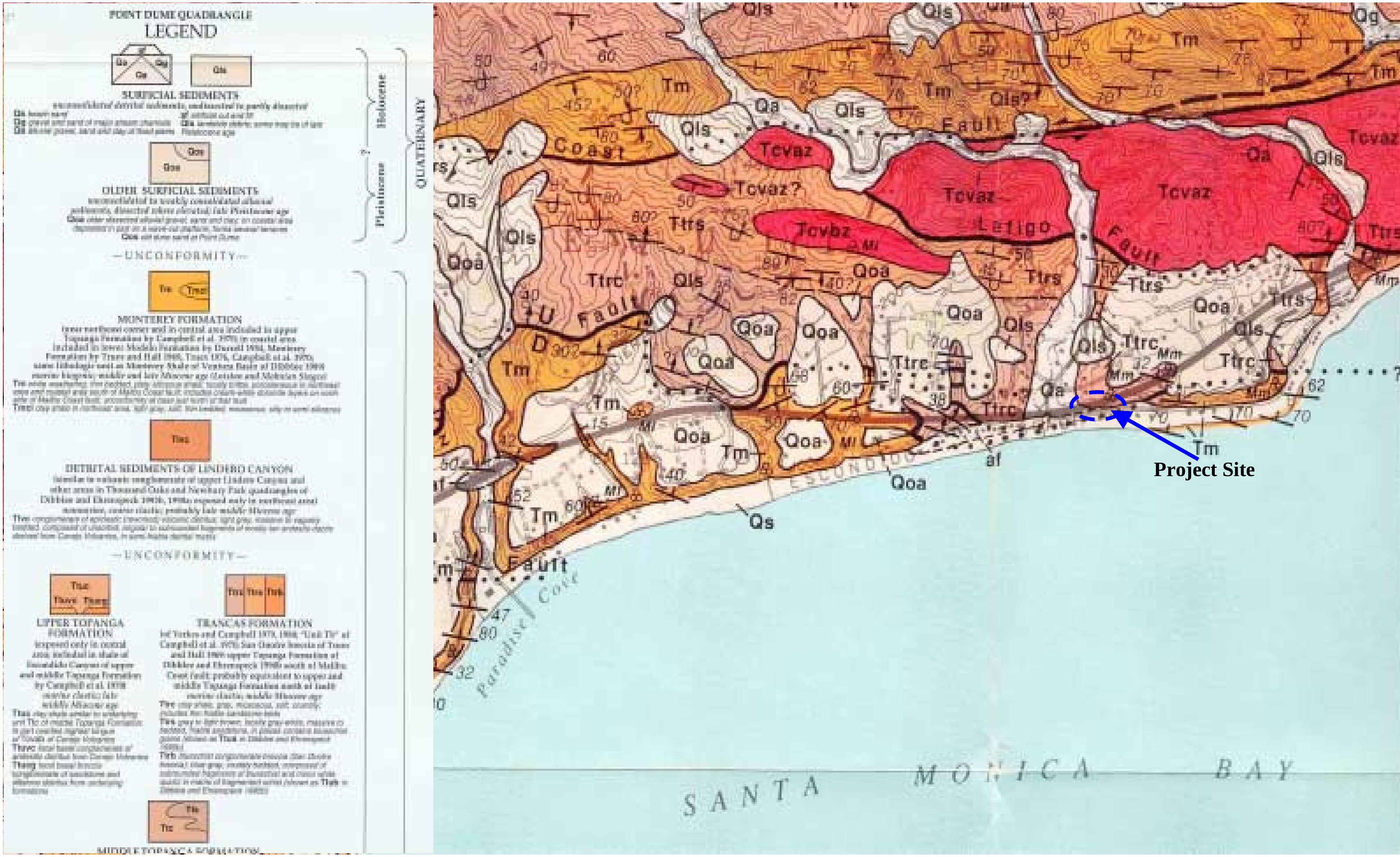


Figure 4a: Regional Geology

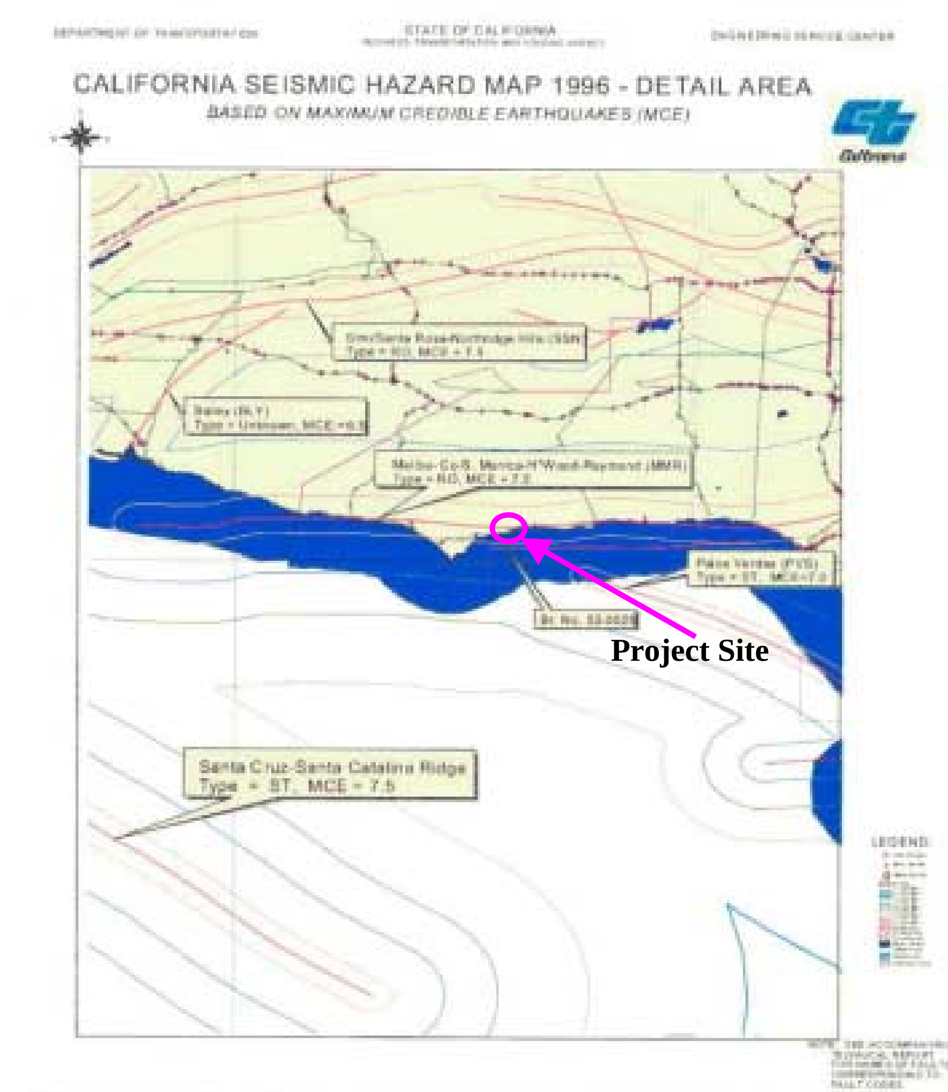


Figure 4b: Faults in the Project Vicinity

Figure 5: Drilled Pile system installed in 1978

Figure 6: Location of Field Instrumentation

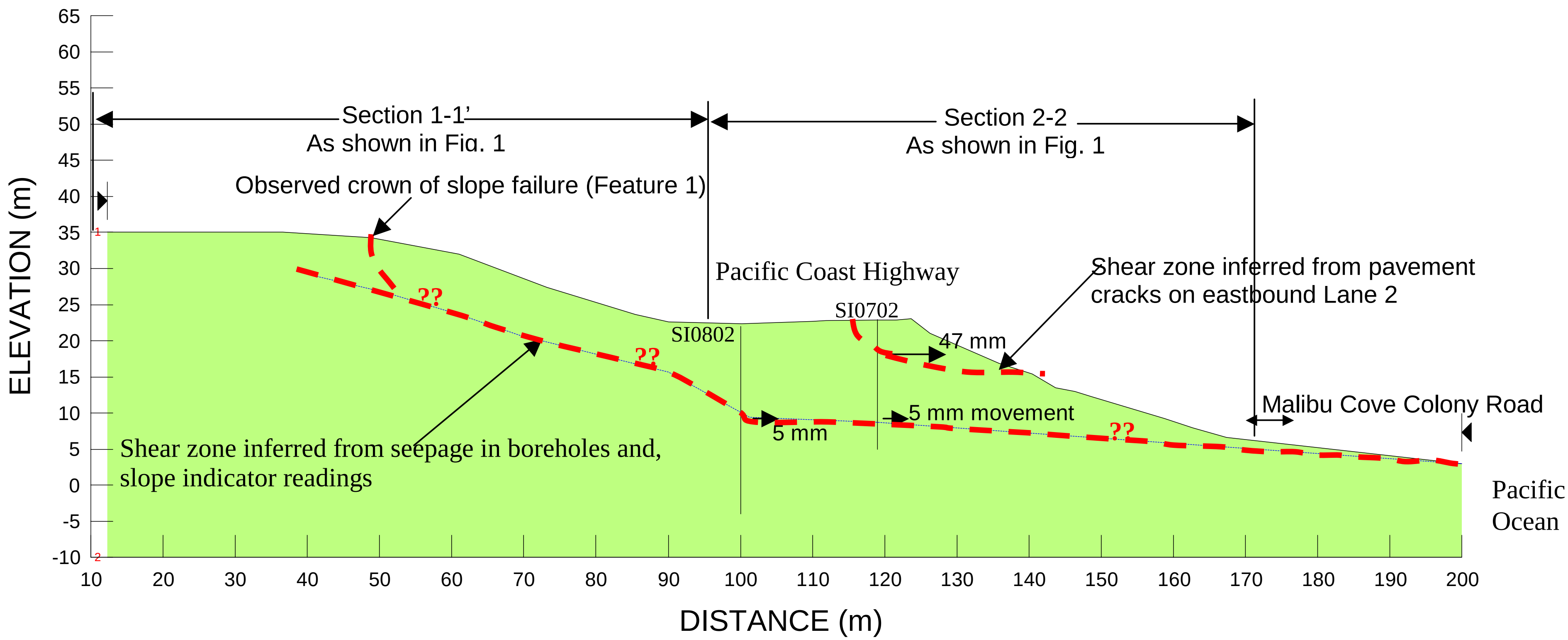


Figure 7a: Cross Section

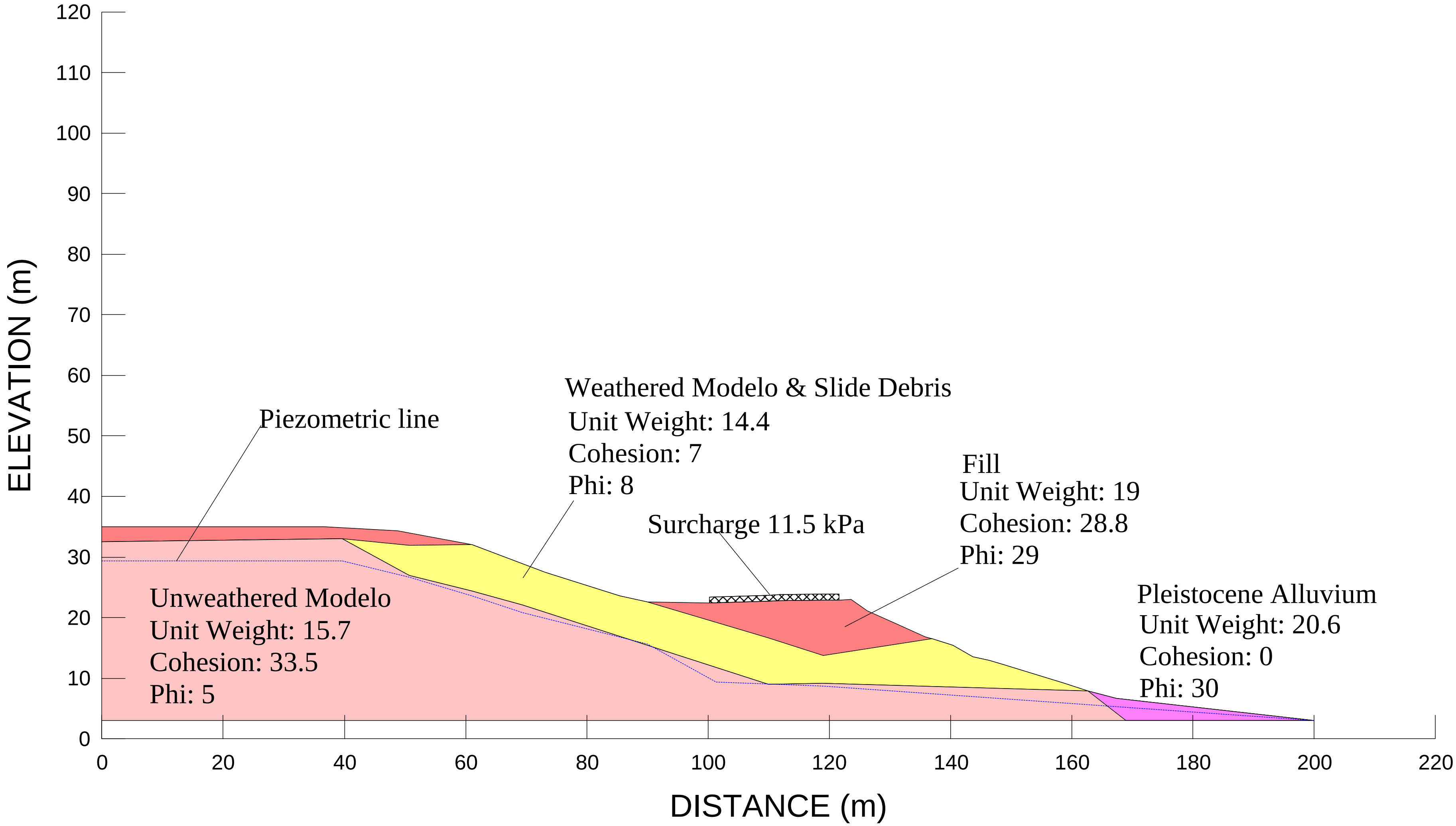
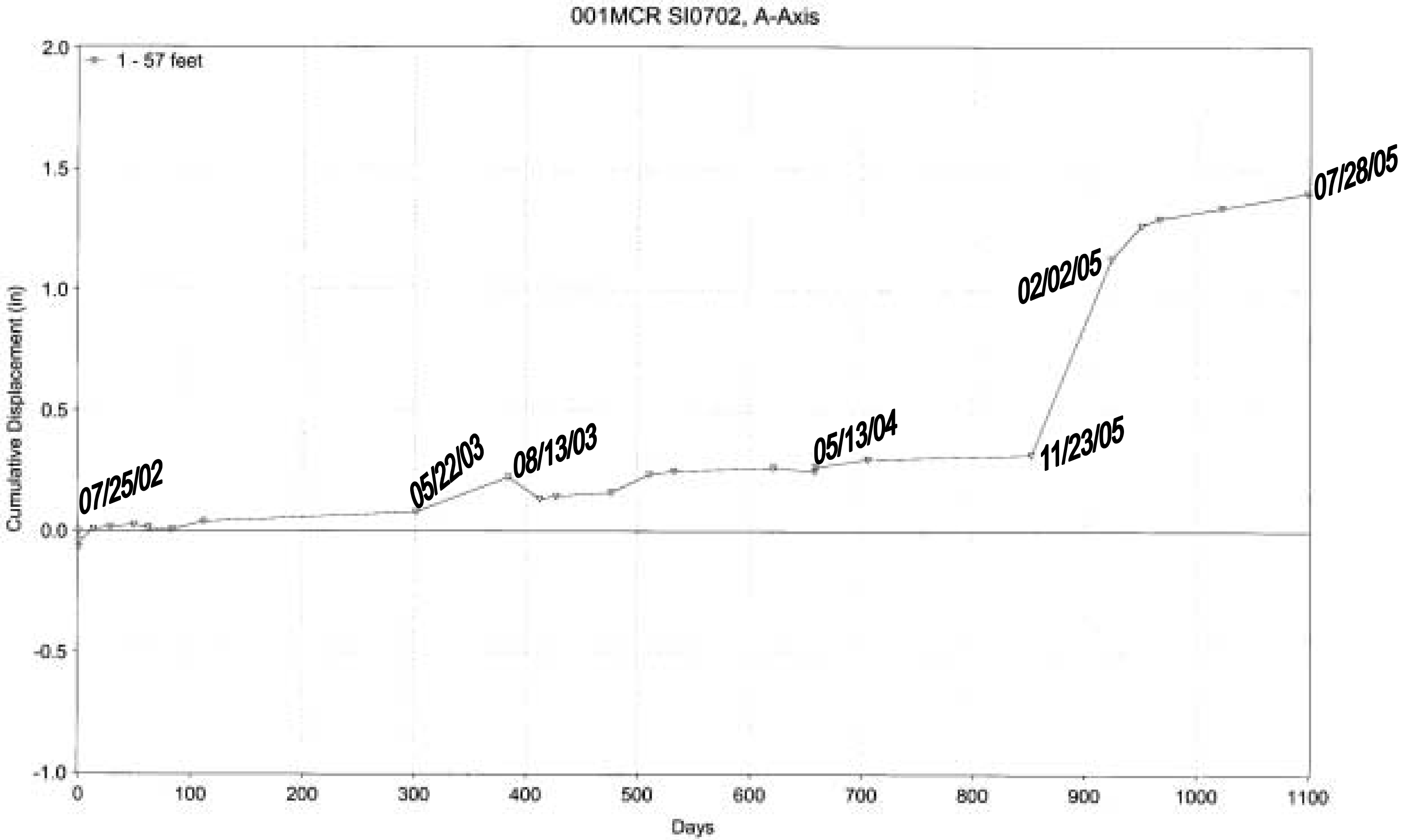


Figure 7b: Idealized Soil Profile

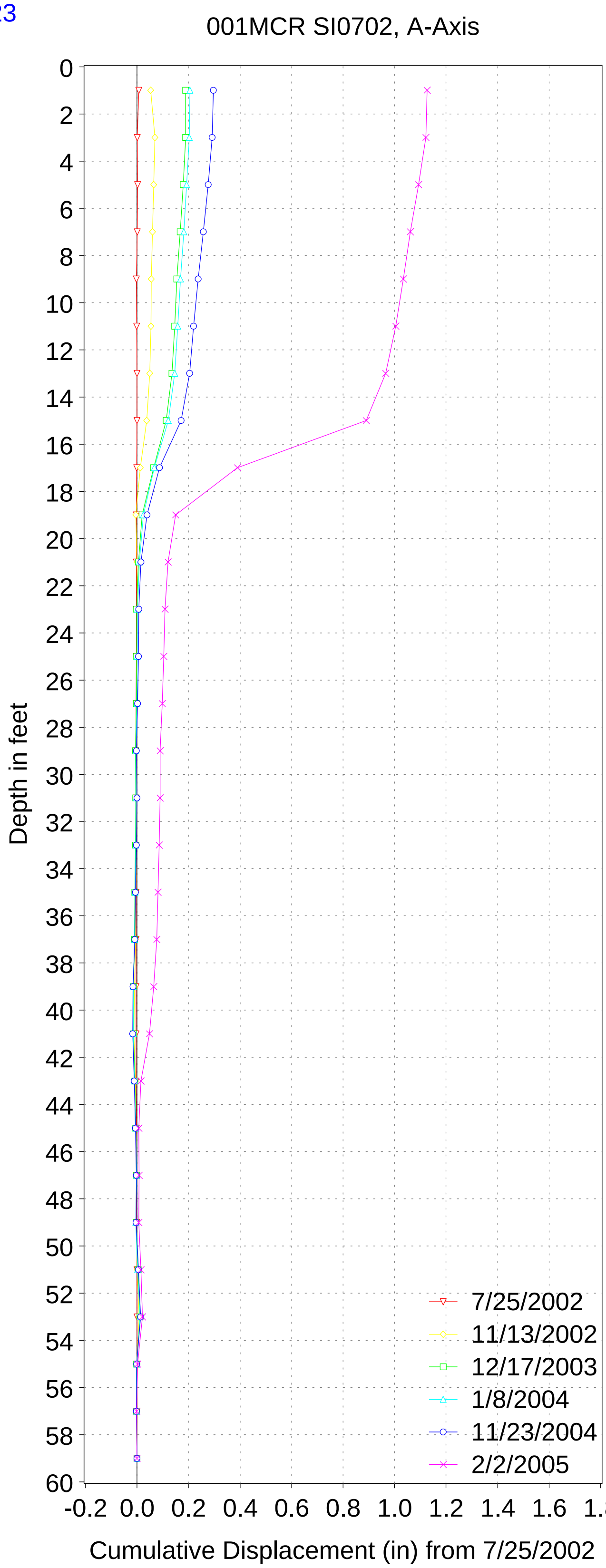


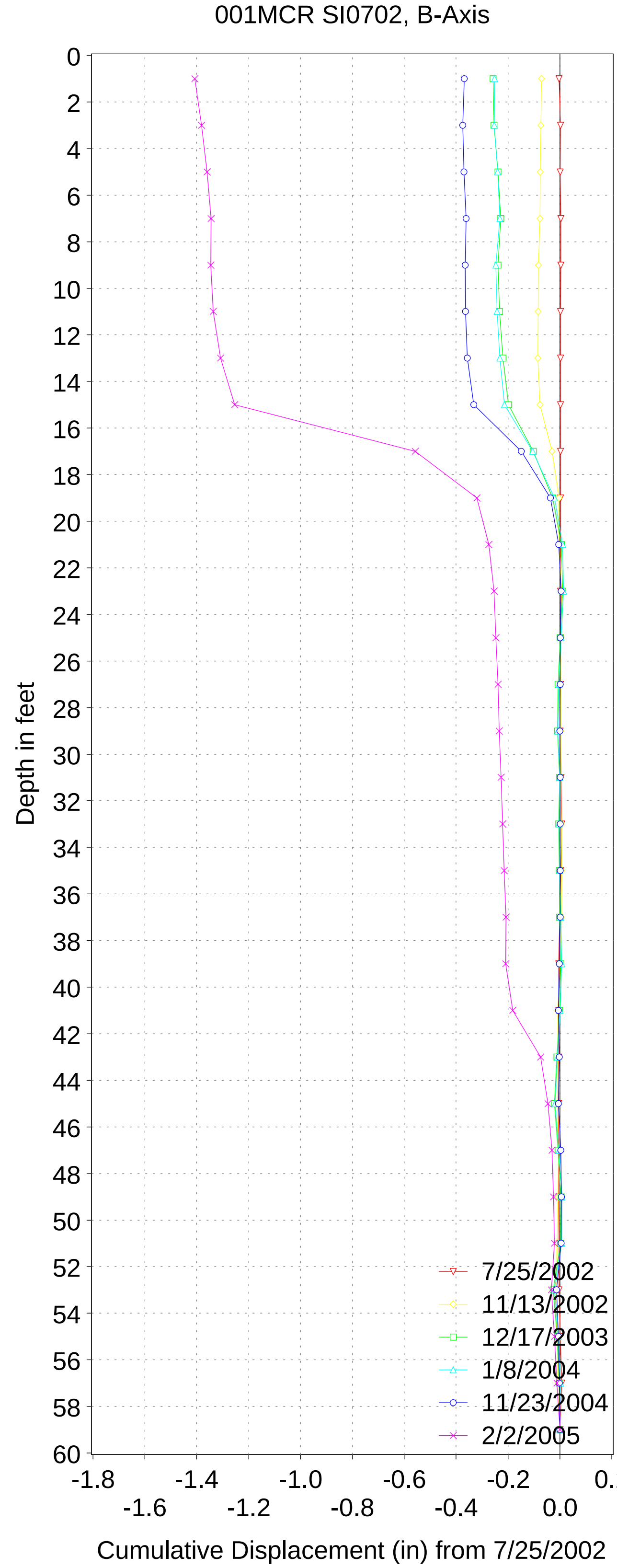
07-LA-01-P.M. 51.6
Escondido Beach Landslide
E.A. No.: 07-OP1401

Depth of Inclinometer Casing: 59 feet
Ao Direction: 200° (Magnetic North)
Location (WGS-84) : 34° 1.581' N ; 118° 45.731' W

Figure 8: Time Series plot for Inclinometer SI_07_02

Figure 9: Record of Slope Indicator No. 0702

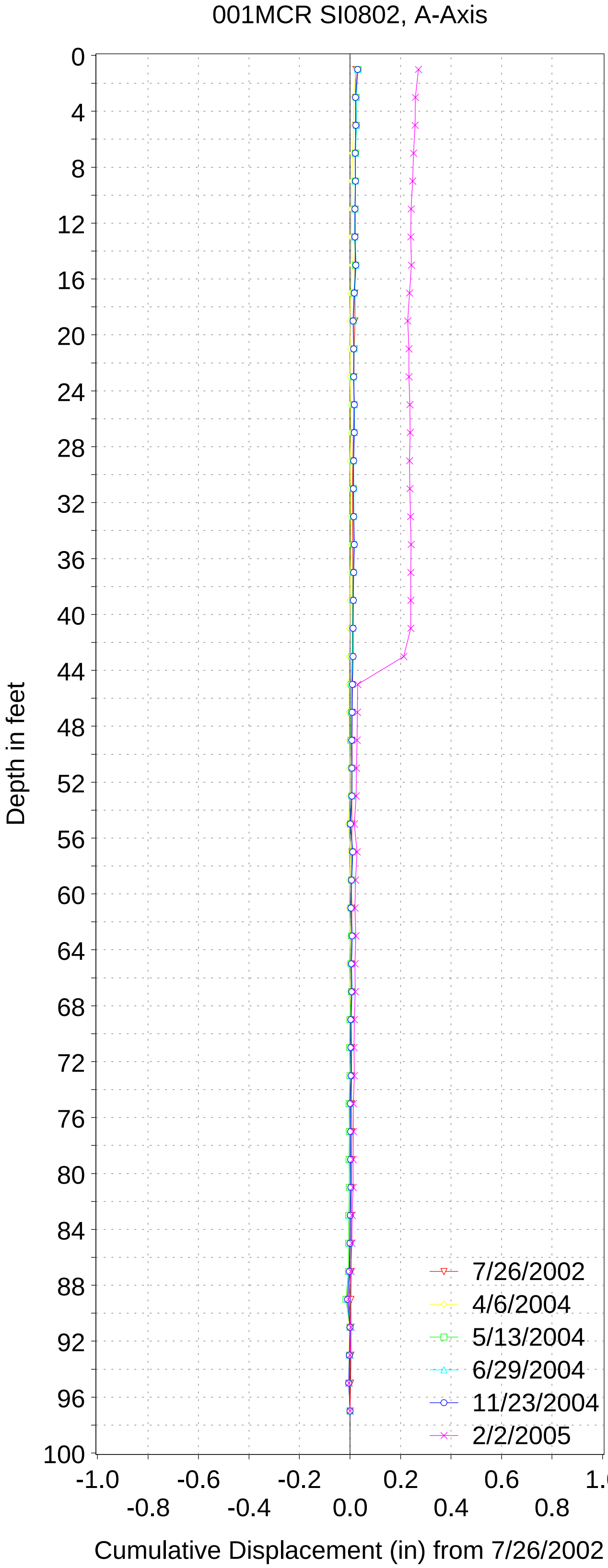


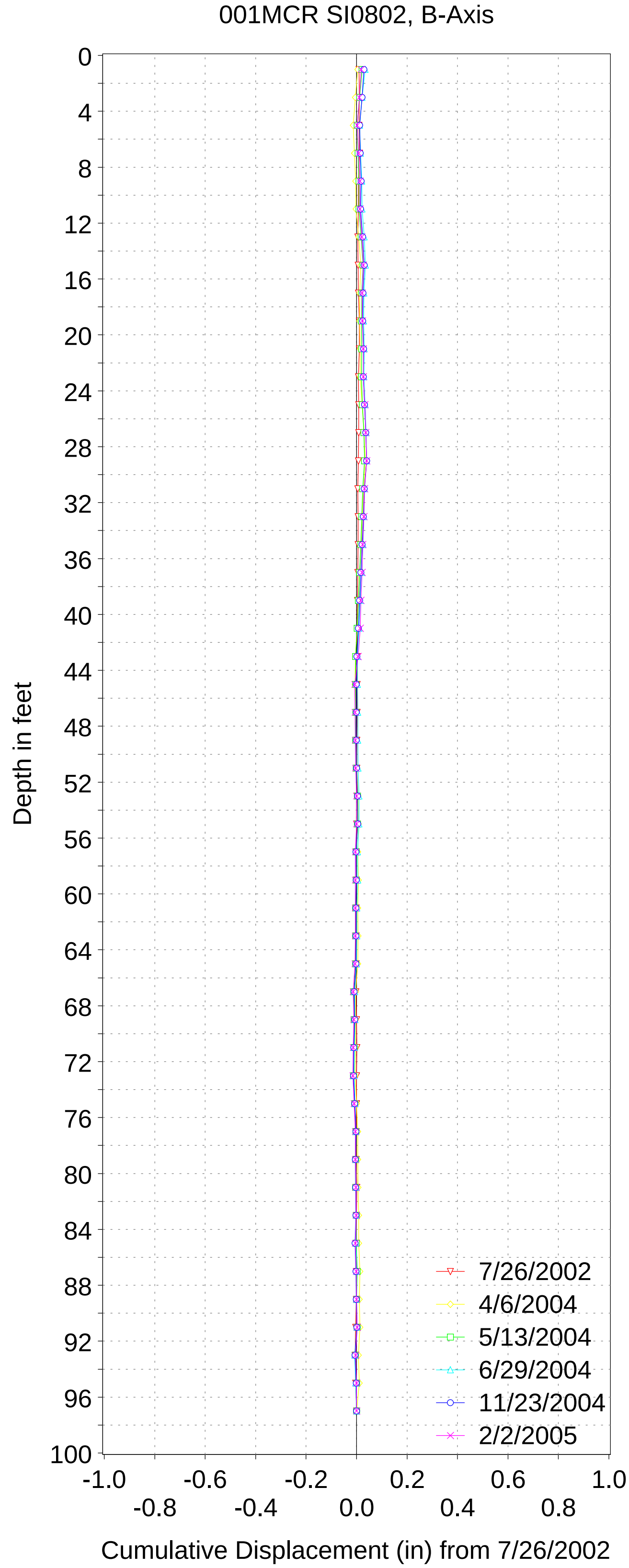


INCLINOMETER RESULTS

07-LA-01-P.M. 51.6	Depth of Inclinometer Casing: 59 feet
Malibu Colony Road Landslide	Ao Direction: 200° (Magnetic North)
E.A. No.: 07-OP1401	Location (WGS-84) : 34° 1.581' N ; 118° 45.731' W

Figure 10: Record of Slope Indicator No. 0802





INCLINOMETER RESULTS

07-LA-01-P.M. 51.6
Malibu Colony Road Landslide
E.A. No.: 07-OP1401

Depth of Inclinometer Casing: 97 feet
Ao Direction: 140° (Magnetic North)
Location (WGS-84) : 34° 01.591' N ; 118° 45.738' W

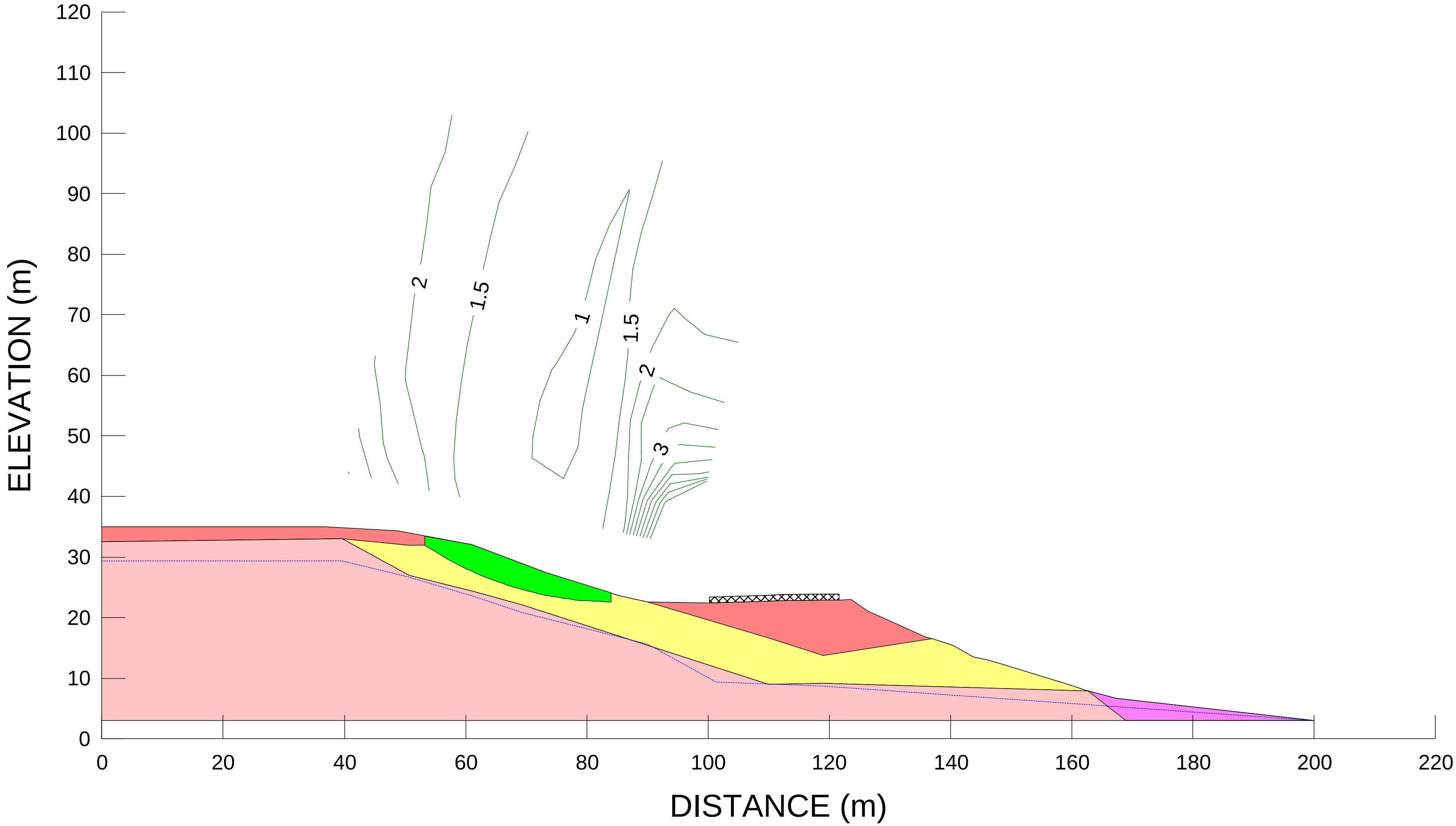


Figure 11: Stability Analyses of Upper Slope

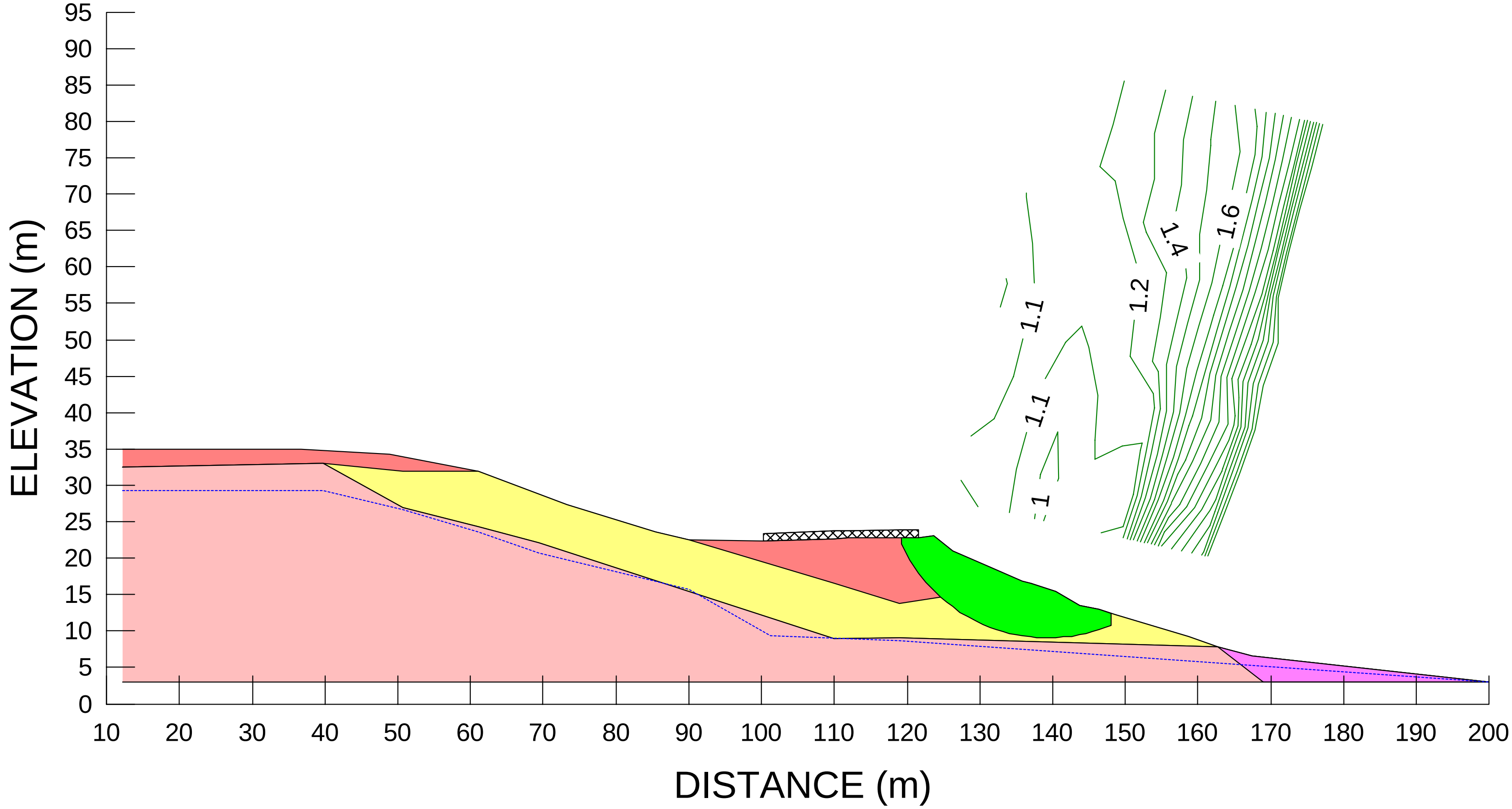


Figure 12: Stability Analyses of Lower Slope

Figure 13: Stability Analyses of Upper & Lower Slope

APPENDIX B (Pages 28-41)

Previous Studies

An excellent study of landslides along Pacific Coast Highway from Colorado Avenue to Latigo Shore Drive is available [3]. The study was authorized by assembly Bill 4129 and was done during 1958-59. The northern extent of this study area (named Latigo Shore Landslide) is approximately 550 m to the east of the Escondido Beach Landslide. The geology at this location is described as terrace alluvium underlain by thin-bedded clay and fine sand of the Modelo Formation.

Groundwater levels (Elevation ~ 9.7 m to 9.9 m) were reported to be within a few meters of the ground surface at the Pacific Coast Highway (Elevation ~ 11.2 m). Laboratory tests of samples collected at Latigo Shore Landslide indicated that intense distortion had made the tertiary clays (Modelo Formation) plastic, and straining of this material continued under a shear stress that was much smaller than the peak strength. Field strengths obtained from back-analyses of observed movements were substantially lower than laboratory strengths at conventional and even low rates of strain. The strengths at actual rates of strain were about half of the strengths at the conventional laboratory strain rates [3].

The Pacific Pallisades Study recommended that at Latigo Shore Landslide, the most cost-effective stabilization measure would consist of interception of groundwater seeping into the slide from the North as well as reduction of seepage pressures within the slide by installation of drainage trenches or horizontal drains in the pervious alluvium that overlies the Modelo Formation. The report also recommended that the most effective scheme would be to control the development of residential areas within ancient slide zones by zoning regulations or publicity about the location of these areas [3].

Geotechnical investigations have been conducted in the project vicinity by various agencies [3,5]. These reports contain good information on the shear strength and other characteristics of the soils that may be similar to those present at the Escondido Beach Landslide location. A summary of this

Table 1: Summary of Geotechnical Information from Previous Investigations

Soil Description	Dry density kN/m^3	Water content %	Cohesion kPa	Friction angle deg	Reference No.
Pleistocene Alluvium A2	16.7	17.3	21.5	30	3 (T2,6)
Weathered Modelo Formation B1[a]	14.4	26	23.9	24.5	3 (T2,6)
Unweathered Modelo Formation B2[b]	15.7	26	33.5	11.5	3 (T2,6)
Modelo Formation B3[c]	17.6	16.5	-	-	3 (T2)
Landslide debris[d]	14.8	33	40-50	20-23	5 (S3)
Landslide debris[e]	14.8	26.6	7.2	12	6 (4.1)
Bedrock[##]	14.4-17.6	25.5	12-25	19-29	5 (S4-6)

[a] Stratum B1: Weathered Modelo: stiff brown and gray silty clay thin bedded w some light gray fine sand
[b]Stratum B2: Unweathered Modelo, hard dark gray silty clay thin bedded w some light gray fine sand
[c]Stratum B3: Compact fine to medium sand w silt and OCC clay seams
[d]These were most likely intact B1 materials since location of Borehole was outside the landslide area
[e]These were based on lab strengths calibrated by stability analyses to a Factor of Safety of Unity
Note 1: (T2,6): Table2 & 6, (S3-6):Plate S3 to S6
Note 2: From T2 and T6 only the test strengths representing normal laboratory test rates (~200 radians/day) were selected.

The Pacific Pallisades Landslide Study [3] contains a detailed analysis of the Latigo Shore Landslide located approximately 550 m east of the project site. The subsoil and groundwater conditions at this site are very similar to Escondido beach. The cross section at this location (Section 48 on Sheet GS26 of [3]) shows about 3 m of fill underlain by 3 m to 5 m thickness each of Strata A2 and Strata B1 followed by a least 36 m thickness of Strata B2. The bedding of Strata A2 and B1 generally follow the slope profile. Stability analyses were used to determine the most probable field strengths for a Factor of Safety ~1 using a failure surface inferred from field measurements. These values are shown in Table 2.

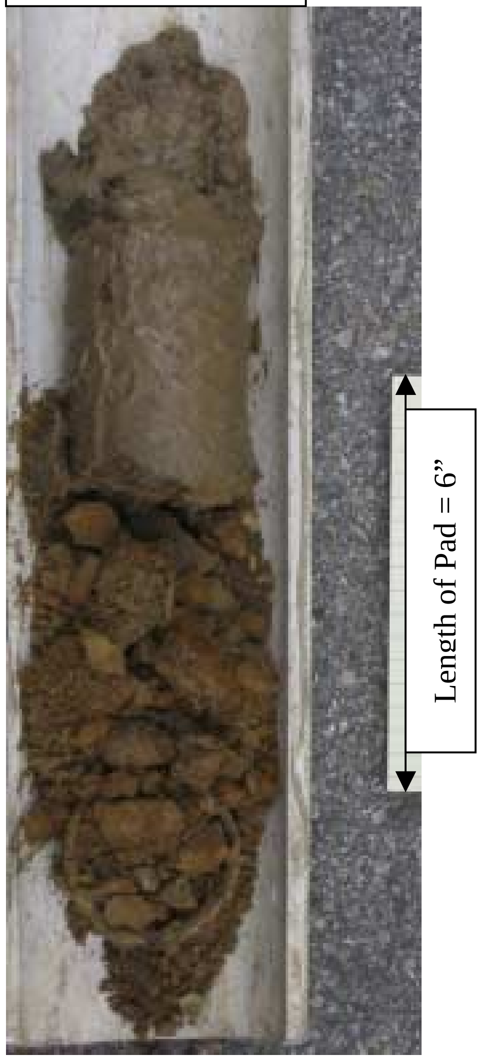
Table 2: Most Probable Field Strength calculated for Latigo Shore Landslide.

Strata involved	Dry density[b] kN/m^3	Water content[b] %	Cohesion[a] kPa	Friction angle[b] deg	Reference No.
Modelo Formation 45% B2, 45%B3*	14.4-15.7	26	19	8.5	3 (row 1, T11)

[a]Most probable field strength inferred from mobilized field strength and laboratory tests
[b] From Table 1 above

0-5 ft

5-10 ft



12-15 ft

PICTURES OF SOIL CORES OBTAINED DURING INSTALLATION OF Slope Indicator No. SI0905
ESCONDIDO BEACH LANDSLIDE RTE 01-PM51.6, CITY OF MALIBU; CORE ROOM ID 21B

18.3-20 ft

20-24.5 ft

25-30 ft

PICTURES OF SOIL CORES OBTAINED DURING INSTALLATION OF Slope Indicator No. SI0905
ESCONDIDO BEACH LANDSLIDE RTE 01-PM51.6, CITY OF MALIBU; CORE ROOM ID 21B

30-34.5 ft

35-36.3 ft

38-40 ft

PICTURES OF SOIL CORES OBTAINED DURING INSTALLATION OF Slope Indicator No. SI0905
ESCONDIDO BEACH LANDSLIDE RTE 01-PM51.6, CITY OF MALIBU; CORE ROOM ID 21B

40-45 ft

45-50 ft

50-55 ft

PICTURES OF SOIL CORES OBTAINED DURING INSTALLATION OF Slope Indicator No. SI0905
ESCONDIDO BEACH LANDSLIDE RTE 01-PM51.6, CITY OF MALIBU; CORE ROOM ID 21B

55-58 ft

58-61 ftt

61-65 ftt

PICTURES OF SOIL CORES OBTAINED DURING INSTALLATION OF Slope Indicator No. SI0905
ESCONDIDO BEACH LANDSLIDE RTE 01-PM51.6, CITY OF MALIBU; CORE ROOM ID 21B

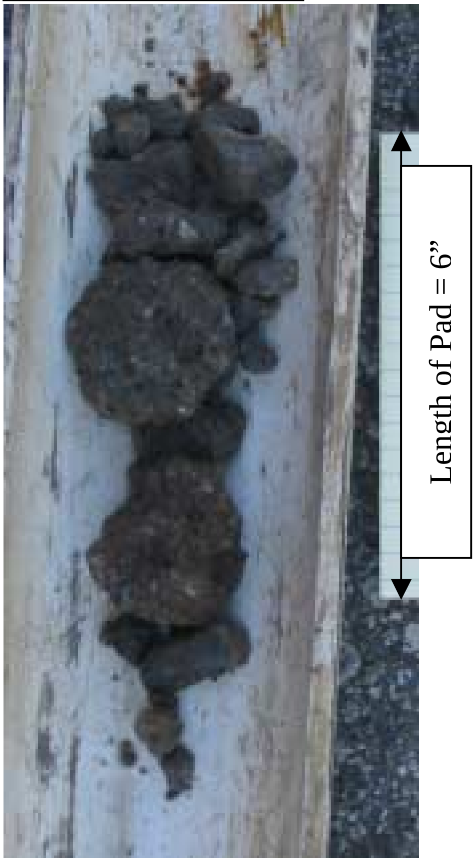
65-65.5 ftt

65.5-69.75 ftt

70-75 ftt

PICTURES OF SOIL CORES OBTAINED DURING INSTALLATION OF Slope Indicator No. SI0905
ESCONDIDO BEACH LANDSLIDE RTE 01-PM51.6, CITY OF MALIBU; CORE ROOM ID 21B

0-1 ft



5-10 ft

10-15 ft

PICTURES OF SOIL CORES OBTAINED DURING INSTALLATION OF Slope Indicator No. SI1005
ESCONDIDO BEACH LANDSLIDE RTE 01-PM51.6, CITY OF MALIBU; CORE ROOM ID 22C

15-20 ft

20-25 ft

25-30 ft

PICTURES OF SOIL CORES OBTAINED DURING INSTALLATION OF Slope Indicator No. SI1005
ESCONDIDO BEACH LANDSLIDE RTE 01-PM51.6, CITY OF MALIBU; CORE ROOM ID 22C

30-35 ft

35-40 ft

40-45 ft

PICTURES OF SOIL CORES OBTAINED DURING INSTALLATION OF Slope Indicator No. SI1005
ESCONDIDO BEACH LANDSLIDE RTE 01-PM51.6, CITY OF MALIBU; CORE ROOM ID 22C

45-50 ft

50-55 ft

55-60 ft

PICTURES OF SOIL CORES OBTAINED DURING INSTALLATION OF Slope Indicator No. SI1005
ESCONDIDO BEACH LANDSLIDE RTE 01-PM51.6, CITY OF MALIBU; CORE ROOM ID 22C

OFFICE MEMO
STD. 100 (REV. 12/85)

Date 11/18/05

TO: **Connie Reyes**

Room Number/Phone Number
289/227-7315

FROM:
B. JOSHI
Office of Geotechnical Design-South

Phone Number
(916) 227-5241

SUBJECT: Escondido Beach Landslide

Structure Name:_______NA

Structure Number:_____NA

District________07, County LA , Route 01, PM 51.6

Structure File Type: (check one)

______________State Bridge

______________County Bridge

______________Forest Service Bridges

______________Fish & Game Structures

______________U.S. Government Agencies

______________Local Transit Authority

______________State Sign Structure

______________Toll Plaza on State highway

______________Weight Stations (Truck Scales)

______________________MSE Retaining Wall

________________Maintenance Station

________________Safety Roadside Rest

____________________Retaining Wall

________________________Sound wall

____________________✓___Roadway

_____Miscellaneous (Culvert, etc.)

Service Request: (check one)

_______Request for a new folder with label.

____√__Folder exists.

Additional Comments:

Please check the highlighted parts of this instruction sheet. Your support is greatly appreciated.