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MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS
4530 EAST LA PALMA AVENUE • ANAHEIM, CALIFORNIA 92807 • (714) 779-2591

OTHER OFFICES:
WEST SACRAMENTO
SANTA ROSA

ADDENDUM REPORT OF GEOTECHNICAL INVESTIGATION

Easterly Portion of Parcel 15
Portuguese Bend Club
Rancho Palos Verdes, California

Client

Palos Verdes Properties, Inc.

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ADDENDUM REPORT OF GEOTECHNICAL INVESTIGATION

Introduction

This report has been prepared as an addendum to our report of "Geotechnical Investigation - Easterly Portion of Parcel 15, Portuguese Bend Club, Rancho Palos Verdes, California", dated February 6, 1981. As such, this report should not be held for consideration without reference to the information and conclusions presented in the original report, with the exception of the Geologic Map (scale 1" = 80') and the cross sections (scale 1" = 80') which have been revised and are attached (in pocket).

Scope

The gross stability of the eastern portion of Parcel 15 (and the Klondike Canyon area, in general) is dependent upon the underlying bedrock structure, particularly as it relates to landsliding in the Portuguese Bend area. For this reason it was necessary to significantly increase the scope of the investigation to include data from the eastern portion of the active Portuguese Bend landslide, Parcel 11, Parcel 12, and the Seaview Tract. Concurrent investigations are presently in progress on Parcel 11 by Lindvall, Richter and Associates and on Parcel 12 by Converse-Ward-Davis-Dixon. Information from these investigations has been freely exchanged among the three consultants to facilitate definition of the bedrock structure underlying the Klondike Canyon area and to expedite each respective investigation.

Reference Material

In addition to those sources mentioned in our original report, the following reports, maps and boring logs were also used:

a) "Subsurface Exploration Adjacent to Klondike Canyon," Moore & Taber, June 9, 1981 (Job No. 381-426) Logs of borings R.P.V.-1, R.P.V.-2, R.P.V.-3 (K4A) appear in Section II of the Appendix. Gamma logs of these borings have been included in "Stratigraphic Correlations" on Plate V (in-pocket).

b) Map "Portuguese Bend Landslide - Subsurface Contours of Slip Plane" (scale 1" = 200'), Palos Verdes Properties by John G. Nordin - R.E. 10587, September, 1957.

c) Geologic Map - Seaview Area (scale 1" = 200'), Stone Geological Service, January 11, 1962 (Job No. 62-104).

d) Boring logs - Parcel 11, Lindvall, Richter and Associates, 1981 Log of boring K-4A, R.P.V.-3 appears in Section III of the Appendix.

e) Boring logs - Parcel 12, Converse-Ward-Davis-Dixon, 1981 (Project No. 81-02167-01) Log of boring F-5 appears in Section III of the Appendix.

f) Topographic map (1" = 40' reduced to 1" = 100' for report presentation), Sikand Engineering and Associates.

Field Investigation

Surface Mapping - The seacliff and intertidal zone were mapped in detail with special care taken in the delineation and location of four (4) marker beds, a unit of altered tuff ("sandy tuff") and the basalt sill near the east edge of Parcel 15. A columnar section including these units was compiled from exposures in the seacliff and intertidal zone. A limited amount of mapping was also done on exposures in and around the Klondike Canyon area to provide structural control for cross sections.

Subsurface Study - Exposures in the seacliff and intertidal zone east of the jetty (see geologic maps) are generally very good, but data in the critical area between the eastern edge of the "Beach Club Landslide" and the jetty were lacking. The primary intent of this additional subsurface study was to delineate the bedrock structure in this area and, where possible, correlate the stratigraphy with other borings in the Klondike Canyon area.

Six rotary wash borings (modified Pitcher barrel/NX core barrel) and four bucket auger borings were drilled. These borings were inspected and logged (downhole in bucket auger borings) by an engineering geologist and subsequently backfilled or capped (Boring 112).

Borings 110 through 115 were rotary wash borings (modified Pitcher barrel/NX core barrel) drilled by Pitcher Drilling Company of Palo Alto, California. Borings 110, 111 and 114 were drilled to depths of 241.5, 234.5 and 115.5 feet, respectively. The primary purpose of these three borings was to delineate structure and stratigraphy by sampling large intervals of the bedrock and geophysically logging each hole. Borings 112, 113 and 115 were drilled to depths of 46.5, 22 and 23.2 feet, respectively. Borings 112 and 113 were drilled in an attempt to confirm projections of known structure and stratigraphy (using dip components in samples). Boring 115 was drilled

30 feet southeast of B-112 in an attempt to determine bedrock orientation in the immediate area through the use of dip components and the projection of a well defined stratigraphic horizon (base of the Portuguese Tuff) between the borings.

Borings 116, 117, 118, 119 and 120 were bucket auger borings (24 to 42-inch diameter) drilled by California Testing of Long Beach, California. Borings 116 and 117 were drilled in the median strip of Palos Verdes Drive South to more accurately define folding of the bedrock underlying the northwest portion of the subject property. Boring 118 was drilled "on-line" and halfway between B-112 and B-115. No bucket auger borings had previously been attempted in the beach area because of severe caving of the beach deposits and the likelihood of groundwater at or near sea level. Boring 118 was placed at this location because there appeared to be an abrupt change in structure in this area, and to insure that a suitable lithology (bentonite) was present under the beach deposits to enable casing set in the bedrock to effectively seal out groundwater. Casing was set in B-118, but groundwater and severe caving precluded downhole logging of the bedrock.

Borings 119 and 120 were drilled at the top of the seacliff near Boring 110 to more accurately define folding of the bedrock underlying the northwest portion of the subject property. Structure was defined not only by downhole examination of the bedrock orientation, but also by stratigraphic correlation with core samples from Boring 110. Very difficult drilling conditions (caving and large cobbles) were encountered in the marine terrace interval, but valuable information was obtained from downhole logging of the borings.

Some bucket auger borings on parcels 11 and 12 by Lindvall, Richter and Associates were also inspected downhole by a representative of Moore & Taber. Core samples from borings in the Klondike Canyon area by both firms have been made available for inspection to all geologists working in the area.

Petrographic Thin Sections

To facilitate correlation of stratigraphic intervals and to clarify questions concerning the genesis of certain rock types, four petrographic thin sections were made from samples provided by Moore & Taber. Karl Vonder Linden of Lindvall, Richter and Associates had the thin sections made and has supplied the following descriptions.

Sample No. 1 was obtained from the interior of the basalt sill at the eastern edge of the subject property. The interior of this sill is very much less resistant to weathering than the relatively prominent margins. Samples of this material examined in the field resembled altered tuff. Sample No. 1 was described in thin section as weathered basalt showing severe alteration to clay minerals.

Sample No. 2 was obtained from the spoils pile of Boring F-5 by Converse-Ward-Davis-Dixon. The sample was taken from the interval between 18.5 and 25 feet. It was described in the field as "altered tuff", intensely fractured, very weathered, with dolomite and gypsum-filled fractures. Sample No. 2 was described in thin section as weathered basalt with widespread iron oxide staining and alteration to clay minerals.

Sample No. 3 was obtained from core samples of Boring 110 by Moore & Taber. The sample is from a core at 133 feet, and was described in the field as "0.3-foot thick, very hard aphanitic tuff? or siliceous siltstone?; upper bedding surface is very irregular". Sample No. 3 was described in thin section as clayey limestone or limey claystone; microcrystalline rock of sedimentary origin - largely carbonate (limestone or dolomite?) and clay minerals.

Sample No. 4 was obtained from Boring R.P.V.-1 by Moore & Taber. The sample is from the interval below 96 feet. It was described in the field as "welded tuff with fine granular texture." Sample No. 4 was described in thin section as siltstone or fine-grained sandstone; poorly sorted, angular fragments of feldspars, quartz, ferromagnesians and glaucophane - equivalent to subfeldspathic lithic wacke described in Vonder Linden's previously referenced doctoral dissertation.

Site Specific Nomenclature

To facilitate discussion of some locations and folds in the text, certain topographic features and fold axes have been given specific names (see map, Plate II).

In the intertidal zone east of the subject property, a fairly prominent rock protrudes approximately 12.5 feet above sea level; this rock is known as "Crab Rock" and the small folds which run under and immediately adjacent to this rock are the "Crab Rock Monocline" and "Crab Rock Syncline". The well defined anticline and associated basalt sill near the east boundary of the property are the "Maritime Anticline" and the "Maritime Basalt" or "Maritime Sill". The artificial fill underlying the gatehouse area is the "Gatehouse Fill". The syncline underlying the central portion of the property is the "Seaview Syncline". The monocline - anticline fold underlying the northwest portion of the property is the "Drainline Monocline - Anticline" and the ravine fill near the seaward extension of this fold is the "Drainline Fill". The syncline underlying the "Beach Club Landslide" is the "Beach Club Syncline". The structural basin underlying the toe area of the active Portuguese Bend landslide near its eastern limit is the "Bunny Hill Basin" (doubly plunging syncline - "Bunny Hill Syncline") and the associated topographic high of landslide debris near the shoreline is "Bunny Hill". The bedrock exposure in the intertidal zone just south of "Bunny Hill" is "North Reef" and the small anticline which forms this rock reef is the "North Reef Anticline". The prominent and well defined monocline which essentially parallels the eastern limit of the active Portuguese Bend landslide is

the "Borderline Monocline" and the associated structural basin to the west is the "Borderline Basin" (doubly plunging syncline - "Borderline Syncline").

Particular beds or intervals in a portion of the local stratigraphy have also been delineated and given specific names, and these are discussed in the "Stratigraphy" section of the test.

Stratigraphy

Bedrock underlying the subject property and the area around Klondike Canyon primarily consists of siltstone, shale, tuff and minor sandstone from the lower and middle divisions of the Altamira member of the Monterey Formation. Also evident in the area are a few small sill-like bodies of basalt (including the "Maritime Sill") which may be directly associated with the intrusion of a relatively large body of basalt exposed in Livingston Quarry (Parcel 12).

Sedimentary rock types in the area are interbedded and interfingered - in some places on a very small scale. The general consensus among geologists who have worked in the area (conversations with P. L. Ehlig and R. H. Jahns) is that the basalts are shallow intrusions into unconsolidated or only partially lithified marine sediments. It has been suggested that these intrusions may have created localized relief (basins) of the depositional surface by deforming the overlying sediments. This possible deformation, localized facies changes, and possibly small scale submarine slumping would account for this interfingering or lensing. Silicification (hydrothermal alteration?) of portions of the sedimentary section adjacent to the intrusives has further complicated local stratigraphy.

In spite of this apparent variability, inspection of a number of bedrock exposures, core samples, bucket auger borings and boring logs in the Klondike Canyon area has shown that generalizations can be made concerning

the local stratigraphy, and correlations along a few relatively consistent horizons are possible. Geophysical logging (primarily Gamma - natural radiation) of a number of borings has significantly reduced the inherent variability of bedrock descriptions in the logs caused by weathering, poor sample recovery (cuttings in rotary boring), slight facies changes, etc. A brief discussion of the geophysical logs is presented on page 14.

As noted in our previous report, the Portuguese Tuff is the most prominent and distinctive unit in the area, and will be used as a reference point for discussion of the local stratigraphy. Locally, the Portuguese Tuff shows a fairly consistent thickness of 45 to 50 feet. It is composed primarily of dense bentonite and bentonitic tuff, with the exception of an approximately 10-foot thick interval of grossly similar, but very highly siliceous material noted in B-105 and B-117 near the center of the unit.

The upper and lower margins of the Portuguese Tuff are generally marked by 4 to 5 feet of thinly interbedded brown to black siltstone and very hard shale. The base of the Portuguese Tuff provides a relatively consistent and easily recognizable stratigraphic horizon, but due to small scale interfingering of the Tuff with the overlying siltstone and shales, the upper contact is less distinct.

The stratigraphic intervals from 20 to 30 feet above and below these hard siltstone and shale margins are relatively softer, thinly-bedded gray and brown tuffaceous siltstone and siltstone, with minor sandstone, bentonite, shale and siliceous siltstone interbeds. Weathered or oxidized portions of these intervals are generally light colored, tending to light shades of brown, gray and yellow. As is the case with the Portuguese Tuff, these siltstones are easily weathered and are commonly covered by slope wash and other debris at the outcrop.

Approximately 130 to 140 feet of the stratigraphic section is exposed in the seacliff and intertidal zone of Parcel 15. Description of this portion of the section was obtained primarily from these exposures and Borings 111 and 114. Four (4) marker beds and an interval of "sandy tuff" have been delineated and described in this area (refer to Plate V and Figures 2, 3 and 4). Based on structural relationships, marker bed No. 4 at the bottom of this interval has been interpreted to be approximately 100 to 120 feet stratigraphically above the top of the Portuguese Tuff. The "Maritime Sill" has been intruded at a horizon approximately equivalent to marker bed No. 4 and it is probably significant that the basalt sill exposed in Inspiration Point has been intruded at an approximately equivalent horizon 100 to 120 feet above the top of the Portuguese Tuff.

The "sandy tuff" is an easily weathered interval from 8 to 10 feet thick, showing buff to yellow-brown color at the outcrop. This unit is typically overlain by a discontinuous, irregular bed of well-cemented fine silty sandstone.

The approximately 26-foot-thick section of thinly interbedded shales and siltstones below the base of the "sandy tuff" shows a gradual change from relatively softer, generally tuffaceous siltstones in its upper portion, to the hard fissile shale and siltstone which predominate in the lower portion.

Thinly bedded shale and fissile siltstone predominate in approximately the next 70 feet of section. Four relatively distinct marker beds have been delineated and numbered in this 70-foot interval. In addition to minor interbeds of sandstone and tuff (bentonite), there are three prominent beds of siliceous siltstone evident in the upper portion of this interval. At the top of this section is a siliceous siltstone that varies in thickness from 0.5 to 1.5 feet. Approximately 11.5 feet below this is a 2.5 to 3.5-foot-thick, thinly laminated siliceous siltstone (dolomitic?) that has been designated as marker bed No. 1. Approximately 11.5 feet below marker bed No. 1

is a 1.0 to 2.0-foot-thick, thinly-laminated siliceous siltstone (dolomitic?) that has been designated as marker bed No. 2. The relative thicknesses, spacing, and resistance to weathering (hardness) makes these three beds easily distinguishable, both at the outcrop and in the borings.

These three prominent siliceous layers are exposed in the seacliff on the north and south limbs of the "Seaview Syncline" and the east or down-turned limb of the "Crab Rock Monocline". Marker bed No. 1 crops out very prominently in the intertidal zone and is evident hundreds of feet from the shoreline at three locations: 1) north of the "Crab Rock Syncline", 2) on the south limb of the "Seaview Syncline" (a small concrete jetty has been built on it), 3) on the north limb of the "Seaview Syncline" - (the only bedrock exposure in the intertidal zone between the jetty and "North Reef"). Examination of a number of aerial photos shows the underwater extension of exposures at locations 2 and 3 (above) forms a continuous outcrop pattern.

A 2 to 6-foot-thick interval approximately 24 feet below marker bed No. 2 is slightly more prominent at the outcrop. This somewhat more siliceous interval has been designated as marker bed No. 3.

At the base of this 70-foot-thick section is an approximately 2-foot-thick bed of dark gray fine silty sandstone or siltstone which has been silicified to variable degrees depending upon its proximity to the "Maritime Basalt". Although alteration of the host rock (sediments?) makes it difficult to be certain, it appears that the "Maritime Sill" has actually split marker bed No. 4 in half. This is most apparent on the seacliff where nearly the full thickness of marker bed No. 4 is exposed below the sill at the apex of the "Maritime Anticline" and only a minimal thickness (if any) is exposed above the sill. A thin wedge-shaped siliceous bed similar to marker bed No. 4 is evident on the upper margin of the sill, which thickens along the south limb of the anticline to a thickness of approximately 2 feet. Here, the sedimentary section is cut by a small dike extending from the upper surface of the sill.

No basalt is evident on the north limb of the "Maritime Anticline", but there is evidence that the equivalent stratigraphic interval may have been involved in the overall "plumbing" of the intrusion. Adjacent to (stratigraphically below) marker bed No. 4, a prominent outcrop of what is described as "siliceous breccia" is exposed in the intertidal zone south of the jetty. This rock is cherty, very hard and black, with thin dark gray laminations. Large portions of this rock are composed of randomly oriented fragments in a matrix of the same composition and have a "baked" appearance and texture. A similar "siliceous breccia" is directly associated with the large basalt sill exposed on Inspiration Point, and "Crab Rock" (stratigraphically above marker bed No. 1) is composed essentially of the same material. The equivalent stratigraphic interval near the axis of the "Seaview Syncline" in Boring 114 (core interval S-10) showed what was described in the field as a "crystal tuff with a high degree of alteration to clay minerals - unconformably adjoining (distinctly across bedding) a thinly laminated siliceous siltstone (marker bed No. 4?)." The stratigraphic relationship suggests that this tuff has been intruded or injected.

Below marker bed No. 4 and the basalt, approximately 20 to 30 feet of shale and fissile siltstone - with minor tuff (bentonite) and sandstone interbeds - are exposed in the axial region of the "Maritime Anticline."

Description of the stratigraphic section below the Portuguese Tuff is based on deep rotary borings R.P.V.-1, 2 and 4, and inspection of core samples from R.P.V.-3 (K-4A). Underlying the tuff-rich interval of siltstone below the base of the Tuff is a distinctly granular or sandy interval ranging in thickness from 5 to 10 feet. This sandy interval may be equivalent to the "lithic wacke" described by Vonder Linden in his doctoral dissertation on the active Portuguese Bend landslide. A thin section of this interval from Boring R.P.V.-1 was described by Karl Vonder Linden as lithologically equivalent to the "lithic wacke." Sandy or granular beds were noted at this horizon in Borings F-5, K-4A, and R.P.V.-2.

Immediately underlying this sandy section is a relatively distinct stratigraphic interval which will be referred to as the "Volcanics". This unit has been described as basalt (thin section examination) by Lindvall, Richter and Associates in Boring K-4A, and as altered tuff (field description) by Converse, Ward, Davis, Dixon in Boring F-5 (subsequently described as weathered basalt in thin section examination by Karl Vonder Linden). Projections between these borings appear to confirm that they are stratigraphically equivalent. The equivalent of this unit has been described by Moore & Taber as welded tuff in Boring R.P.V.-2 (field description - rotary cuttings) and as fine-grained or aphanitic tuff in R.P.V.-4 (field description - rotary cuttings). Inspection of those borings in which both the Portuguese Tuff and the "Volcanics" occur shows a relatively consistent stratigraphic thickness of around 40 feet between the base of the "Volcanics" and the base of the Portuguese Tuff.

Interbedded gray-green and black siltstone and shale predominate in the section below the base of the "Volcanics". Scattered thin beds of bentonite and fine sandstone are evident below this horizon, but tuffaceous material appears to decrease rapidly with depth. A "basal shear zone" has been noted by Converse, Ward, Davis, Dixon in Boring F-5, approximately 27 feet below the base of the "Volcanics" (approximately 67 feet below the base of the Portuguese Tuff). Projection of this horizon across Klondike Canyon indicates it may be equivalent to a "basal shear zone" noted in Boring K-5 by Lindvall, Richter and Associates and a "slide surface" noted in Boring B-2 (near the intersection of Dauntless and Exultant Drives) by Robert Stone and Associates.

Approximately 35 to 40 feet below the base of the "Volcanics" a relatively consistent, very hard, siliceous layer was noted in Borings R.P.V.-2, 3 (inspection of core samples) and 4.

Geophysical Logs and Stratigraphic Correlation

The stratigraphic section discussed above is based primarily on lithologic logging of the borings and description of bedrock exposures.

Seven deep borings in the area were also geophysically logged by Ryland-Cummings of Pasadena, California. Electrical logs (spontaneous potential - SP and electrical resistivity - ER) of each of these borings were obtained, but the data is incomplete due to the absence of fluid (drilling mud or groundwater) for the full depth of the hole in most of the borings. However, data from gamma logs of these borings is complete, and stratigraphic correlations based on the gamma and lithologic logs of these borings and a columnar section (from the seacliff and intertidal zone of Parcel 15) are shown on Plate V (in pocket).

Gamma logs respond to the natural gamma radiation produced by the radioactive decay of naturally-occurring minerals. Primarily, the radiation encountered is produced by potassium-40 and the decay products in the uranium and thorium series present in the underlying earth materials. Due to the statistical nature of radiation detection and variables associated with the logging process, any two gamma logs of the same boring will not be exact duplicates, but most prominent features coincide.

Siltstones, particularly organic-rich beds, and to a lesser extent shales, characteristically show a relatively "hot" or more radioactive gamma profile (to the right). Sandstones, siliceous siltstones, dolomites, limestones, tuffs (bentonite) and basalts characteristically show a relatively "cold" or less radioactive profile (to the left).

Structure

The gross structure of the Palos Verdes hills is that of a doubly plunging anticline with an axis near the crest of the hills trending approximately N60W. Fold axes within the Klondike Canyon area appear to show three general trends: N50-70W, N30-50E and east-west.

1) Folds trending N50-70W parallel the gross anticlinal structure of the Palos Verdes hills and tend to be broad, step-like flexures which dictate the regional dip to the southwest.

2) Approximately perpendicular to these seaward dipping flexures are a number of trough and ridge-like folds showing a general seaward plunge.

3) The most pronounced folding within the area trends approximately east-west. This trend is askew to the gross structure and for this reason, appears to be the least influenced by the general seaward (southwest) dip of the strata on the south side of the Palos Verdes hills.

Bedrock structure in the area is a complex combination of these three basic trends. Folds appear to either be accentuated or flattened in those areas where these trends converge.

Orientation of bedrock strata in the Klondike Canyon area, including that underlying the active Portuguese Bend landslide, generally shows a regional dip to the southwest at low to moderate angles, averaging about 15 degrees. There are significant departures from this regional dip, however, within the Klondike Canyon area.

The "Borderline Monocline" (trending N30-50E) is generally well defined north of Palos Verdes Drive South, and it is readily apparent that here the abrupt change from the regional dip has limited the easterly extent of the active Portuguese Bend landslide. Bedrock structure between the "Borderline Monocline" and the easterly portion of Parcel 15 generally conforms to the regional dip, with only subtle folding or warping of the bedrock apparent ("Bunny Hill Syncline", "North Reef Anticline", and "Beach Club Syncline").

Three folds underlying the subject property (eastern portion of Parcel 15) show a marked departure from the regional dip similar to that of the "Borderline Monocline".

A. "Drainline Monocline-Anticline" - The axis of this fold trends approximately east-west and has been well-defined by downhole logging of a number of borings in the median strip of Palos Verdes Drive South and at the top of the seacliff. These data, in addition to bedrock exposures in the seacliff and vertical to near vertical bedding in B-113 at the base of the bluff, confirm the presence of a broad band of bedrock from 150 to 250 feet wide, striking east-west and dipping steeply (often near vertical) to the south.

B. "Seaview Syncline" - The steeply dipping bedding described above forms the north limb of the generally east-west trending "Seaview Syncline". The seaward extension of this syncline is well-defined in a number of airphotos by underwater exposures of marker bed No. 1. These exposures may indicate an eastward plunge of the fold and possibly a closed structural basin offshore, similar to the "Bunny Hill Basin".

C. "Maritime Anticline" - South of the relatively broad "Seaview Syncline" is the sharp, well-defined "Maritime Anticline". The eastward extensions of both of these folds have been approximately located using northerly components of dip in Borings B-4 and B-5 logged by Stone Geological Service in 1962. The geologic map (Stone, 1962, Job No. 62-104) from which this information was taken, also shows well-defined synclinal and anticlinal axes in the exposures near the east boundary of the developed Seaview Tract. Recent mapping of a cut slope east of Forrestal Drive confirms the presence of these anticlinal and synclinal axes at locations approximately 500 and 750 feet, respectively, north of Palos Verdes Drive South.

Some exposures of the steeply dipping strata on the south limb of the anticline are highly silicified (some small scale brecciation evident) and at least one small stringer of highly weathered basalt was observed.

East of the "Maritime Anticline" two small, well-defined folds ("Crab Rock Syncline" and "Crab Rock Monocline") are evident in the seacliff and intertidal zone. These folds are significant because they illustrate the complexity of structure where general trends of the folding overlap. Both folds trend approximately N30-50E and show a moderate (20°-25°) plunge to the southwest between the seacliff and shoreline. At the shoreline, the axes of these folds abruptly flatten or show no plunge where they cross a broad flexure which approximately parallels the shoreline (N50-70W). 100 to 150 feet seaward from the shoreline, the axes once again plunge to the southwest at moderate angles, illustrating the step-like, seaward sloping structure of much of the strata in the area.

Groundwater

Boring R.P.V.-1 was drilled May 6, 1981 by Moore & Taber for the City of Rancho Palos Verdes for the purpose of installing a slope inclinometer. At a depth of approximately 66 feet (base of the Portuguese Tuff) an artesian condition was encountered during the drilling operation. Measurements during drilling showed a flow of approximately 10 g.p.m. (gallons per minute) at a depth of 80 feet. At a depth of 96 feet (in fine-grained sandstone equivalent to "lithic wacke"), the flow abruptly increased to approximately 150 g.p.m. A dewatering well was established by casing the upper 15.5 feet of the boring with 6-inch diameter PVC pipe and connecting a 4-inch diameter PVC line to carry the water over the ground surface between the well and the ocean shoreline.

Flow from this well decreased to 50 g.p.m. after three weeks and has subsequently diminished to a rate of approximately 25 g.p.m. on October 29, 1981.

Nearly constant surficial flow has been noted in Klondike Canyon over the last 50 years (Jim Ishibashi - farmer and long time resident in the Portuguese Bend area). The primary source of this water appears to be some small springs up the canyon near the boundary between the Cities of Rancho Palos Verdes and Rolling Hills (Robert Stone and Associates, April 17, 1981, Job No. 1750-00C). Three culverts carry this surficial water under the road fills for a small dirt road north of the Seaview Tract, for Palos Verdes Drive South and for Yacht Harbor Drive. In the beach area, this flow runs across Seawall Road (near B-16) and into a concrete surface drain between two houses (Lots 45 and 46) before emptying onto the beach.

Measurements taken on February 11, 1981 showed flow from the culvert under the upper road fill at a rate of approximately 12 g.p.m., 4 g.p.m. from the culvert under Palos Verdes Drive South and no flow across Seawall Road. On August 13, 1981, flow from the culvert under the upper road fill was measured at 15 g.p.m. No measurements were taken at Palos Verdes Drive, and no flow was observed crossing Seawall Road. Since this last measurement, the upper road fill and culvert have been removed by the Klondike Canyon Residents Protective Association based on recommendations of the City's geologic consultant, Robert Stone and Associates.

Although it is covered by alluvium and fill in many areas, bedrock below the Portuguese Tuff is exposed in most of the canyon bottom from the source of the water to a point near the Yacht Harbor Drive road fill. Based on observations by the maintenance men for the Portuguese Bend Club, significant flow across Seawall Road occurs only during or shortly after periods of rainfall. Location of the artesian well and the above information would seem to indicate that surface and subsurface flow in Klondike Canyon is one of the sources, if not the primary source, of groundwater emmanating from the well.

Free water was noted in Boring R.P.V.-2 below a depth of 153 feet during drilling. The top of water in the inclinometer tubing at this location now stands at a depth of 132 feet. The significance of water in the tubing is uncertain because the borings and the tubing were flushed with water to settle the gravel backfill.

The top of water in the inclinometer tubing at locations R.P.V.-3 and R.P.V.-4 is within 15 feet of the bottom of the tubing. Tubing sections are 20 feet long and only the bottom of the lowest section may have been sealed sufficiently to prevent free inflow of water. The absence of water in the tubing above this level probably indicates no standing water in the borings above those depths.

With the exception of brackish water encountered in the beach deposits at or very near sea level in borings on Seawall Road, no free water was apparent in any of the other borings logged by Moore & Taber within the Klondike Canyon area.

Slope Inclinometers

Slope inclinometers were installed at locations R.P.V.-2, 3 and 4 by the City of Rancho Palos Verdes and at location B-105 by Palos Verdes Properties to monitor possible ground movement. Readings have been taken intermittently on the City's inclinometers since May 29, 1981, and on Palos Verdes Properties' inclinometer since February 17, 1981. No movement indicative of landslide displacement has been noted.

CONCLUSIONS

"Klondike Canyon" Landslide

Surface evidence of ground movement was noted in the Seaview Tract about September 1979. Robert Stone and Associates, the geologists for the City of Rancho Palos Verdes, have determined this movement is associated with an ancient landslide (the "Klondike Canyon" landslide) which underlies the northwest portions of both the Seaview Tract and the subject property. A primary concern of our investigation was a determination of the eastern boundary of this possible landslide within the site.

The controlling factor of much of the sliding within the Portuguese Bend area is the regional seaward dip of the beds. It appears the major sliding has occurred along unsupported bedding planes caused by erosion of the bedrock at the base of wave-cut terraces, including the present seacliff. Numerous zones or planes of relative weakness are present in the bedrock of the area because much of the tuffaceous material has been altered to bentonite. This bentonite is characteristically subject to volume changes in response to moisture content and typically has low shear strengths, especially in previously sheared material under conditions of high moisture content. It is readily apparent that high moisture content and the presence of bentonite layers in the bedrock are also factors contributing to the development of landslides in the area.

The axis of the "Drainline Monocline-Anticline" which crosses the northwest portion of the subject property, marks the relatively abrupt departure of the underlying structure from that of the regional geology. The area of this abrupt change is very similar to structural and stratigraphic conditions

in the axial region of the "Borderline Monocline" north of Palos Verdes Drive South. Steeply dipping beds in the downturned limb of this fold appear to structurally control the easterly extent of the adjacent active slide. In a similar fashion, the "Drainline Monocline-Anticline" would limit the southeasterly extent of any landsliding in the seaward dipping bedrock northeast of its axis. An exact determination of the boundary condition may not be possible as it would require additional concentrated deep subsurface exploration, detailed stability analyses and determination of other parameters beyond the scope of this investigation. The easterly limit of the possible "Klondike Canyon" landslide (area of unconfirmed stability) shown on the geologic map (Plate I, scale 1" = 80') was determined by interpretation of possible slide related topography and data showing the continuity of geologic features east of this line.

Photos pre-dating the grading of the Seaview Tract show a relativley prominent drainage gully crossing the northwest portion of the subject property and the Seaview Tract (see photocopy, Figure 1). This gully is essentially straight (discounting the redirection of the drainage associated with the construction of Yacht Harbor Drive) and proceeds in a northeasterly direction to a point approximately under the present location of Lot No. 107 in the Seaview Tract. At this point, the gully is less distinct, becoming more of a drainage swale which turns relatively sharply to the northwest (passing approximately under the intersection of Dauntless and Exultant Drives) before becoming indistinguishable at the edge of Klondike Canyon. Northwest across Klondike Canyon from this point, small but relatively distinct grade breaks are evident crossing the two knobs of the adjacent ridge (Parcel 11).

Adjacent to the landward side of Palos Verdes Drive South, a smaller parallel arcuate drainage course branches off of the previously mentioned northeast trending gully. This swale or slight depression trends in a north to northwesterly direction, passing through the approximate present locations

of Lots 2, 3, 27, 28 and 29 in the Seaview Tract. This shallow drainage becomes indistinguishable near the head of the very distinct scarp of the "Beach Club" Landslide.

The relatively recent tension cracks in the pavement and minor house distress noted by Stone and Associates in the Seaview Tract are located in those areas formerly underlain by these arcuate drainages. Stone and Associates have reported that this damage is related to a small amount of movement of an ancient landslide mass (the "Klondike Canyon" Landslide).

It appears that the drainage in this area may have been locally controlled by landslide-related features; both by the actual "break" in the topography (scarps) created by landslide movement, and the tendency of the surface water to create drainage paths in the less resistant landslide disturbed material (tension cracks, shear zones, etc.).

The seaward extension of the previously mentioned drainage gully cut a deep ravine in the face of the seacliff which was filled for the construction of Yacht Harbor Drive ("Drainline Fill"). Marker beds No. 1 and No. 2 and the siliceous siltstone above them are exposed in a prominent outcrop immediately southeast of the "Drainline Fill". The continuity of this outcrop with exposures of the same beds extending hundreds of feet from the shoreline indicates these beds are "in place". Definitive conclusions concerning the stability of the area between this fill and the "Beach Club" Landslide are precluded by the presence of complex folding and sheared (tectonic?-flexural slip) bentonite in the borings (B-106, B-110, B-119, B-120) and lack of bedrock exposures in the seacliff and intertidal zone.

Displacements Possibly Related to Landslide Movement

The relatively subdued nature of the scarp-like features in the headward portion of this possible landslide indicate ground displacements have been minimal since the development of the present topography. Evidence for recent movement of a landslide is based on slight surface deformation and tension cracks within the northwest portion of the Seaview Tract and surficial cracks or fissures extending a distance of 900 feet across undeveloped land on either side of Klondike Canyon (Stone, December 10, 1980). Measurements taken in slope inclinometers beginning in February, 1981, have shown no movement indicative of landslide displacements.

Location of Shear Surface

Information on the location and depth of a slide surface is limited to three borings (B-2, S-1980; F-5, CWDD; K-5, LRA) in the headward portion of the possible Klondike Canyon Landslide. A two dimensional projection of the lowest (basal) shear surface noted in these borings is a nearly horizontal straight line between the borings. Based on projection and correlation of the "Volcanics" in R.P.V.-3 (K-4A) to an equivalent horizon in F-5, this shear surface would be located approximately 67 feet stratigraphically below the base of the Portuguese Tuff. In the toe area of this possible landslide, the equivalent horizon is approximately 124 and 107 feet below sea level at locations R.P.V.-1 and B-112, respectively. Using the previously noted tentative stratigraphic relationships between the top of the Portuguese Tuff and the marker beds, this same horizon is located at a depth of 310 feet below sea level at location B-114. If ground cracks and slight surface deformation on Parcel 11 and near the intersection of Dauntless and Exultant Drives are related to a landslide, the plane of movement is probably located below the Portuguese Tuff. Tension cracks in Palos Verdes Drive (frontage road) and Admirable Drive could have resulted from movement along a landward projection of the "Beach Club" Landslide shear surface, which is above the Tuff.

Setback Lines

Favorably dipping strata in the cliff face minimizes sliding potential, and the threat of seacliff retreat is considered to be low. Based on a comparison of aerial photographs (1928 to present), the cliffs have shown no detectable retreat in nearly fifty years. The slide and talus accumulations at the base of the cliffs probably serve to protect them from wave erosion and reduce the threat of undercutting.

A foundation setback from the present rim of the seacliff has been delineated on the attached geologic map (Plate I, 1" = 80'). This line was determined by whichever of the following criteria provided the largest setback.

1) A minimum arbitrary setback of 50 feet from the top of the slope.

2) A 1.5:1 projection from the base of the seacliff.

3) A 1.5:1 projection from the base of the steepest portion of the cliff face.

This building setback is recommended to allow for possible local slumping, ravelling and erosion of the cliff edge.

As a precautionary measure to account for irregularities and unknowns regarding the exact location of a possible slide edge, a tentative setback of 50 feet from this area of unconfirmed stability is recommended.

Portuguese Tuff

The occurrence of the Portuguese Tuff within the subject area is important not only because it is a distinctive horizon for structural control, but also because of its relationship to the large scale landslides evident in the area. The close relationship of the Portuguese Tuff to these large failures is due primarily to its structural position (unsupported beds dipping seaward). The relative weakness of the altered tuff beds (bentonite) prevalent in the stratigraphic interval bordering the Tuff is also an important factor. Under conditions of high moisture content and previous shearing (flexural slip or landsliding) the shear strength of these bentonite layers decreases considerably.

Other probable factors in the occurrence of these large scale landslides are the expansive and essentially impermeable characteristics of the bentonite. Volume changes associated with intermittent wetting and drying of these clay layers could create distinct planes of weakness in the bedrock interval. The relatively large thickness of the Portuguese Tuff acts as an effective groundwater barrier. In addition to the decrease in shear strengths generally commensurate with high moisture content, trapped groundwater (R.P.V.-1) in seaward dipping strata below the Tuff would create hydrostatic forces which could significantly effect the stability of the overlying bedrock. Perched groundwater in the stratigraphic interval immediately above the Tuff would create similar forces and conditions.

In the western and central portions of the Klondike Canyon area, the Portuguese Tuff is well located in a number of borings and by exposures in the canyon itself. No known exposures of the Tuff exist east or southeast of those found in Borings B-117, B-105, B-18 and B-112. No evidence of the Tuff was found in relatively deep Borings B-110, B-111 and B-114. Structural and stratigraphic relationships show the abrupt folding of the "Drainline Monocline-

Anticline" has put the Portuguese Tuff below these borings at considerable depths below the ground surface. The absence of exposures to the southeast is consistent with the general deepening of the stratigraphic section evident from bedrock exposed in the intertidal zone south of the "Maritime Anticline".

Maritime Sill

The abrupt termination of the "Maritime Sill" at the apex of the "Maritime Anticline" was the subject of some concern in the review of our original geotechnical investigation performed by Robert Stone and Associates (dated April 7, 1981, Job No. 1750-00B). The marker beds immediately above this sill are symmetrical relative to the axis of the anticline, so it is reasonable to assume that the section above the sill is continuous or unbroken across its axis.

At least one stringer of basalt and an associated area of highly silicified (hydrothermally altered?) bedrock is present on the south limb of the probable easterly extension of the "Maritime Anticline". No evidence of this basalt or highly altered bedrock is evident in the north limb of this anticline.

Structural relationships in the geologic sections indicate the "Maritime Sill" is located at approximately the same stratigraphic horizon as the basalt sill in Inspiration and Portuguese Points. These points appear to be "islands" of stable bedrock directly adjoining the landslide masses of the Portuguese Bend landslide complex. Stability of these areas is likely due to the presence of this large basalt sill. Beds at the heel of these points are upturned at steep to near vertical angles, and it has been suggested by others (conversations with P. L. Ehlig) that this deformation may have resulted from "bulldozing" of these beds by the Portuguese Bend Landslide.

Similarly, the "Maritime Sill" being a relatively more competent unit, may have acted as a locus for folding. Gravity folding (resulting from local uplift or deformation) grossly contemporaneous to the intrusion of basalt in the area may have resulted in the structural and stratigraphic configuration at the axis of the "Maritime Anticline".

General Conditions

This report is based on the project as described and the geotechnical data obtained from the exploration performed at the locations indicated on the plan. The conclusions and recommendations do not reflect any variations that may occur between the test holes. Our firm should be notified of any pertinent change in the project plans or if geologic conditions are found that differ from those described in this report, since this may require a revaluation of the recommendations. This report has not been prepared for use by parties or projects other than those named or described above. It may not contain sufficient information for other parties or other purposes.

This report has been prepared in accordance with generally accepted geotechnical practices and makes no other warranties, either expressed or implied, as to the professional advice or data included in it.

MOORE & TABER

Scott T. Kerwin
Geologist
STK/DNK/JTE:rb

Reviewed by Jack T. Eagen
Engineering Geologist 231

Distribution: (3) Palos Verdes Properties, Inc.
(3) Sikand Engineering
(1) Mr. Dick Jahns

APPENDIX - SECTION I

BORING LOGS BY MOORE & TABER FOR PALOS VERDES PROPERTIES

B-1 through B-7; Job No. 2376-80, January 10, 1977
B-8 through B-19; Job No. 377-417, May 23, 1977
B-101 through B-109; Job No. 380-462, February 6, 1981
B-110 through B-120; Job No. 380-462, November 23, 1981

TEST PITS BY MOORE & TABER FOR PALOS VERDES PROPERTIES

TP-101 and TP-102; Job No. 380-462, February 6, 1981

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 222 | BORING 1

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU.FT)	MOISTURE (%)	BLOWS/FOOT /300 FT./lbs.	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.	
		88	18.1	3	2.5	1			CL	SOIL: Dark brown CLAYEY SILT with SHALE fragments
		75	18.3	2	2.5	2	5			TERRACE DEPOSITS: Brown CLAYEY SILT with some SHALE fragments
		89	22.2	3	2.5	3	10			
							15			Pinkish-brown CLAYEY SILT with some SHALE fragments
		83	26.7	3	2.5	4				Orange CLAYEY SILT with SHALE fragments and BOULDERS
		89	22.2	4	2.5	5	20			Orange CLAYEY SILT with SHALE
							25			
							30			
							35			
							40			
							45			
							50			Continued

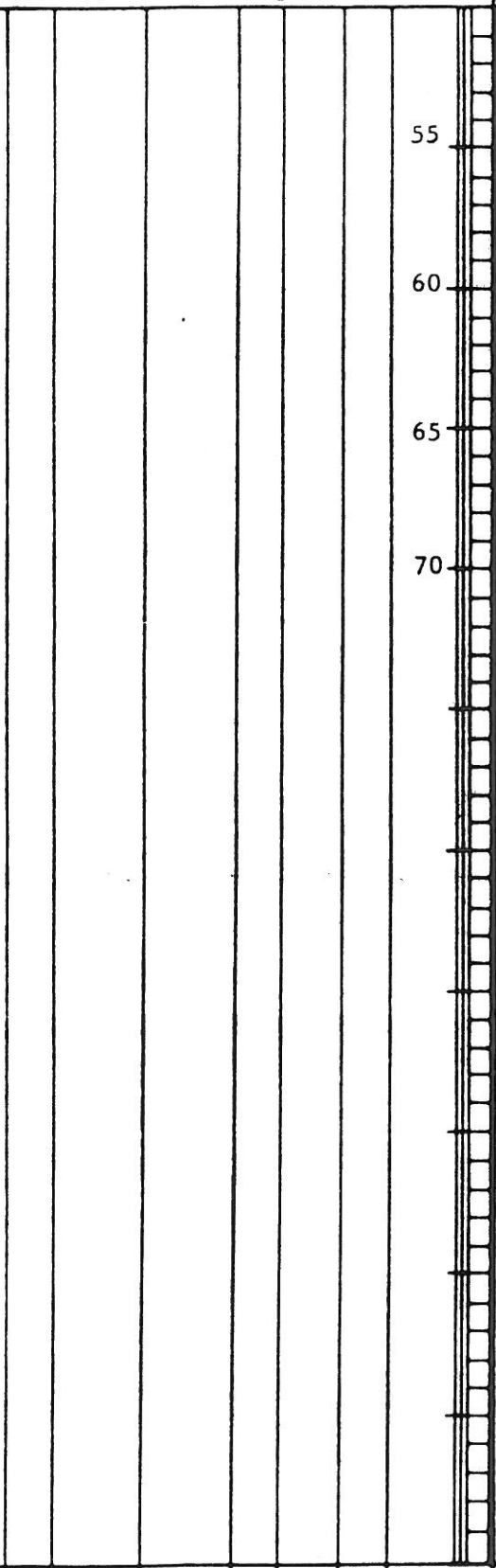
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 10/20/76

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger	ELEVATION 222	BORING 1 Con't



MARINE TERRACE:
2 to 8" rounded BOULDERS in black medium grained SAND matrix

Refusal

NOTES:

1. No groundwater
2. No caving

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU.FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE NR	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 10/20/76

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 208 | BORING 2

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT /300 ft./6in.	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.	
							5	ML		SOIL: Light brown SANDY SILT
										TERRACE DEPOSITS: Orange CLAYEY SILT with SHALE fragments
		94	22.0	6	2.5	1	10			
							15			
										Light yellow-brown SANDY SILT with many SHALE fragments
		86	19.3	7	2.5	2	20			
							25			
							30			
							35			
							40			
							45			ALTAMIRA SHALE: Mottled orange, gray & yellow poorly-bedded CLAY
75W / 22N							50			Gray-beige and brown interbedded SILTSTONE & CLAYSTONE

NOTES: 1. No groundwater
2. No caving

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 10/20/76

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 197 | BORING 3

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU.FT)	MOISTURE (%)	BLOWS/FOOT /500 FT. /6 IN.	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.	
					Bag	1	0		ML	SOIL: Brown SANDY SILT with some SHALE fragments
							5			TERRACE DEPOSITS: Reddish-brown CLAYEY SILT with some SHALE fragments
		88	19.0	2	2.5	2	10			
							15			Orange-brown SANDY SILT with many SHALE fragments
		94	21.4	3	2.5	3	20			
							25			
							30			
							35			
							40			
							45			
							50			MARINE TERRACE DEPOSITS: Gray coarse SAND and well-rounded COBBLES. Caving of sides Refusal

NOTES: 1. No groundwater

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 10/21/76

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 198 | BORING 4

DEPTH IN FEET	SAMPLE Nº	SAMPLE SIZE (INCHES)	BLOWS/FOOT /300 ft/lbs.	MOISTURE (%)	DRY DENSITY (LBS/CU.FT)	UNIFIED SOIL CLASS.	MATERIAL SYMBOL
5							
10	1	2.5	6	16.3	90		
15							
20	2	2.5	4	14.9	92		
25							
30							
35							
40							
45							
50							

SOIL:
Pinkish-brown SANDY SILT with SHALE frag.

TERRACE DEPOSITS:
Reddish-brown SANDY SILT with SHALE fragments

Orange SANDY SILT with SHALE fragments

Reddish-brown SANDY SILT with SHALE fragments

Pinkish-orange SANDY SILT with SHALE fragments

Continued

STRIKE / DIP | RELATIVE COMPACTION

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 10/21-22/76

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger	ELEVATION 198	BORING 4 Con't

55

60

65

MARINE TERRACE DEPOSITS:
Gray, white & orange, coarse SAND with rounded BOULDERS. Caving of sides

Refusal

NOTES:

1. No groundwater

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU.FT.)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

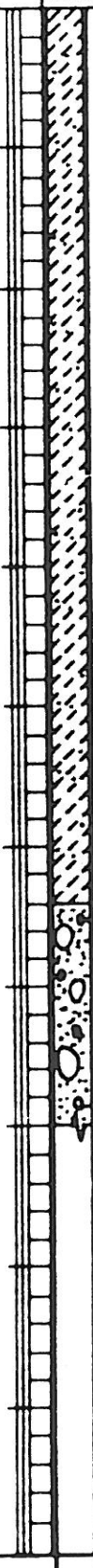
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 10/21-22/76

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 178 | BORING 5



TERRACE DEPOSITS:
Orange and pinkish-brown SANDY SILT with SHALE fragments

MARINE TERRACE DEPOSITS
Gray & white coarse SAND & GRAVEL with many 4 to 12" BOULDERS
Caving

Refusal due to large boulder

NOTES:

1. No groundwater

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU.FT.)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 10/25-26/76

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 122 | BORING 6

STRIKE / DIP	GEOLOGIC UNIT	DRY DENSITY (LBS/CU.FT.)	MOISTURE (%)	BLOWS/FOOT /SAMPLE FT./Blow	SAMPLE SIZE (INCHES)	SAMPLE NO	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.
					Bag	1			
	Landslide Mass	83	18.2	2	2.5	2	5		
		81	23.5	1	2.5	3	10		
GSW 115		97	23.6	16	2.5	4	15		
		106	14.2	8	2.5	5	20		
SOW 85							25		
SSW 125	Undisturbed Altamira Shale						30		
							35		

Disturbed Terrace Deposits -

Reddish-brown fine SANDY SILT with SHALE fragments

Gray and orange CLAY with SHALE fragments

Disturbed Altamira Shale -
Gray, orange and brown interbedded SANDSTONE, SILTSTONE & CLAY. Many gypsum seams and minor shear planes.
Damp material

Shear Surface
1/2" GYPSUM layer in BENTONITE seam.
Some water seeping at 24-1/2 to 25-1/2'

Gray-brown and orange interbedded SANDSTONE, SILTSTONE & CLAY with gypsum seams. Material denser than that above 24'

NOTES:

1. No groundwater
2. No caving.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 10/27/76

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 197 | BORING 7

STRIKE / DIP	GEOLOGIC UNIT	DRY DENSITY (LBS/CU.FT)	MOISTURE (%)	BLOWS/FOOT /600 FT/lbs	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.	
	Landslide Mass	92	14.8	3	2.5	1	10	ML	ML	SOIL Reddish-brown fine SANDY SILT with SHALE fragments
							5			Disturbed Terrace Deposits - Yellow-brown fine SANDY SILT with SHALE fragments
		93	15.7	3	2.5	2	20			Orange-brown fine SANDY SILT with SHALE fragments
							15			
							25			
							30			
							35			
							40			
							45			Gray and brown thickly bedded SILTSTONE with many 2" beds and gypsum seams
							50			Continued

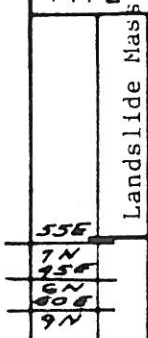
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 10/27/76

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 197 | BORING 7 Con't



50
55
60

Sheared Material -
Yellow, brown and gray mottled CLAY with many SILTSTONE fragments

Altamira Shale -
Gray and brown thickly bedded SILTSTONE with many 1/2" siltstone beds and gypsum seams

NOTES:

1. No groundwater
2. No caving

STRIKE / DIP	GEOLOGIC UNIT	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

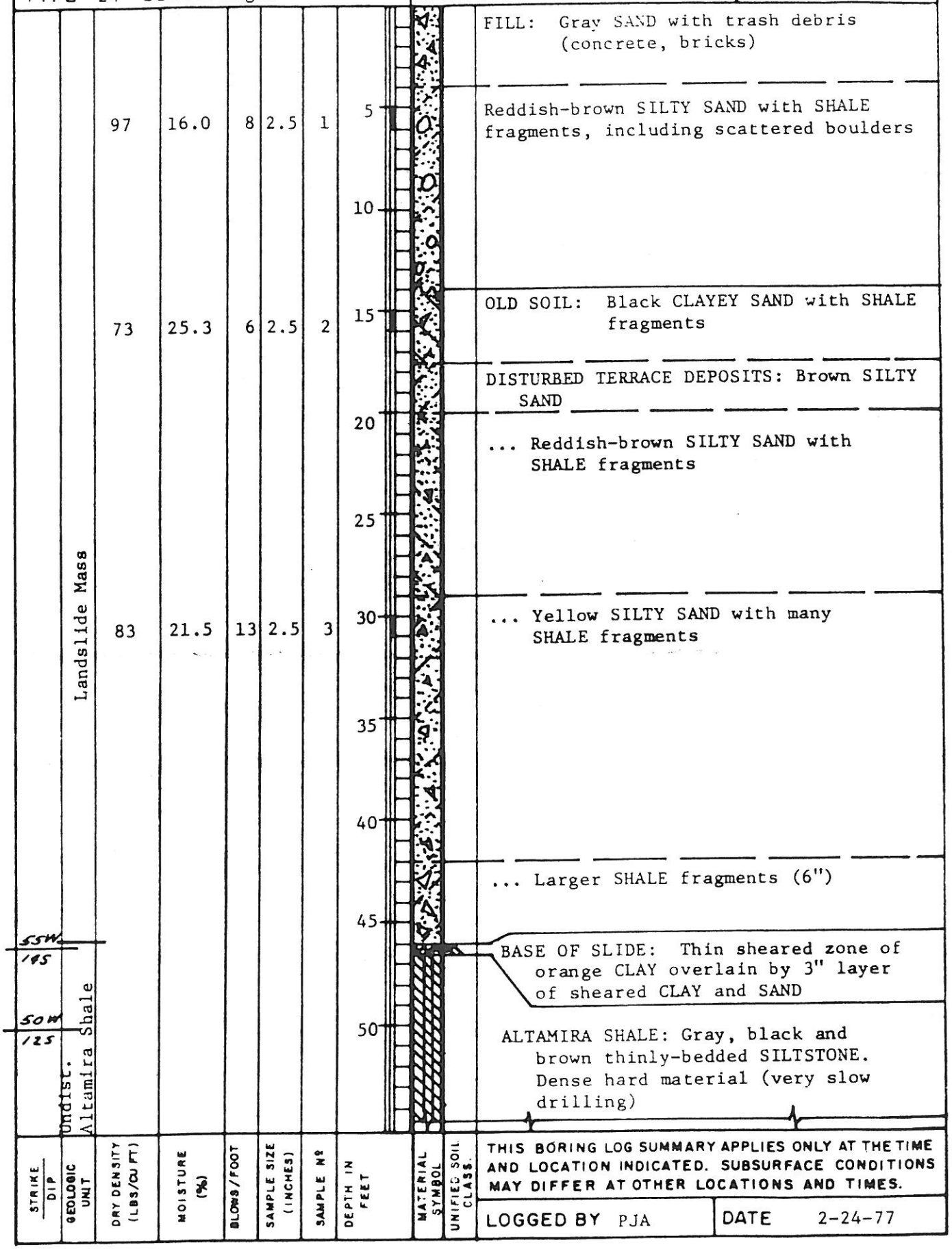
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 10/27/76

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 212 | BORING 8



DEPTH IN FEET	SAMPLE Nº	SAMPLE SIZE (INCHES)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (LBS/CU FT)	GEOLOGIC UNIT	STRIKE / DIP	MATERIAL SYMBOL	UNIFIED SOIL CLASS.	
0						Landslide Mass				FILL: Gray SAND with trash debris (concrete, bricks)
5	1	2.5	8	16.0	97					Reddish-brown SILTY SAND with SHALE fragments, including scattered boulders
10										
15	2	2.5	6	25.3	73					OLD SOIL: Black CLAYEY SAND with SHALE fragments
										DISTURBED TERRACE DEPOSITS: Brown SILTY SAND
20										... Reddish-brown SILTY SAND with SHALE fragments
25										
30	3	2.5	13	21.5	83					... Yellow SILTY SAND with many SHALE fragments
35										
40										
										... Larger SHALE fragments (6")
45										BASE OF SLIDE: Thin sheared zone of orange CLAY overlain by 3" layer of sheared CLAY and SAND
50						Undist. Altamira Shale	55W/19S 50W/12S			ALTAMIRA SHALE: Gray, black and brown thinly-bedded SILTSTONE. Dense hard material (very slow drilling)

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 2-24-77

Job No. 377-417 - May 23, 1977

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 135 | BORING 9

STRIKE / DIP	GEOLOGIC UNIT	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS
	Landslide Mass	86	15.7	7	2.5	1	5		
							10		
		88	17.2	3	2.5	2	15		
70W 85							20		
70W 85	Undisturbed Altamira Shale	88	25.0	16	2.5	3			
							25		

DISTURBED TERRACE DEPOSITS:

... Reddish-brown SILTY SAND with SHALE fragments

... Increasing amounts of SHALE fragments. Up to 6" wide.

SHEARED TERRACE AND SHALE: Reddish-brown and gray SILTY CLAY and SILTSTONE

BASE OF SLIDE: White CLAY bed ~1/4" thick.

ALTAMIRA SHALE: Gray and brown SILTSTONE with many gypsum seams. Very dense ~ 3" beds

NOTES:

1. No groundwater.
2. No caving.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 2-28-77

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 70 | BORING 10

STRIKE / DIP	GEOLOGIC UNIT	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.	
	Landslide Mass									DISTURBED TERRACE DEPOSITS: Reddish-brown SILTY SAND with SHALE fragments
							5			Disturbed TERRACE with BEDROCK: Brown CLAYEY SANDSTONE with CLAYEY SILTSTONE
67W/11S		75	37.0	7	2.5	1				BASE OF SLIDE: 2" layer of brown CLAY
25W/15SW	Undisturbed Altamira Shale						10			ALTAMIRA SHALE : Gray and brown SILTSTONE with some interbedded SANDSTONE. Many gypsum seams. Dense material
30W/19SW							15			

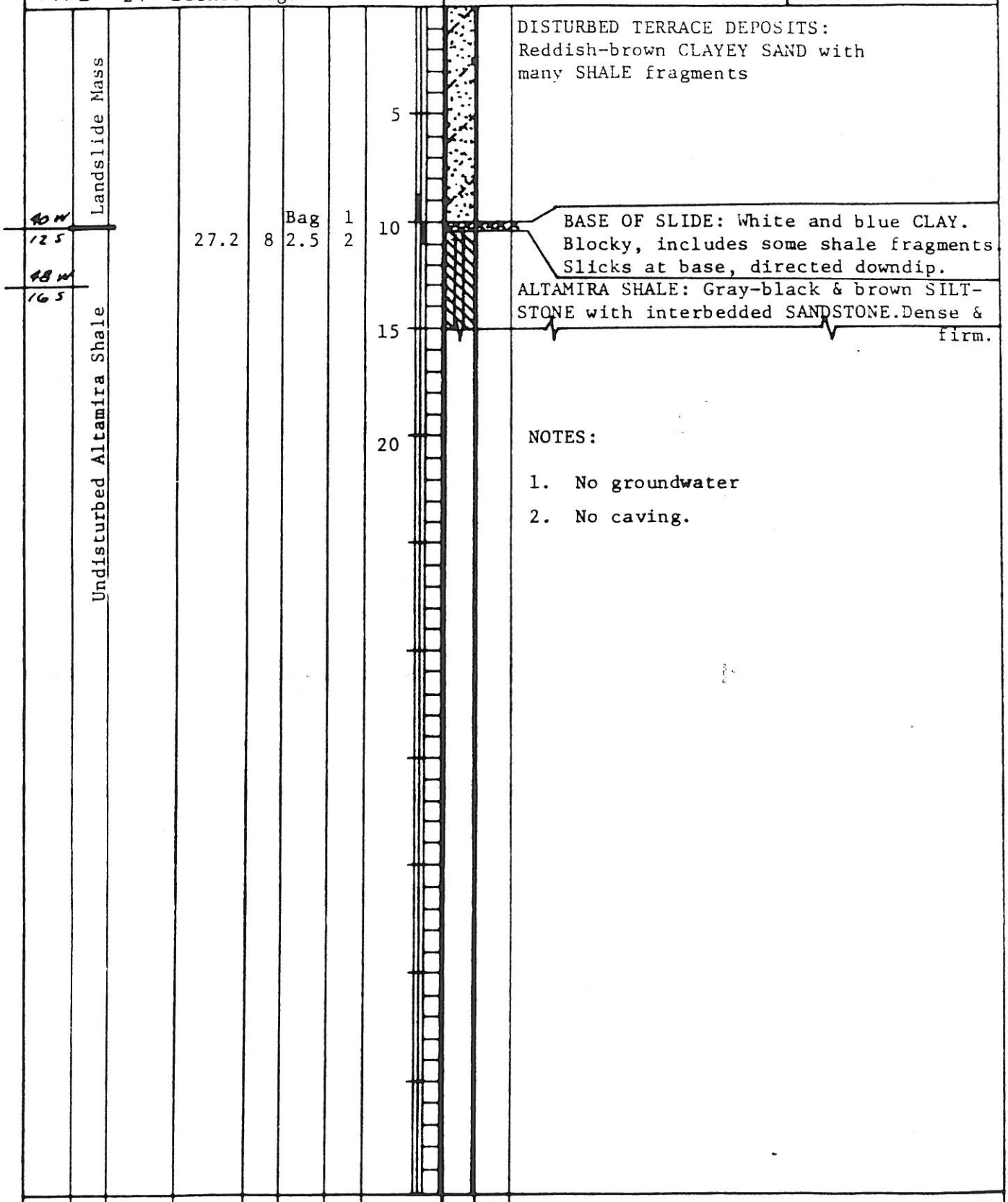
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 2-28-77

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 90 | BORING 11



NOTES:

1. No groundwater
2. No caving.

STRIKE / DIP	GEOLOGIC UNIT	DRY DENSITY (LBS/CU.FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.
	Landslide Mass								
	Undisturbed Altamira Shale		27.2	8	Bag 2.5	1 2	10		

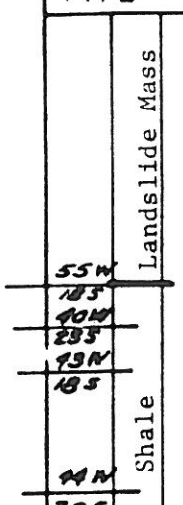
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 2-28-77

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 18" Bucket Auger | ELEVATION 50 | BORING 12



Undisturbed Altamira Shale Landslide Mass

5

10

15

20

DISTURBED TERRACE DEPOSITS:

Reddish brown SANDY SILT with many SHALE fragments

Increased CLAY (bentonite)

DISTURBED ALTAMIRA SHALE: Gray and black SILTSTONE and SHALE. Highly fractured, many roots, some clay. Slickensides.

BASE OF SLIDE

ALTAMIRA SHALE: Gray-black & brown SILTSTONE with interbedded SANDSTONE and CLAYSTONE. Dense, unfractured material. Many gypsum seams.

NOTES:

1. No groundwater.
2. No caving.

STRIKE / DIP	GEOLOGIC UNIT	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

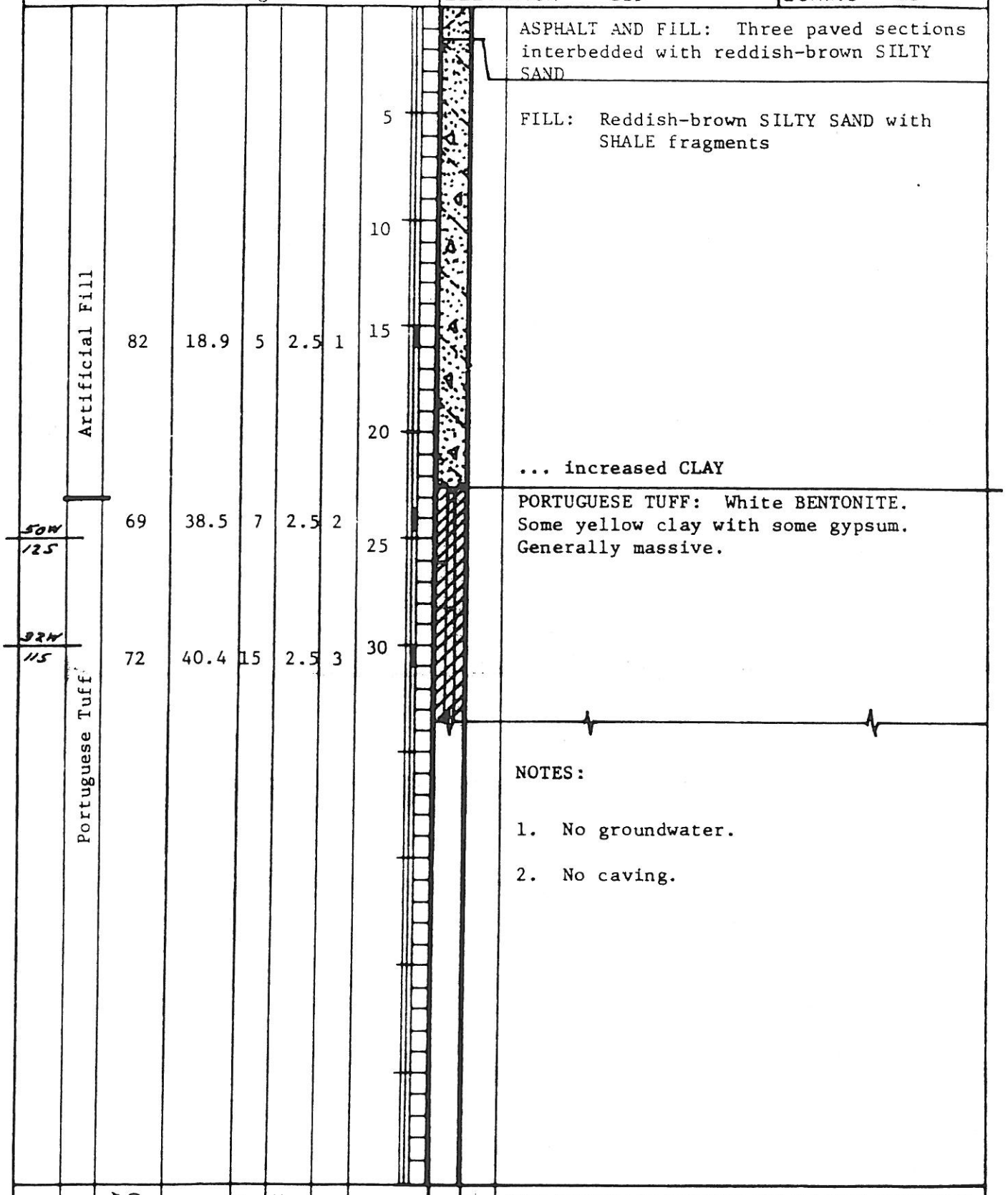
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 3-1-77

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 115 | BORING 13



DEPTH IN FEET	GEOLOGIC UNIT	DRY DENSITY (LBS/CU.FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	MATERIAL SYMBOL	UNIFIED SOIL CLASS.
0–23	Artificial Fill	82	18.9	5	2.5	1		
23–30	Portuguese Tuff	69	38.5	7	2.5	2		
30+	Portuguese Tuff	72	40.4	15	2.5	3		

SOW 125

92W 115

5 10 15 20 25 30

ASPHALT AND FILL: Three paved sections interbedded with reddish-brown SILTY SAND

FILL: Reddish-brown SILTY SAND with SHALE fragments

... increased CLAY

PORTUGUESE TUFF: White BENTONITE. Some yellow clay with some gypsum. Generally massive.

NOTES:

1. No groundwater.
2. No caving.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 3-1-77

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 176 | BORING 14

STRIKE / DIP	GEOLOGIC UNIT	DRY DENSITY (LBS/CU.FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.
	Landslide Mass	81	14.8	4	2.5	1	10		
		87	17.6	3	2.5	2	20		
		87	21.1	6	2.5	3	25		
7W / 11W							30		
80E / N S		69	51.5	12	2.5	4			
70E / 10S							35		
70E / 11S	Undisturbed Altamira Shale						40		

DISTURBED TERRACE DEPOSITS:

Reddish-brown SILTY SAND with some SHALE fragments

DISTURBED MARINE TERRACE: 3"to 1' COBBLES in sandy matrix

DISTURBED ALTAMIRA SHALE (Portuguese Tuff) White BENTONITE. Massive and blocky.

BASE OF SLIDE: One-half inch orange CLAY with small grains. Slickenslides trend N30E.

ALTAMIRA SHALE: Gray-black & brown SILTSTONES with interbeds of SANDSTONE and SHALE. 1-3" beds, gypsum seams. Dense, firm material. Damp.

NOTES:

1. No groundwater
2. No caving.

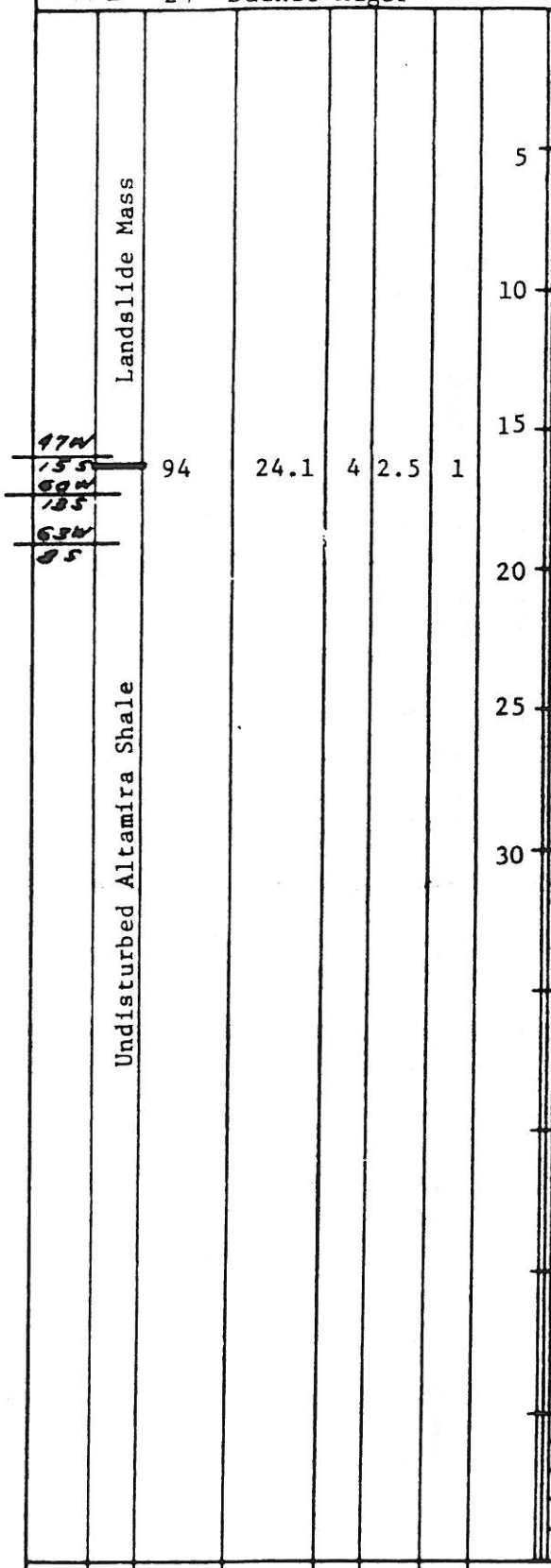
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 3-2-77

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 112 | BORING 15



STRIKE / DIP	GEOLOGIC UNIT	DRY DENSITY (LBS/CU.FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET
47N 15 E	Landslide Mass	94	24.1	4	2.5	1	0
60N 18S							
65N 9S	Undisturbed Altamira Shale						

DISTURBED TERRACE DEPOSITS:

Reddish-brown CLAYEY SAND with many SHALE fragments

BASE OF SLIDE: Blue-gray CLAY underlain by disturbed and mildly distorted SILTSTONE.

ALTAMIRA SHALE: Gray, brown, and black SILTSTONE with interbedded SANDSTONE. 1-3" beds. Some gypsum seams. Dense, firm material.

NOTES:

1. No groundwater
2. No caving.

MATERIAL SYMBOL | UNIFIED SOIL CLASS.

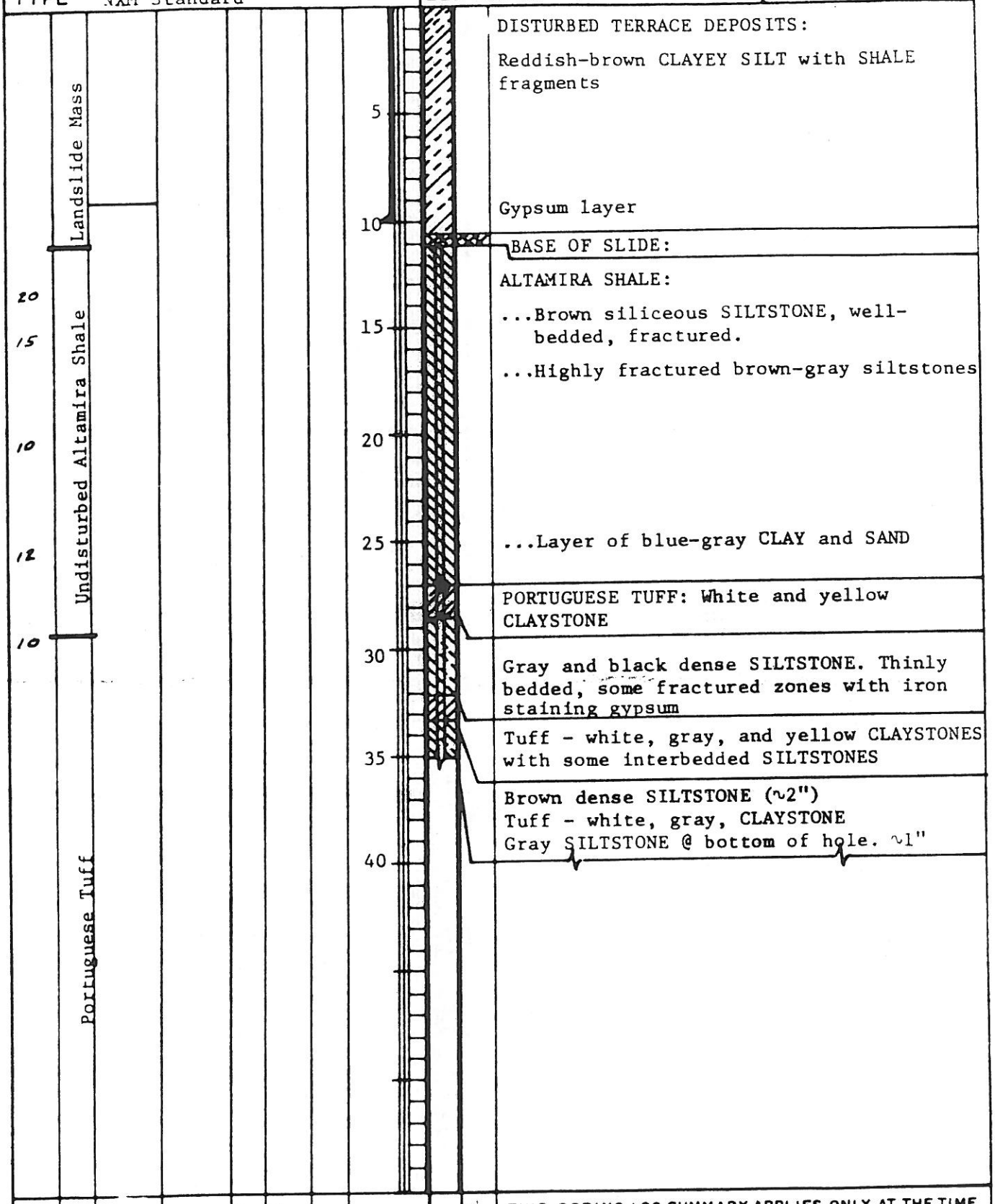
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 3-2-77

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE NXM Standard | ELEVATION 90 | BORING 17



DISTURBED TERRACE DEPOSITS:

Reddish-brown CLAYEY SILT with SHALE fragments

Gypsum layer

BASE OF SLIDE:

ALTAMIRA SHALE:

...Brown siliceous SILTSTONE, well-bedded, fractured.

...Highly fractured brown-gray siltstones

...Layer of blue-gray CLAY and SAND

PORTUGUESE TUFF: White and yellow CLAYSTONE

Gray and black dense SILTSTONE. Thinly bedded, some fractured zones with iron staining gypsum

Tuff - white, gray, and yellow CLAYSTONES with some interbedded SILTSTONES

Brown dense SILTSTONE (~2")
Tuff - white, gray, CLAYSTONE
Gray SILTSTONE @ bottom of hole. ~1"

DIP | GEOLOGIC UNIT | CORE NO INTERVAL | MOISTURE (%) | BLOWS/FOOT | SAMPLE SIZE (INCHES) | SAMPLE NO | DEPTH IN FEET | MATERIAL SYMBOL | UNIFIED SOIL CLASS.

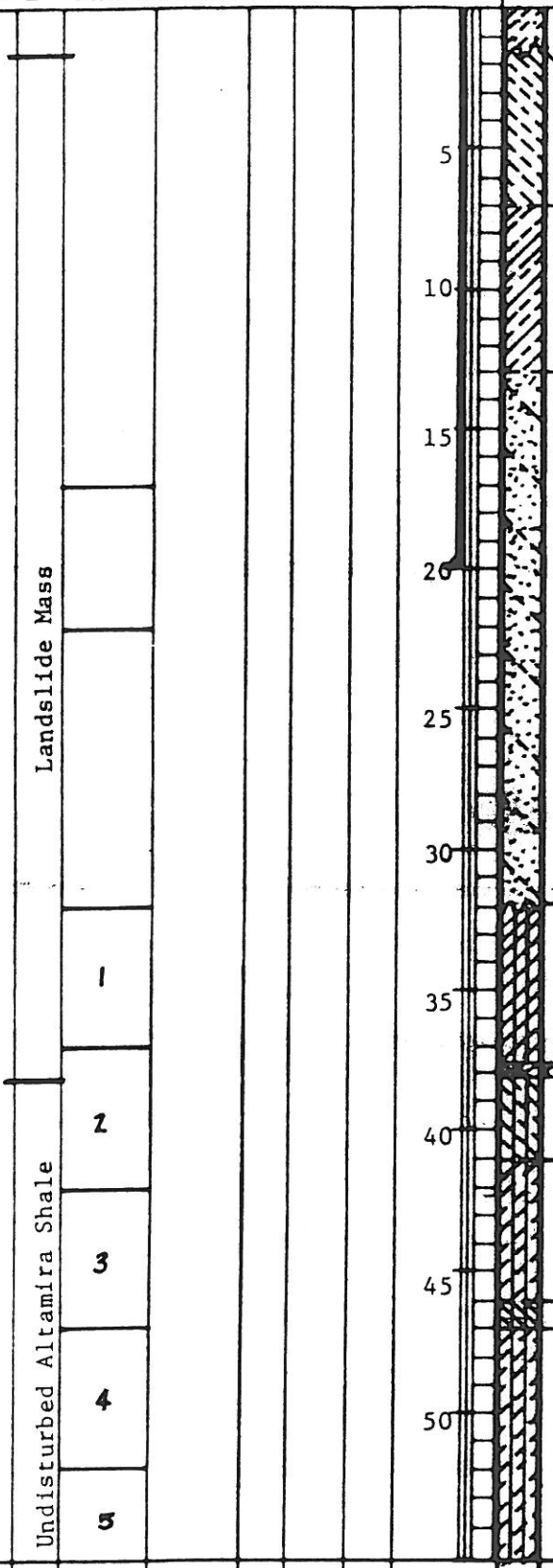
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 4-15-77

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE NXM Standard | ELEVATION 155 | BORING 18



FILL: Pinkish-brown SANDY SILT

DISTURBED TERRACE DEPOSITS:

Pinkish-brown SANDY SILT

Reddish-brown CLAYEY SILT with SHALE fragments

... increasing CLAY

Yellow-brown SILTY SAND

DISTURBED ALTAMIRA SHALE: Brown, yellow, and gray interbedded SILTSTONES. Highly weathered & fractured with gypsum veins 33'-34'. Minor coarse SANDSTONE layers

BASE OF SLIDE: 3" brown sheared CLAY-STONE

ALTAMIRA SHALE: Light and dark gray, blue and yellow SILTSTONE and SANDSTONE. Some fracturing. Three one-half inch clay layers (39',40' and 40.5'). Predominantly dark and light gray SILTSTONE

Gray, white and yellow CLAYSTONE (Tuff) highly fractured & weathered, rust staining. Gray at 46', white at 47'. Dark gray and black thinly-bedded SILTSTONE. Hard, dense, lightly fractured.

Some blue CLAYSTONE beds @ ∿ 54'.

DIP | GEOLOGIC UNIT | CORE Nº INTERVAL | MOISTURE (%) | BLOWS/FOOT | SAMPLE SIZE (INCHES) | SAMPLE Nº | DEPTH IN FEET | MATERIAL SYMBOL | UNIFIED SOIL CLASS.

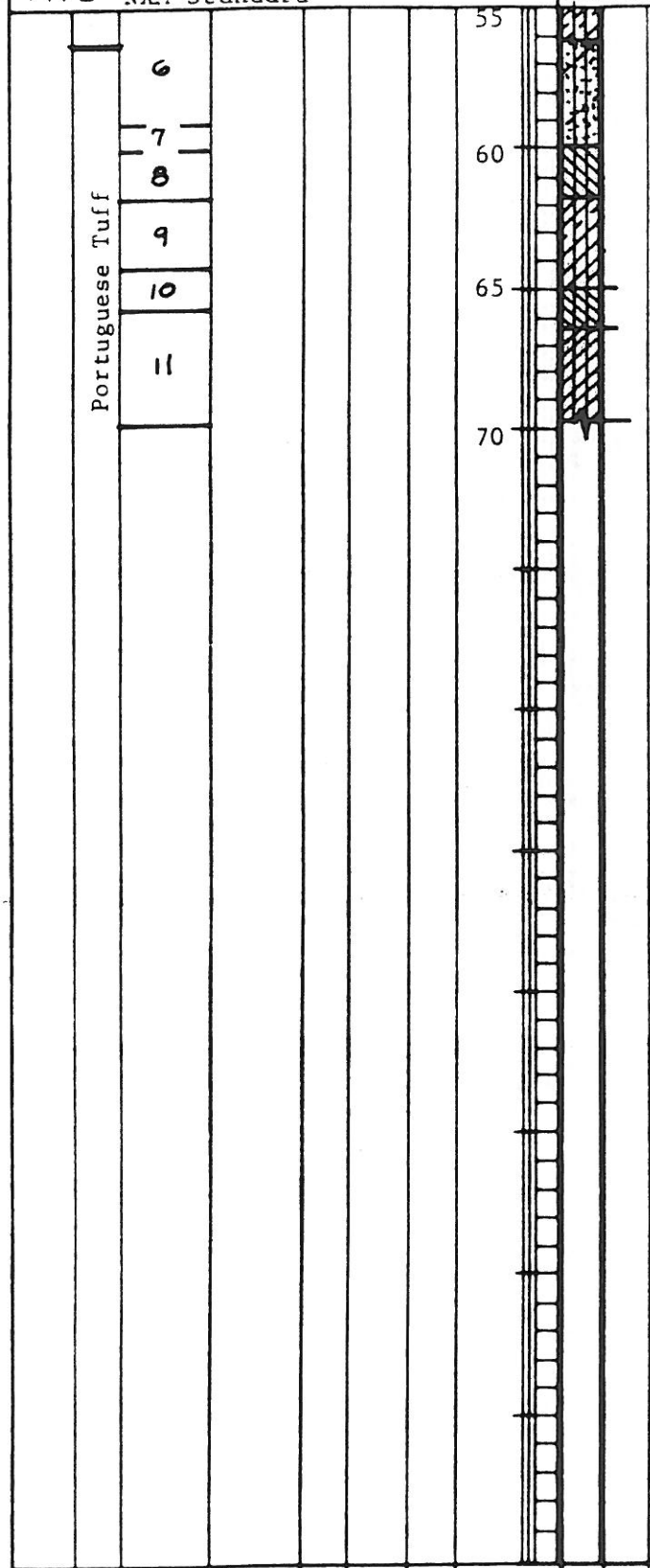
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 4-18-77

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE NXM Standard | ELEVATION 155 | BORING 18 (cont'd)



Blue-gray thinly bedded SANDSTONE and SILTSTONE

PORTUGUESE TUFF:

... Blue-gray SILTY CLAYSTONE, dense, hard material.

... Blue-gray interbedded SILTY CLAYSTONE and TUFFACEOUS CLAYSTONE

... Blue-gray, thinly bedded SILTY CLAYSTONE

... Blue-gray TUFFACEOUS CLAYSTONE

... Blue-gray SILTY AND SANDY CLAYSTONE

STRIKE / DIP	GEOLOGIC UNIT	CORE Nº INTERVAL	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS

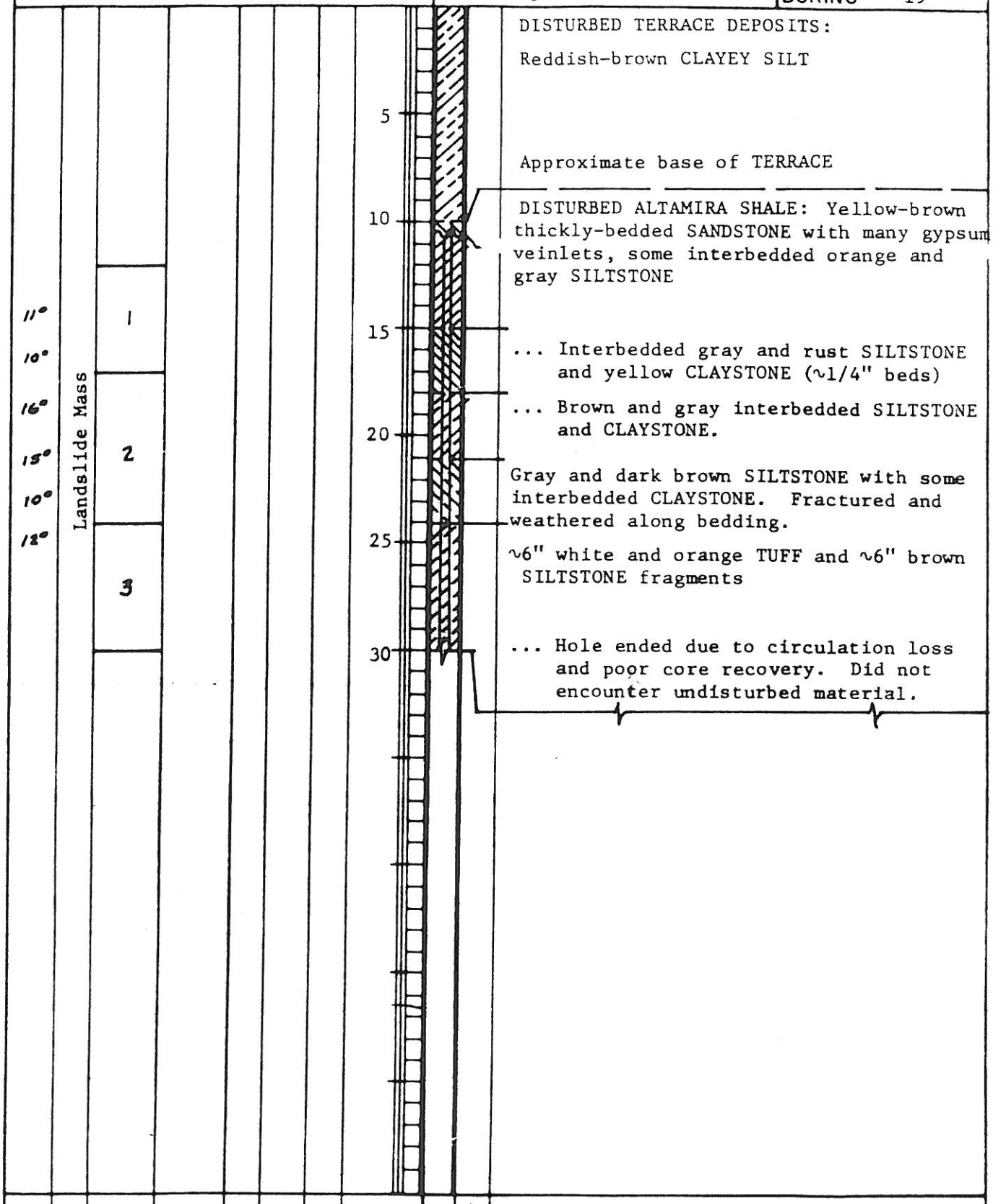
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 4-18-77

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE Mud Barrel (2") | ELEVATION 75 | BORING 19



DISTURBED TERRACE DEPOSITS:

Reddish-brown CLAYEY SILT

Approximate base of TERRACE

DISTURBED ALTAMIRA SHALE: Yellow-brown thickly-bedded SANDSTONE with many gypsum veinlets, some interbedded orange and gray SILTSTONE

... Interbedded gray and rust SILTSTONE and yellow CLAYSTONE (∿1/4" beds)

... Brown and gray interbedded SILTSTONE and CLAYSTONE.

Gray and dark brown SILTSTONE with some interbedded CLAYSTONE. Fractured and weathered along bedding.

∿6" white and orange TUFF and ∿6" brown SILTSTONE fragments

... Hole ended due to circulation loss and poor core recovery. Did not encounter undisturbed material.

DIP	GEOLOGIC UNIT	CORE Nº INTERVAL	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY PJA | DATE 4-18-77

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 227 | BORING 101

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT /1500 ft-lbs	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.	
							5		CL	TOPSOIL: Brown SILTY CLAY with a few scattered rock fragments
				3	2.5	1	10			TERRACE DEPOSITS: Brown CLAYEY SILT and SILTY CLAY with rock fragments and a few small COBBLES (up to 6" in diameter)
							15			...becoming orange-brown CLAYEY SILT with rock fragments at 14'
N50W 11 S				3	2.5	2	20			...scattered layers of fine to medium orange-brown SILTY SAND; numerous rock fragments and small COBBLES form a relatively well defined, slightly irregular, basal contact at 20'
							25			Yellow-brown CLAYEY SILT with relatively few or no rock fragments
				7	2.5	3	30			
							35			...some scattered layers of orange-brown SANDY SILT and less commonly SILTY SAND at 37'
				6	2.5	4	40			Orange-brown SANDY SILT with rock fragments; relatively well defined irregular basal contact at 50'
							45			
							50			--- Continued

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 101 Cont.

BLOWS/FOOT /500 ft. lbs.	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET
7	2.5	5	50
			55
			60
8	2.5	6	
			65
			70
			75
			80

Orange-brown CLAYEY SILT with few or no rock fragments

...some scattered layers of SANDY SILT at 58'

MARINE TERRACE: Rounded COBBLES (up to 8" in diameter) and rock fragments (rounded to subangular) in a matrix of brown fine to coarse SANDY SILT (slightly CLAYEY); increasing SAND, matrix becoming fine to coarse SAND at 74'

NOTES:

1. Refusal on 12" rounded COBBLES at 77'.
2. Slight caving below 74'.
3. No groundwater.
4. Backfilled 8/27/80.

STRIKE / DIP | RELATIVE COMPACTION | DRY DENSITY (LBS/CU FT) | MOISTURE (%) | MATERIAL SYMBOL | UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 8/26-27/80

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE	24" Bucket Auger	ELEVATION	212	BORING	102

Blows/Foot /500 ft. lbs.	Sample Size (Inches)	Sample No.	Depth in Feet	Material Symbol	Unified Soil Class.	
	Bag	1		CL		TOPSOIL: Dark brown SILTY CLAY with some small rock fragments
5	2.5	2	5			
			10			TERRACE DEPOSITS: Brown SILTY CLAY and CLAYEY SILT with rock fragments and a few scattered COBBLES (up to 4" in diameter)
4	2.5	3	15			
			20			Light brown fine SANDY SILT
7	2.5	4				
			25			
			30			
						...increased rock fragments and some small COBBLES from 31-34' and from 36-38'
			35			
			40			Color change to light brown; scattered layers fine SILTY SAND
			45			
			50			Continued

Strike / Dip | Relative Compaction | Dry Density (LBS/CU FT) | Moisture (%)

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

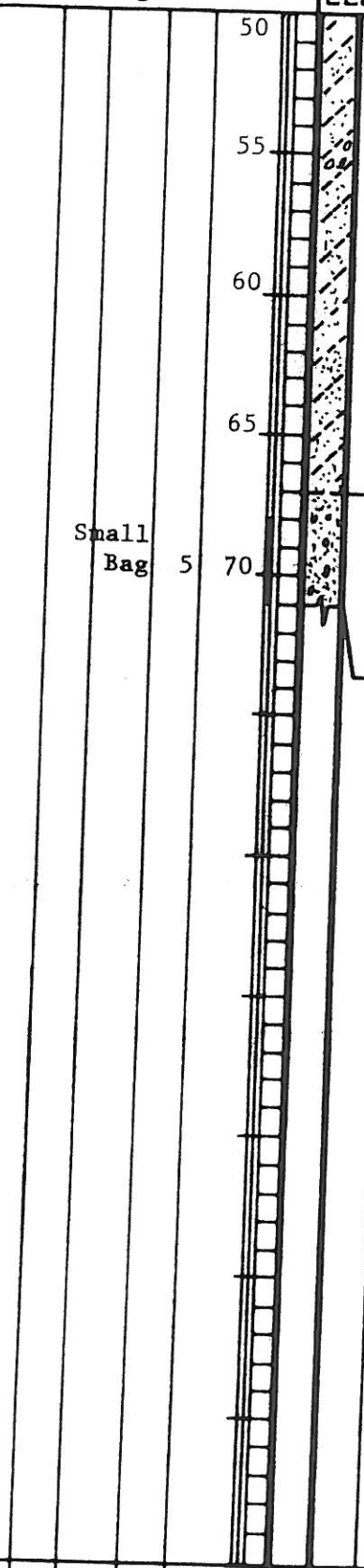
LOGGED BY | DATE

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 212 | BORING 102 Cont.



...increased rock fragments and some small COBBLES at 56'

Small Bag 5

MARINE TERRACE: Transitional from 67-68'; becoming black to orange fine to medium SAND with scattered well-rounded COBBLES and shell fragments at 68'

NOTES:

1. Refusal on COBBLES at 71'.
2. Slight caving below 68'.
3. No groundwater.
4. Backfilled 8/28/80.

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 8/27-28/80

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE	24" Bucket Auger	ELEVATION	189	BORING	103

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS / FOOT / 500 ft. lbs.	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.	
					Bag	1				FILL: Light brown SANDY SILT with scattered rock fragments and small bits of organic debris, relatively dry and loose - becoming dark brown SILTY CLAY at 3'; relatively moist and loose
				1	2.5	2	5		ML / CL	
				1	2.5	3	10			
							15			
										...relatively drier at 18'
				3	2.5	4	20			
							25			
										...6" piece of leather strap in fill at 28'
N60E / 55 W		Orientation of natural ground surface		8	2.5	5	30			TERRACE DEPOSITS: Light brown SILT (slightly clayey) with scattered rock fragments; scattered layers of light brown fine SANDY SILT
							35			
							40			
							45			...increased rock fragments at 47' forming a relatively well defined basal contact at 48'
N27W / 4 NE										
							50			Light brown SANDY SILT — Continued

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 103 Cont.

50

55

60

...numerous sub-rounded to sub-angular (predominantly tabular) SHALE fragments in a brown SANDY SILT matrix from 50-55'

MARINE TERRACE: Brown fine to medium SILTY SAND with rock fragments and small rounded COBBLES

NOTES:

1. Refusal on COBBLES at 57.
2. Slight caving below 55'.
3. No groundwater.
4. Backfilled 8/29/80.

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 8/29/80

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE	24" Bucket Auger	ELEVATION	183	BORING	104

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.
N30W 4 SW		shear surface					5	ML	
N38W 8 SW							10		
N37W 10 SW							15		
							20		
							25		
							30		
							35		
							40		
							45		
							50		

FILL(?)/SLIDE DEBRIS(?): Light brown SANDY SILT with rock fragments and scattered COBBLES (up to 6" in diameter)

SLIDE DEBRIS: Rock fragments and COBBLES in a light brown SILTY SAND matrix; relatively dry and loose; scattered white limy patches

BEDROCK: Thinly interbedded brown and gray (tuffaceous?) SILTSTONE; scattered thin beds of black SILTSTONE and gray fine (tuffaceous?) SANDSTONE; well defined slide surface at 34', gypsum encrusted striations on slide surface; abundant gypsum seams, most commonly parallel to bedding

Thinly interbedded gray to black SILTSTONE; scattered thin beds (up to 3") of hard, black SILICEOUS SHALE; slightly decreased gypsum

NOTES:
1. Refusal on siliceous shale(?) @ 50'.
2. Slight caving between 19 and 26'.
3. Very hard drilling below 34'.
4. Backfilled 9/2/80.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 8/29 & 9/2/80

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE	ELEVATION	BORING
5-5/8" Diameter Rotary	235	105

CL

SOIL: Brown SILTY CLAY; large surficial soil cracks (up to 3" wide)

TERRACE DEPOSITS: Light brown to orange-brown CLAYEY SILT with rock fragments interbedded with scattered layers or lenses of SILTY SAND with rock fragments

...increased SAND and rock fragments from 35 to 44 feet

Cont.

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE	ELEVATION	BORING 105 (Cont.)

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT 600 FT. LBS.	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.	
				48	2.5	1	55			
							60			
							65			
							70			
							75			
							80			
				60	1.4	2				MARINE TERRACE: Rounded PEBBLES and COBBLES in a black SAND(?) matrix
				8 inches			85			
				100	1.4	3				BEDROCK: ALTAMIRA SHALE - thinly interbedded buff (tuffaceous), orange-brown and dark brown SILTSTONE, scattered thin gypsum veins parallel to bedding
N21W 14 SW		Oriented sample (140 lbs. hammer)		400	2.5	4	90			
				4 inches			95			
										Interbedded gray to blue-gray BENTONITIC TUFF and dark brown to black SILTSTONE with minor yellow-orange BENTONITIC TUFF
				Small	Bag	5	100			Cont.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 105(Cont.)

Sample No.	Sample Size (Inches)	Blows/Foot 600 ft.lbs.	Depth in Feet	Material Symbol	Unified Soil Class.	Description
5	Bag	Small				...interbeds of hard black SILICEOUS SHALE at 100 and 103 feet
6	Bag	Small	105			Gray to blue-gray BENTONITIC TUFF massive, no apparent infra-structure; waxy texture
7	1.4	75	110			
			115		TUFF	
8	Bag	Small	120			Gray TUFFACEOUS SILTSTONE or SHALE; relatively hard and brittle
			125			
			130		PORTUGUESE	Gray to blue-gray BENTONITIC TUFF; waxy texture with indistinct color bands or laminations in sample at 150 feet
			135			
			140			
			145			
1	1.4	37	150			

NOTES:

1. Drill mud (water) at approximately 57' when left to stand 3.5 days.
2. Slope inclinometer placed 11/24/80- aluminum tubing placed to the bottom of the boring; backfilled with 1/2" well rounded gravel; 153' of tubing (~2' protruding above ground surface).

STRIKE / DIP | RELATIVE COMPACTION | DRY DENSITY (LBS/CU FT) | MOISTURE (%)

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

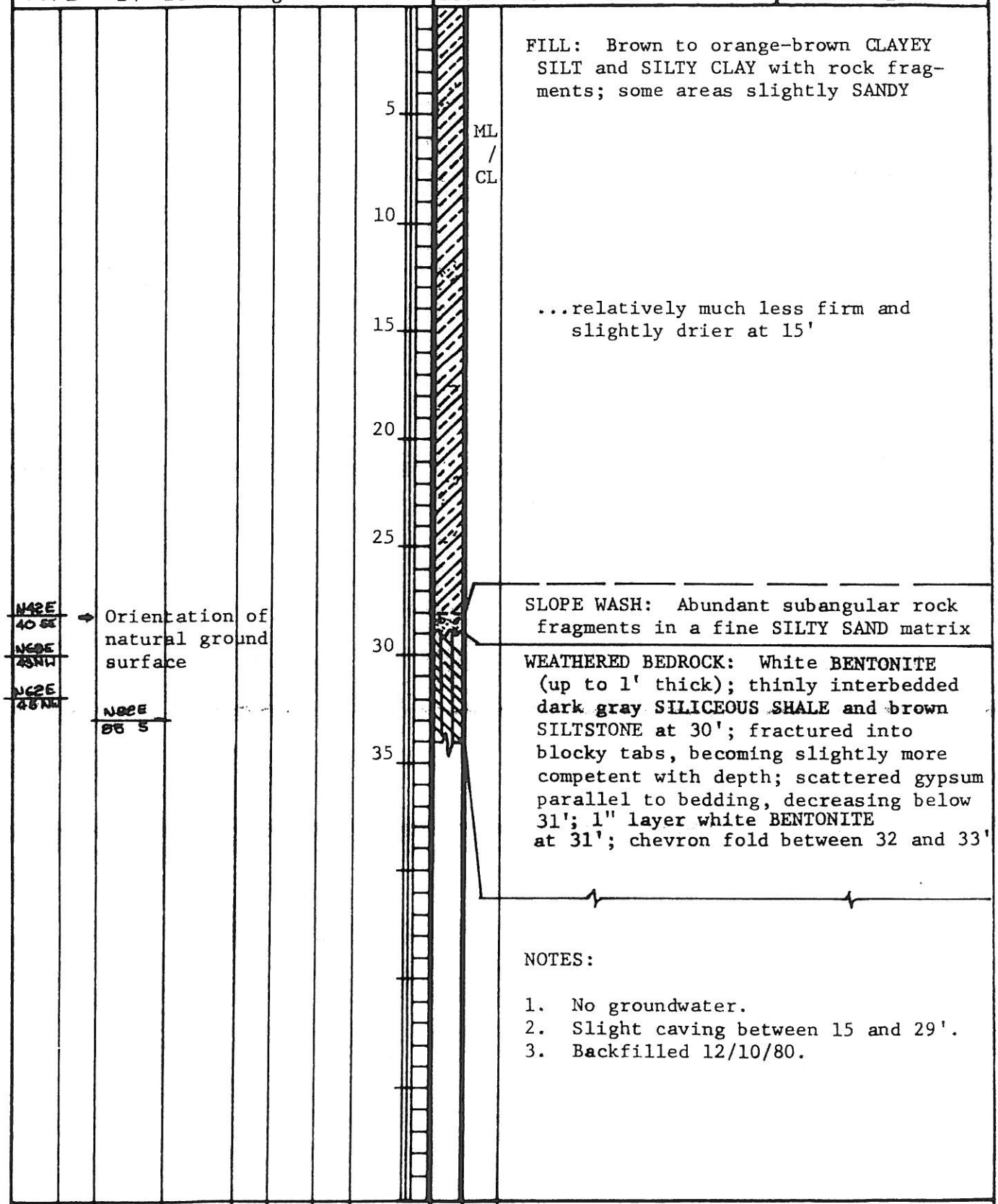
LOGGED BY STK | DATE 11/20,21,25/80

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger	ELEVATION 122	BORING 106



FILL: Brown to orange-brown CLAYEY SILT and SILTY CLAY with rock fragments; some areas slightly SANDY

...relatively much less firm and slightly drier at 15'

SLOPE WASH: Abundant subangular rock fragments in a fine SILTY SAND matrix

WEATHERED BEDROCK: White BENTONITE (up to 1' thick); thinly interbedded dark gray SILICEOUS SHALE and brown SILTSTONE at 30'; fractured into blocky tabs, becoming slightly more competent with depth; scattered gypsum parallel to bedding, decreasing below 31'; 1" layer white BENTONITE at 31'; chevron fold between 32 and 33'

NOTES:

1. No groundwater.
2. Slight caving between 15 and 29'.
3. Backfilled 12/10/80.

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 12/9-10/80

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE	24" Bucket Auger	ELEVATION	226	BORING	107

DEPTH IN FEET	DESCRIPTION
0	TERRACE DEPOSITS: Dark brown SILTY CLAY with scattered rock fragments
13	Color change to yellow-brown; scattered layers and lenses (up to 6" thick) of dark brown SILTY SAND with abundant rock fragments
20	Color change to red-brown
30	Yellow-brown SILT, scattered small lenses of dark brown SILTY SAND with abundant rock fragments
35	...becoming slightly CLAYEY at 35' with scattered rock fragments
45	MARINE TERRACE: Yellow-brown SILTY SAND with well rounded PEBBLES grading into fine-medium oxidized beach sand with scattered shell fragments and well rounded COBBLES (up to 6" in diameter)
50	Cont.

NBGE 7-75

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS / FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 107 (Cont.)

E-W 24 S

N87W 56 S

N84N 42 S

N82W 37 S

N85W 39 S

55

60

65

70

BEDROCK: Thinly laminated or banded hard gray SHALE (tuffaceous?) with scattered thin (up to 1") interbeds of light gray and yellow BENTONITIC TUFF; SHALE fractured or jointed into blocky tabs with red-brown oxidation staining on bedding planes and joints; becoming more competent below 55'; increased yellow, gray and gritty gray BENTONITIC TUFF (up to 6" thick) with few scattered thin (up to 2") layers of white and light gray BENTONITE below 55'

...6" light gray and yellow banded BENTONITE at 66!

NOTES:

1. No groundwater and very slight caving in Marine Terrace.
2. Careful examination of all bentonite layers showed no apparent shear surfaces or sheared material.
3. Backfilled 12/12/80.

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

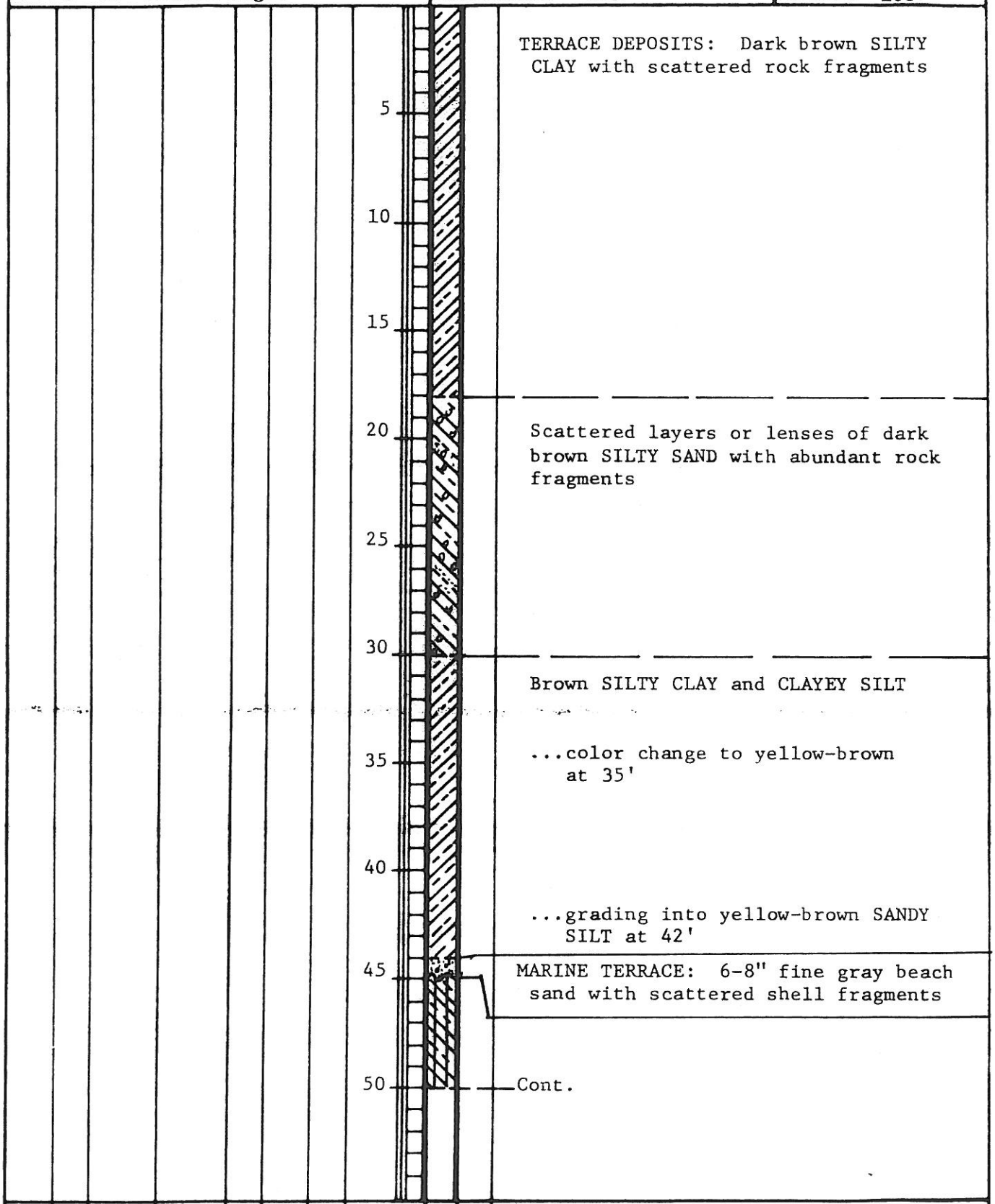
LOGGED BY STK | DATE 12/11-12/80

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger	ELEVATION 225	BORING 108



STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY	DATE

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 108(Cont.)

N85E 70 S
N86E 68E
E-W 69S

55
60

BEDROCK: White BENTONITIC TUFF with thin interbeds of tan and orange-brown (oxidized) TUFFACEOUS SILTSTONE; scattered thin interbeds of SILICEOUS SHALE between 54 and 56'

NOTES:

1. No groundwater or caving.
2. Backfilled 12/15/80.

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

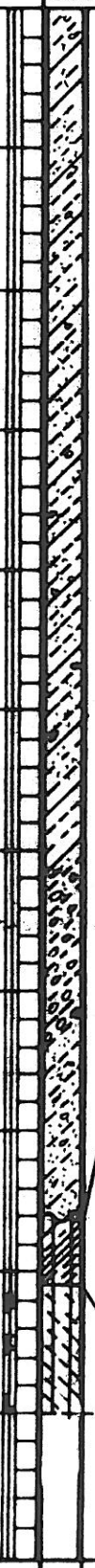
LOGGED BY STK | DATE 12/15/80

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Bucket Auger | ELEVATION 224 | BORING 109



TERRACE DEPOSITS: Red-brown CLAYEY SILT and SANDY SILT with scattered rock fragments

...abundant sub-rounded to sub-angular rock fragments in a SANDY SILT maxtrix from 32-37'; scattered layers and lenses of dark brown SILTY SAND

...yellow-brown SILT with scattered rock fragments at 37'; scattered layers or lenses of fine SILTY SAND with numerous rock fragments

BEDROCK: Thinly interbedded blue-gray BENTONITIC TUFF and tan to orange-brown (tuffaceous?) SILTSTONE, abundant orange oxidation markings; 4" brown SILICEOUS SILTSTONE at 45'

Blue-gray hard TUFFACEOUS SILTSTONE (some fossil fish scales); (1" white BENTONITE at 46'; nobbly and waxy texture; 2" granular BENTONITIC TUFF at 47.5'); 2' of light gray BENTONITE at 48', nobbly and waxy texture

Cont.

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.
N39W / 15SW			Small	Bag		1	45		
N46W / 14SW			Small	Bag		2			
N48W / 13SW			Small	Bag		3	50		

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 109 (Cont.)

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.	
							55			Light gray BENTONITIC SILTSTONE (tuff?) with orange oxidation staining
N48W 12 SW	Possible Shear Surface?		Small	Bag	4		60			Light gray BENTONITE; nobbly and waxy texture; possible shear surface(?) 1" of lightly sheared(?) light gray stiff, plastic, BENTONITE at 61'; relatively softer and more moist than above
N40W 10 SW							65			Thinly bedded dark brown to tan SILTSTONE with scattered thin interbeds of light gray TUFFACEOUS SILTSTONE and light gray BENTONITIC TUFF
							70			

NOTES:

1. No groundwater or caving.
2. Four small hand samples taken during downshole logging.
3. Backfilled 12/16/80.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 12/16/80

Job No. 380-462 -

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 4-7/8" Diameter Rotary/Core | ELEVATION 185.5 | BORING 110

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL (feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE
6/15	R	—	—	—	—	—	5, 10, 15, 20, 25, 30, 35, 40, 45		
6/16	R	—	—	—	—	—	50		

TERRACE DEPOSITS: Red-brown CLAYEY SILT and SANDY SILT with small rock fragments

MARINE TERRACE DEPOSITS: Abundant sub-angular to well-rounded GRAVEL and COBBLES in a fine to medium SAND matrix

---- Continued ...

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 110 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET CASING SET	STRUCTURE	
	MP	2.0	75%	5	32°	S-1			BEDROCK (ALTAMIRA SHALE): Thinly bedded light gray, yellow and brown SILTSTONE and TUFFACEOUS SILTSTONE with minor thin interbeds of fine SANDSTONE and BENTONITIC TUFF
	R	-	-	10	-	-	55		
	MP	2.5	100%	15	24°	S-2			
	MP	1.0	100%	20	-	S-3			
	NX	0.7	100%	15	21°	S-4	60		0.5 foot thick hard SILICEOLS SILTSTONE grading into 0.3 foot thick hard SILICEOUS FINE SANDSTONE
6/16	NX	2.8	85%	45	23°	S-5			
	NX	5.0	100%	40	-	S-6	65		Interbedded light brown SILTSTONE, fine SILTY SANDSTONE and SANDSTONE: siltstone shows some dark brown streaks or laminations parallel to bedding; few scattered thin GYPSUM seams on bedding surfaces
	NX	4.8	93%	70	24°	S-7	70		Thinly interbedded and sometimes laminated black, gray and gray-brown SILTSTONE with minor thin beds of fine SANDSTONE; relatively much harder
	NX	4.0	100%	60	-	S-8	75		Same as between 59.5 and 68 feet; some approximately vertical, gypsum filled fractures showing a preferred orientation parallel to the dip of the bedding
	NX	5.2	100%	45	25°	S-9	80		...fracturing is less pronounced, color change to gray and dark gray (unoxidized or unweathered), becoming more distinctly bedded and more tuffaceous below 81 feet
	NX	5.0	100%	45	-	S-10	85		... 1.5 to 2.0 inch BENTONITE beds at 82 and 85 feet
6/17	NX	5.0	100%	60	-	S-11	90		Interbedded blue-gray BENTONITE, gray to black TUFFACEOUS SILTSTONE and SHALE; scattered thin beds of blue-gray, fine granular TUFF (welded?); some vertical fracturing apparent
	NX	5.0	100%	55	25°	S-12	95		... 0.5 foot soft brown SILTSTONE at 92 feet
	NX	5.0	100%	70	-	S-13	100		Bedded or banded blue-gray to black BENTONITE, generally aphanitic, but some layers show a coarse granular texture; 1.0 foot thick blue-gray fine granular TUFF (welded?) at 96 feet; breaks into blocky fragments; some pyrite evident on fracture surfaces
									---- Continued ...

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 110 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL (feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE
6/17						S-13			
	NX	3.5	100%	70	30°	S-14	105		
	NX	5.0	100%	55	40°	S-15			
6/18	NX	5.0	100%	65	58°	S-16	110		
	NX	3.0	83%	65	67°	S-17	115		
	NX	5.0	80%	40	67°	S-18	120		
	NX	3.7	85%	45	-	S-19	125		
	R	-	-	-	-	-			
6/23	NX	3.0	80%	45	-	S-20			
	NX	3.0	83%	60	70°	S-21	130		
	NX	4.8	85%	65	76°	S-22	135		
	NX	4.0	25%	130	84°	S-23	140		
	NX	0.6	30%	15	-	S-24			
6/24	NX	1.4	70%	30	84°	S-25			
	NX	3.4	95%	40	vert. overturned	S-26	145		
	NX	1.8	100%	30	-	S-27			
						S-28	150		

Same as above

Thinly interbedded gray to black SILTSTONE, TUFFACEOUS SILTSTONE, and SHALE; minor thin beds of fine granular TUFF (welded?); tuffaceous material shows varying degrees of alteration to BENTONITE

...2.0 inches dark brown SILTSTONE (Bentonitic?) at 110 feet: sheared(?)

...increased SHALE and decreased TUFF below 114 feet; 0.5 inch thick blue-gray BENTONITE with abundant pyrite inclusions at 114 feet

...possible sheared(?) SILTSTONE (Bentonitic?) at 117 feet; vertical hairline fracturing still apparent, no macrocrystaline secondary mineralization evident

...lightly sheared BENTONITE at 126 feet

...becoming more thinly bedded and almost laminated below 128 feet; relatively much harder

0.5 foot thick blue to dark gray banded BENTONITE at 132 feet - grading into 0.3 foot thick very hard, light gray-brown, aphanitic TUFF? or SILICEOUS SILTSTONE bed; upper bedding surface is very irregular (the result of alteration of the tuff? or depositional?)

Hard gray-brown to very dark brown SHALE; near vertical bedding; 0.5 foot relatively soft dark brown SILTSTONE at 134 feet; possible sheared BENTONITE at 135 feet; 0.3 inch BENTONITE (sheared) filled fracture across bedding at 135.5 feet; abundant pyrite in BENTONITE beds

...vertical bedding at 146 feet, overturning at 147 feet

...0.2 inch BENTONITE (sheared) filled fracture across bedding at 148.5 feet

Continued ...

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 110 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL (feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE
8/24	NX	2.4	66%	45	52°	S-28			
	NX	2.8	100%	30	vert.	S-29	155		
8/25	NX	4.3	77%	30	orig. orientation 80°	S-30			
	NX	2.0	40%	30	-	S-31	160		
	NX	4.8	80%	55	80°	S-32	165		
	NX	2.5	33%	40	-	S-33			
	R	-	-	-	-	-			
	MP	1.3	100%	20	N-S 77W	S-34	170		
8/29	NX	2.7	85%	40	-	S-35			
	NX	2.9	35%	50	40°	S-36	175		
8/30							180		
							185		
	R	-	-	240	-	-	190		
							195		
							200		

0.3 foot thick very hard, light gray-brown aphanitic TUFF(?) or SILICEOUS SILTSTONE(?); irregular lower bedding surface with blue-gray BENTONITE; thin, plastic sheared layers of blue to dark gray BENTONITE at 152 feet; bedding near vertical

...0.3 foot thick, very hard, light gray-brown aphanitic TUFF(?) or SILICEOUS SILTSTONE; upper bedding surface irregular

Hard gray-brown to very dark brown SHALES and some interbedded SILTSTONES; scattered thin layers of blue-gray BENTONITIC TUFF and BENTONITE

...some 0.2 inch layers of soft, plastic, sheared(?) layers of dark brown SILTSTONE (Bentonitic?) between 168 and 170 feet

-- Continued ...

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 110 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL (feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE
6/30	R	-	-	-	-	-	205		
							210		
							215		
							220		
							225		
							230		
							235		
	MP	2.5	60%	30	170E 36SE	S-37	240		
							245		
							250		

NOTES:

1. Losing circulation to a depth of approximately 105 to 110 feet.
2. Hole cased to a depth of 53 feet with 5-inch diameter casing to prevent fluid loss and caving in marine terrace deposits; hole cased to a depth of 77 feet with 3-inch diameter (HX) casing to prevent fluid loss.
3. Steeply dipping (near vertical and overturned) bedding between 110 and 175 feet makes core sampling very difficult due to slight caving of the steeply inclined rock fragments and jamming of the sample in the core barrel.
4. Oriented samples taken at 170 feet (S-34) and 240 feet (S-37). Sample S-34 should be within a range of ± 20° for the strike and ± 5° for the dip. Orientation of sample S-37 is unreliable due to a breakdown in the sampling method.
5. Hole reamed with 4-7/8" diameter rotary to accommodate geophysical logging.
6. 3-inch diameter (NX) casing pulled and geophysical logs run 6/30/81; gamma log run to a depth of 239 feet; SP log run from 81.5 feet (top of drill mud) to 239 feet; ER log malfunctioning.
7. Boring bridged at a depth of 15 feet with drill mud sacks and then backfilled and tamped with the kelly bar 7/1/81.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 5/15 to 6/30/81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 4-7/8" Diameter Rotary /Core | ELEVATION 202.0 | BORING 111

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET CASING SET	STRUCTURE
7/1 and 7/2	R	-	-	-	-	-	5, 10, 15, 20, 25, 30, 35, 40, 45, 50	

SOIL: Dark brown SILTY CLAY with small rock fragments

TERRACE DEPOSITS: Light brown to red-brown CLAYEY SILT and fine SANDY SILT with scattered small rock fragments; scattered layers or lenses of fine SILTY SAND with abundant rock fragments

Continued ...

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 111 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL (feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE
							55		
							60		
							65		
							70		
							75		
							80		
7/7	D	3.4	100	-	52°	S-1			
	MP	2.2	90	20	N53W 30NE	S-2	85		
	MP	1.5	60	15	N40W 35SW	S-3			
	R	-	-	-	-	-			
	D	1.0	100	-	N30W 42SW	S-4	90		
	MP	1.5	100	10	28°	S-5			
	MP	1.2	90	5	35°	S-6			
	MP	1.3	90	5	-	S-7	95		
7/8	D	-	-	-	-	-			
					-	-	100		

MARINE TERRACE DEPOSITS: Well-rounded GRAVEL and COBBLES in a fine to medium SAND matrix

BEDROCK (ALTAMIRA SHALE): Thinly bedded light gray to light brown SILTSTONE and TUFFACEOUS SILTSTONE with minor thin interbeds of fine SANDSTONE, BENTONITE and hard SHALE; weathered with abundant yellow to red-brown staining evident on bedding and fracture surfaces; scattered thin seams of gypsum parallel to bedding

...slightly less weathered below 89 feet

Continued ...

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 111 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE	
7/8	R	-	-	-	-	-	105			...0.8 to 1.0 foot hard SILICEOUS SHALE(?) at 108 feet
							110			BENTONITE(?): (pump pressure greatly increased, drilling smoothly)
							115			
										0.8 to 1.0 foot hard SILICEOUS SHALE(?)
	D	.4	100	-	-	S-8	120			Dark brown SILTSTONE (Petroliferous); hard and dense
	R	-	-	-	-	-	125			Interbedded SILTSTONE(?) and BENTONITE(?) (smooth drilling)
7/9	NX	4.0	62	50	30°	S-9	130			Thinly bedded and sometimes laminated gray to very dark gray SHALE with scattered interbeds of TUFFACEOUS SILTSTONE and blue-gray fine granular TUFF (welded?); abundant fractures, generally near-vertical or steeply inclined and possibly showing preferred orientation parallel to dip; portions of shale are very hard and brittle (silicified or altered?) below 135.6 feet
	NX	4.7	75	65	26°	S-10	135			
	NX	1.9	26	40	-	S-11	140			
	NX	2.4	100	30	25°	S-12				...increased SILTSTONE between 142.6 and 145 feet; less brittle, little or no fracturing
7/10	NX	4.0	80	60	27°	S-13	145			
	NX	4.2	88	60	32°	S-14				Very hard SILICEOUS SILTSTONE (Dolomite?); stratigraphic thickness 1.4 feet
										Continued ...

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 111 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL (feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE	
						S-14				
7/10	NX	5.0	25	40	25°	S-15	155			Thinly bedded and sometimes laminated SHALE and SILTSTONE with minor fine SANDSTONE interbeds; generally hard and brittle (cherty-altered slightly by basalt intrusion?); fractured with abundant orange staining
	NX	3.0	40	30	37° 26°	S-16				
	R	-	-	-	-	-	160			
		1.9	62	50	27°	S-17				Very hard thinly laminated SILICEOUS SILTSTONE (Dolomite?); stratigraphic thickness 3.2 feet; marker bed No. 1
		3.1	90	70	-	S-18	165			
7/13	R	-	-	40	-	-	170			Same as above 161.4 feet
							175			
	NX	4.3	70	60	25°	S-19	180			Very hard, thinly laminated SILICEOUS SILTSTONE (Dolomite?); stratigraphic thickness 1.8 feet; marker bed No. 2
7/14	R	-	-	-	-	-	185			Same as above 177.5 feet
							190			
							195			
							200			Continued ...

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 111 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET CASING SET	STRUCTURE
7/15	R	-	-	-	-	-	205	
							210	
							215	
							220	
							225	
							230	
	D	0.6	100	-	N27E 85E	S-20	235	
							240	
							245	
							250	

Hard SILICEOUS SILTSTONE; marker bed No. 4?

Interbedded SILTSTONE, TUFFACEOUS SILTSTONE and SHALE

NOTES:

1. Very poor or no circulation for much of the drilling, most pronounced between 94-100 feet.
2. Hole cased to a depth of 84 feet with 5" diameter casing; hole grouted from 100-120 feet to minimize circulation loss.
3. Oriented samples taken at 84 feet (S-2), 86 feet (S-3), 89 feet (S-4), 234 feet (S-20), orientation of samples S-2 and S-3 are unreliable due to a breakdown in the sampling method. Samples S-4 and S-20 should be within a range of ±20° for the strike and ± 5° for the dip.
4. Hole reamed to 4-7/8" diameter rotary to accomodate geophysical logging.
5. Geophysical logs run 7/18/81; gamma logs run to a depth of 235.5 feet; electrical logs run from 187 feet to 235.5 feet.
6. Top of drilling fluid at 187 feet after 72 hours.
7. Boring bridged at a depth of 15 feet with drill mud sacks and then backfilled and tamped with kelly bar 7/27/81.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY CTK | DATE 7/1 to 7/15/81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 4-7/8" Diameter Rotary/Core | **ELEVATION** 12.5 | **BORING** 112

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL (feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET
	R	-	-	-	-	-	5
							10
	D	1.0	100	-	-	S-1	15
7/16							
	R	-	-	-	-	-	20
							25
							30
							35
	D	0.4	25	-	-	S-2	
	MP	0.6	66	5	-	S-3	
7/21	R	-	-	-	-	-	40
							45
	D	0.5	100	-	36°	S-4	
							50

CASING SET → STRUCTURE

ALLUVIUM(?), SLOPE WASH(?), FILL(?): Dark brown CLAYEY SILT with scattered rock fragments

BEACH DEPOSITS: Brown fine SANDY SILT and SILTY SAND with abundant rounded GRAVEL and small COBBLES

BEDROCK (ALTAMIRA SHALE): PORTUGUESE TUFF - blue-gray BENTONITE and BENTONITIC TUFF: massive to indistinctly banded or bedded

Thinly bedded, very dark brown to black SHALE and TUFFACEOUS SILTSTONE with scattered interbeds of blue-gray BENTONITE and BENTONITIC TUFF; decreased SHALE below 40 feet

NOTES:

1. Boring cased to a depth of 15 feet with 5-inch diameter casing to minimize caving and fluid loss.
2. Drilled from 16 feet to 37 feet with 4-inch diameter drag bit.
3. Top of drilling fluid at a depth of 8 feet - at 9 feet after eight days.
4. Casing left in place and sealed with pipe plug for possible further exploration.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | **DATE** 7/16 and 7/21/81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 4-7/8" Diameter Rotary/Core | ELEVATION 13.0 | BORING 113

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE
7/22	R	-	-	-	-	-	5		
							10		
	D	0.5	80	-	vert.	S-1	15		
	NX	5.0	8	80°	near vert.	S-2	20		
							25		
							30		
							35		
							40		
							45		
							50		

ALLUVIUM(?), SLOPE WASH(?), FILL(?): Red-brown SANDY SILT and SILTY SAND with scattered rock fragments

BEACH DEPOSITS: Brown fine to medium SILTY SAND and SAND with abundant rounded GRAVEL and small COBBLES

BEDROCK (ALTAMIRA SHALE): Thinly bedded greenish-gray to black SHALE with minor SILTSTONE interbeds; vertical to very near vertical bedding

NOTES:

1. Boring cased to a depth of 15 feet with 5-inch diameter casing to minimize caving and fluid loss.
2. Coring of sample S-2 very hard drilling; small recovery is due to the hardness, vertical orientation and possibly fractured(?) condition of bedrock (unable to break across bedding to recover sample).
3. Boring was backfilled with sand, tamped with the kelly bar, and capped with 3 inches of A.C. on 7/22/81.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 7/22/81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE	4-7/8" Diameter Rotary/Core	ELEVATION	25.5	BORING	114

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL (feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE	
7/22	R	-	-	-	-	-	5			ALLUVIUM(?), SLOPE WASH(?), FILL(?), TALUS(?), LANDSLIDE DEBRIS(?): Brown CLAYEY SILT, SANDY SILT, and SILTY SAND with abundant rock fragments and scattered large COBBLES
							10			
							15			
							20			
							25			BEDROCK (ALTAMIRA SHALE): Thinly bedded brown to very dark gray-brown SHALE with minor SILTSTONE and blue-gray BENTONITE interbeds; some vertical fractures showing a preferred orientation parallel to dip; microcrystalline secondary mineralization (GYPSUM?) evident on some fracture surfaces
	NX	2.0	30	25	11°	S-1	30			
	NX	1.5	60	20	14°	S-2				
7/23	NX	2.9	40	90	10°	S-3	35			Very hard thinly laminated SILICEOUS SILTSTONE (Dolomite?); some vertical or near vertical fractures; stratigraphic thickness 2.9 feet - marker bed No. 1
	NX	2.6	88	60	14°	S-4				Thinly interbedded brown to very dark gray-brown SHALE and SILTSTONE
	NX	5.0	84	120	10°	S-5	40			...increased SHALE between 44 and 48.5 feet
	NX	5.0	70	100	8°	S-6	45			
						S-7	50			Very hard thinly laminated SILICEOUS SILTSTONE (Dolomite?); stratigraphic thickness 1.8 feet - marker bed No. 2
										Continued ...

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY	DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 4-7/8" Diameter Rotary/Core | ELEVATION | BORING 114 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET CASING SET	STRUCTURE
	HX	5.0	90	120	11°	S-7		
	HX	1.9	55	60	10°	S-8	55	
	R	-	-	-	-	-	60	
							65	
							70	
7/24	MP	0.4	100	5	9°	S-9	75	
	R	-	-	-	-	-	80	
							85	
							90	
							95	
							100	

Thinly interbedded brown to very dark gray-brown SHALE and SILTSTONE with minor scattered thin beds of blue-gray BENTONITIC TUFF AND BENTONITE

...increased SILTSTONE(?) between 58 and 61 feet, and 64.5 and 67.5 feet

...increased SHALE between 67.5 and 71.5 feet

...very hard thinly bedded (laminated?) SILICEOUS SHALE or SILTSTONE between 71.5 and 73.5 feet - marker bed No. 3(?)

...increased SILTSTONE(?) and BENTONITE(?) between 73.5 and 89 feet

Continued ...

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 114 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE
	NX	2.0	20	55	39°	S-10	105		
	NX	2.4	5	60	-	S-11			
7/27	R	-	-	-	-	-	110		
	HP				12°	S-12	115		
							120		
							125		
							130		
							135		
							140		
							145		
							150		

...0.3 to 0.5 foot thinly laminated SILICEOUS SILTSTONE (Dolomite?) - marker bed No. 4(?); unconformably (distinctly across bedding) adjoining this siliceous bed is a blue-gray CRYSTAL TUFF (welded?) showing a high degree of alteration to clay minerals - intruded or injected(?) approximate extent of TUFF 100-106 feet(?)

NOTES:

1. Boring cased to a depth of 26 feet with 5-inch diameter casing to minimize caving and fluid loss.
2. Geophysical logs run 7/28/81; gamma log run to a deoth of 112 feet, electrical logs run from 21 feet to 112 feet.
3. Top of drilling fluid at a depth of feet after 24 hours.
4. Boring bridged at a depth of 10 feet with a small cobble, backfilled and tamped with the kelly bar and capped with 3 inches of A.C. 7/27/81.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 7/22-24 & 27/81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 4-7/8" Diameter Rotary/Core | **ELEVATION** 12.0 | **BORING** 115

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET CASING SET	STRUCTURE
7/28	R	-	-	-	-	-	5	ALLUVIUM(?), SLOPE WASH(?), FILL(?): Red-brown SANDY SILT with scattered rock fragments
							10	BEACH DEPOSITS: Brown fine to medium SILTY SAND and SAND with abundant rounded GRAVEL and small COBBLES
	D	1.6	100	-	62°	S-1		BEDROCK (ALTAMIRA SHALE): Thinly interbedded gray to very dark gray-brown SHALE and SILTSTONE with scattered thin beds of blue-gray BENTONITE
	R	-	-	-	-	-	15	
	D	1.0	100	-	N70W 82°	S-2		...disturbed from 17 to 22 feet
	R	-	-	-	-	-		
	D	0.6	100	-	N65E vert.	S-3		
	MP	2.7	72	10	60° vert.	S-4		
	MP	1.5	65	10	20-40°	S-5	20	...sheared BENTONITE and SILTSTONE at 21 feet
	MP	2.2	100	10	60° 33° 26°	S-6		...conformable and undisturbed below 22 feet
							25	NOTES:
								1. Samples S-2 and S-3 are oriented samples and should be within a range of ± 20° for the strike and ± 5° for the dip.
							30	2. Boring was backfilled with sand, tamped with the kelly bar, and capped with 3 inches of A.C. 7/28/81.
							35	
							40	
							45	
							50	

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | **DATE** 7/28/81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 24" Diameter Bucket Auger	ELEVATION 224.5	BORING 116

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET CASING SET	STRUCTURE
9/10					N74W 21S N80W 22S		5 10 15 20 25 30 35 40 45 50	

TERRACE DEPOSITS: Dark brown to red-brown CLAYEY SILT with scattered rock fragments

...light brown fine SANDY SILT and SILT with scattered rock fragments below 10 feet

...increased SAND and abundant rock fragments between 32 and 37 feet

BEDROCK (ALTAMIRA SHALE): Interbedded gray, buff and light brown TUFFACEOUS SILTSTONE; abundant orange oxidation marking parallel to bedding

Thinly bedded or laminated dark brown to light (chocolate) brown SILTSTONE and minor fine SILTY SANDSTONE; relatively harder; some microcrystalline GYSPUM(?) parallel to bedding

Interbedded light brown SILTSTONE, SILTY SANDSTONE and fine SANDSTONE; greatly decreased oxidation

Continued ...

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY	DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 116 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET CASING SET	STRUCTURE
					N85W/27S		55	
					N85E/23S		60	
					N83E/20S		65	
					N80E/30S		70	
							75	
							80	
							85	
							90	
							95	
							100	

...4-inch SANDSTONE at 51 feet

...5-inch SANDSTONE at 53 feet

...6-inch well indurated (SILICEOUS?) SILTSTONE or SANDSTONE at 55 feet

Interbedded light gray to light brown TUFFACEOUS SILTSTONE

1.0 foot gray-brown SILICEOUS SILSTONE; black staining(?) up to 0.5 inch thick on upper bedding surface

Thinly bedded and banded light gray to blue-gray BENTONITE and minor BENTONITIC TUFF
...3-inch white (salt and pepper), granular BENTONITE at 64 feet
...4-inch white (salt and pepper), granular BENTONITE at 67 feet
...1.0 foot hard blue-gray, granular TUFF (welded?) at 68.5 feet; breaks into blocky fragments

NOTES:

1. No groundwater or caving.
2. Backfilled 9/10/81.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 9/10/81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE	24" Diameter Bucket Auger	ELEVATION	223.0	BORING	117

TERRACE DEPOSIT: Brown CLAYEY SILT to SANDY SILT with scattered rock fragments

...red-brown SANDY SILT to fine SILTY SAND with abundant rock fragments and scattered subangular to subrounded small COBBLES between 7 and 20 feet

NOTE: Terrace/Bedrock contact is irregular and approximately parallels orientation of bedding in bedrock

BEDROCK (ALTAMIRA SHALE): Thinly interbedded orange-brown to light gray SILTSTONE and TUFFACEOUS SILTSTONE; abundant orange oxidation markings (predominantly parallel to bedding)

Continued ...

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE N°	DEPTH IN FEET CASING SET	STRUCTURE
9/11					N76W 15S		5, 10, 15, 20, 25, 30, 35, 40, 45, 50	

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY	DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 117 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE
9/11					E-W / T4S N45W / T2SW N67W / T0S N60W / T3S N42W / T0SW		55 60 65 70		
9/16 and 9/17			orientation of gypsum seams		N30W / T0SW N26E / vert. N43E / T1NW		75 80 85		
							90 95 100		

...3-inch SHALE at 53 feet

...6-8 inches of hard (slightly SILICEOUS?) SILTSTONE or SHALE at 59 feet

...6-8 inches of hard (slightly SILICEOUS?) SILTSTONE or SHALE at 63 feet

Thinly bedded and banded cream to light gray BENTONITE with abundant orange oxidation markings generally parallel to bedding (banding); some thin, slightly irregular layers of red BENTONITE (staining?) between 65 and 65.2 feet showing some shiney partings along bedding surfaces (no striations evident) - some small portions of the basal 0.2 inch of this layer have a slightly plastic consistency

0.3-0.5 foot of thinly bedded gray TUFFACEOUS SILTSTONE and BENTONITE underlain by a discontinuous 1.0-2.0 inch hard, white DIATOMACEOUS(?) SILTSTONE with black (manganese?) staining on bedding surfaces - in some areas the margins of this bed are very soft and moist with abundant black staining (like a thick black and white chalky paste)

Interbedded brown to gray SHALE, SILTSTONE, and TUFFACEOUS SILTSTONE - relatively very much harder than above

PORTUGUESE TUFF: Interbedded blue-gray BENTONITE and BENTONITIC TUFF between 71 and 74 feet;
...hard, yellow-green and blue-gray BENTONITE below 74 feet; massive to indistinctly bedded; abundant GYPSUM seams (approx. parallel to bedding and near vertical across bedding - filled fractures?), seams may show a preferred orientation between N10E and N50E dipping to the northwest; yellow-green coloration appears to be the result of weathering or slight alteration (color change evident along margins of GYPSUM seams)
...very hard blue-gray SILICEOUS TUFF(?) at 84.5 feet; similar color and texture to BENTONITE above, but extremely hard-fractures conchoidally

NOTES:

1. Refusal on hard siliceous layer at 85 feet, tried coring bucket and breaking rock up with gad for approximately 6 hours and gained only 0.5 inches.
2. No groundwater or caving.
3. Backfilled 9/17/81.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 9/11, 9/16 and 9/17/81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 30"-42" Diameter Bucket Auger | **ELEVATION** 12.5 | **BORING** 118

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL (feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET CASING SET	STRUCTURE
9/18							5	
9/21 and 9/22							10	
							15	
							20	
							25	
							30	
							35	
							40	
							45	
							50	

ALLUVIUM(?), SLOPE WASH(?), FILL(?): Brown CLAYEY SILT to fine SILTY SAND with scattered rock fragments

BEACH DEPOSITS: Brown fine SILTY SAND and SAND with abundant rounded GRAVEL and COBBLES (up to 18 inches in diameter); decreased COBBLES below 9 feet

BEDROCK (ALTAMIRA SHALE): PORTUGUESE TUFF(?) - blue-gray BENTONITE, minor thin interbeds(?) of dark gray BENTONITIC SILTSTONE

...dark gray-brown SHALE in lower portion of hole

NOTES:

1. Groundwater at a depth of 9.3 feet (in beach deposits); moderate to severe caving between 4 and 12 feet.
2. Accurate logging of the bedrock was greatly impaired by caving of the beach deposits above.
3. An attempt was made to drive 39-inch diameter casing into the bedrock to protect against caving and seal out groundwater present on top of the bedrock.
4. The boring was drilled to a depth of approximately 25 feet and the hole cased to a depth of 11.5 feet on 9/21/81.
5. The boring caved (sand flowing under the casing) to a depth of 12.5 feet through the night - casing was driven to a depth of 12.5 feet on 9/22/81. Pumping of the hole and downhole inspection showed a substantial flow under the casing and no apparent bedrock within 6.0 inches of the bottom of the casing. It is probable that caving of the hole ravelled the top of the bedrock to a diameter larger than the casing.
6. Considering the above conditions and lack of an effective means for driving the casing, further attempts at sealing the bottom of the casing were abandoned and the boring was backfilled and tamped 9/22/81.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | **DATE** 9/18, 9/21 and 9/22/81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 30 - 42" Daimeter Bucket Auger

ELEVATION 182.0

BORING 119

FILL: Brown CLAYEY SILT to SANDY SILT with abundant lithic fragments (chaotic) and scattered organic debris

TERRACE DEPOSITS: Brown CLAYEY SILT with scattered angular to subrounded lithic fragments

MARINE TERRACE DEPOSITS: Abundant subangular to well-rounded GRAVEL and COBBLES in a light brown SAND matrix; COBBLES up to 18 inches in diameter; boring bells to approximately 6 feet diameter

BEDROCK (ALTAMIRA SHALE): Thinly bedded buff, tan and orange-brown SILTSTONE with interbeds of fine SILTY SANDSTONE and SANDSTONE; SILTSTONE shows some dark brown streaks parallel to bedding; some slightly irregular bedding (lenses); scattered thin GYPSUM seams on bedding surfaces

Continued ...

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE
					N65W / 14SW		5, 10, 15, 20, 25, 30, 35, 40, 45, 50		

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY

DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 30 - 42" Diameter Bucket Auger | ELEVATION 182.0 | BORING 119 (cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL(feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET CASING SET	STRUCTURE
					N55W 10SW		55	
					N60W 15SW			
					N68W 15SW		60	
					N45W 15SW		65	
					N60W 14SW		70	
					N38W 10SW		75	
					? N53W 14SW ?			
					N52W 15SW		80	
							85	
							90	
							95	
							100	

... more thinly bedded and sometimes laminated between 54 and 56 feet; relatively much harder

... 1.5 inch dark gray to black SILTSTONE at 57 feet

... 2 inch very hard SILICEOUS? Bed at 59.2 feet

Interbedded gray to black SILTSTONE and white to dark-gray BENTONITE; scattered thin GYPSUM seams, generally parallel to bedding; 2-3inch gray BENTONITE at 60 feet; 2-3 inch gritty white (salt and pepper) BENTONITE at 61 feet: 3-4 inch granular TUFF? or SANDSTONE? at 61.7 feet; 1.5 feet white to gray-brown banded BENTONITE at 62.1 feet; 2-3 inch gritty-white (salt and pepper) BENTONITE at 64.4 feet; 3-4 inch cream to gray BENTONITE at 65.2 feet; predominately gray to black SILTSTONE between 65.5 to 68 feet (relatively much harder)

Bedded or banded blue-gray to black BENTONITE; scattered thin (.25 inch) beds of gritty-brown (salt and pepper) BENTONITE; 1 foot blue-gray TUFFACEOUS SANDSTONE between 69.6 and 70.6 feet; basal 1 foot of this unit is distrubed, 2-4 inches broken BENTONITE showing some orange oxidation staining around fragments--lower 8-10 inches sheared BENTONITE (stiff and slightly plastic-showing very small shiny partinings), lower bedding surface is well defined and shiny-no evidence of striations--tectonic?

Thinly interbedded greenish-gray to black SILTSTONE and SHALE; relatively very hard

NOTES:

1) No groundwater
2) Very difficult drilling due to large cobbles and slight to moderate caving in Marine terrace deposits 31 to 39 feet-hole cased with 10 feet of 30 inch diameter sauna tubing for downhole logging.
3) Many hard intervals of bedrock necessitated utilization of a coring bucket with carbide teeth.
4) Very hard drilling below 77 feet-refusal at 79 feet
5) Backfilled 10-26-81

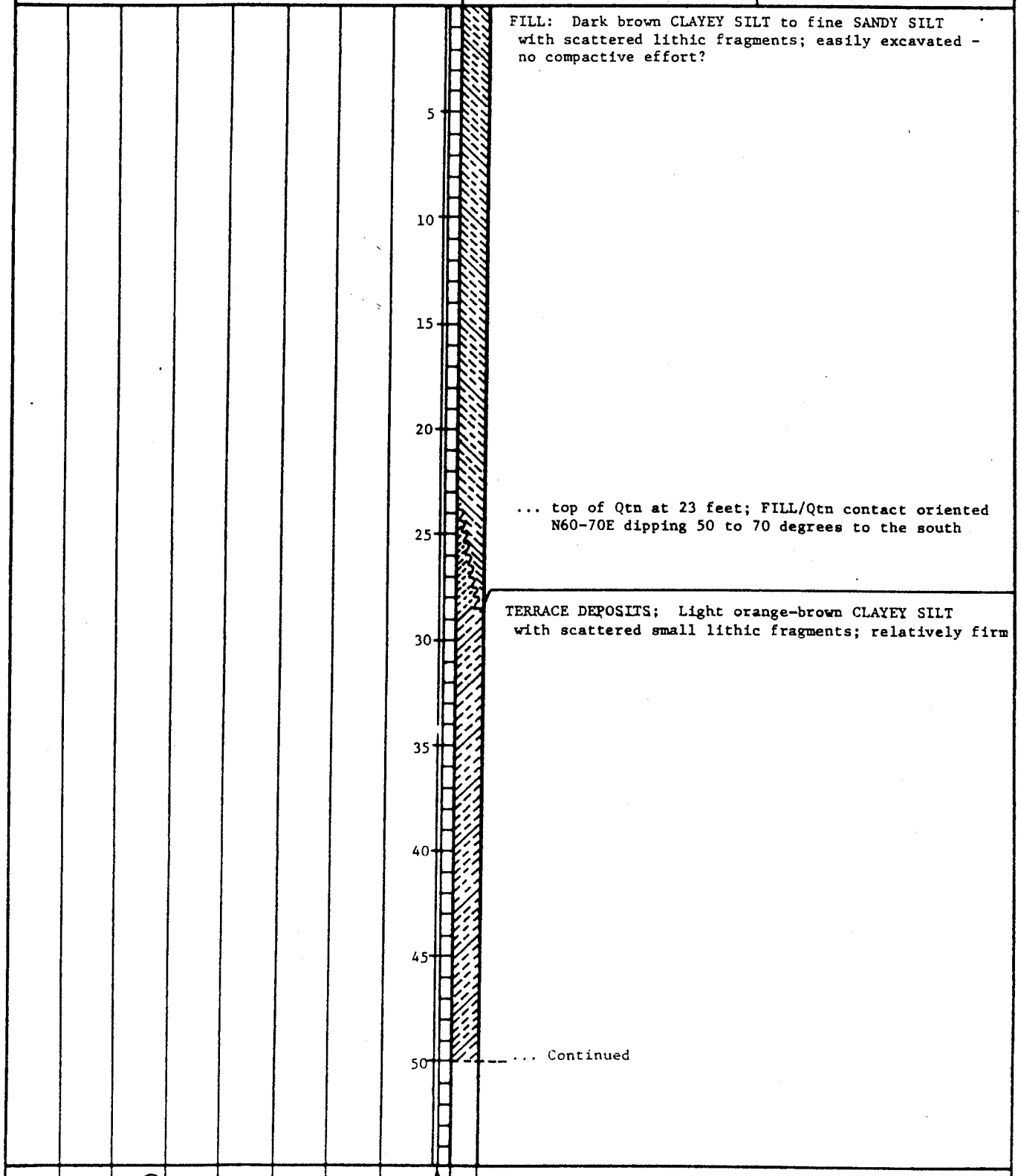
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 10-23-81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 30" Diameter Bucket Auger	ELEVATION 189.5	BORING 120



FILL: Dark brown CLAYEY SILT to fine SANDY SILT with scattered lithic fragments; easily excavated - no compactive effort?

... top of Qtn at 23 feet; FILL/Qtn contact oriented N60-70E dipping 50 to 70 degrees to the south

TERRACE DEPOSITS; Light orange-brown CLAYEY SILT with scattered small lithic fragments; relatively firm

... Continued

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL (feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET CASING SET	STRUCTURE

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY	DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE | ELEVATION | BORING 120 (Cont.)

DATE	CORE/SAMPLE TYPE	CORE/SAMPLE INTERVAL (feet)	RECOVERY %	DRILL TIME (minutes)	ATTITUDE	SAMPLE Nº	DEPTH IN FEET	CASING SET	STRUCTURE
					N74W 28S E-W 49S N80E 71S N80E 61S N86E 67S N85E 61S N82E 72S E-W 77S		55 60 65 70 75 80 85 90 95 100		

MARINE TERRACE DEPOSITS: Abundant subangular to well rounded GRAVEL with scattered COBBLES in a brown SILTY SAND matrix; few scattered remnants of shell; boring bells to approximately 5 feet in diameter.

BEDROCK (ALTAMIRA SHALE): Thinly bedded light gray, buff and light brown TUFFACEOUS SILTSTONE with minor interbeds of fine SILTY SANDSTONE; some yellow staining along bedding surfaces; few well defined (dark brown to black manganese? staining) planar surfaces, discontinuous across bedding, oriented N50-60E and dipping 25-35 degrees to the northwest; 1 foot hard SILICEOUS SILTSTONE and fine SANDSTONE (distinctively banded) between 57 and 63.5 feet.

... increased SILTY SANDSTONE and SANDSTONE below 76 feet; color change to tan and orange-brown

NOTES:

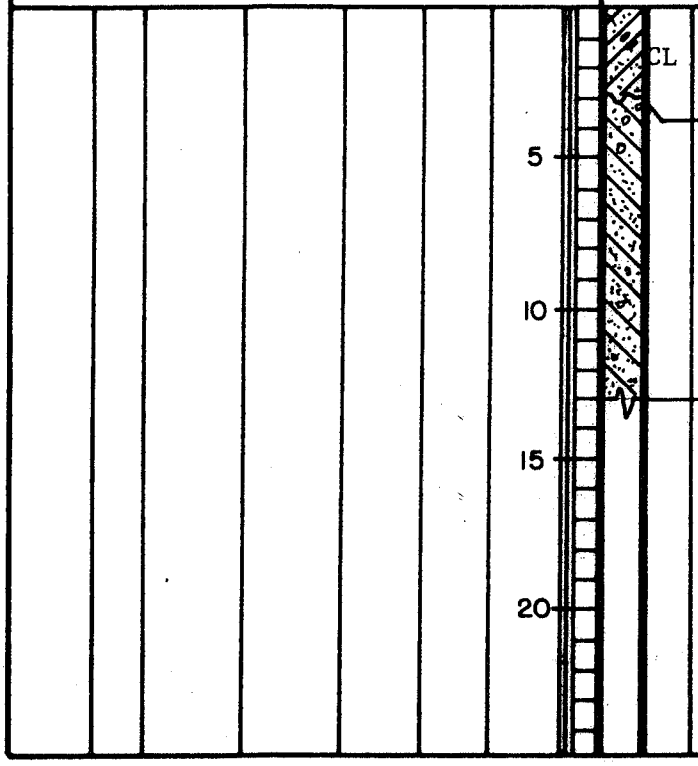
1) No groundwater.
2) Very difficult drilling between 51 and 56 feet due to COBBLES and slight to moderate caving of the MARINE TERRACE DEPOSITS.
3) Coring bucket with carbide teeth used between 56 and 66 feet.
4) Backfilled 10/29/81.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 10/29/81

TEST PIT LOG

TYPE 24" Backhoe	ELEV. 196	T.P. Nº 101



FILL: Dark brown fine SANDY CLAY with rock fragments and pieces of asphalt concrete

TERRACE DEPOSITS: Dark brown SANDY CLAY with rock fragments (up to 3" in diameter)

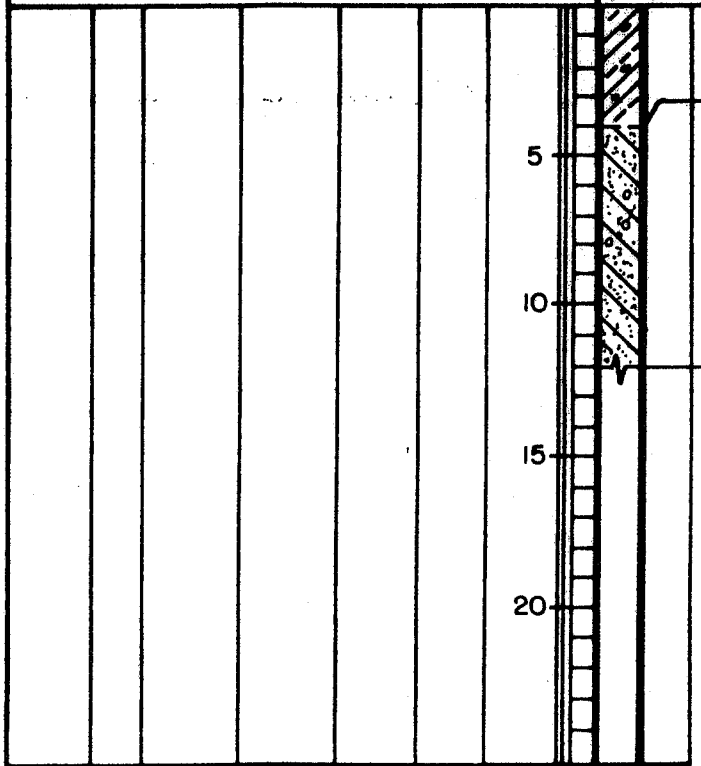
...light brown SILTY SAND with abundant rock fragments and scattered COBBLES at 11'

NOTES:

1. Trench trending N45W; 30' long.
2. No apparent fractures, voids or disturbed material.
3. No groundwater or caving.
4. Backfilled 1/8/81.

TEST PIT LOG

TYPE 24" Backhoe	ELEV. 222	T.P. Nº 102



SOIL: Dark brown SILTY CLAY with rock fragments

TERRACE DEPOSITS: Light brown to brown fine SANDY CLAY and CLAYEY SAND with irregular interbeds and lenses (small channel deposits) of brown SILTY SAND with abundant rock fragments and a few scattered COBBLES

NOTES:

1. Small fracture (up to 0.5" wide) trending N60W to N70W approximately vertical; no apparent offset or other evidence of movement; fracture extends from 7' below ground surface to bottom of trench (expansive soil?)
2. Trench trending N80W (10') and N40W (28'); 38' long.
3. No groundwater or caving.
4. Backfilled 1/8/81.

LOGGED BY STK	DATE 1/8/81

APPENDIX - SECTION II

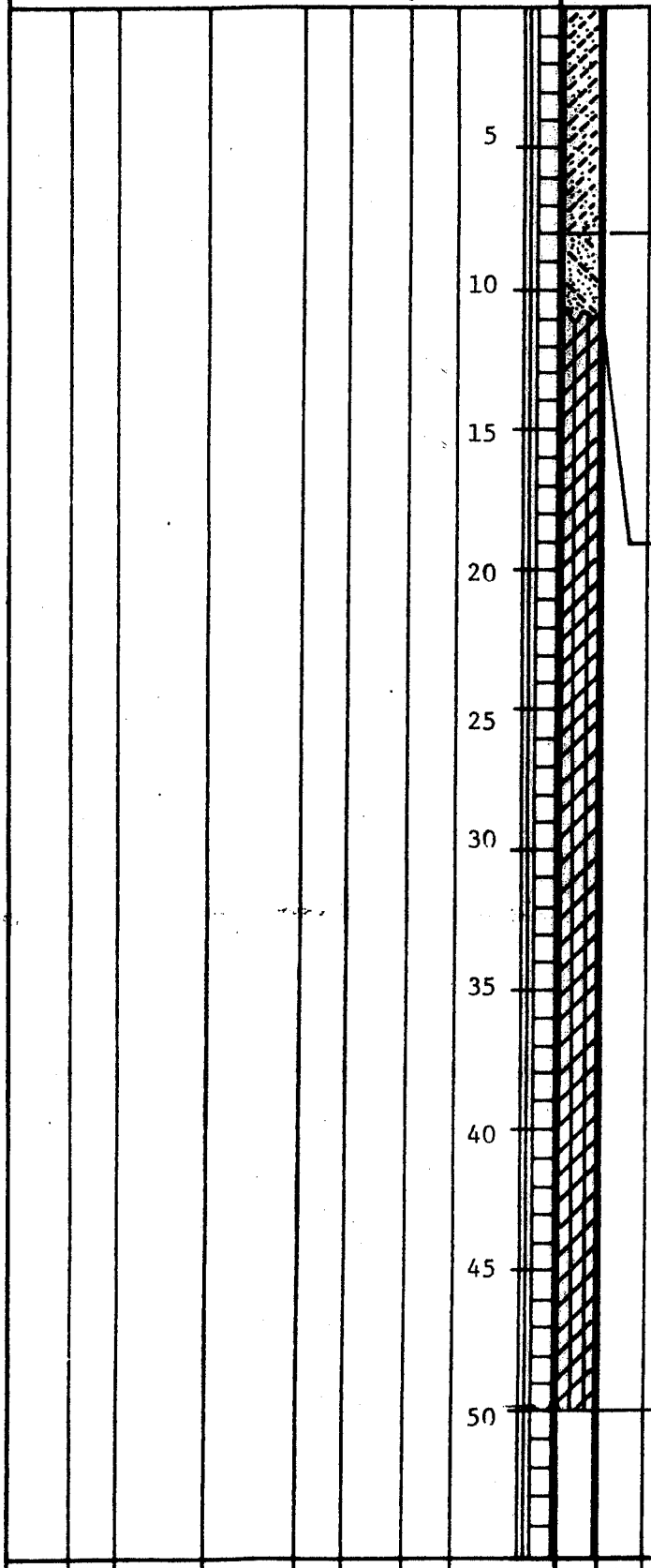
BORING LOGS BY MOORE & TABER FOR
THE CITY OF RANCHO PALOS VERDES

R.P.V.-1 through R.P.V.-4; Job No. 381-426; June 9, 1981

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 5.75" diameter rotary (mud) | ELEVATION 12 | BORING RPV-1



ALLUVIUM(recent non-marine terrace deposits): Brown SANDY SILT (some CLAYEY areas) with scattered small rock fragments

BEACH DEPOSITS (recent marine terrace deposits): Brown fine SILTY SAND with abundant rock fragments

BEDROCK(Altamira Shale): PORTUGUESE TUFF - Blue-gray BENTONITE and BENTONITIC TUFF; massive to indistinctly banded or bedded

--- Continued

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 5.75" diameter rotary(mud) | ELEVATION 12 | BORING RPV-1con't

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT 300 lbs.	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.
				48	1.4	1	60		
							65		
				63	1.4	2	80		

Significant G.W. noted

max. dip in sample ~16°

substantial artesian flow from 2:30 pm 5/6/81 150 gal/min.

PORTUGUESE TUFF: (continued)

...Coarse granular TUFF with small SHALE fragments below 65.5 feet

Interbedded hard black SILICEOUS SHALE, gray to very dark gray SILTSTONE and scattered thin beds of gray BENTONITE and BENTONITIC TUFF: decreased SHALE below 72 feet; making water in mud tank below 66' tank overflowing

...Increased number of BENTONITE and BENTONITIC TUFF beds between 77 and 86 feet (some tuff beds have fine sandy texture)

...Measured water flow at 80 feet - making approximately 10 gallons/minute

0.5 to 1.0 foot thick dark brown SILTSTONE; relatively soft; dark brown oily residue floating on surface of drill mud

Dark brown SILTSTONE with thin interbeds of gray to dark gray SILTSTONE and minor SHALE

Blue-gray welded TUFF fine granular texture; relatively hard, but brittle massive to indistinct bedding; increased water flow below 96 feet, approximately 150 gallons/minute

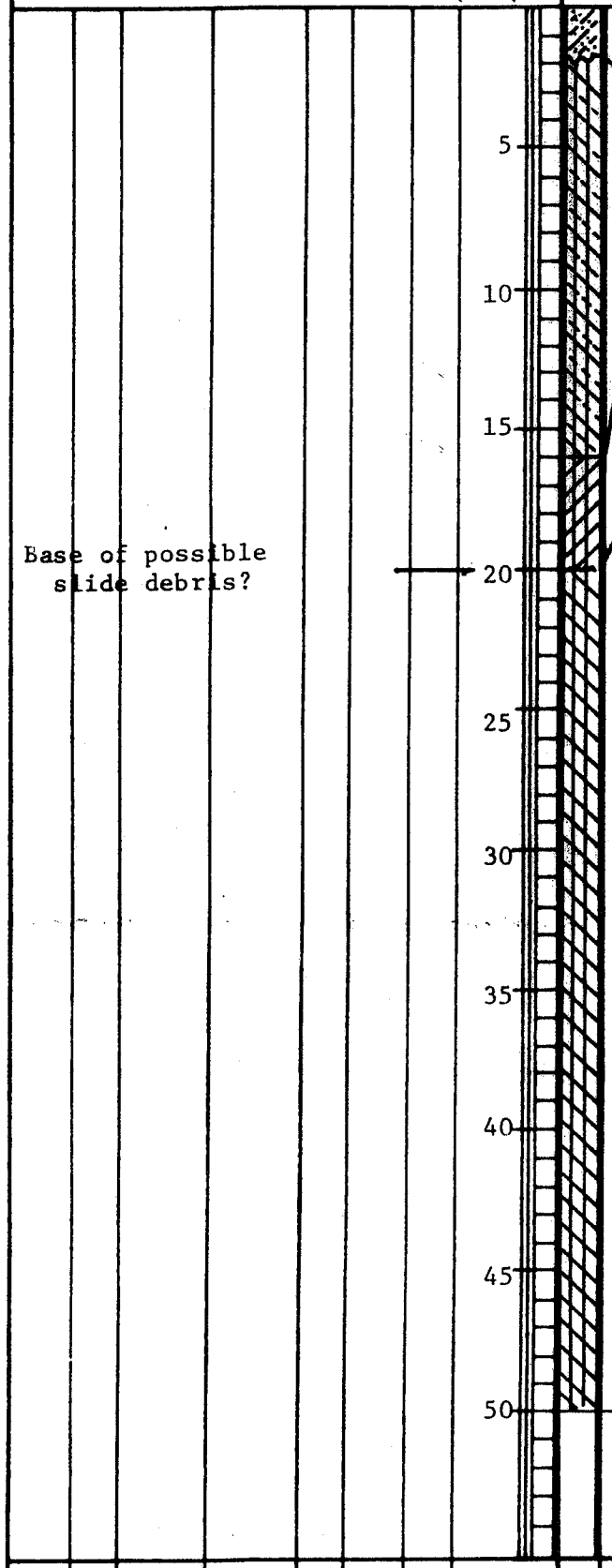
NOTES: 1) Drilling terminated due to the risk of getting drill rod stuck; large blocky rock fragments lodging behind drill bit below 96'.2) Hole cased w/6-inch dia. P.V.C. to depth of 15.5' 5/7/81.3)Geophysical logs 5/7/81. 4)Artesian water flow measured 5/11/81 ~75 gal/min.;5/14/81 ~75 gal/min; 5/27/81 ~50-75 gal/min.

LOGGED BY STK | DATE 5/1 to 5/6/81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 5.75" diameter rotary (air) | ELEVATION 207.5 | BORING RPV-2



FILL: Brown fine SANDY SILT with abundant small rock (SHALE) fragments

BEDROCK - Qls?(ALTAMIRA SHALE): Thinly interbedded tan, brown and gray SILTSTONE and TUFFACEOUS SILTSTONE; few scattered thin interbeds of orange and cream colored BENTONITE; thin interbeds of hard,gray SILICEOUS SHALE at 7.5, 11 and 14 feet.

White to buff BENTONITE and BENTONITIC TUFF with minor thin interbeds of gray to brown TUFFACEOUS SILTSTONE; slight caving between 17 and 20 feet

PORTUGUESE TUFF: White to buff BENTONITE and BENTONITIC TUFF; few scattered seams or veins of gypsum; some thin black oxidized surfaces evident.

Note: Boring R.P.V.-2 was drilled down through what was formerly the north west wall of Klondike Canyon; the anomalous thickness of the PORTUGUESE TUFF may be due to the fact that the boring was drilled through a small slump block created by undercutting of the bedrock (near the top of the P_t) at the bottom of Klondike Canyon; a number of these small slump blocks are evident on the adjacent canyon walls. The base of possible landslide debris was placed at 20' because of material change, slight caving, and elevation at that depth relative to the present canyon bottom.

Continued

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 5.75-inch dia.rotary (air) | ELEVATION 207.5 | BORING RPV-2 cont

DEPTH IN FEET	BLOWS/FOOT 300 lbs.	SAMPLE SIZE (INCHES)	SAMPLE Nº	MATERIAL SYMBOL	UNIFIED SOIL CLASS.	
55						PORTUGUESE TUFF: (continued)
						Interbedded brown to dark brown and gray to dark gray SILTSTONE with minor SHALE and scattered thin interbeds of cream to orange BENTONITE; 0.5 to 1.0 foot thick BENTONITE at 56 feet;few scattered thin seams or veins of gypsum.
60	100 for 0.5 foot	1.4	1			...Thin (up to 0.5 foot thick) cream BENTONITE at 62 feet
65						...0.5 to 1.0 foot thick blue-gray BENTONITE at 67 feet Thinly interbedded blue-gray hard SHALE and relatively softer dark brown to dark gray SILTSTONE; few scattered thin beds of dark brown SILTY CLAYSTONE(BENTONITIC?), relatively soft and moist.
70						
75						1.0 foot hard SILICEOUS SHALE
						Same as between 68 and 73 feet
80						Light blue-gray welded TUFF; fine granular texture; massive to indistinctly bedded
						0.5 to 1.0 foot thick dark gray to very dark brown SILTSTONE.
85						Light blue-gray welded TUFF; granular texture - increasing in grain size from silt at 86 feet to fine sand at 88 feet; abundant PYRITE below 88 feet.
90						0.5 foot thick very dark brown SILTSTONE (very slight petroleum smell in fresh cuttings)
95						Thinly interbedded blue-gray to dark gray SHALE and SILTSTONE
						0.5 foot thick very dark brown SILTSTONE
100						MARINE SILTSTONES AND SHALES
						Continued

STRIKE / DIP | RELATIVE COMPACTION | DRY DENSITY (LBS/CU FT) | MOISTURE (%)

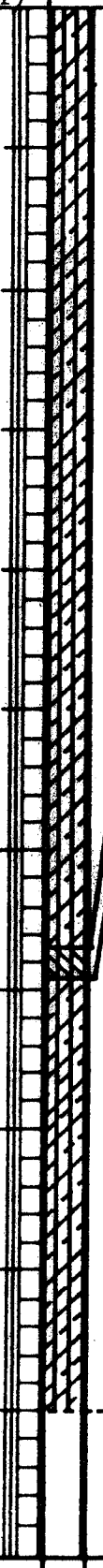
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 5.75" diameter rotary (air) | ELEVATION 207.5 | BORING RPV-2 cont



MARINE SILTSTONES AND SHALES: interbedded gray to very dark gray SILTSTONE and gray to blue-gray SHALE; scattered thin layers of CLAYEY (BENTONITIC?) SILTSTONE

...slightly increased relative number of CLAYEY (BENTONITIC?) SILTSTONE interbeds between 116 and 118 feet

...slightly increased relative number of thin SHALE interbeds below 124 feet

1.0 foot hard, gray SILICEOUS SHALE

Same as above 128.5 feet

...greatly increased relative number of SILTSTONE interbeds between 135 and 138 feet

...slightly increased relative number of SHALE interbeds between 144 and 148 feet

...0.5 to 1.0 foot thick very dark brown SILTSTONE at 148 feet; relatively soft

Continued

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

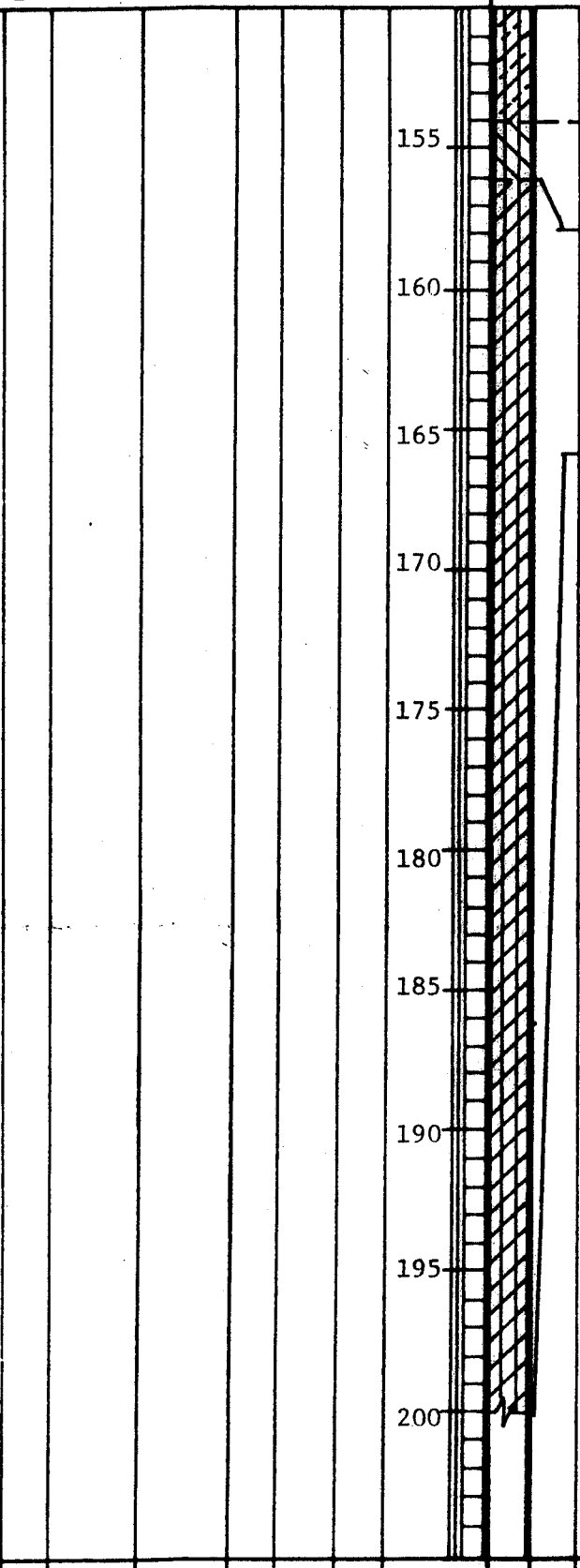
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 5.75 inch dia. rotary (air) | ELEVATION 207.5 | BORING RPV-2 con't



MARINE SILTSTONES AND SHALES: (cont.)

Very thinly bedded or laminated hard, dark gray SILICEOUS SHALE; fossil fish scales?

Same as above 154', greatly increased relative number of SHALE interbeds; few scattered thin interbeds of fine TUFFACEOUS SANDSTONE and minor BENTONITIC TUFF.

NOTES:

1) Pulled drill rod at 160 feet to replace bit 4/29/81 - 7 feet of standing water after 14 hours (153 feet) - possible seepage at approximately 90 feet.

2) Filled hole with water to approximately 43 feet 5/4/81 to run electrical logs - hole caved shut at approximately 73 feet.

3) Re-opened hole to a depth of approximately 182 feet 5/8/81 - standing water at approximately 115 feet, first evidence of seepage at approximately 88 feet.

4) 182.2 feet of inclinometer tubing placed and annular space around tubing backfilled with 0.5 inch diameter well-rounded pea gravel 5/8/81.

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 4/28 to 4/30/81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE	ELEVATION 325	BORING RPV-3

NOTES:

1) RPV-3 was drilled by Lindvall, Richter and Associates as part of a geologic investigation of parcel 11 for Palos Verdes Properties. This boring was designated as K-4 in their investigation, but will be re-numbered as RPV-3 for this report. A 24-inch diameter bucket auger boring was drilled and logged to a depth of 90 feet. The boring was then offset and re-drilled as a rotary wash boring to a depth of 179.6 feet. From 86 to 179.6 feet a nearly continuous sample was obtained either with a "Pitcher" barrel or core barrel sampler. Logs of this boring and the samples will be made available to the city's representative on request.

2) The boring was reamed out to 4.75 inch diameter and drilled to a final depth of approximately 204 feet by Lindvall, Richter and Associates (P.V. Properties) to accommodate geophysical logging and placement of an inclinometer (slope indicator) by Moore & Taber.

3) Geophysical logs - 5/9/81.

4) 201.5 feet of inclinometer tubing placed and annular space around tubing backfilled with 0.5 inch diameter well rounded pea gravel 5/11/81.

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY	DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 5.75" diameter rotary (air) | ELEVATION 276 | BORING RPV-4

TERRACE DEPOSITS: Red-brown fine SANDY SILT and SILTY SAND with scattered rock fragments; scattered layers or lenses of fine to medium SAND with abundant rock fragments.

...slight caving at 26 feet

MARINE TERRACE?: Abundant sub-angular to sub-rounded rock fragments

BEDROCK (ALTAMIRA SHALE): Thinly interbedded tan, brown, and gray SILTSTONE and TUFFACEOUS SILTSTONE with scattered thin interbeds of light gray BENTONITIC TUFF and minor cream to light gray BENTONITE.

maximum dip in sample ~24°

60 for 1.4' / 0.5 foot

1

Continued

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT 300 4or.	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

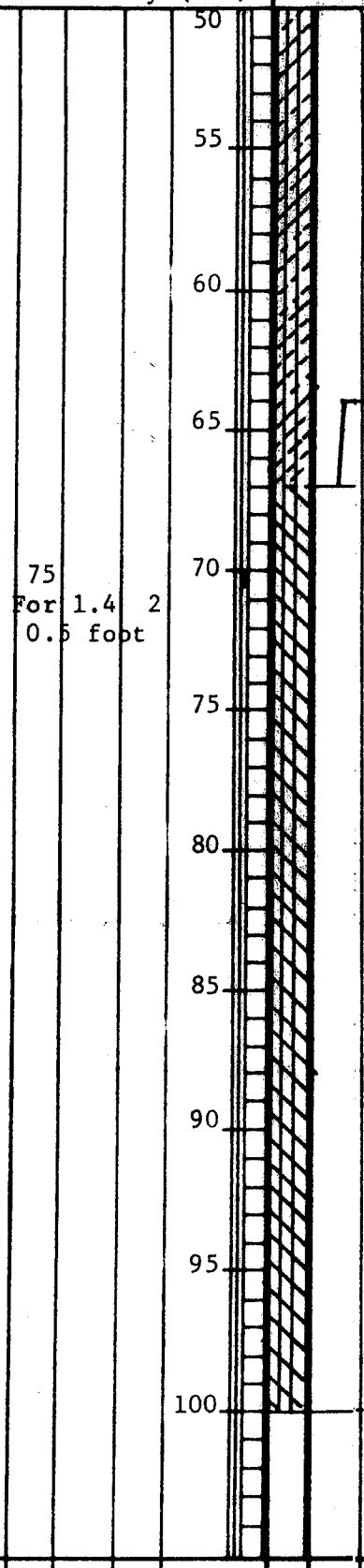
THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 5.75 inch dia. rotary (air) | ELEVATION 276 | BORING RPV-4 cont.



...increased relative number of blue-gray to red BENTONITIC TUFF interbeds and cream BENTONITE with orange oxidation banding below 59 feet

PORTUGUESE TUFF: Blue-gray BENTONITE and BENTONITIC TUFF: waxy texture; massive to indistinctly bedded or banded.

75
For 1.4 2
0.5 foot

-- Continued

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY | DATE

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 5.75" diameter rotary (air) | ELEVATION 276 | BORING RPV-4 cont.

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.	
							105			PORTUGUESE TUFF as above
							110			
							115			Interbedded hard black SILICEOUS SHALE, gray TUFFACEOUS SILTSTONE and blue-gray BENTONITE; 0.2 to 0.5 foot thick hard, black SHALE beds at 116.5, 117.5 and 118 feet
							120			Thinly interbedded gray to dark gray SHALE; gray to gray-brown SILTSTONE and blue-gray to dark gray BENTONITE
							125			
							130			1.0 foot thick hard SILICEOUS SHALE
							135			Same as above 133.5 feet
										Blue-gray BENTONITIC TUFF; possible groundwater of slight seepage at 142 feet (cuttings blown to surface are very small and very slightly moist)
							140			1.5 to 2.0 feet hard SILICEOUS SHALE or SILTSTONE
							145			Blue-gray to dark gray TUFFACEOUS SHALE(?) or TUFF(?); very fine grained to aphanitic texture
							150			

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 5/13 to 5/15/81

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

TEST BORING LOG

TYPE 5.75" diameter rotary (air) | ELEVATION 276 | BORING RPV-4 cont.

DEPTH IN FEET	LOG
155	As above
	1.0 foot thick very dark gray-brown SILTSTONE, relatively soft
160	1.0 foot thick hard gray SHALE
	Thinly interbedded gray to gray-brown SHALE and SILTSTONE
165	0.5 to 1.0 foot thick very dark gray-brown SILTSTONE; relatively soft.
170	MARINE SILTSTONES AND SHALES: Interbedded gray to gray-brown SILTSTONE and SHALE; minor thin interbeds of CLAYEY (BENTONITIC?) SILTSTONE
175	
180	
185	
190	0.8 to 1.0 foot thick hard gray SILICEOUS SHALE
	Same as above 193 feet
195	
200	

NOTES:

1) Standing water at 127 feet after 60 hours. Possible seepage at 90 feet.
2) Gamma logs - 5/15/81 (hole partially closed at approximately 70 feet).
3) 187.8 feet of inclinometer tubing placed & annular space around tubing backfilled w/0.5 inch pea gravel 5/18/81

STRIKE / DIP	RELATIVE COMPACTION	DRY DENSITY (LBS/CU FT)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS.

THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES.

LOGGED BY STK | DATE 5/13 to 5/18/81

APPENDIX - SECTION III

BORING LOGS BY OTHERS

Summary of Boring Log Data, Eastern Portion of Active Portuguese Bend Landslide

K-4 and K-4A (R.P.V.-3); Lindvall, Richter and Associates, 1981

F-5; Converse Ward Davis Dixon, Project No. 81-02167-01, 1981

Job No. 380-462 - November 30, 1981

SUMMARY OF BORING LOG DATA*

Eastern Portion Active Portuguese Bend Landslide

Boring No.	Slip Surface Elevation	Water Level Elevation	Portuguese Tuff Top Elevation	Portuguese Tuff Base Elevation
PVP - 9 (1956-57)	-20	-3(?)	-33	----
PVP - J4 (1956-57)	214	207	178	101
PVP - K (1956-57)	57	-10(?)	----	----
PVP - S (1956-57)	204	37	172	101
PVP - W (1956-57)	203	21	----	117
PVP - X (1956-57)	65	25	34	-38
PVP - Z (1956-57)	12	30	----	----
PVP - AA (1956-57)	132	20	97	35
PVP - CC (1956-57)	217	54	180	110
PVP - DD (1956-57)	45	-31(?)	20	-40
PVP - GG (1956-57)	2	-7(?)	----	----
PVP - LL (1956-57)	3	----	----	-93
DW - 13 & 14 (1956-57)	10	12	----	----
PVP - 9 (1968-69)	226	256	193	134

*Boring Log Data from: "An Analysis of the Portuguese Bend Landslide, Palos Verdes Hills, California", Karl Vonder Linden, Doctoral Dissertation, Stanford University, 1972.

BASIC EXPLORATORY BOREHOLE

DRILLING AND SAMPLING LOG

PROJECT Grant Lakes - 80-177-12 DATE DRILLED 4-8 to 4-9-81 HOLE NO. K-4

LOCATION Palos Verdes - Parcel 11 GROUND SURFACE ELEV. —

DRILLING CONTRACTOR Cal-Testing LOGGED BY JLV DEPTH TO GROUND WATER NA

TYPE OF RIG BA HOLE DIAMETER 36 to 24 @ 70' HAMMER WEIGHT AND FALL —

SURFACE CONDITIONS Surface Datum 89' WEATHER —

DEPTH	CLASS.	FIELD DESCRIPTION	SAMPLE		MODE	REMARKS
		SILTY CLAY, medium brown				Soil
		CLAYEY SILT, lt. yellow brown, dense				
		SILTSTONE, lt. yellow brown, fractured	N57°W	Z10	SW	Slide Debris
10		SILTSTONE & BENTONITE, interbedded				
		SILTSTONE, orange brown, conformable				
		BENTONITE TUFF, conformable				Tuff
		SILTSTONE, orange brown, contains gypsum stringers, 3" gypsum layer around hole @ 18.5'				Slide Debris
20						
		SILTSTONE, alternate bands of N. gray and orange brown, gypsum stringers, hard, lt. gray, silicified layer @ 25'				
30		SILTSTONE & SHALE, very hard, some near vertical gypsum stringers.				
		Silicified Layer				
40		BENTONITE TUFF, yellowish white with orange & purple banding. Gypsum @ 40'				Tuff
		Hard wavy layer				
		orange, fractured, jointed, gypsum stringers				
		Dirty-white, hard				
50		yellow, wavy				
		Dark Gray, wavy				
		Gypsum layer @ 54.5'				
60						
70		hole diameter changes to 24"				
80						
		Dark gray band containing coarse-sand sized particles of white pumice @ 85'	N65°W	Z2°	SW	
90		TD - 90'				

SHEET 1 OF 1

BASIC EXPLORATORY BOREHOLE

DRILLING AND SAMPLING LOG

PROJECT 80-127-12 DATE DRILLED 5-5-81-5-6-81 HOLE NO. K4A

LOCATION Palos Verdes Parcel 11 GROUND SURFACE ELEV. _____

DRILLING CONTRACTOR Pitcher LOGGED BY KVK-JLV DEPTH TO GROUND WATER NA

TYPE OF RIG Calyx HOLE DIAMETER NX HAMMER WEIGHT AND FALL NA

SURFACE CONDITIONS _____ WEATHER _____

DEPTH	CLASS.	FIELD DESCRIPTION	SAMPLE	MODE	REMARKS
84				AD	
86		Portuguese BENTONITE TUFF, lt gray, coarse-grained, thin layers of dk gray clasts (med. to coarse sand-size)	Box 1 R-1	PB	3:50 Recovery 1.5/1.5
			R-2		4:10 4:28 Recovery 2.0/2.0
88		Coarse, hard zone 88.25-88.50			
		Unit becoming more coarse grained w/ depth	R-3		4:51 5:02 Recovery 2.0/2.0
90					
			R-4		5:47 5:59 Recovery 1.6/1.7
92					6:24 Lost circulation
		Softer layer 0.1 foot thick from 93.4 to 93.5	R-5		7:10 Recovery 1.5/2.3
94					
		Very hard, coarse-grained layer 95.3 to 95.5			7:32
			Box 2 R-6		7:50 Recovery 0.5/0.8
96			R-7		8:00
		SILTSTONE, alternately lt gray and dark gray brown, thinly bedded, very hard.	Box 3 R-8	NX	8:20-8:30 Rec. 0.3/0.3 8:48
	ESD				
98					
		BENTONITE TUFF with layers of SILTSTONE			Recovery 5.0/5.0
100		SILTSTONE, lt gray to dk gray brown, vertical fracture from 99.6 to 101.2			
			R-9		10:11 10:40 Slow drilling - changed to diamond bit 11:02 11:12
102					
		BENTONITE TUFF lt blue gray, coarse-grained			
104					

SHEET 1 OF 5

PROJECT 80-127-12 DATE DRILLED 5-5-81-5-8-81 HOLE NO. K4A

DEPTH	CLASS.	FIELD DESCRIPTION	SAMPLE	MODE	REMARKS
104				NX	
					Recovery 5.0/5.0
106		SILTSTONE, alternately lt. gray and dk. gray, brown	Box 4		12:42
			R-10		12:59
108	14°				Recovery 2.6/3.0
					2:13
		BENTONITE. TUFF, dk blue-gray, massive, waxy	R-11		2:33
110					Recovery 0.5/2.5
					3:52
112		Laminated siltstone - dark. green to lt greenish gray; distinctively bedded - Dip at 12°-15° - Alternating shale, in place (undisturbed)	R-12		4:32
114					Recovery 4.3/5.0
116		PRELIMINARY SUBJECT TO REVISION			
					5:17
			R-13		6:36
118			Box 5		
					Recovery 4.5/5.0
120		alternating shades of orange-gray tuffaceous sandstone @ 119.5 to 122.0. Distinctive beds at dip of 15°-20°; conformable w/ R-12 VITRIC TUFF			
122		~~SANDSTONE~~ (weathered) KVL 5-8-81 ~~SANDSTONE~~, lt yellow, change to lt. orange brown @ 122.8 med. grained + poorly sorted, Cross-bedded (?)	R-14		6:05 5-6-81 8:59 5-7-81
					Recovery 1.8/1.8
124		As R-14; grain size grossly increasing w/ depth.	R-15		9:24 10:05
					Recovery 5.0/5.0
126		Shale, downward decrease in grain size at 126.25'			
128			Box 6		

SHEET 2 OF 5

PROJECT 80-177-12 DATE DRILLED 5-5/5-8-81 HOLE NO. K4A

DEPTH	CLASS.	FIELD DESCRIPTION	SAMPLE	MODE	REMARKS
128				NX	
		Laminated, tufac. siltstone, bet 112-122	R-16		10:50
					11:06
130		BASALT, lt. gray, contains pyrite crystals and inclusions of calcite and gypsum			Recovery 3.7/3.7
132					11:46
			R-17		12:06
		PRELIMINARY SUBJECT TO REVISION			
134					Recovery 3.8/3.8
136					1:02
			R-18		1:21
			Box 7		
138					Recovery 2.5/2.5
					1:50
		Tuff, porphyritic, dk gray/white	R-19		2:26
		SILTSTONE AND SHALE, alternate lt gray to black, fractures from 139.5 to 140.5			Circulation loss 139-140
140		Dip about 20°			Recovery 3.8/3.8
		TUFF, bentonitic, waxy, dk gray			
142		SILTSTONE, Laminated: lt. green gray to black-green, dip about 25° to 30°, conformable	R-20		3:18
					4:21
144		0.3' Granular tuff at 149.1-144.4 conformable			Recovery 5.0/5.0
		Thin layers of granular bentonitic tuff interbedded w/ siltstone			
146			Box 8		
		Coarse-grad, granular, bentonitic tuff: Green-gray			5:13
		Siltstone, laminated as 142 — 144: Dip about 15°: some possible cross bedding	R-21		5:31
148					Recovery 1.5/1.5
		Dark gray waxy altered tuff, altered			5:43
		Siltstone; distinctively laminated greenish-gray to dark green	R-22		6:04
		Dip about 30°			
150					Recovery 3.2/3.5

SHEET 3 OF 5

PROJECT 80-127-12 — DATE DRILLED 5/6 to 5/8-81 HOLE NO. K4A —

DEPTH	CLASS.	FIELD DESCRIPTION	SAMPLE	MODE	REMARKS
154			R-23	NX	6:30 6:50 Recovery 2.4/3.0 7:27 7:30
156		Bentonite Tuff Zone 156.5 to 161.1	R-24 Box 9		Recovery 2.2/3.0
158			R-25		7:47 7:56
160		PRELIMINARY SUBJECT TO REVISION			Recovery 3.8/4.5
162			R-26		8:33 8:59
164					Recovery 2.2/2.5
166		Bentonite Tuff interbedded with Siltstone 165.5 to 168.5	R-27		10:17 10:48
168			Box 10		Recovery 4.6/5.0
170		Thin bed of dk gray Lith. tuff 169.8 to 170.2	R-28		12:03 12:38
172		Bentonite Tuff, dk gray aphanitic 172.2 to 172.6			Recovery 4.5/4.5
174			R-29		1:24 1:54
176					

PROJECT 80-177-12 DATE DRILLED 5/7-8/81 HOLE NO. K4A

DEPTH	CLASS.	FIELD DESCRIPTION	SAMPLE	MODE	REMARKS
176				NX	
					Recovery 3.5/4.2
178			Box 11		
					2:40 PM 5-8-81
		TD - 179.2/204.5		RD to 204.5	Drilled hole to 204.5 on 5-8 & 5-9-81. No core samples taken from 179.2 to 204.5. Geophysical logging of hole conducted by Ryland-Cummings on 5-9-81.
180					

PRELIMINARY
SUBJECT TO REVISION

SHEET 5 OF 5

SUMMARY
BORING NO. F-5

DATE DRILLED 5-20-81

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

ELEVATION 339'±

DEPTH IN FEET	SAMPLES SYMBOL					DRIVE ENERGY FT KIPS/FT	FIELD MOISTURE : DRY WEIGHT	DRY DENSITY LB/CU FT	SHEAR RESISTANCE KIPS/SQ FT
0	CL	slightly moist	v stiff	yl brown	SLOPEWASH--SILTY CLAY				
			soft to mod hard	yellow gray to gray yellow	LANDSLIDE DEBRIS (BLOCK) TUFFACEOUS & DIATOMACEOUS SHALE				
5			very hard	gray orange to pale yellow brown & light brown	DOLOMITE & SILICEOUS SILTSTONE moderately to very fractured slightly to moderately weathered				
10					few tuffaceous interbeds				
					shear surfaces Bentonitic gouge Gypsum (2" thick) at 13'				
			mod hard to very hard	yellow gray to gray orange	SANDSTONE & SANDY SILTSTONE fine to medium grained Calcium cemented laminated to very thinly bedded interlayered with siliceous Siltstone & Dolomite				
		v moist	soft	gr green	Bentonitic gouge				
20		slightly moist	hard	yellow gray to pale orange brown	ALTERED TUFF intensely fractured very weathered Dolomite & Gypsum filled fractures thin Chert layers				
25			very hard	black to dusky yellow	SILICEOUS SILTSTONE thinly lam, mod fractured few thin Chert layers				
			hard	yellow gray	SILTSTONE & SHALE interbedded with Tuff v fractured, thinly lam				
30	(1)	v moist	soft	orange	BENTONITE many slicks				

(1) Indicates number and range of bulk sample

(Continued)

Project No

TENTATIVE TRACT 37885

81-02167-01

FOR REVIEW ONLY. Approved publication by

SUMMARY
BORING NO. F-5 (Continued)

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

DEPTH IN FEET	SAMPLES	SYMBOL					DRIVE ENERGY FT KIPS/FT	FIELD MOISTURE % DRY WEIGHT	DRY DENSITY LB/CU FT	SHEAR RESISTANCE KIPS/SQ FT
30	1		moist	mod hard	ol green	LANDSLIDE DEBRIS (BLOCK)	1.6	23.5	87	0.07
					red brown	BENTONITE many slicks very fractured				0.46
			slightly moist	mod hard	gray orange	SILTSTONE & SHALE laminated to thinly bedded mod to very fractured mod to very weathered few tuffaceous interbeds				0.70 *
35	2						23.3	16.4	89	
			slightly moist to moist		yellow gray to gray orange	SHALE thinly laminated very fractured moderately weathered few tuffaceous & diatomaceous Shale interbeds				
40		(2)				SHALE & SILTSTONE Bentonite with slicks at 42'				
			v. moist	soft	gr green	gouge (Bentonite)				
					orange	SHALE & SILICEOUS SHALE				
45	3		slightly moist	mod hard	red brown to gray orange	moderately to very fractured few fish scales	31.0	49.4	71	
			v moist	soft	gr green	gouge (Bentonite)				
			slightly moist to moist	mod hard	gray orange & yellow brown	SHALE laminated to thinly laminated very fractured moderately to very weathered				
50						few thin Gypsum veins between bedding				
55						1" thick soft plastic zone at 55.9' (Basal shear zone)				
			v moist	soft	gr green					
	4		slightly moist to moist	mod hard	gray yellow	BEDROCK BENTONITE few Gypsum veins (1")	47.3	14.8	91	
				hard	gray orange	SILTSTONE & SILICEOUS SHALE few Gypsum veins				
60										

(2) Indicates number and range of bulk sample

(Continued)

*Sample soaked and sheared at 0.5, 1.0, & 2.0 ksf (residual)

Project No

TENTATIVE TRACT 37885

81-02167-01

SUMMARY
BORING NO. F-5 (Continued)

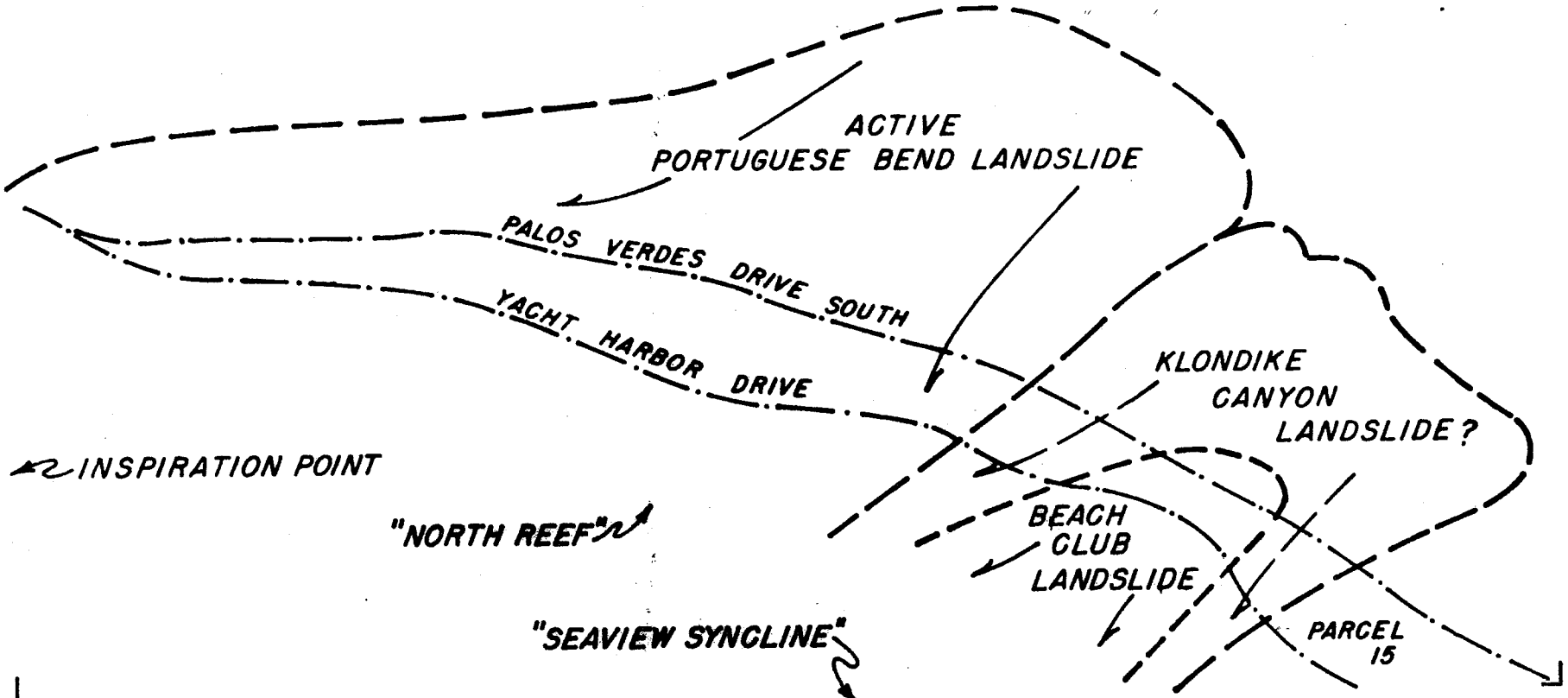
THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

DEPTH IN FEET	SAMPLES	SYMBOL					DRIVE ENERGY FT. KIPS/FT.	FIELD MOISTURE % DRY WEIGHT	DRY DENSITY LB/CU FT	SHEAR RESISTANCE KIPS/SQ FT
60–65			slightly moist to moist	hard	gray black & gray orange	BEDROCK SILTSTONE thinly laminated moderately fractured slightly weathered few fish scales & other small fossils slight organic & petroliferous odor				
65–70			slightly moist	hard to very hard	light olive gray to light blue gray to medium blue gray	interbedded massive ashflow Tuff & thinly laminated Siliceous Siltstone slightly to moderately fractured slightly weathered few interbeds of Shale				
70–76 (▽ 74)			very moist to wet							
74–76						SILTY & BENTONITIC PYROCLASTIC-FLOW BRECCIA				

end of boring at 76'

groundwater encountered at 74' after 3 days
slight seepage at 70'

ATTITUDES:
N30°W/38°SW at 3' (bedding)
N40°W/48°SW at 6' (bedding)
N60°W/44°SW at 13' (shear)
N36°W/38°SW at 19' (bedding)
N30°W/35°SW at 29' (bedding)
N45°W/25°SW at 36' (bedding)
N28°W/24°SW at 42' (bedding)
N24°W/25°SW at 44' (shear zone)
N33°W/32°SW at 48' (shear zone)
N30°W/35°SW at 54' (bedding)
N40°W/40°SW at 67' (bedding)



PORTUGUESE BEND AREA — NOVEMBER 28, 1931

Figure 1

Approximate Extent of Klondike Canyon Landslide
Photo courtesy of Spence Air Photo Collection - Dept. of Geography - U.C.L.A.

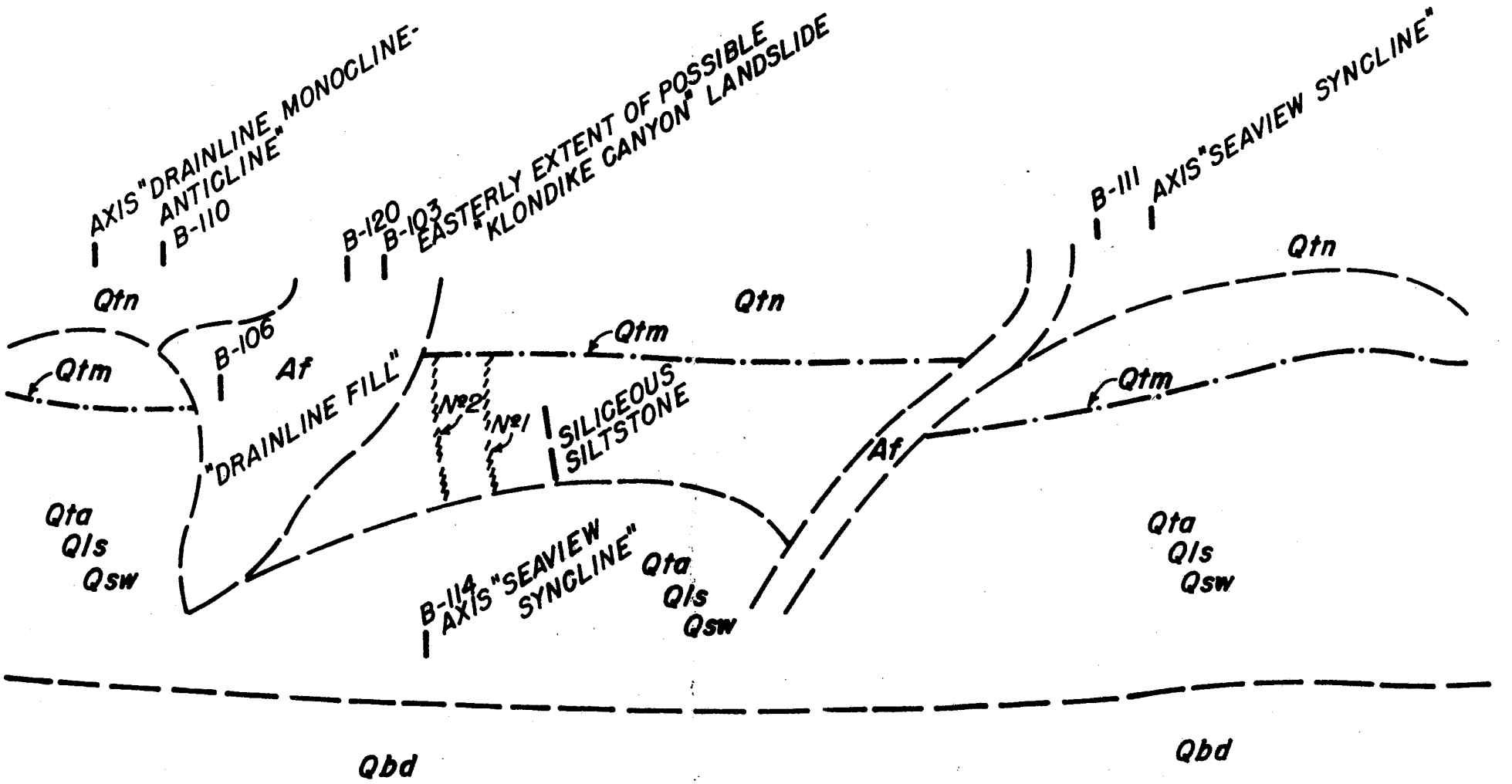
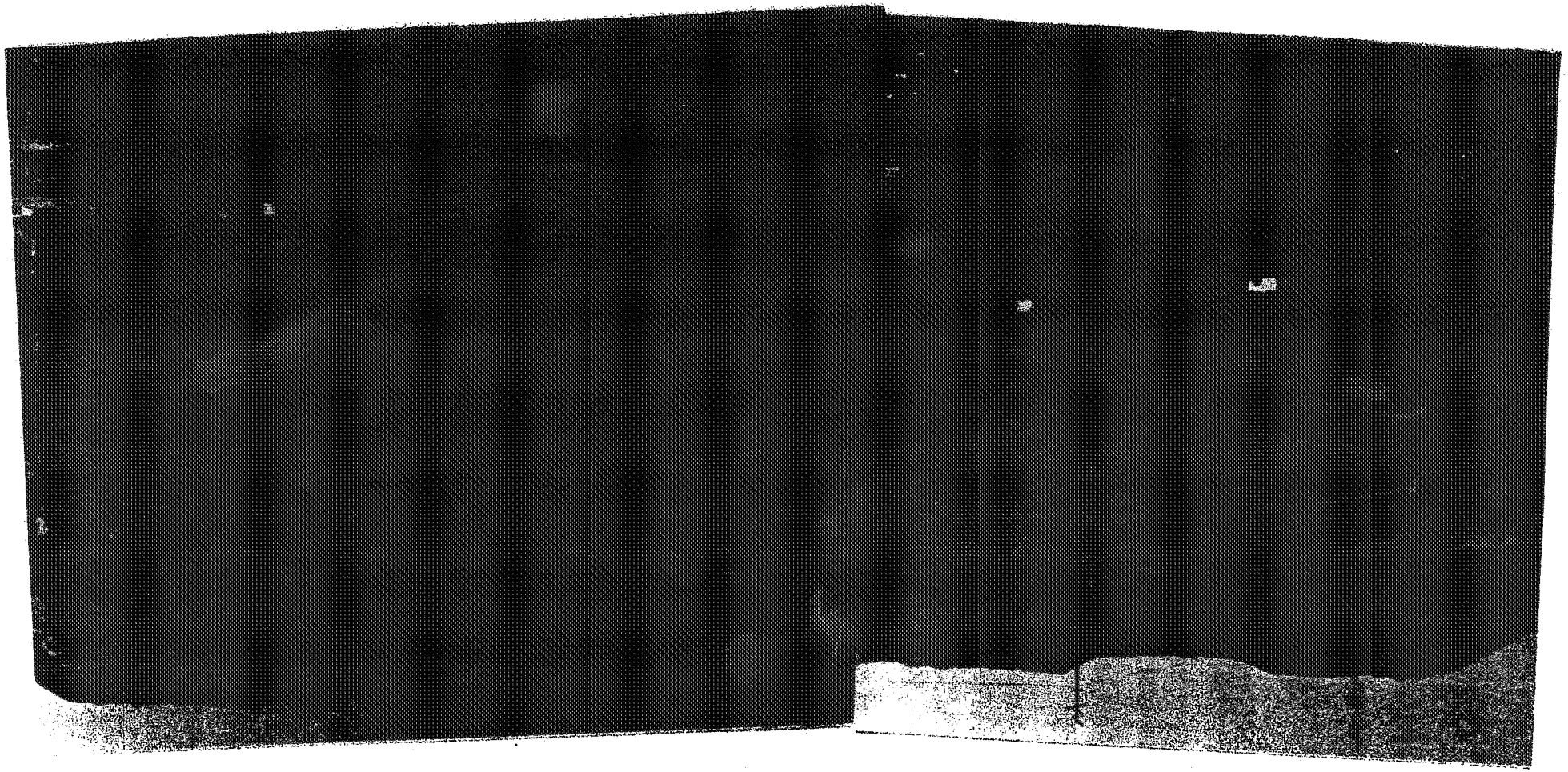


Figure 2

SEACLIFF PARCEL 15-"SEAVIEW SYNCLINE"

AUGUST, 1981



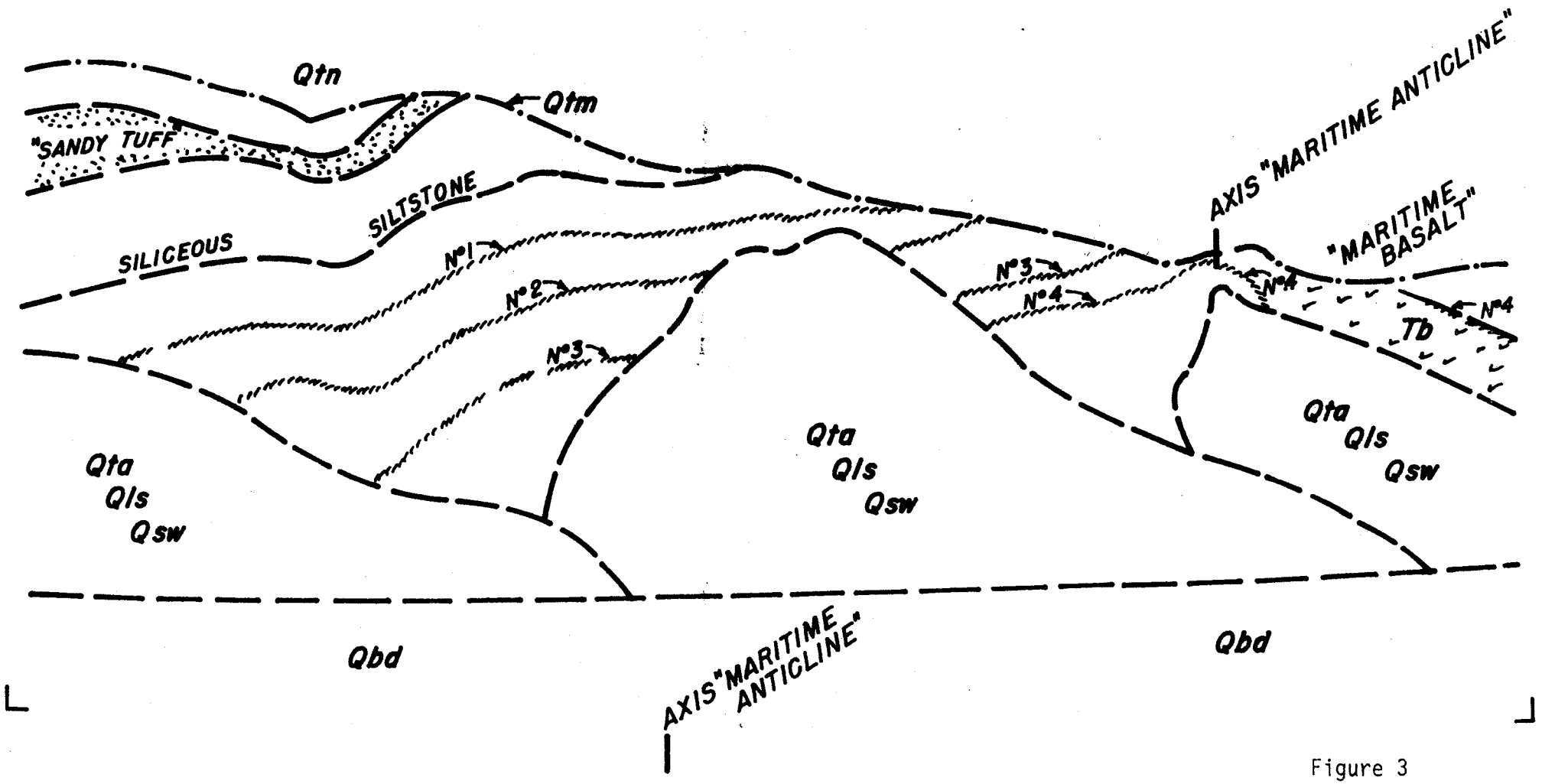
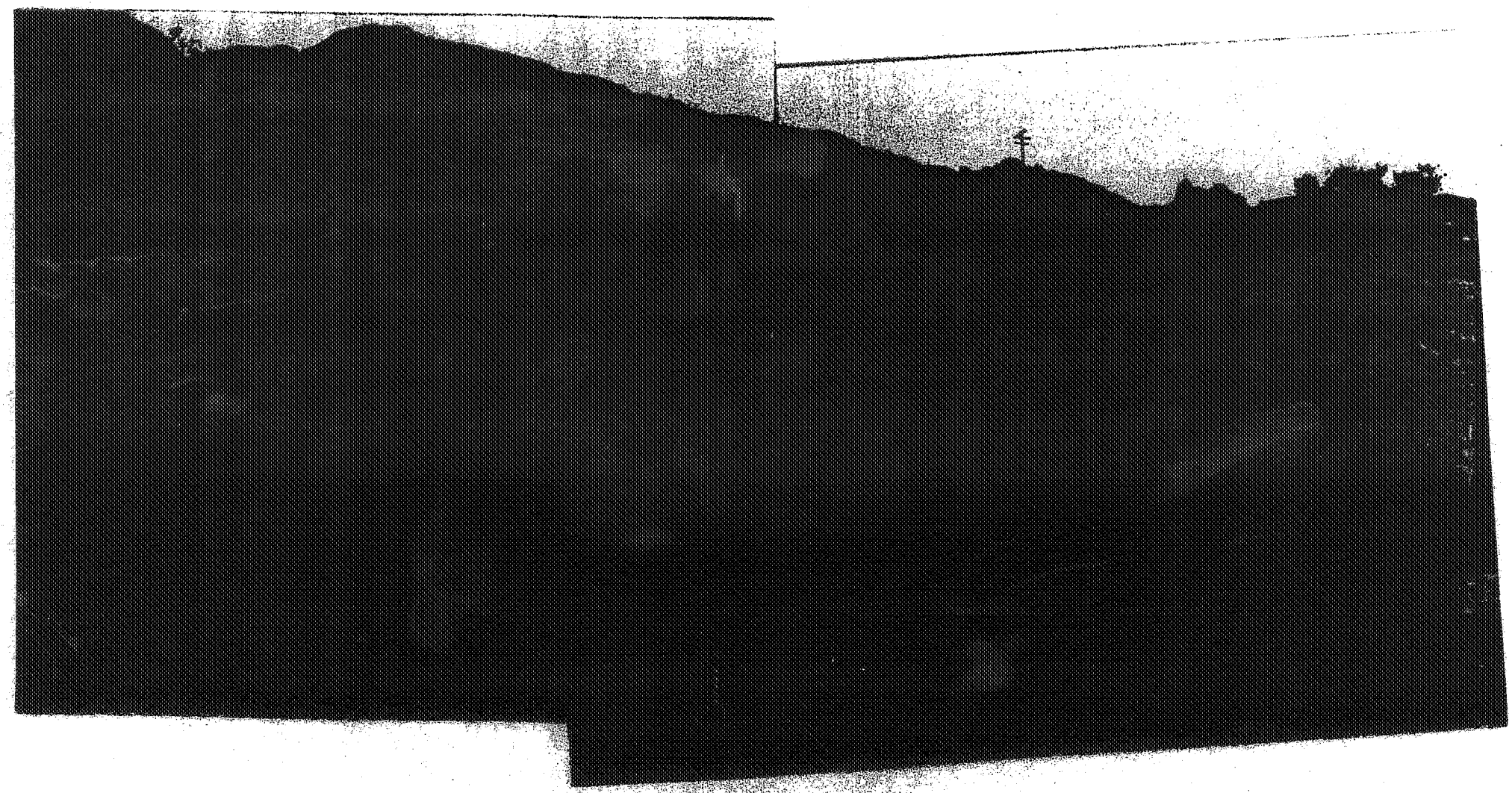


Figure 3

SEACLIFF PARCEL - MARKER BEDS

AUGUST, 1981



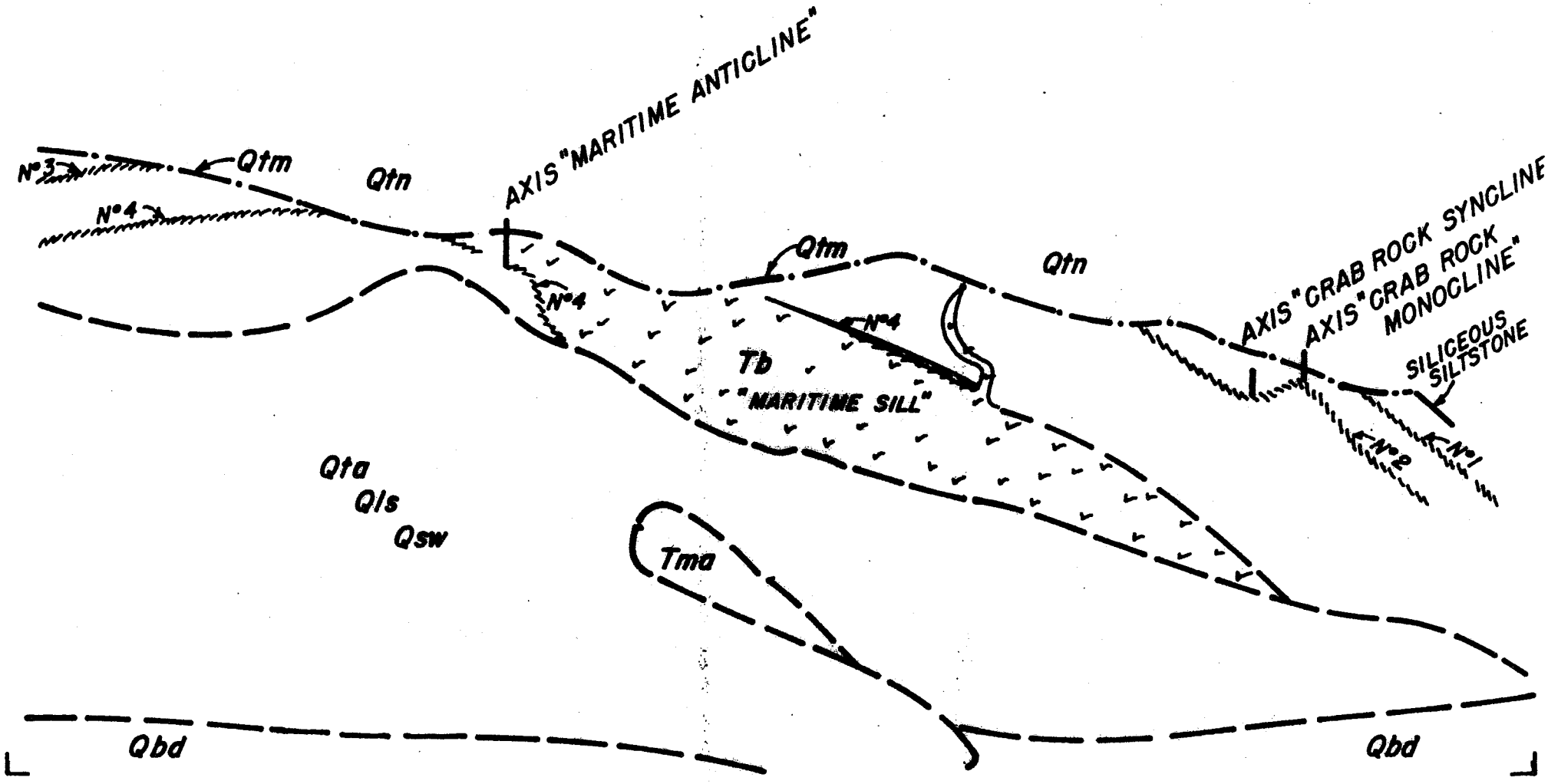


Figure 4

SEACLIFF PARCEL 15 – MARITIME ANTICLINE

AUGUST, 1981