APPENDIX C

PRELIMINARY ENVIRONMENTAL AUDIT

PRELIMINARY ENVIRONMENTAL AUDIT
PLAYA VISTA PROJECT - PARCEL A
FIJI WAY/LINCOLN BOULEVARD/BALLONA CREEK
MARINA DEL REY, CALIFORNIA
FOR
COX, CASTLE & NICHOLSON
(OUR JOB NO. F-88473)

December 21, 1988

Cox, Castle & Nicholson
Twenty-Eighth Floor
2049 Century Park East
Los Angeles, California 90067 (Our Job No. F-88473)

Attention: Mr. Tamar C. Stain

Gentlemen:

Our report "Preliminary Environmental Audit, Playa Vista Project, Parcel A, Fiji Way/Lincoln Boulevard/Ballona Creek, Marina Del Rey, California, for Cox, Castle & Nicholson" is herewith submitted. As authorized by your letter dated December 12, 1988, the audit was limited to data search.

The scope of the study was planned in collaboration with Mr. Tom McCarthy and Ms. Gabrielle Tierney of Maguire Thomas Partners. An oral report of the findings was provided on December 13, 1988. Copies of aerial photographs are not included as they could not be obtained within the required time frame.

Past use of various portions of the property has included oil wells, dredged fill disposal, and a vegetable matter dump. Five active oil wells, now used as part of natural gas storage in the underlying oil field, are present in addition to one abandoned well. The site has been filled with soils excavated from the adjacent Ballona Creek channel and Marina Del Rey Harbor. The dump operated from about 1945 to 1953 as a disposal site for celery packing house wastes. As part of the dump operation, the wastes were sprayed with lindane and fuel oil to control insects and odors.

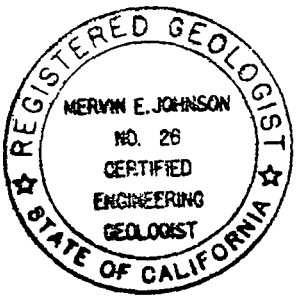
Potential environmental impacts from the dump include soils containing a high percentage of organic materials containing residual lindane and fuel oil. The impact of the oil (gas) wells include their physical location and the presence of sumps related to drilling. Gas storage is below a depth of 5,000 feet.

Please call on us if we can be of further service.

Respectfully submitted,

LeROY CRANDALL AND ASSOCIATES

by
Keith G. Farrell, C.E.G. 1314
Project Engineering Geologist



by
Mervin E. Johnson, C.E.G. 26
Director of Geological
Services/Vice President

YC56/HS/dg
(5 copies submitted)

PRELIMINARY ENVIRONMENTAL AUDIT

PLAYA VISTA PROJECT - PARCEL A

FIJI WAY/LINCOLN BOULEVARD/BALLONA CREEK

MARINA DEL REY, CALIFORNIA

FOR

COX, CASTLE & NICHOLSON

SCOPE

This report presents the results of our preliminary environmental audit of the subject property. The purpose of this study was to review the site history regarding the potential for toxic or hazardous materials. The site is shown on Plate 1, Site Plan.

The scope of our investigation included a review of various records pertaining to the site history to determine whether portions of the property were used for activities which might have resulted in the presence of toxic or hazardous materials. The site history review included:

- Examination of the State of California Division of Oil and Gas (D.O.G.) maps and records for the location and construction status of present or former oil wells.
- Examination of the California Office of Permit Assistance (OPA) Hazardous Waste and Substance Site List for the Cities of Los Angeles and Santa Monica for reports of hazardous materials releases in the vicinity of the property.
- Examination of Regional Water Quality Control Board records regarding a former dump site located on the eastern portion of the property.

- Examination of Los Angeles County Waste Management Department records for information on the former dump site.
- Examination of available in-house aerial photographs and topographic maps, as well as historic aerial photographs from the Spence Collection at UCLA.

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional advice included in this report.

CURRENT SITE CONDITIONS

The site is located northwest of Lincoln and Culver Boulevards, in the Marina Del Rey district of Los Angeles County. The property is bordered on the northwest by Fiji Way, and on the southeast by Ballona Creek channel. Five active oil wells and one abandoned well are present at the site. The wells are operated by the Southern California Gas Company (see Plate 1). The remainder of the property is currently vacant, except for various dirt roads and paths which cross the site. The site is fenced with restricted access.

FINDINGS

RECORDS SEARCH

Oil Wells

A review of maps from the State of California Division of Oil and Gas (D.O.G.) indicates that six oil wells have been drilled on the western portion of the site and a seventh has been drilled adjacent to

the property (see Plate 1). According to D.O.G. Field Map 120 (1986), the wells are owned by the Southern California Gas Company. Five of the six wells on site, the Del Rey #13, #14, #15, #17, and #19, are shown on the map as active. The Del Rey #15 is listed as an oil well and the rest as observation wells. The Del Rey #16 which is also on the property is shown as abandoned. The nearby Del Rey #18 well, adjacent to the property, is also shown as a producing oil well.

Records on file with the D.O.G. in Long Beach were examined for further information on the history and construction of these wells. The well files indicate that wells #13 through #19 were drilled in 1936-1937 by the Union Oil Company. Approximately the upper 750 feet of each well was set with 11 3/4" diameter surface casing which was cemented in place. Casing with a diameter of 6 5/8" was cemented in place to depths of approximately 5,800 to 6,100 feet. The casing was perforated in the producing horizon of these wells which occurred at approximately 5,850 to 6,200 feet. Construction details for each well are listed at the end of this section. Records on file for well #16 indicate that this well was abandoned on April 17, 1938. The abandonment report (dated May 3, 1938) indicates that the well was abandoned by plugging with cement at depths of 5,981 to 6,074 feet, 1,450 to 1,700 feet, and 502 to 732 feet. A subsequent letter to the Union Oil Company from the D.O.G. dated June 9, 1938 indicates that D.O.G. requirements for abandonment of this well had been fulfilled.

A "Report of Property and Well Transfer" dated February 23, 1960 indicates that Union Oil transferred ownership of Del Rey #14 through #19 (inclusive) to the Southern California Gas Company in 1959. No record was found of the transfer of ownership of Del Rey #13, but the available records indicate that the Southern California Gas Company has owned this well since at least 1961. Casing alteration records from wells #14, #15, #17, and #19 indicate that additional casing was added to the wellheads in 1960-1961 to raise the wells to "new elevation required by Marina Del Rey construction." One "Report of Operations" from 1980 on well #18 indicates that this well was in use for the storage of natural gas.

A plot plan of the property by Psomas and Associates dated September 23, 1985 indicates that easements have been filed on the southwestern portion of the property for the injection and storage of natural gas by the Southern California Gas Company. The explanation provided on the map indicates that gas injection and storage is allowed at depths of 500 to 7,000 feet below ground surface.

Well construction details from available D.O.G. files are as follows:

Union Oil Co. Del Rey #13
Information from "Notice of Intention to Drill New Well" dated 1/31/36 and "Notice of Intention to Alter Casing in Well" dated 3/21/61.

11 3/4" surface casing cemented to 750'
6 5/8" casing cemented to 6011'
4 3/4" liner from 5985' to 6078'
Perforated (producing) zone from 6015' to 6078'

Union Oil Co. Del Rey #14
Information from "Notice of Intention to Drill" dated 5/29/36 and "Notice of Intention to Alter Casing in Well" dated 3/21/61.

11 3/4" surface casing cemented to 750'
6 5/8" casing cemented to 5972'
4 3/4" liner from 5946' to 6069'
Perforated (producing) zone from 5975'to 6069'

Union Oil Co. Del Rey #15
Information from "Notice of Intention to Drill" dated 10/5/36 and "Notice of Intention to Alter Casing in Well" dated 7/11/60.

11 3/4" surface casing cemented to 750'
6 5/8" casing cemented to 5892'
4 3/4" liner from 5866' to 6031'
Perforated (producing) zone from 5888'to 6031'

Union Oil Co. Del Rey #16
Information from "Notice of Intention to Drill" dated 12/7/36, "Notice of Intention to Plug Casing in Well" dated 12/15/37, and "Special Report of Operations Witnessed" dated 4/25/38.

11 3/4" surface casing cemented to 750'
6 5/8" casing cemented to 6030'
4 3/4" liner from 5995' to 6091'
Perforated (producing) zone not reported
Plugged with cement at intervals from 5981' to 6074', 1450' to 1700', and 502' to 732 on April 16-17, 1938.

Union Oil Co. Del Rey #17
Information from "Notice of Intention to Drill" dated 2/19/37 and "Notice of Intention to Alter Casing in Well" dated 3/21/61.

11 3/4" surface casing cemented to 740'
6 5/8" casing cemented to 5900'
4 3/4" liner from 5843' to 6000'
Perforated (producing) zone from 5929'to 6000'

Union Oil Co. Del Rey #18
Information from "Notice of Intention to Drill" dated 4/25/37 and "Report on Operations; Gas Storage" dated 4/28/80.

11 3/4" surface casing cemented to 756'
6 5/8" casing cemented to 5818'
4 3/4" liner from 5792' to 6036'
Perforated (producing) zone from 5837'to 6036'

Union Oil Co. Del Rey #19
Information from "Notice of Intention to Drill" dated 7/29/37 and "Notice of Intention to Alter Casing in Well" dated 3/21/61.

11 3/4" surface casing cemented to 760'
6 5/8" casing cemented to 5924'
4 3/4" liner from 5860' to 6194'
Perforated (producing) zone from 5908'to 6194'

Hazardous Waste and Substance Site List

The Hazardous Waste and Substance Site List for Marina Del Rey area was checked for reports of identified hazardous waste or substance sites in the vicinity of the subject site. The list is compiled by the State of California Office of Permit Assistance (OPA) from data from the State Department of Health Services, the State Water Resources Control Board, and the California Waste Management Board. The site is not on the list as of September 1988; the nearest listed site is a tank leak at a Unocal service station located east of the property, at 4801 Lincoln Boulevard. Other nearby sites include a tank leak north of the site at a GTE facility at 4750 Lincoln Boulevard, and another tank leak site to the south on Jefferson Boulevard, on Howard Hughes Property.

Regional Water Quality Control Board Records

The Regional Water Quality Control Board (RWQCB) in Los Angeles was contacted for information on a reported dump site on the eastern portion of the property. According to Ms. Myra Hart with the RWQCB, information on the RWQCB computer files indicates that a landfill site known as the Celery Dump was previously located at the northwest corner of Lincoln and Culver Boulevards. The RWQCB does not have a file on

this site, so no other information was available. The Celery Dump is listed Rank 5 on the "Ranked List of Solid Waste Disposal Sites" by the State Water Resources Control Board dated December 18, 1987. Rank 5 disposal sites require Solid Waste Assessment Tests (SWAT) to be completed by July 1, 1991.

Los Angeles County Waste Management Records

The Los Angeles County Waste Management Division was contacted regarding information on the former Celery Dump site. Records on file with Waste Management indicate that the Celery Dump was used for the disposal of packing house wastes, specifically celery leaves and trimmings, from 1945 through 1953. An Industrial Waste Permit (#75) filed with the County Engineer was found dated July 5, 1950. The owner of the site listed on the permit was Rancho Del Rey Farms, while the operator of the dump was the American Fruit Association.

The location of the dump was reported on various documents in the file as 800 feet north and either 500 or 800 feet west of the intersection of Lincoln and Culver Boulevards. County inspection reports indicate that the extent of the dump varied from approximately 5 acres to 10 acres. According to an inspection report from 1950, the dump consisted of piles of celery trimmings up to four feet high, which were allowed to decompose naturally. The remains were disced into the soil once a year. During decomposition the piles were sprayed with a mixture of benzene hexachloride (lindane) and fuel oil for control of both insects and odor. The last dump inspection report in the file was

dated 1953; according to a notation on the cover of the report, the file was cancelled in 1961. No evidence was found that materials other than vegetable refuse were regularly dumped on the site; however, one inspection report from 1949 indicated that approximately 100 cubic yards of trash had been illegally disposed of at the site.

Aerial Photographs and Topographic Maps

In order to further identify past site usage, historic aerial photographs and topographic maps were examined. A review of our in-house photographs, which date back to 1965, indicate that the property was vacant in that year except for the five existing oil well pads. A large area of recently deposited sediment is visible adjacent to Marina Del Rey Harbor, on the northwestern portion of the site. Our 1986 photograph generally depicts current site conditions.

A review of topographic maps dated 1942, 1950, 1972 and 1981 was also conducted. The maps indicate that the majority of the site consisted of marshland in 1942; the five currently existing wells are present on the southwestern portion of the site, while a small building is also present northwest of well #14. An unpaved access road extending from Lincoln Boulevard to the oil wells is present along the southern border of the site, adjacent to Ballona Creek. A Pacific Electric rail line is present at the southeastern corner of the site, paralleling Culver Boulevard. The 1950 map shows only the northwestern portion of the site as marshland; the oil wells are shown unchanged, but the building adjacent to well #14 is larger. The Pacific Electric rail line

is no longer present. On the 1972 and 1981 maps the building adjacent to well #14 is absent and only three wells, #14, #15, and #19, are shown, though elevated pads are indicated for wells #13 and #17. Dirt roads are not shown on site on the 1972 map, but are present on the 1981 map.

Historic aerial photographs from the Spence Collection at UCLA were also examined. Coverage of the site was available from 1928 to 1970; photographs of the site were found dated 1928, 1930, 1933, 1934, 1937, 1938, 1941, 1947-1949, 1951-1953, 1957-1962, 1964, 1966, and 1968-1970. The photographs indicate that the site was vacant until 1937. In photographs prior to 1937 the Ballona Creek channel is not present south of the site; in photographs from 1933-1934 the channel ended east of Lincoln Boulevard.

In photographs from 1937 oil derricks are present on wells #13, 14, 15, and 16, on the western portion of the site, while the southern portion of the site is covered with fill apparently from the newly excavated Ballona Creek channel to the south. Based on older topographic maps, the fill may be about ten feet thick. The eastern portion of the site adjacent to Lincoln Boulevard was covered with piles of fill in photographs from 1938 through 1941, while in photographs from 1947 through 1959 this area appears cultivated; harrowing is evident on many photographs from this time period.

In photographs from 1947 through 1958 several towers which appear to be radio towers are present on the north-central portion of

the site, northeast of the oil producing area. Oil derricks are present on wells #13-19 in a 1948 photograph, and a small metal building apparently housing oil production equipment or valves is present between wells #14 and #16. This structure and well #16 are present in photographs through 1960; in photographs from 1960 through 1970, they are absent.

In photographs from 1961 and 1962 the adjacent basins of Marina Del Rey are being dredged, and sediment is being deposited on the subject site. In a February 1962 photograph a dike is present around the perimeter of the site and the entire site, except for the oil well pads, is covered with water; pipelines are visible leading from dredging operations in Basin H of the Marina to the northwestern corner of the site. In a subsequent photograph from May 1962 the site is dry and a large area of sediment deposition is visible on the northwestern portion of the site. Based on topographic maps, 10 to 15 feet of fill may have been placed.

In photographs from 1964 through 1968 a grasshopper pump is visible on well #14, and an apparent workover derrick is present on well #17. In one photograph from 1968 piles of a white colored material, possibly concrete rubble, are visible on the southern portion of the site, adjacent to Ballona Creek.

A listing of all photographs examined including Spence photograph identification number, date, and notes on what was observed, is presented below:

Photo #E-2148 August 28, 1928
Site vicinity vacant. Ballona Creek channel not present. Pacific Electric rail line to southeast.

Photo #E-4395 September 26, 1930
Site vicinity vacant. No change from 1928.

Photo #E-3951-22 February 24, 1933
Site vicinity vacant. Ballona Creek channel present east of Lincoln Boulevard.

Photo #E-5761-22-b November 24, 1934
Site vicinity vacant. No change from 1933.

Photo #E-7710-22 March 23, 1937
Southern portion of site covered with fill from Ballona Creek channel (now present to south). Oil derricks present on wells #13, #14, #15, and #16 on southwestern portion of site.

Photo #E-8051-22 November 1, 1937
No change from previous photograph. Bridge over Ballona Creek for Culver Boulevard under construction.

Photo #E-8380-22 February 6, 1936
Eastern portion of site adjacent to Lincoln boulevard has hummocky appearance, possibly covered with fill. Oil derricks visible to west.

Photo #E-8452-22-b March 3, 1938
Entire site vicinity flooded; Ballona Creek high.

Photo #E-11027-22 March 5, 1941
No change from 1936 photograph.

Photo #E-22-26-b April 29, 1947
Eastern portion of site level, appears cultivated(?). Oil derricks present on southwestern portion of site on wells #13, #14, #15, #17, and #18. Metal building present northwest of well #14, appears to be related to oil field operations. Numerous tall radio towers (?) present in an apparently random pattern north and east of the oil well area.

Photo #E-22-59 November 12, 1949
No change from previous photograph.

Photo #E-22b-3 December 31, 1951
No change from 1947 photograph.

Photo #E-22-b-9 November 16, 1952
Eastern and southeastern portions of site appear cultivated. Two small white structures present east of well #17, near metal building. Uncertain what these are, but probably related to oil production.

Photo #E-22-b-12 June 15, 1953
No change from 1952 photograph. Can see evidence of harrowing on southeastern portion of site.

Photo #E-22-b-33 October 2, 1957
No change from 1952 photograph.

Photo #E-22-b-34 February 17, 1958
No change from 1952 photograph.

Photo #E-22-b-62 May 13, 1959
Radio towers no longer present.

Photo #E-22-b-66 June 28, 1960
No change from 1959 photograph.

Photo #E-22-b-79 July 5, 1961
Metal building no longer present. Eastern portion of site no longer cultivated, appears covered with brush. Basin H of Marina Del Rey (to the northwest) undergoing dredging; northwestern portion of site (north of oil wells) covered with sediment from dredging operation.

Photo #E-22-b-81 January 9, 1962
Earthen dike present around perimeter of site; entire site (except for oil well pads) covered with water. Dredging of adjacent Basin H in progress; can see pipelines extending from dredging barge to northwestern portion of site.

Photo #E-22-b-82 February 12, 1962
No change from previous photograph.

Photo #E-22-b-86 May 23, 1962
Site no longer covered with water; large area of sediment deposition visible covering northwestern portion of site. Dredging of Basin H apparently complete.

Photo #E-22-b-111 November 5, 1964
Area of sediment deposition visible. Grasshopper pump on well #14, workover derrick (?) on well #17.

Photo #E-22b-114 September 9, 1966
No change from 1964 photograph.

Photo #E-22-b-131 January 18, 1968
Well pads on wells #14, #15, #17, and #19 surrounded by fencing; well #13 enclosed in some sort of metal box (?). Piles of some white material, possibly concrete rubble, are present on southeastern portion of site. Some standing water visible on northeastern and northwestern corners of site.

Photo #E-22-b-135 August 21, 1968
Grasshopper pump on well #14, workover derrick (?) on well #17.

Photo #E-22-b-141 November 29, 1968
Central portion of site appears harrowed.

Photo #E-22-b-142 June 13, 1969
Dirt roads visible cutting diagonally across eastern portion of site.

Photo #E-22-b-147 March 19, 1970
No change from 1969 photograph.

Photo #E-22-b-149 August 17, 1970
No change from 1969 photograph.

CONCLUSIONS

The site has been occupied from 1936-1937 through the present by five oil wells which are currently used for the injection and recovery of natural gas by the Southern California Gas Company in the underlying Del Rey Oil Field. A sixth well was abandoned on site in 1938.

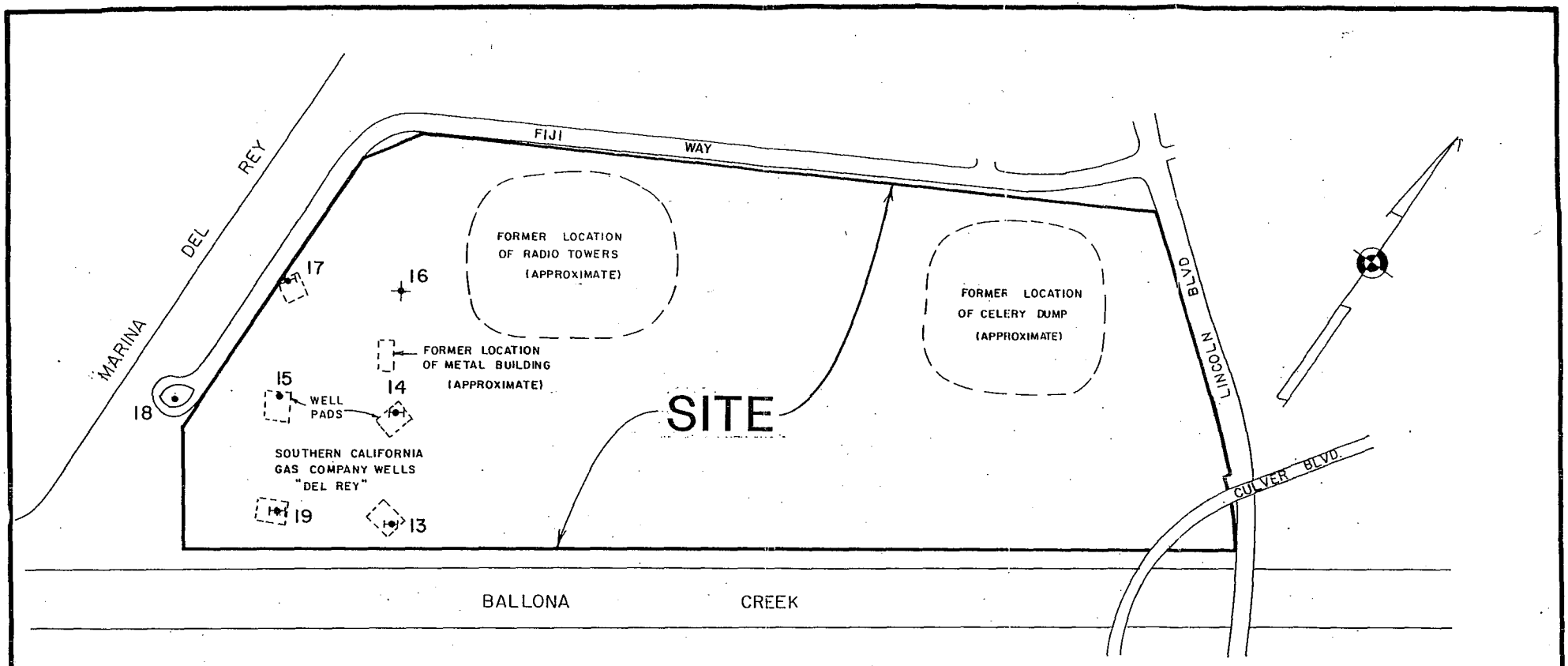
The eastern portion of the site was used from 1945 through 1953 by a packing house disposal facility known as the Celery Dump. No evidence was found that the Celery Dump was used for disposal of significant amounts of any materials other than vegetable refuse. According to the records, the dump was regularly sprayed with a mixture of

benzene hexachloride (lindane) and fuel oil for insect and odor control. The decomposed refuse was annually disced into the soil. Lindane is a pesticide which is listed in Title 22 Section 66699 of the California Administrative Code as a persistent and bioaccumulative toxic substance. The California Department of Health Services (DHS) Soluble Threshold Limit Concentration (STLC) and Total Threshold Limit Concentration (TTLC) for lindane are 0.4 ml/L (parts per million) and 4 mg/kg (parts per million), respectively. Water with lindane concentrations greater than 0.4 ppm or soil with concentrations greater than 4 ppm would be subject to classification as hazardous waste under these guidelines.

In order to determine the potential for residual pesticides and fuel oil and the possible presence of methane gas, an assessment including borings for soil and ground water sampling for chemical characterization will be necessary. As part of this assessment, a gas probe survey could be conducted in the vicinity of the active gas storage wells and at the location of the abandoned well to determine if methane gas is migrating to the surface on the site. The assessment should include at least four monitoring wells near the Celery Dump as well as soil sampling in the same area. These wells would be applicable to the future SWAT requirements for the Celery Dump.

-oOo-

A Site Plan is attached and completes this report.



REFERENCES:

MODIFIED FROM PLAN (DATED SEPT. 23, 1985) BY PSOMAS & ASSOCIATES

OIL WELL LOCATIONS FROM D.O.G. MAP 120 (1986)

CELERY DUMP LOCATION FROM L.A. COUNTY WASTE MANAGEMENT FILES

EXPLANATION

15 • OIL WELL

14 ⊢•⊣ OBSERVATION WELL

16 + ABANDONED WELL

SITE PLAN

SCALE 1" = 400'

LeROY CRANDALL AND ASSOCIATES

PLATE 1

JOB F-88473 DATE 12/15/88 DR. JCHN O.E. CHKD.

FORM 137

APPENDIX D

1988 PRELIMINARY GEOTECHNICAL INVESTIGATION—PARCEL A

REPORT OF

PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED PLAYA VISTA MARINA

PLAYA VISTA DEVELOPMENT - PARCEL A

LINCOLN BOULEVARD AND BALLONA CREEK

LOS ANGELES COUNTY, CALIFORNIA

FOR

HOWARD HUGHES PROPERTIES

LAW/CRANDALL, INC. ▲ geotechnical, environmental & construction materials consultants
200 Citadel Drive, Los Angeles, California 90040-1554, Phone (213) 889-5300, Fax (213) 721-6700
Los Angeles ▲ Anaheim ▲ Los Alamitos ▲ Marina del Rey ▲ Riverside ▲ San Diego

August 6, 1991

Maguire Thomas Partners
13250 Jefferson Boulevard
Los Angeles, California 90094

(L91096.AFB)

Attention: Mr. Joel Stensby
Vice President

Gentlemen:

Report of Preliminary Geotechnical Investigation
Proposed Marina
Playa Vista Project - Parcel A
Lincoln Boulevard and Ballona Creek
Los Angeles County, California

This letter transmits our prior report of preliminary geotechnical investigation for the proposed marina. That report, which is dated April 4, 1988 (AE-88473), was performed for Howard Hughes Properties and was submitted in draft form. The report was never finalized.

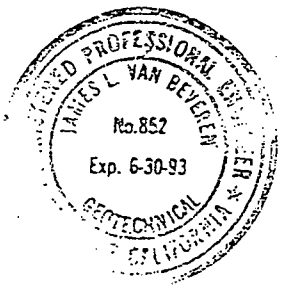
The configuration of the marina has changed somewhat from that described in our April 4, 1988 report. Currently, the marina is planned to extend closer to Ballona Creek and two islands are planned inside the marina. The entrance channel will also be located further to the south. The marina is still planned to be developed by excavating to about Elevation -15. The other aspects of the marina, including perimeter treatment and surrounding development are unchanged from that described in the report.

Our report of April 4, 1988 may still be used for preliminary design purposes. As discussed in that report, prior to final design, the recommendations should be reviewed to determine the appropriateness of the design data based on the final configuration.

Sincerely,

LAW/CRANDALL, INC.

James L. Van Beveren
Vice President
Director of Engineering Services



G1-25/bgs
(2 copies submitted)

cc: (2) Psomas & Associates
Attn: Mr. Jacob Lipa
(1) Moffatt & Nichol, Engineers
Attn: Mr. James Kimo Walker III
(3) City of Los Angeles, Planning Division
(unbound and unpunched)
Attn: Mr. Dick Takase

LeROY CRANDALL AND ASSOCIATES Geotechnical Consultants • One of the Law Companies

900 Grand Central Avenue, Glendale, California 91201-3009, Phone (818) 243-4140, Fax (818) 246-4308

Offices: Glendale • Anaheim • Marina del Rey • San Diego

April 4, 1988

Howard Hughes Properties
13250 Jefferson Boulevard
Los Angeles, California 90094 (LCA AE-88473)

Attention: Mr. Charles A. Alders

Gentlemen:

Our draft "Report of Preliminary Geotechnical Investigation, Proposed Playa Vista Marina, Playa Vista Development - Parcel A, Lincoln Boulevard and Ballona Creek, Los Angeles County, California, for Howard Hughes Properties" is herewith submitted.

The report is being submitted in draft form so that comments and suggestions may be incorporated in the final submittal. We will be pleased to discuss the draft with you at your convenience.

Respectfully submitted,

LeROY CRANDALL AND ASSOCIATES

by
Boris Korin
Project Engineer

by
James L. Van Beveren
Principal Engineer/Vice President

X95/pa
(5 copies submitted)

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PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED PLAYA VISTA MARINA

PLAYA VISTA DEVELOPMENT - PARCEL A

LINCOLN BOULEVARD AND BALLONA CREEK

LOS ANGELES COUNTY, CALIFORNIA

FOR

HOWARD HUGHES PROPERTIES

1.0 SCOPE

This report presents the results of a preliminary geotechnical investigation of the site of a proposed marina to be located within Parcel A of the Playa Vista Development. The locations of the site and our exploration borings are shown on Plate 1, Site Plan. We previously performed a preliminary environmental audit for the project, and presented the results in our report dated December 21, 1988 (our Job No. F-88473). We performed a concurrent study to determine the location of an existing natural gas storage reservoir, and the effect of the reservoir on the marina construction. The results of that study were presented in a report dated March 31, 1989 (LCA L89101.AEB).

This investigation was authorized to determine the static physical characteristics of the soils beneath the site and to provide recommendations for: perimeter wall design including recommended lateral pressures and foundation support; various sloping configurations of perimeter treatment; information on excavation and dewatering; and preliminary information for location of building foundations adjacent to the perimeter. The investigation was to include a geologic-seismic hazards study to determine any geologic hazards that might affect the proposed construction.

This investigation is based on the presently anticipated layout of the marina. Prior to final design, the recommendations contained herein should be reviewed to determine the appropriateness of the design data based on the final configuration. Additional explorations may be required.

The recommendations contained herein are based on the results of our field explorations and laboratory tests, the engineering analyses based thereon, and on the geologic studies. The results of the exploration

borings and laboratory tests are presented in the attached Appendix A. Cone penetration test results are presented in Appendix B.

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has been prepared for Howard Hughes Properties and their design consultants to be used solely in the preliminary design of the proposed marina. The report has not been prepared for use by other parties, and may not contain sufficient information for purposes of other parties or other uses.

2.0 PROPOSED CONSTRUCTION

It is proposed to construct a marina within the subject 139-acre Parcel A; the marina will connect with the existing Marina del Rey. The configuration of proposed marina, as presently planned, is shown on Plate 1. The configuration shown is based on the Playa Vista Land Use Plan; we understand that other configurations are being studied. The marina will be developed by excavating and dredging to about Elevation -15, some 23 to 33 feet below the existing grade. The perimeter treatment for the marina may consist of gravity retaining walls, sheet pile walls, slopes, or combinations of walls and slopes.

The areas surrounding the marina are to be developed with hotels, office buildings, retail stores, and condominiums. Some of these structures may be built near or adjacent to the marina perimeter. Foundation design data for these structures are not within the scope of this report.

3.0 SITE CONDITIONS

The site is located northwest of Lincoln and Culver Boulevards in the Marina del Rey district of Los Angeles County. The property is bordered on the north and northwest by Fiji Way and on the southeast by the Ballona Creek Channel. There are seven wells on or adjacent to the site. The wells were originally drilled as oil wells. One of the wells has been abandoned. The other six wells are operated by the Southern California Gas Company in conjunction with their subterranean natural gas storage reservoir for gas withdrawal and monitoring. There are pipelines between the wells.

The site has been previously filled with excavated materials and dredgings from the existing marina and Ballona Creek Channel, and is about 8 to 18 feet above sea level.

Except for the wells, the property is currently vacant; various dirt roads and paths cross the site. There were structures formerly on the site including radio towers; the foundations may still be in place. The eastern portion of the site was formerly used as a dump for celery trimmings. The site is fenced to restrict access.

The Ballona Creek Channel was excavated in the 1930s and the excavated/dredged soils were placed on the southern portion of the site. Material dredged for development of the existing Marina del Rey in the early 1960s was deposited on the site as hydraulically placed fill.

4.0 GEOLOGY

4.1 GENERAL

The project site is located on the Los Angeles Coastal Plain within the Peninsular Ranges geomorphic province of California which extends from Baja California on the south to the Transverse Ranges on the north. The Peninsular Ranges geomorphic province is characterized by northwest-southeast trending mountain ranges and basins composed predominantly of Mesozoic era igneous and metamorphic rocks and Cenozoic era sedimentary rocks.

The site is situated in the Ballona Creek Flood Plain at the north end of the El Segundo Sand Hills. The Ballona Escarpment, which is an erosional feature caused by the ancient Los Angeles River that flowed through Ballona Gap, is located about one-half mile to the south of the site. The Ballona Escarpment rises approximately 120 to 140 feet above the flood plain and is composed of Pleistocene sediments, dune sand deposits, and the underlying Lakewood and San Pedro Formations.

The site is located approximately 2½ miles west-southwest of the Baldwin Hills, which are part of a northwest trending succession of hills which represent the surface expression of the Newport-Inglewood Fault Zone.

The Pacific Ocean is located approximately one-half mile west-southwest of the site. The current site elevation is about 8 to 18 feet above mean sea level (U.S. Geological Survey datum - Mean Sea Level = Elevation 0).

The southwestern portion of the site overlies a section of the Del Rey Hills area of the Playa del Rey Oil field.

The geology and topography in the vicinity of the site are shown on Plate 2, Local Geology. A section showing the typical soil profile beneath the site is presented on Plate 3, Generalized Soil Profile.

4.2 GEOLOGIC MATERIALS

4.2.1 Fill

Fill soils, 9 to 17½ feet in thickness, were encountered in the borings. The fill consists of silt, clay, and silty sand. The silt and clay are soft to medium stiff; the silty sand is loose to medium dense. There are traces of organic matter in the clayey soils. Debris was encountered and the presence of a hydrocarbon was detected in the fill in Boring 17. The majority of the fill was apparently placed hydraulically during dredging of the Marina del Rey harbor although some dump fill is also apparent. The fill appears to have been placed directly over vegetation present on the surface of the natural soils.

4.2.2 Holocene Deposits

Beneath the fill, the site is underlain by Holocene alluvium extending to an estimated depth of 100 feet below ground surface (California Department of Water Resources, 1961). The alluvial deposits appear to be fairly uniform throughout the parcel, consisting predominantly of cohesive soils to depths of about 50 to 70 feet underlain by dense sand and gravel. The upper cohesive soils

consist of soft to medium stiff silts with some layers of loose to dense silty sand and sand with occasional minor layers of peat. The alluvial deposits are of estuarine origin and contain decomposing organic materials which generate the organic odor (hydrogen sulfide) noted on the boring logs.

The dense sand and gravel deposits were encountered at depths between 48 and 67 feet. These coarser sediments were described by Poland (1959) as the "50-foot gravel," a ground water aquifer.

4.2.3 Pleistocene and Older Deposits

Early Pleistocene age San Pedro Formation sediments underlie the Holocene deposits. These sediments consist primarily of sand with some gravel. Locally, there are thick interbeds of silt. The San Pedro Formation deposits extend to an estimated depth of 200 feet below the site (Poland, 1959). In our other recent investigations in the Ballona Gap area that penetrated into the San Pedro Formation, the sediments consisted of silts and clays.

At depth, approximately 5,800 feet of Tertiary age sedimentary rocks underlie the San Pedro Formation. These sedimentary rocks rest upon metamorphic basement rocks of the Mesozoic (?) age Catalina Schist.

4.3 GROUND WATER

The site is within the Santa Monica Hydrologic Subarea of the Coastal Plain of Los Angeles. Regional ground water levels are near sea level. Ground water was encountered in our borings at

depths of about 7 to 15½ feet below ground surface corresponding to elevations of about 3 feet below sea level to 7 feet above sea level.

Nearly all ground water from the Ballona Gap subunit, which underlies the project area, has been degraded. This degradation has been attributed to sea water intrusion resulting from overpumping in the past.

4.4 OIL AND GAS WELLS

One oil well, designated Del Rey #16, is located in the planned area of excavation. Records on file for the well indicate that it was abandoned on April 17, 1938, in accordance with D.O.G. requirements in effect at that time. The abandonment report (dated May 3, 1938) indicates that the well was abandoned by plugging with cement at depths of 5,981 to 6,074 feet, 1,450 to 1,700 feet, and 502 to 732 feet. This well may have to be reabandoned following current D.O.G. requirements to allow the completion of the proposed marina.

Oil wells Del Rey #13, #14, #15, #17, #18, and #19 are currently used as monitoring and withdrawal wells for gas storage in the Playa del Rey Oil Field, see Plate 1 for the locations of the wells.

4.5 NATURAL GAS STORAGE

The Southern California Gas Company owns the existing on-site and adjacent wells, Del Rey #13 through #19, and uses the underlying Playa Del Rey Oil field for storage of natural gas. Gas storage is

generally at a depth of approximately 6,200 feet below the surface (D.O.G., 1974), although an easement allows storage at depths of 500 to 7,00 feet below ground surface. The lateral extent of the Playa Del Rey Oil Field is shown on Plate 2.

4.6 GEOLOGIC HAZARDS

4.6.1 General

The geologic hazards at the site are essentially limited to those caused by earthquakes. The major cause of damage from earthquakes results from violent shaking from earthquake waves; damage to structures from surface rupture is typically confined to facilities located directly over a fault, and therefore is much less frequent. Violent earthquake shaking would occur not only immediately adjacent to the earthquake epicenter, but within many miles in all directions.

4.6.2 Faults

The numerous faults in Southern California include active, potentially active, and inactive faults. Based on criteria modified from the Association of Engineering Geologists (1973), a fault is considered active if it has moved during historic time (approximately the last 200 years), or is included in a State of California Special Studies Zone for fault rupture hazard. A potentially active faults has moved in the last two million years, but not during historic time. Faults which have not moved in the last two million years are considered inactive.

The closest active fault to the site is the Inglewood Fault of the Newport-Inglewood Fault Zone, located 4.4 miles to the east-northeast. The large number of low magnitude earthquake epicenters on or near the Newport-Inglewood Fault indicates that it is active, at least at depth. The 1933 Long Beach earthquake (Magnitude 6.3) occurred on the Newport-Inglewood Fault Zone.

The active Malibu Coast Fault is located about 7 miles northwest of the site. The major San Andreas Fault Zone is located about 43 miles north-northeast of the site.

The potentially active Charnock Fault is mapped as being located 1.7 miles east-northeast of the site. This fault trends north-northwesterly from the Gardena area, beneath the El Segundo Hills, across Ballona Creek, and through the alluvial narrows southwest of Beverly Hills. We performed a detailed investigation to locate the Charnock Fault in the area of Parcel D between Jefferson Boulevard and the Ballona Escarpment. The results were presented in our report dated May 25, 1988 (LCA AE-86125-L). During our investigation, evidence of the fault was not encountered in late Pleistocene age materials nor was there evidence of a fault-related ground water barrier within the 47- to 71-foot depth explored by our borings.

Other nearby potentially active faults include the Overland Fault located 2½ miles east- northeast of the site, the Santa Monica-Hollywood Fault, 5 miles to the north, and the Palos Verdes Fault, 5 miles to the south-southwest.

The California Division of Oil and Gas report on the Playa del Rey Oil Field (1974) indicates one inactive fault underlying and six small inactive faults near the project area. These faults are depicted as offsetting Miocene age bedrock, but not offsetting Pliocene age rock. This indicates that the faults have been inactive since the beginning of Pliocene (5 million years) time. The potential for surface rupture from these inactive faults is extremely low.

4.6.3 Seismicity

In the last 60 years, three earthquakes have caused major damage in the metropolitan Los Angeles area. These events are the Long Beach, San Fernando, and Whittier Narrows earthquakes. The Long Beach earthquake occurred March 10, 1933. The epicenter of this event was located about 35 miles southeast of the site. This earthquake, although only Richter Magnitude 6.3, ranks as one of the major disasters in Southern California. The majority of damage occurred in structures which are now considered to have been of substandard construction and/or were located on filled or saturated ground.

The epicenter of the Magnitude 6.5 February 9, 1971 San Fernando earthquake was located about 29 miles north of the site. Surface rupture occurred on various strands of the San Fernando Fault Zone including the Sylmar and Tujunga Faults. The large amount of damage caused by this earthquake led to the adoption of more stringent building codes.

The Magnitude 5.9 Whittier Narrows earthquake occurred October 1, 1987 on a previously unrecognized east-west trending reverse fault. The earthquake epicenter was located approximately 22 miles east-northeast of the proposed marina. The majority of structural damage resulting from the earthquake occurred in buildings constructed prior to the more stringent building codes which were developed after the 1971 San Fernando Earthquake.

More recently, two Magnitude 5.0 earthquakes, occurring on December 3, 1988 and January 18, 1989, have shaken the greater Los Angeles area. These earthquakes were not associated with a great amount of damage. The epicenter of the December 3rd earthquake was in the Pasadena area (verbal communication, California Institute of Technology) about 21 miles to the northeast of the site. The January 18, 1989 earthquake occurred offshore in the Santa Monica Bay (verbal communication, California Institute of Technology); the epicenter was located about 9 miles west-southwest of the site.

4.6.4 Liquefaction and Seismically Induced Settlement

Liquefaction potential has been found to be the greatest where the ground water level is shallow and loose fine sands occur within a depth of about 50 feet or less. Liquefaction potential decreases with increasing grain size and clay and gravel content, but increases as the ground acceleration and duration of shaking increase. The County of Los Angeles Seismic Safety Element indicates that the project site is located in an area subject to potential liquefaction based on shallow ground water.

The natural soils consist of soft to medium stiff deposits of silt to depths of 50 to 70 feet with layers of loose to dense silty sand and sand underlain by dense sand and gravel. The relative density of the silty sands and sands within the upper 50 to 70 feet varies from about 60% to 80%. The layers of silty sand and sand within the upper 50 to 70 feet are typically less than three feet in thickness (although an eight-foot thick layer was encountered in one boring) and are confined within layers of cohesive silts. The layers of the looser silty sand and sand have a total thickness of up to 18 feet at some of our boring locations. The relative density of the sand and gravel below the 50- to 70-foot depth is greater than 80%.

Water was measured in our borings at depths of 7 to 15½ feet, corresponding to an elevation of 3 feet below sea level to 7 feet above sea level.

In the event of a severe earthquake on the San Andreas Fault Zone or a moderate earthquake on one of the nearby capable faults, liquefaction of the looser sand and silty sand deposits in the upper 50 feet could occur. The liquefaction would not be extensive across the site, but would be confined to the looser sandy layers of limited thickness. Because the potentially liquefiable soils are confined within cohesive layers, sand boils are not expected to develop. Settlements ranging from about one to four inches should be anticipated due to liquefaction.

4.6.5 Stability

For the most part, the site is essentially level with no known slope stability problems. Slopes present on-site are limited to minor 2:1 (horizontal to vertical) graded (both cut and fill) slopes along the existing channel in the northeastern portion of the site, adjacent to Culver Boulevard, along service roads for the existing oil and gas wells, and bordering the Ballona Creek Channel. These graded slopes are generally ten feet or less in height with no indications of major slope instabilities.

The potential for slope stability problems on-site is judged to be low. Additionally, the site is not on or in the path of any existing or potential landslides.

4.6.6 Subsidence

The site is underlain by the Playa del Rey Oil Field which has been identified as a subsidence area in the Urban Geology Master Plan (California Division of Mines and Geology, 1973). Development within the field began in the 1920s with peak production in the area underlying the site in 1935 (California Division of Oil and Gas, 1974). Minor subsidence on the order of 0.02 to 0.07 feet per year was noted between the years 1925 and 1938 (Castle and Yerkes, 1976) within the vicinity of the oil field. These rates of subsidence apparently decreased with no subsidence noted in the area between 1949 and 1955 (Castle and Yerkes, 1976). The field has been essentially depleted and is now used for underground natural gas storage by the Southern California Gas Company. Accordingly, the potential for continued subsidence at the site is low.

4.6.7 Peat

Peat deposits have been known to cause subsidence due to oxidation and shrinkage in the event of drying. As stated previously, layers of peat were encountered in our borings. The peat layers are below the ground water level and not subject to oxidation or drying. Accordingly, the potential for subsidence due to peat oxidation or drying is low.

4.6.8 Collapsible Soils

Collapsible soils are those soils that are subject to increased consolidation with increase in moisture content. The majority of the soils at the site are either below water level or have been subjected to higher water levels in the past. Collapsible soils were not encountered within our investigation.

4.6.9 Tsunamis and Seiches

Ocean access for the proposed marina will be through the existing entrance channel for Marina del Rey. The estimated run-up for the 100-year tsunamis (seismic sea wave) at the mouth of the entrance channel is 7.9 feet (Houston and Garcia, 1974). Tsunamis could cause the water level in the proposed marina to rise accordingly. Locally generated tsunamis have the potential for greater run-up, although there have been no historic tsunamis generated from local offshore earthquakes.

Seiches are oscillations in a body of water caused by earthquake shaking. The resultant "sloshing" of a captive body of water may

occur during moderate to great earthquakes of Richter Magnitude 5.0 and greater. The result of seiching of the planned marina could cause the water level to temporarily rise or fall a few inches to a few feet.

4.6.10 Flooding

The subject property is located within "Zone C" as designated by Federal Emergency Management Agency for flood hazard (1985). "Zone C" designates areas of minimal flooding outside the 100-year and 500-year flood zones. Ballona Creek which lies along the south-eastern boundary of the subject parcel has been channelized to contain the 100-year flood zone. To the north and west of the site, existing improvements along the main channel and the harbor basins contain the 100-year flood zone within Marina del Rey. Estimated base flood elevations within the Marina del Rey facilities are six feet. Similar base flood elevations may be expected within the proposed marina.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

Based on the geologic findings, no active or potentially active faults are known to exist within the site. Accordingly, no surface rupture hazard is deemed to affect the site. The inactive fault beneath the site will not impact the development. The site could be subject to strong ground motion in the event of an earthquake. Due to the nature of the project, hazards due to tsunamis and seiches are inherent. The 100-year run-up in the project area due to tsunamis is 7.9 feet. The potential 100-year flood elevation is approximately six feet, similar to that designated for the existing Marina del Rey facilities. The effects of ground shaking, tsunamis, seiches, and flooding can be mitigated if structures are designed and constructed with current building codes and proper engineering practice. Construction of the marina is not expected to affect the natural gas storage reservoir nor is the reservoir expected to have any effect on the marina.

The proposed marina may be developed as planned. The perimeter treatment may consist of vertical walls, revetted slopes, or combinations of slopes and walls. The upper soils are relatively weak and the required slopes will need to be relatively flat.

The upper soils are not suitable for direct support of retaining walls or other structures on spread footings. Driven piling will be required for support on major walls or other structures. Low walls could be supported on spread footings if the soils beneath the footings are excavated and replaced as compacted fill.

Liquefaction is expected to occur in localized zones of loose silty sand. Based on the borings and cone penetration tests, most of the layers of loose silty sand and sand are less than three feet in thickness. In the event of liquefaction, localized settlement of the ground surface of about one to four inches could occur; the settlement is not expected to be uniform. However, the liquefaction is not expected to affect the stability of the proposed perimeter walls, because of its localized nature. Localized slope sloughing could, however, occur. We do not believe that it will be necessary to design the facilities to resist any liquefaction effects; these conclusions should be verified prior to final design after the design scheme is finalized.

Water was measured in our borings at depths of 7 to 15½ feet. The upper fill soils may be excavated to near the water level using conventional equipment. Below these depths, the soils are not expected to be capable of supporting conventional equipment. Draglines or large backhoes operating from levels above water level could be used to excavate below water level. Dredging could also be considered. Dewatering could be performed to facilitate excavation. The soils are relatively impermeable and trapped water pockets may be encountered during excavation even if the site is dewatered.

The conclusions and recommendations presented below are preliminary and necessarily general in nature. The data contained in this report should be reviewed prior to preparing final plans for the site development. The data are not intended for final design of buildings adjacent to the marina.

5.2 FOUNDATIONS

5.2.1 General

The proposed gravity retaining walls should be supported on driven friction piling. The piles should be driven through the soft upper soils and develop their support into the dense sand and gravel which occur about 60 feet below existing grade (30 feet below dredged level). Minor retaining walls may be supported on spread footings.

5.2.2 Driven Piling

5.2.2.1 Driven Pile Capacities

The downward and upward capacities of 14-inch-square prestressed concrete piles and are presented on Plate 4, Driven Pile Capacities. Dead plus live load capacities are shown. A one-third increase may be used when considering wind, seismic, or berthing loads. The indicated capacities are based on the supporting characteristics of the soils and would be applicable for either foundation piling or slip guide piling. The pile section itself should be checked to verify its capability of supporting the imposed loads.

The capacities are presented as a function of penetration into the dense sand and gravel, for various depths to the sand and gravel. The piles should be driven at least five feet into the dense sand and gravel, which was encountered below Elevation -38 to -55; the elevation of the surface of the dense sand and gravel at each boring location is shown on Plate 1.

Piles in groups, if any, should be spaced at least three feet on centers. If so spaced, no reduction in the downward capacity of the piles due to group action need be considered in design.

The settlement of the walls, supported on driven piling in the manner recommended, will be depend on the loads imposed but should be well within acceptable limits.

5.2.2.2 Lateral Resistance

The soils adjacent to an 14-inch-square concrete pile may be assumed to resist horizontal thrusts applied at the top of a pile. The available lateral resistance is presented in the following table.

	1/4-inch Deflection (pounds)	1/2-inch Deflection (pounds)
Free Head	3,500	7,000
Fixed Head	10,000	20,000

The lateral resistance of other sizes of piles would be proportional to the width. The presented capacities are for total loads, including wind, seismic, and impact loads.

In calculating the maximum bending moment in a pile, due to the lateral load applied at the top of the pile, the lateral load may be multiplied by an assumed moment arm of four feet. For design, it may be assumed that the maximum bending moment will occur at the pile cap or at the adjacent grade, whichever is lower, and that the

bending moment will decrease to zero at a depth of 20 feet below the bottom of the pile cap or adjacent grade.

Batter piles may also be used to resist lateral loads. Batter piles should also be driven at least five feet into the dense sand and gravel. The axial capacity of a batter pile may be taken as equal to the capacity of a vertical pile driven to the same tip elevation.

5.2.2.3 Installation

We anticipate that the driving resistance will range from very low to high. All piles should be driven to the lengths discussed above, except as may be modified on the basis of the driving criteria defined on Plate 5, Pile Driving Criteria. The piles may run until they encounter a stiffer or denser layer. The driving resistance may be moderately high in the silty sand and sand layers and in the stiffer silt layers. Hard driving may be encountered within the deeper dense sand and gravel, and some predrilling may be required. The diameter of the predrilled hole should not exceed the width of the pile. Predrilling may be performed to within five feet of the design tip elevation of the pile.

Prior to ordering the production piles, an indicator pile program will be required to evaluate the driving resistance prior to ordering production piling. The program can be developed after the design is finalized.

5.2.3 Spread Foundations

5.2.3.1 Bearing Value

Retaining walls less than about six feet in height and extending less than ten feet below the existing ground surface, may be supported on spread footings established in properly compacted fill. Footings extending at least 2 feet below the adjacent grade and underlain by at least three feet of compacted fill may be designed for a soil bearing pressure 1,500 pounds per square foot. The allowable bearing pressure would have to be reduced if the footings are located near the face of a downward slope.

While the actual bearing value of any required fill will depend on the material used and the compaction methods employed, the quoted bearing values will be applicable if acceptable soils are used and are compacted as recommended. The bearing value of the fill should be confirmed during the grading.

5.2.3.2 Lateral Resistance

A coefficient of friction of 0.4 may be used between the footings and the supporting soils. The passive pressure against footings may be assumed to be equal to that developed by a fluid with a density of 250 pounds per cubic foot. The available passive pressure would have to be reduced if the footings are near the face of a downward slope.

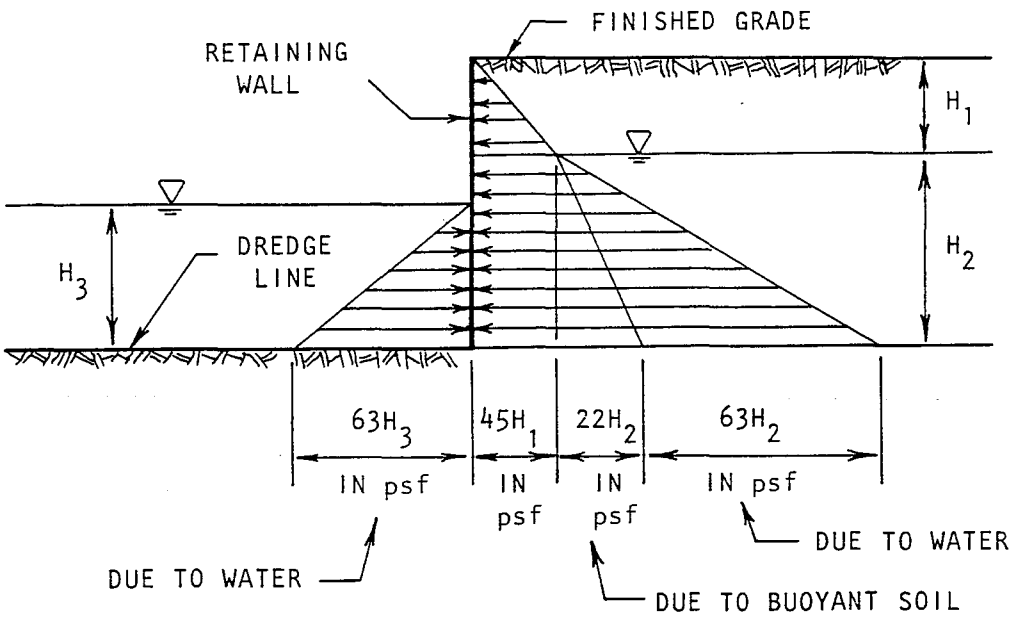
5.2.3.3 Foundation Observation

To verify the presence of satisfactory soils at design elevations, all footing excavations should be observed by personnel of our firm. Inspection of footing excavations may also be required by the appropriate reviewing governmental agencies. The contractor should familiarize himself with the inspection requirements of the reviewing agencies.

5.3 WALLS BELOW GRADE

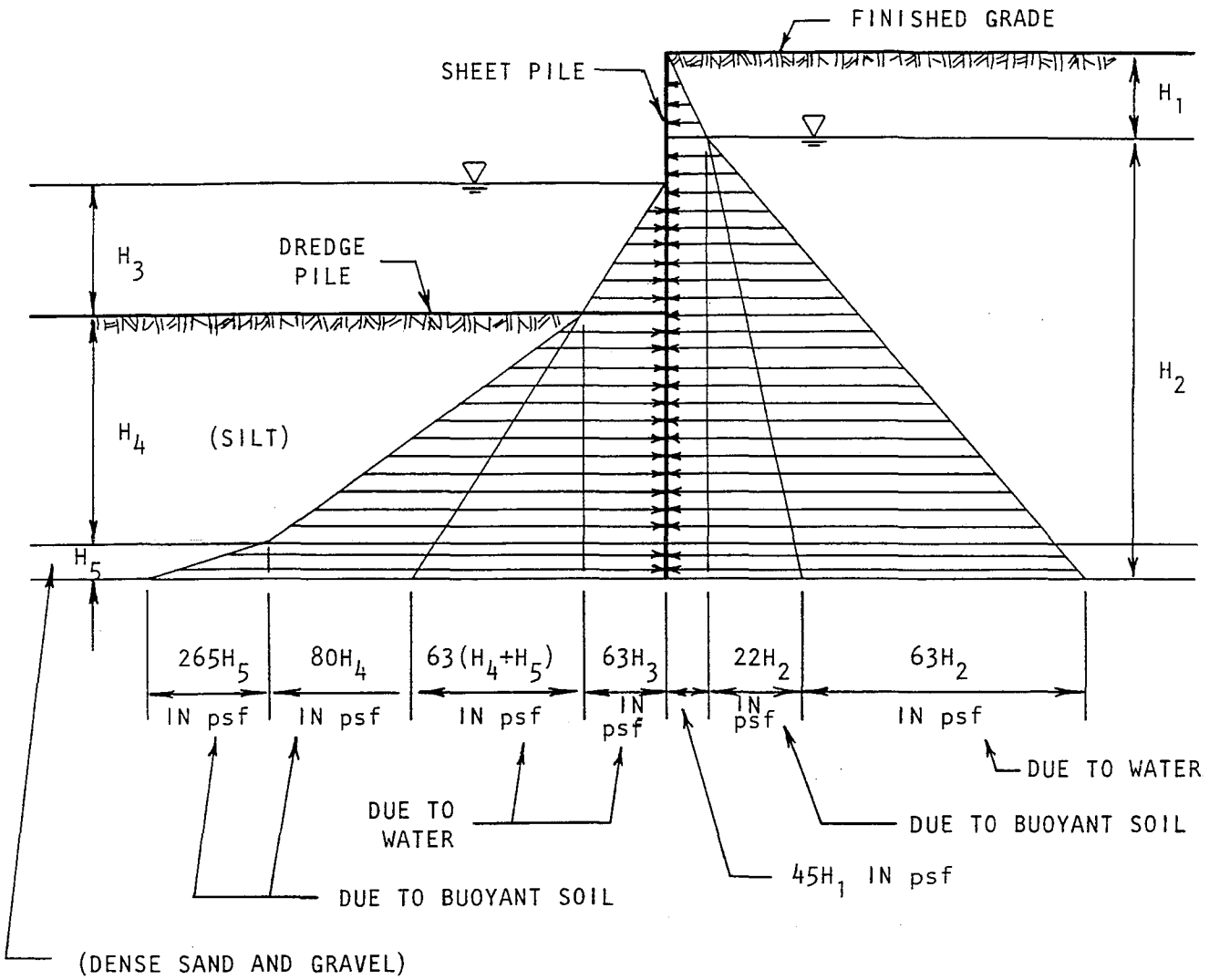
5.3.1 Gravity Retaining Walls

For design of gravity retaining walls, it may be assumed that the lateral pressure of the on-site soils with level backfill above the water level will be equal to that developed by a fluid with a density of 45 pounds per cubic foot. Below the water level, the lateral pressure due to the soil and the water will be equal to that developed by a fluid with a density of 85 pounds per cubic foot. (The soil buoyant pressure would be 22 pounds per cubic foot and the water would be 63 pounds per cubic foot.) The recommended pressure distribution is shown on the following page. (The water pressure on the marina side of the wall may be considered in the design.) If sloping backfill is used, the pressure would be greater; we can provide the necessary data when the configuration is known.



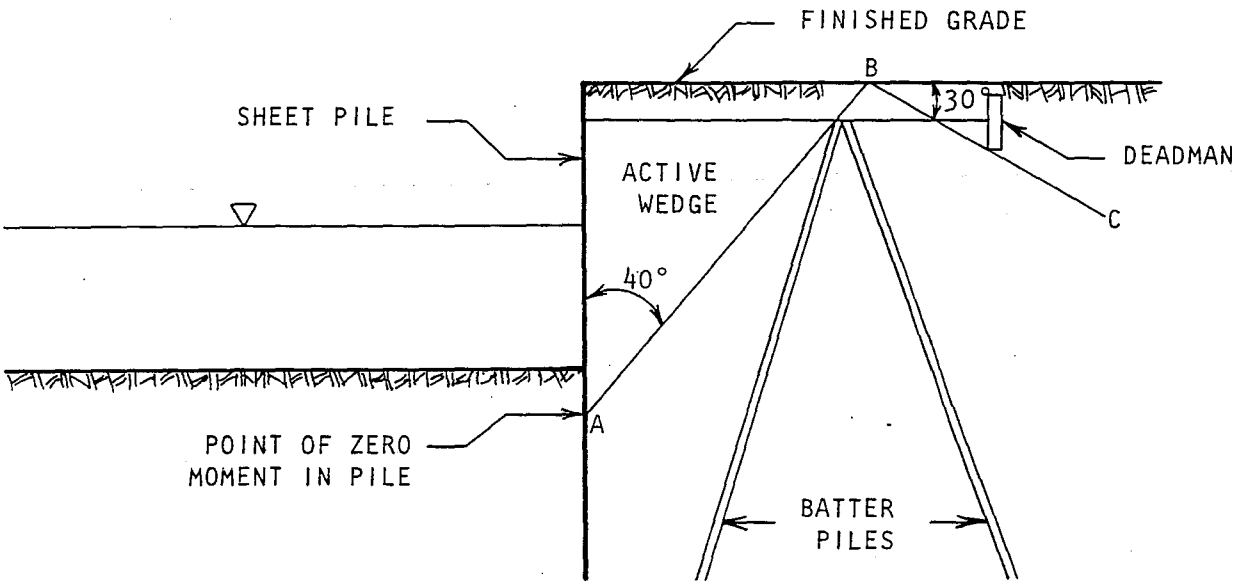
5.3.2 Sheet Pile Walls

The sheet pile walls with level backfill should be designed to resist the lateral pressures imposed by the soils and the ground water as shown on the following page. Sheet piles should extend at least two feet into the dense sand and gravel (see Plate 1 for elevations of dense sand and gravel at the locations explored.) If sloping backfill is used, the pressures would be greater; we can provide the necessary data when the configuration is known.



It may be desired to restrain the upper portion of the sheeting by using tie-rods. The tie-rods should connect to either deadmen or batter piles. The locations of the anchor deadmen or batter piles are illustrated below. The passive resistance of the deadmen may be assumed to be equal to that developed by a fluid with a density of 250 pounds per cubic foot. A coefficient of friction of 0.4 may be used between the deadman and the supporting soils. Lines A-B

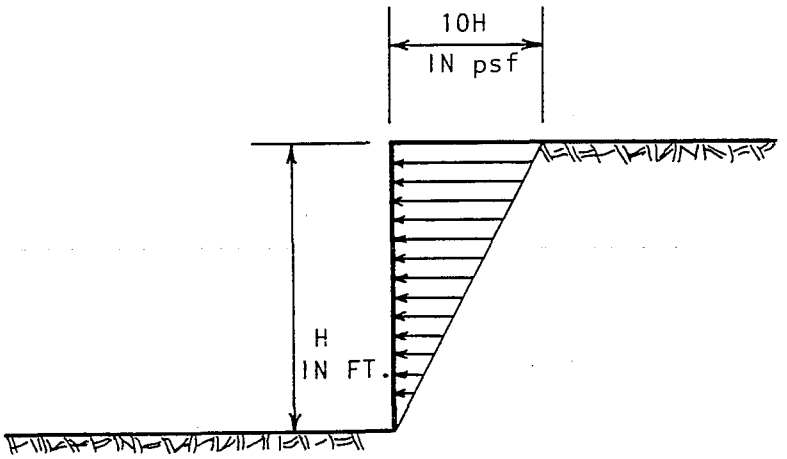
and B-C define the limits of the active and passive wedges, respectively. The entire deadman should be to the right of line B-C. Where a tie-rod is connected to piles, the connection should be to the right of line A-B.



5.3.3 Seismically-Induced Earth Pressure

It is our opinion that the incremental increase in earth pressure due to seismic loading on the walls of the structures will be low and will merely result in a reduction in the factor of safety. If it is desired to maintain the same factor of safety during an

earthquake as under static conditions, we suggest the use of the following seismically induced earth pressure distribution. This pressure distribution would be in addition to the earth pressure and any surcharge.



5.3.4 Backfill

All required backfill for walls below grade should be mechanically compacted in layers not more than eight inches in thickness to at least 90% of the maximum density obtainable by the ASTM Designation D1557-70 method of compaction. Proper compaction of the backfill will be necessary to reduce settlement of the backfill and consequent settlement of overlying slabs and paving. In order to minimize the potential for development of differential hydrostatic pressures on the walls, the backfill should consist of granular, free-draining soils. It may be possible to use the on-site silty sand soils; the silt soils should not be used.

Even at 90% compaction, some settlement may occur within the backfill. Accordingly, provisions should be made for some possible settlement of overlying slabs and paving. Also, we suggest that any utility lines partially supported on the backfill and crossing the walls be designed to accept differential settlement, particularly at the points of entry through the walls.

5.4 GRADING

5.4.1 Excavation

5.4.1.1 Cut Slopes

The allowable permanent slope inclination will vary with the height of the slope. The allowable slope inclinations for various slope heights are presented in the following table:

Slope Height (feet)	Slope Inclination (Horizontal to Vertical)
0 to 10	2:1
10 to 20	3:1
20 to 30	4:1

We recommend that combinations of slopes with gravity retaining walls above not be used. It would be possible to use a slope at the toe of a sheet pile wall. We can provide data for design of sheet pile walls with slopes when the desired configuration is known. The slopes should be revetted to protect against erosion

from tide fluctuations, tidal currents, wave action, prop wash, etc. The revetment should be placed as soon as possible after the slopes are excavated.

5.4.1.2 Dredging

As discussed, dredging excavation methods may be needed below water level. This could involve the soils between depths of about 10 and 30 feet. Based on our borings, the soils in this zone are primarily silts. Although the materials are slightly cohesive we believe that they could be excavated using dredging techniques. However, because of their fine-grained nature, sedimentation of these materials will be slow, and drainage of the dredged materials will require relatively long periods of time.

5.4.1.3 Dewatering

Depending on the final design and selected construction methods for the marina perimeter, dewatering of the site will be required. Well points and/or deep wells could be used to achieve proper dewatering. The lowering of the water table will cause compression of the underlying material. Our analyses indicate that ¼ o ½ inch of surface subsidence will occur for each foot the ground water surface is lowered. If the ground water is lowered 15 feet, this will result in about 6 inches of subsidence. Our calculations assume that the site has not been previously dewatered. If the site has been previously dewatered, the anticipated settlement would be less.

The extent of the ground water drawdown away from the excavations will vary depending on the method of dewatering used.

If the site is to be dewatered, supplementary studies to determine the required pump rates and anticipated drawdown should be performed.

5.4.2 Compacted Fill

5.4.2.1 General

The site is underlain by existing hydraulic fill, and some dumped fill. This material is not suitable for foundation support. Retaining walls less than about six feet in height could be supported on spread footings in compacted fill if the existing fill soils to depths of three feet below the footings are excavated and replaced as a compacted fill.

Elsewhere, excavation of the upper soils to a depth of about two feet below the existing grade will be required prior to placing any new fill. After making that excavation, the exposed soils should be carefully observed by competent geotechnical personnel to verify removal of unsuitable material. As discussed, a former dump, referred to as the celery dump, existed on the east portion of the site. The feature was not encountered in the borings. If encountered during grading, special handling of these materials may be necessary.

5.4.2.2 Site Preparation

Where spread footings will be used, the on-site soils should be excavated to a depth at least three feet below footing bottoms and five feet beyond the footings in plan. Elsewhere, where new compacted fill is to be placed, the soils should be excavated to at least two feet below existing grade. Next, the exposed soils should be scarified to a depth of six inches and rolled with heavy compaction equipment. The upper six inches of exposed soils should be compacted to at least 90% of the maximum density obtainable by the ASTM D1557-70 method of compaction. The exposed soils may be wet and soft. In this event, the soils should not be scarified, instead a geotextile and a layer of gravel should be placed to provide a stable working surface for men and equipment.

5.4.2.3 Compaction

After compacting the exposed soils or placing the layer of gravel, the required fill should be placed in loose lifts not more than eight inches in thickness and compacted to at least 90%. It is recommended that the soils be compacted at a moisture content varying no more than 2% below or above optimum moisture content.

5.4.2.4 Material For Fill

The on-site silty sand and sandy silt soils, less any debris or organic matter, may be used in the required fills beneath footings. The on-site clayey silt soils should not be used. Any required imported fill should consist of relatively non-expansive soils.

The Expansion Index of the select soil should be less than 35. The imported material should contain sufficient fines (binder material) so as to result in a stable subgrade.

5.4.2.5 Geotechnical Observation

The excavation of the upper soils and the compaction of all required fill should be observed and tested by our firm. Any imported fill material should be approved for use prior to importing.

5.4.2.6 Subsidence

The settlement due to the placement of the existing fill at the site is complete. If additional fill is placed on the site during development of the marina, there will be additional settlement of the areas receiving fill. We estimate that the areal settlement due to the placement of additional fill will be up to about two inches per foot of fill placed. We estimate that 80% of this settlement will occur within about one year after completion of this fill. The rate of settlement can be effectively increased by placing a surcharge fill. We can develop surcharge criteria if necessary.

5.5 FOUNDATIONS FOR STRUCTURES ADJACENT TO MARINA PERIMETER

It is anticipated that structures may be constructed adjacent to the perimeter of the marina in the future. Major structures adjacent to the perimeter of the marina should be supported on piling.

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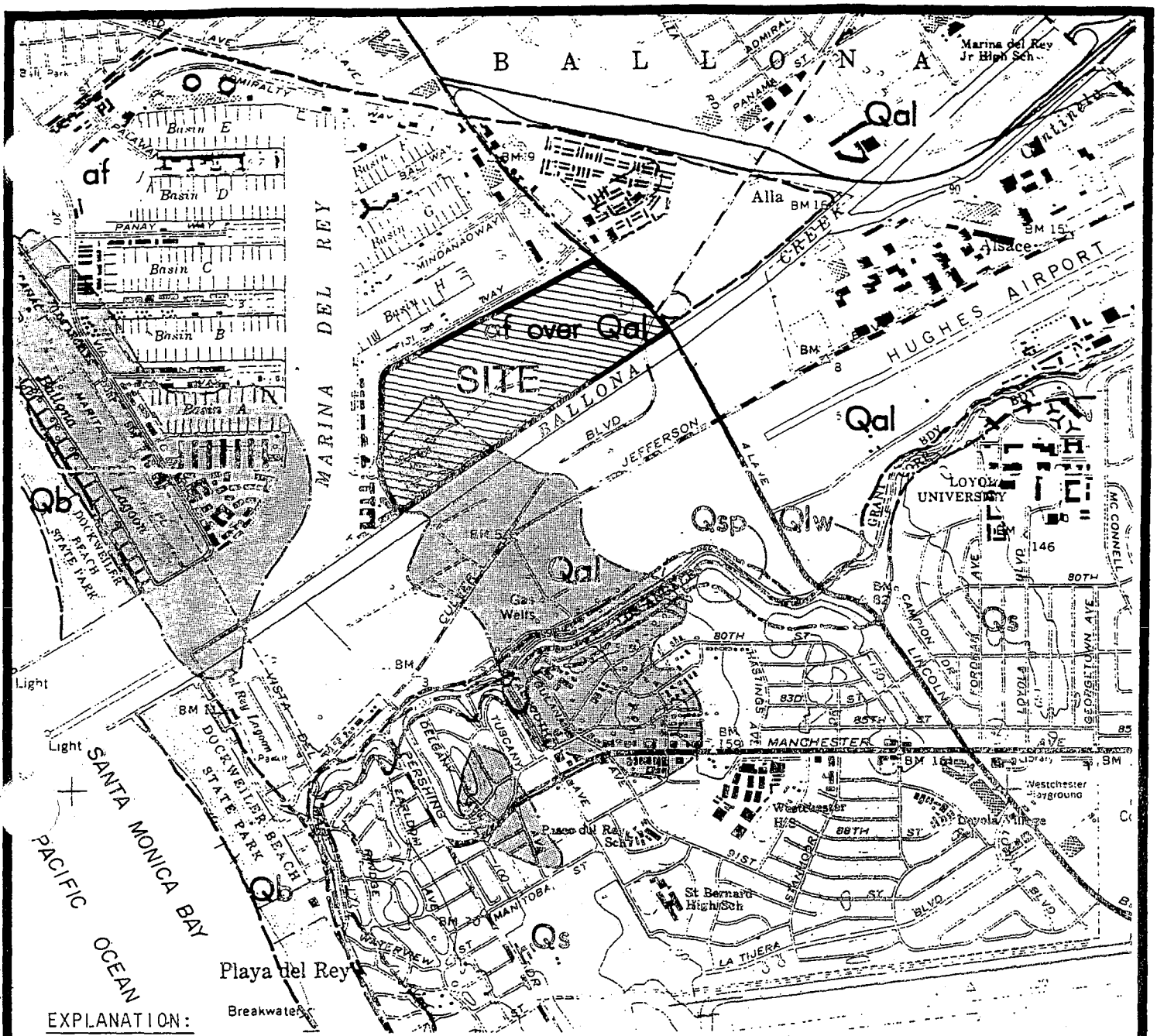
Site plan

Available in original physical file.



EXPLANATION:

af	ARTIFICIAL FILL
Qal	QUATERNARY ALLUVIUM
Qb	QUATERNARY BEACH DEPOSITS
Qs	QUATERNARY DUNE SAND
Qlw	UPPER PLEISTOCENE TERRACE DEPOSITS
Qsp	PREISTOCENE SAND PEDRO FORMATION
	GEOLOGIC CONTACT
	OIL AND GAS FIELD

N

REFERENCE:

BASE MAP FROM U.S.G.S. 7.5' VENICE QUADRANGLE 1964, PHOTOREVISED 1981.

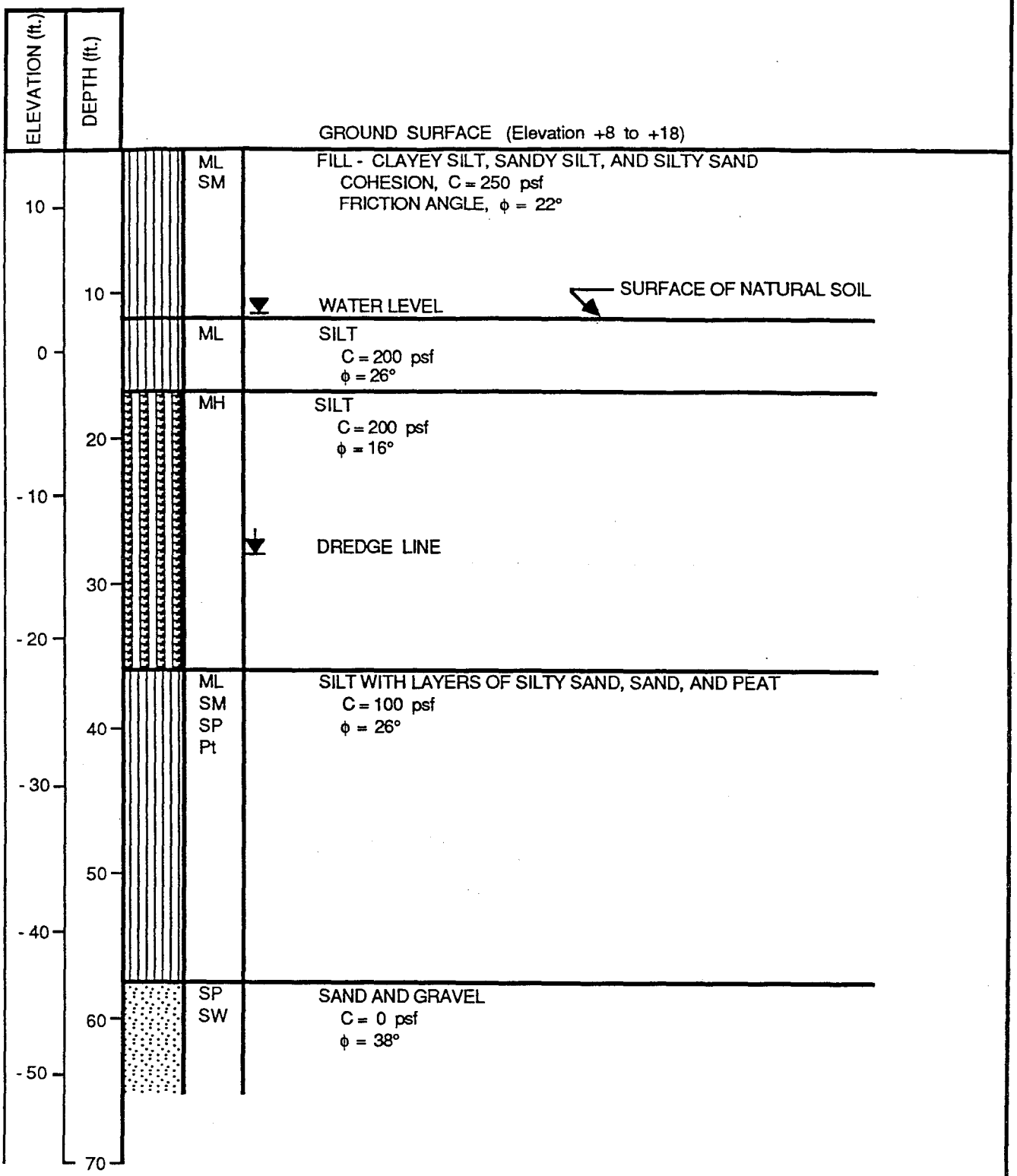
GEOLOGY ADAPTED FROM U.S.G.S. WATER SUPPLY PAPER 1461 (1959), OIL AND GAS FIELDS FROM D.O.G. (1974).

LOCAL GEOLOGY

SCALE 1"= 2000'

LeROY CRANDALL AND ASSOCIATES

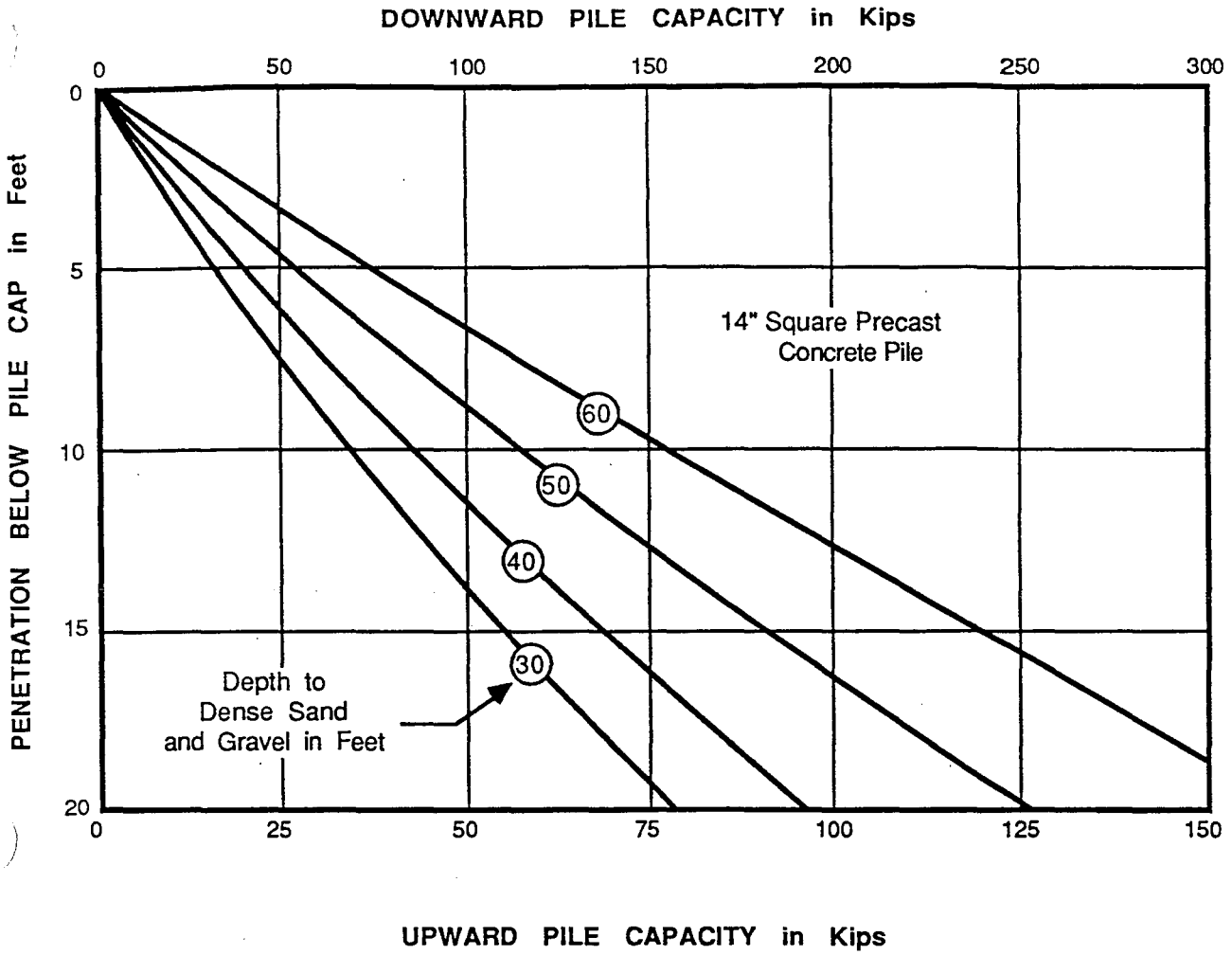
PLATE 2



GENERALIZED SOIL PROFILE

LeROY CRANDALL AND ASSOCIATES

PLATE 3



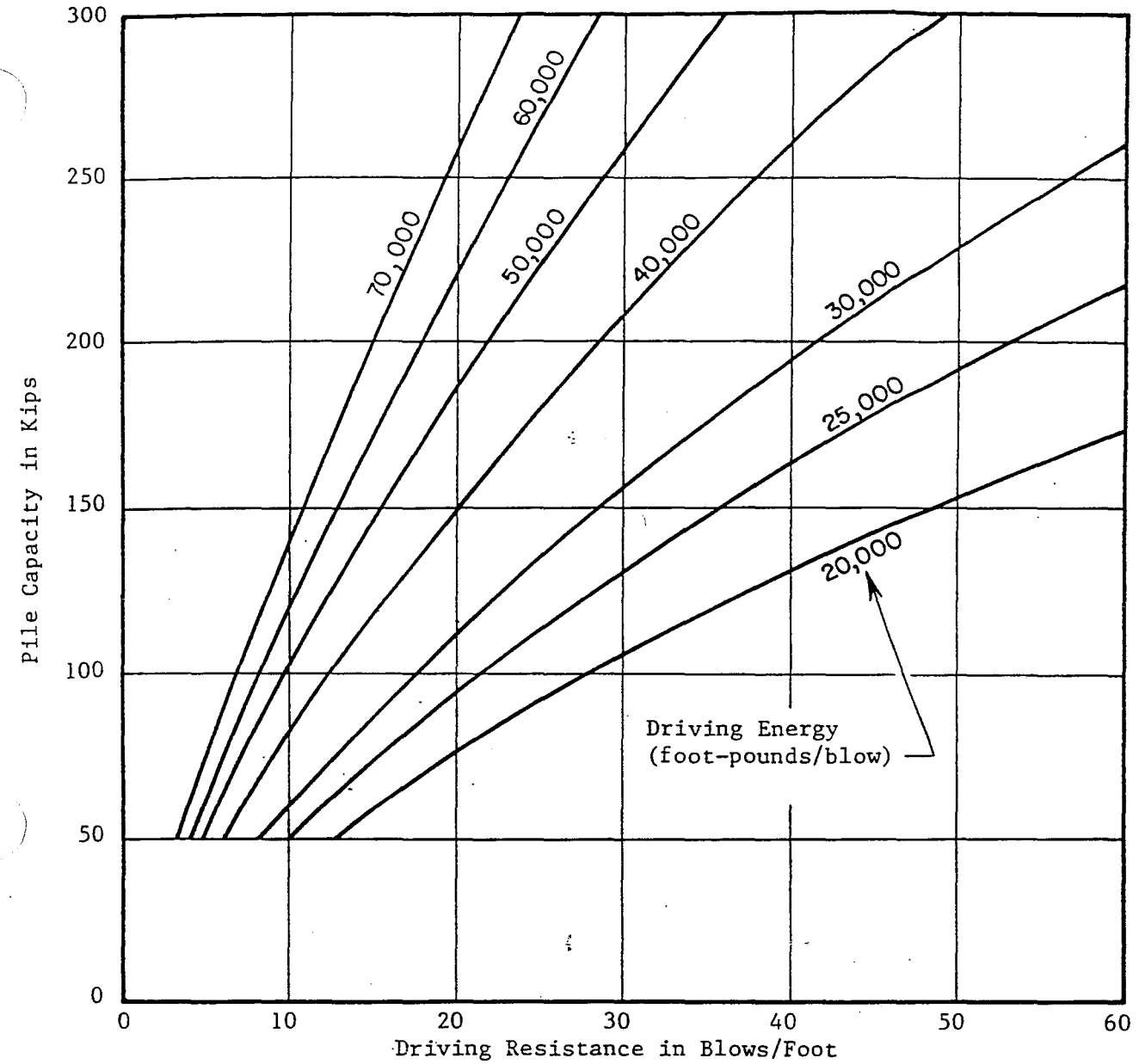
NOTES :

(1) The indicated values refer to the total of dead plus live loads; a one-third increase may be used when considering wind or seismic loads.

(2) Piles in groups should be spaced a minimum of 3 feet on centers.

(3) The indicated values are based on the strength of the soils; the actual pile capacities may be limited to lesser values by the strength of the piles.

DRIVEN PILE CAPACITIES



NOTES:

1) The above driving resistance should be obtained for the last foot of driving at design pile length. If the driving resistance at the design length is less than above, the piles should be lengthened until the desired driving resistance is obtained.

2) As an alternate to lengthening when low driving resistance is obtained, the piles may be allowed to set overnight and the number of blows to drive the pile one inch the following day should be determined. If the restarting resistance is at least two times the above criteria, the pile may be considered satisfactory.

3) If driving resistance of three times the above criteria is encountered within five feet of design length, the pile driving may be stopped.

PILE DRIVING CRITERIA

LeROY CRANDALL AND ASSOCIATES

APPENDIX A
EXPLORATIONS

The soil conditions beneath the site were explored by drilling 20 borings at the locations shown on Plate 1. Five cone penetration tests were performed to supplement the exploration borings. The cone penetration test results are presented in Appendix B.

Borings 1 through 7, 11, 14, and 16 through 20 were drilled to depths of about 60 feet below the existing grade using 5-inch-diameter rotary wash-type drilling equipment with drilling mud to prevent caving. The mud was removed from some of the borings following completion of the drilling to permit measurement of the water level. Borings 8, 9, 19, 12, 13, and 15 were drilled to depths of between 16 and 20 feet below the existing grade using 16- and 18-inch bucket-type drilling equipment. Bucket-type borings were also drilled to depths of between 11½ and 16 feet below the existing grade adjacent to Borings 1, 6, 16, and 18 to provide information on the water levels. Drilling mud or casing was not used to extend the bucket borings to the depths drilled. Caving and squeezing in of the boring walls occurred during drilling as noted on the boring logs.

The soils encountered were logged by our field technician, and undisturbed and loose samples were obtained for laboratory inspection and testing. The logs of the borings are presented on Plates A-1.1 through A-1.20; the depths at which undisturbed samples were obtained are indicated to the left of the boring logs. The energy required to drive the sampler twelve inches is indicated on the logs. Standard penetration tests were performed in selected borings; the results are indicated on the boring logs. The soils are classified in accordance with the Unified Soil Classification System described on Plate A-2.

LABORATORY TESTS

The field moisture content and dry density of the soils encountered were determined by performing tests on the undisturbed samples. The results of the tests are shown to the left of the boring logs.

The liquid limit and plasticity index of selected samples were determined. In order to assess whether or not the soils were organic, the liquid limit test was repeated on some of the samples after they were oven dried. The results of the tests are presented on the boring logs.

Direct shear tests were performed on selected undisturbed samples to determine the strength of the soils. The tests were performed at field and increased moisture contents and at various different surcharge pressures. Tests were also performed on remolded samples compacted to 90%. The yield-point values determined from the direct shear tests are presented on Plates A-3.1 and A-3.2, Direct Shear Test Data.

Confined consolidation tests were performed on 23 undisturbed samples to determine the compressibility of the soils. The samples were tested at field moisture content. The results of the tests are presented on Plates A-4.1 through A-4.12, Consolidation Test Data.

To determine the particle size distribution of the soils and to aid in classification, mechanical and hydrometer analyses were performed on six samples. The results of the analyses are presented on Plates A-5.1 through A-5.3, Particle Size Distribution.

The optimum moisture content and maximum dry density of the soils were determined by performing compaction tests on samples from Borings 8 and 9. The tests were performed in accordance with the ASTM Designation

D1557-70 method of compaction. The results of the tests are presented on Plate A-6, Compaction Test Data.

Permeability tests were performed on ten undisturbed samples to determine the coefficient of permeability of the soils. The samples were tested under confining pressures of between 200 and 1,000 pounds per square foot. The test results are presented on Plate A-7, Permeability Test Data.

Soil corrosivity tests were performed on eleven samples. The tests were performed for us by M.J. Schiff & Associates. The results are presented on Plates A-8.1 through A-8.6.

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BORING 1

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.9*

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SM	FILL - SILTY SAND - fine, brown
							ML	FILL - CLAYEY SILT - dark grey
			17.8	91	9		SM	FILL - SILTY SAND - fine, lenses of Clayey Silt, brownish grey
10	5							
			22.2	101	17			Some seashells
							ML	FILL - SANDY SILT - lenses of Clayey Silt, some seashells, grey
5	10	6						
			41.2	77	1			SURFACE OF NATURAL SOIL
							ML	CLAYEY SILT - some seashells, grey
0	15							
		6						
			47.3	74	3			
-5	20						ML	SANDY SILT - grey
		11						
							MH	CLAYEY SILT - dark grey
-10	25		62.4	60	2			(LL = 68; PI = 21)
		2						
-15	30		79.9	53	2			Organic odor
		3						
-20	35		59.4	65	2			
							ML	CLAYEY SILT - brownish grey
-25	40	18						

* Elevations provided by Psomas & Associates.

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-88413 DATE 1/19/89 F.I. FH DH. Jmh O.E. JC W.P. CHKD

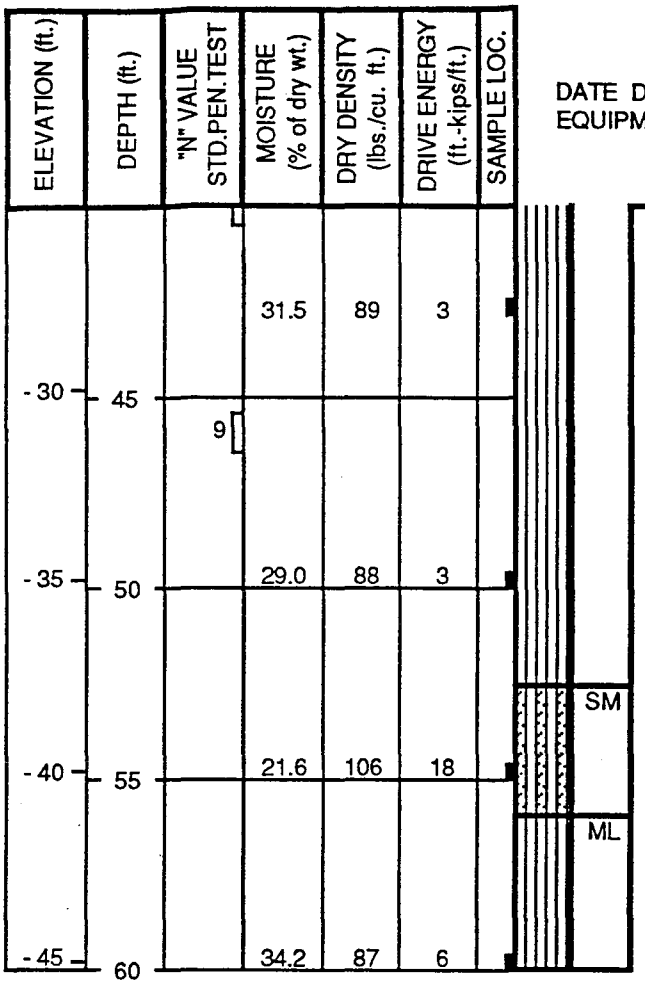
LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.1a

BORING 1 (Continued)

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



Bluish grey

SILTY SAND - fine, bluish grey

CLAYEY SILT - dark grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' south of Rotary Wash Boring to a depth of 11-1/2' on 1/12/89 for water level determination. Water seepage encountered at a depth of 9-1/2'. Caving below 9-1/2' (to 2' in diameter).

Note : The log of subsurface conditions shown hereon ... s only at the specific boring location and at the date indicated. It is not warranted to be representative of subsu... conditions at other locations and times.

JOB ...E-8... DATE ...19/8... F... FH Dr... dmh O.E. JC W.P. ...mh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.1b

BORING 2

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	5		37.8	80	2		ML	FILL - SANDY SILT - some seashells, brown
								Large amount of seashells, greyish brown
			12.9	93	4		SM	FILL - SILTY SAND - fine, light brown
			59.3	66	1			Layers of Sandy Silt, some seashells, dark grey
5	10		26.6	99	4			Grey
			43.6	76	<1		ML	FILL - CLAYEY SILT - grey (LL = 43; PI = 10; oven dry LL = 39)
0	15		34.0	88	3		ML	SURFACE OF NATURAL SOIL SANDY SILT - slightly Clayey, brown and grey
								Some seashells
-5	20							Large amount of seashells
							MH	CLAYEY SILT - organic odor, grey
-10	25		77.9	55	1			
								Dark grey
-15	30		48.4	71	2			
-20	35		54.3	69	2			
							ML	CLAYEY SILT - dark grey
-25	40		35.4	85	4			(LL = 39; PI = 5)

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon s only at the specific boring location and at the date indicated. It is not warranted to be representative of subsu...e conditions at other locations and times.

JOB ...E-88-... DATE ...1/19/89 F.I. BG Dft. dmh O.E. JG W.P. ... CHKD ...

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.2a

BORING 2 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30	45		33.8	86	4	
-35	50		52.3	65	3	
-40	55		19.1	111	18	
-45	60		19.5	104	54	

Layer of Peat

Traces of Peat

SANDY SILT - bluish grey

SILTY SAND - fine, some Gravel, traces of Peat, bluish grey

SAND - fine to medium, few Gravel and Cobbles, greyish brown

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 35' at completion of drilling. Water level measured at 7' after removal of mud. Boring grouted with cement-bentonite mixture.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB .E-85... DATE 11/9/89 F.I. BG Dft. dmh O.E. JC W.P. CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.2b

BORING 3

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 13.4

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	5		4.3	93	5		SM	FILL - SILTY SAND - fine, light brown
			16.0	90	2		ML	FILL - CLAYEY SILT - brownish grey
5							SM	FILL - SILTY SAND - fine, light brown
	10		45.8	76	<1		ML	FILL - CLAYEY SILT - dark grey
0		6					ML	SURFACE OF NATURAL SOIL SANDY SILT - grey
	15		54.0	71	1			Layer of Clayey Silt with seashells
-5		5					ML	CLAYEY SILT - greyish brown
	20						ML	SANDY SILT - some seashells, dark grey
			37.6	83	2			
-10							MH	CLAYEY SILT - organic odor, dark grey
	25	2						
			77.5	53	1			
-15	30	4						
-20			50.2	73	1			
	35							Layer of Silty Sand
		9					ML	CLAYEY SILT - dark grey
-25	40		32.8	90	2			

Note : The log of subsurface conditions shown hereon s only at the specific boring location and at the date indicated.
It is not warranted to be representative of subs. conditions at other locations and times.

JOB E-8 ATE 19/8 F. FH DI dmh O.E. C.P. 1 IKD

(CONTINUED ON FOLLOWING PLATE)

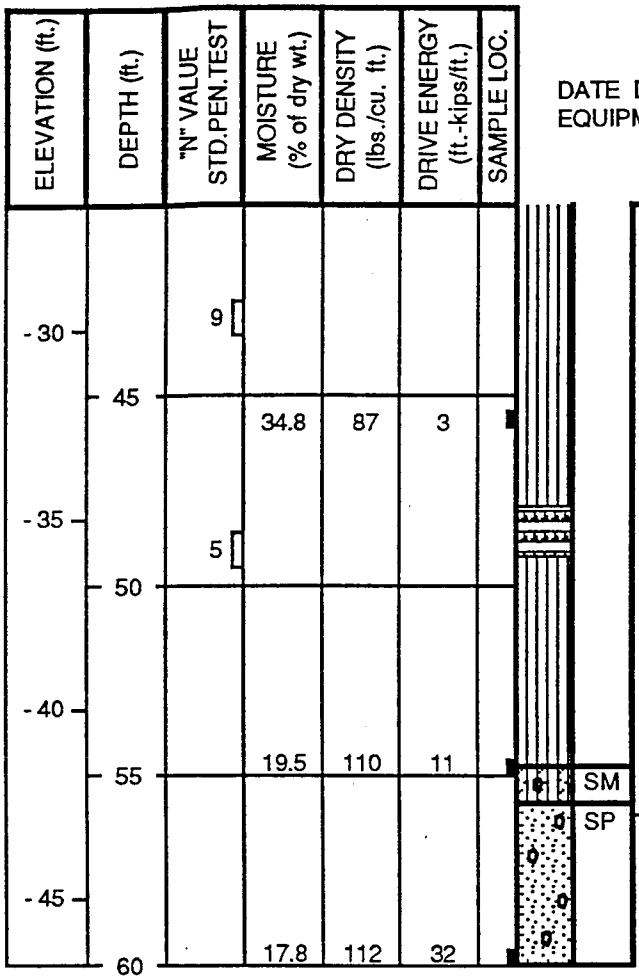
LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.3a

BORING 3 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



Layer of Peat

SILTY SAND - fine to medium, some Gravel, traces of Peat, grey

SAND - medium to coarse, about 15% Gravel, light grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB ...E-86-... DATE .../19/89 F... FH... DH. Jmh O.E. JK W.P. ... DRKD ...

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.3b

BORING 4

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			14.4	91	3		SM	FILL - SILTY SAND - fine, lenses of Clayey Silt, brown and grey
	5		35.3	84	1		MH	FILL - CLAYEY SILT - dark grey
5			63.0	63	<1			Some rootlets
	10		39.5	82	<1		ML	FILL - CLAYEY SILT - brown
0								SURFACE OF NATURAL SOIL
			33.6	88	4		ML	CLAYEY SILT - lenses of Sandy Silt, light grey
	15		37.6	84	<1		SM	SILTY SAND - fine, light brown
-5								Grey
	20		37.9	84	1			
-10							OH	CLAYEY SILT - some seashells, organic odor, dark grey
	25		85.8	49	1			(LL = 109; PI = 30; oven dry LL = 68)
-15								
	30		46.5	71	1			About 20% seashells, brownish grey
-20							ML	CLAYEY SILT - some seashells, bluish grey
	35		23.5	104	3			
-25								
	40		35.5	88	3			Dark grey

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon only at the specific boring location and at the date indicated. It is not warranted to be representative of subsu... conditions at other locations and times.

JOB ...E-88... DATE ...9/89 F... FH Df... Jmh O.E. ... ...P. ... ...KD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.4a

BORING 4 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30						
	45		81.3	49	3	
-35						
	50		22.7	104	5	
-40						
	55		12.5	129	40	
-45						
	60		8.2	137	50	

Traces of Peat

PT — PEAT - brown

ML — CLAYEY SILT - traces of Peat, dark grey

SP — SAND - fine to coarse, about 30% Gravel and Cobbles, grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB ...E-8... DATE ...19/8... F... FH Di... Jmh O.E. ... P. 1 ...IKD ...

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.4b

BORING 5

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 10.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10							ML	FILL - SANDY SILT - lenses of Clayey Silt, greyish brown and dark grey
			48.7	73	1			
	5						SM	FILL - SILTY SAND - fine, light brown
5			57.5	66	<1		MH	FILL - CLAYEY SILT - dark grey (LL = 50; PI = 13)
								SURFACE OF NATURAL SOIL
	10		36.8	84	4		ML	CLAYEY SILT - traces of organic matter, dark grey
0		5						Some Sand
	15							
-5			37.8	84	1		SM	SILTY SAND - fine, brownish grey
	20						MH	CLAYEY SILT - organic odor, bluish grey
-10		1						Few shells
	25		56.6	66	1			(LL = 68; PI = 24)
-15		14					ML	CLAYEY SILT - dark grey
	30							
-20			25.1	101	5			Lenses of Sandy Silt
	35							
-25		24					SP	SAND - fine to coarse, few Gravel, bluish grey
	40						ML	CLAYEY SILT - bluish grey

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB ...AE-... ...ATE... 1/20... F... BG... Df... lmh... O.E.... ...P.... I... ...KD...

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.5a

BORING 5 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30			29.2	89	6	
	45	8				
-35			17.7	114	54	
	50	53				
-40						
	55		9.4	128	39	
-45						
	60					
-50						
	65					

Traces of Peat

SP

SAND - fine to coarse, some Silt, some Gravel and Cobbles, grey

Large amount of Gravel and Cobbles

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-8[illegible] DATE 1/20[illegible] F[illegible] BG Dft. mh O.E. [illegible] T.P. [illegible] C.KD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.5b

BORING 6

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 8.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			39.6	83	2		ML	FILL - CLAYEY SILT - lenses of Sandy Silt, dark grey
	5		53.7	70	< 1			
0			50.7	70	< 1			
	10		42.2	80	< 1			SURFACE OF NATURAL SOIL
							ML	CLAYEY SILT - grey
							ML	SANDY SILT - brownish grey
-5			52.2	69	1		MH	CLAYEY SILT - some seashells, bluish grey
	15		70.5	57	< 1			Dark grey
-10								
	20		70.4	57	< 1			
							ML	SANDY SILT - layers of Clayey Silt, bluish grey
-15								
	25		23.5	103	2			
-20								
	30		20.9	107	2			
-25							SM	SILTY SAND - fine, bluish grey
	35		16.5	114	11		ML	SANDY SILT - bluish grey
-30							PT	PEAT - brown to dark brown
	40		59.7	64	2		ML	CLAYEY SILT - large amount of Peat, dark brown

Note : The log of subsurface conditions shown hereon s only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

JOB AE-6047.3 DATE 1/20/89 F.I. FH DR. JMH O.E. JC W.P. SMJ CH.KD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.6a

BORING 6 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-35	45		20.2	108	14	SM
-40	50		11.3	126	32	SP
-45	55		10.0	130	36	SW
-50	60					

SILTY SAND - fine to medium, bluish grey

SAND - fine, grey

SAND - well graded, about 20% Gravel, grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' south of Rotary Wash Boring to a depth of 12-1/2' on 1/12/89 for water level determination. Water seepage encountered at a depth of 11'. Hole squeezing in below 11'.

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-[illegible] DATE 1/20/[illegible] F.[illegible] FI[illegible] DH. dmh O.E. JC W.P. [illegible] CHKD [illegible]

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.6b

BORING 7

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
10			20.3	96	6		ML FILL - SANDY SILT - brown
			29.0	88	2		Lenses of Clayey Silt Some seashells, brown and grey
	5		37.6	86	1		
5			46.5	76	1		ML FILL - CLAYEY SILT - some Sand, light grey Large amount of seashells
	10		31.9	83	1		Brownish grey
0							SURFACE OF NATURAL SOIL
			35.0	87	4		ML CLAYEY SILT - lenses of Sandy Silt, light grey
	15		32.6	87	1		
-5							
	20		80.1	53	1		MH CLAYEY SILT - some organic matter, light grey
-10							
	25		78.0	54	2		
-15							
	30		36.6	84	2		Bluish grey
-20							
	35		46.6	72	2		
-25							
	40		33.6	88	7		

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.7a

BORING 7 (Continued)

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-30								
	45		36.8	81	5			(LL = 56; PI = 23)
-35								
	50		23.8	103	10		ML	SANDY SILT - few seashells, bluish grey
-40								
	55		26.6	96	6		ML	Black CLAYEY SILT - grey
-45								
	60		22.5	102	40		SP	SAND - fine to medium, grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 60' at completion of drilling. Water level measured at 7' after removal of mud. Boring grouted with cement-bentonite mixture.

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-8[illegible] DATE 1/20[illegible] F.[illegible] BG DR. mh O.E. JV W.P. [illegible] CHKD BK

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.7b

BORING 8

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 12.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
10	5		24.8	92	<1		ML FILL - SANDY SILT - brownish grey Some lumps of Clayey Silt
5	10		33.8	89	<1		ML FILL - CLAYEY SILT - grey (LL = 37; PI = 8)
			57.4	70	<1		MH FILL - CLAYEY SILT - bluish grey Brownish grey
0	15		48.1	73	<1		SURFACE OF NATURAL SOIL ML CLAYEY SILT - light brown
-5	20		35.8	86	<1		

NOTE: Water seepage encountered at 13'. Water level measured at 15' at completion of drilling and at 13' 20 minutes later. Caving below 13'.

Note : The log of subsurface conditions shown hereon only at the specific boring location and at the date indicated. It is not warranted to be representative of subsu conditions at other locations and times.

JOB AE-8 DATE 1/20/ F.I. TC Dr. mh O.E. W.P. CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.8

BORING 9

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 12.0

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
10	0		19.2	96	<1		SM FILL - SILTY SAND - fine, light brown
							ML FILL - SANDY SILT - greyish brown
			41.6	82	<1		ML FILL - CLAYEY SILT - dark grey
5	5		64.0	62	<1		MH FILL - CLAYEY SILT - dark grey
0	10		47.9	72	<1		
			55.6	68	<1		SURFACE OF NATURAL SOIL ML CLAYEY SILT - some Sand, some cemented nodules, dark brown
-5	15						
	20						

NOTE: Water seepage encountered at 13-1/2'. Water level measured at 13' 20 minutes after completion of drilling. Caving below 12'. Hole squeezed in below 14' after drilling to 17'.

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-E... DATE 1/20/... F... TC DF... mh O.E. ... P. ... KD ...

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.9

BORING 10

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 10.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			32.9	89	<1		ML	FILL - SANDY SILT - brown
							MH	FILL - CLAYEY SILT - bluish grey and brown
			62.5	61	<1			Some organic matter
5	5		83.5	53	<1			Lenses of Sandy Silt
							ML	FILL - CLAYEY SILT - brownish grey
			32.7	86	<1			▼ SURFACE OF NATURAL SOIL
0	10		35.0	88	<1		ML	SANDY SILT - brownish grey
-5	15		37.4	87	<1		ML	CLAYEY SILT - bluish grey
	20							

NOTE: Water seepage encountered at a depth of 11'. Caving below 11'. Hole squeezed in below 12-1/2' after drilling to 16'.

s only at the specific boring location and at the date indicated.
conditions at other locations and times.

Note : The log of subsurface conditions shown hereor
It is not warranted to be representative of subsu...e

JOB AE-8... DATE 1/20... F... TC Dr.. Jmh O.E. ... ...P. ... ...KD ...

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.10

BORING 11

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 10.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10							ML	FILL - CLAYEY SILT - greyish brown
			14.2	94	4		SM	FILL - SILTY SAND - fine, greyish brown
5	5						ML	FILL - CLAYEY SILT - some organic matter, brown
			39.6	83	4		ML	FILL - SANDY SILT - light grey
			41.7	83	2			▼ SURFACE OF NATURAL SOIL
0	10						MH	CLAYEY SILT - traces of organic matter, light greyish brown
		3						Greyish brown
-5	15		48.1	74	<1			Some seashells, organic odor, grey
		0						Bluish grey
-10	20		77.6	52	<1			
		5						
-15	25		19.1	109	1			Some Sand, dark grey
-20	30						SP SM	SAND - fine to coarse, some Silt, about 10% Gravel, dark grey
		33						
			25.7	99	7		ML	SANDY SILT - bluish grey
-25	35							
		14					MH	CLAYEY SILT - bluish grey
	40		46.5	75	2			(LL = 67; PI = 32; oven dry LL = 62)

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.11a

BORING 11 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-30								Traces of Peat
		11						
-35	45		26.6	97	7			Some Sand
							SP	SAND - fine to medium, grey
		58					SW	SAND - well graded, about 30% Gravel, grey
-40	50							
			7.6	119	36			
-45	55							
							SP	SAND - fine to medium, some Gravel, light grey
	60		21.9	105	28			

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-[illegible] DATE 1/20[illegible] F[illegible] FH Dr[illegible] Jmh O.E. [illegible] ...P. [illegible] ...KD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.11b

BORING 12

DATE DRILLED: January 12, 1989
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 13.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
10			20.1	85	2		ML — FILL - CLAYEY SILT - layers of Sandy Silt, light brown and brown
			30.3	83	< 1		Some organic matter ML — FILL - SANDY SILT - layers of Clayey Silt, brown and dark grey
5	5		22.7	91	< 1		
			27.7	87	< 1		
5							MH — FILL - CLAYEY SILT - dark grey
	10		45.6	75	< 1		
0							SURFACE OF NATURAL SOIL MH — CLAYEY SILT - some Sand, few seashells, brownish grey
	15		53.4	69	< 1		
- 5							
	20		40.2	81	< 1		Bluish grey

NOTE: Water seepage encountered at a depth of 13'. Water level measured at 16' 10 minutes after completion of drilling. Caving below 13' (to 2' in diameter).

Note : The log of subsurface conditions shown hereon s only at the specific boring location and at the date indicated. It is not warranted to be representative of subsu...e conditions at other locations and times.

IOB AE-... DATE 1/20... F... FH Dr... Jmh O.E. ... P. ... KD ...

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.12

BORING 13

DATE DRILLED: January 12, 1989
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 11.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0		39.4	83	< 1		ML	FILL - SANDY SILT - light brown
							ML	FILL - CLAYEY SILT - bluish grey
			21.3	83	< 1		ML	FILL - SANDY SILT - light brown
	5						MH	FILL - CLAYEY SILT - bluish grey
5			62.5	65	< 1			Layers of Silty Sand and Sandy Silt, grey and dark grey
			35.8	87	< 1			
	10							
0			34.0	87	< 1			SURFACE OF NATURAL SOIL
							ML	CLAYEY SILT - some organic matter, bluish grey
	15		30.5	92	1			Brownish grey
-5							MH	CLAYEY SILT - bluish grey
	20							

NOTE: Water seepage encountered at a depth of 12'. Water level measured at 14-1/2' 10 minutes after completion of drilling. Caving below 12' (to 2' in diameter).

Note : The log of subsurface conditions shown hereon
s only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsu
conditions at other locations and times.

JOB AE-bu+3 DATE 1/20.. F.. Fh. DI.. Jmh O.E. .. ..P. .. ..KD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.13

BORING 14

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 11.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0		19.9	92	5		ML	FILL - CLAYEY SILT - some rootlets, brownish grey
			24.3	86	5			Light brown
5	5		25.6	91	3		ML	FILL - SANDY SILT - greyish brown
								Some organic matter
	10		51.6	70	2			Dark brown to black, organic odor, some seashells
0			47.8	78	3		ML	SURFACE OF NATURAL SOIL CLAYEY SILT - light grey
	15						ML	SILT - brownish grey
-5			37.9	83	3		MH	CLAYEY SILT - few seashells, organic odor, bluish grey
	20		64.6	67	1			
-10								
	25		43.5	74	1			Lenses of Sandy Silt, light grey Dark grey
-15								
			32.8	91	1		ML	CLAYEY SILT - some Peat, dark grey (LL = 38; PI = 11)
	30							
-20			27.1	96	1			
	35							
-25			23.8	99	5			
	40							

Note : The log of subsurface conditions shown hereon ; only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsu... conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.14a

BORING 14 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
-30			45.4	76	3		Bluish grey
	45		29.1	93	5		Dark grey
-35			35.9	84	4		
	50						
-40			80.2	52	4		Layers of Peat, dark brownish grey and brown
	55						
-45			89.6	45	4		
	60						
-50			31.1	93	7		Dark grey
	65						

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-[illegible] DATE 1/20[illegible] F... BG ... Jmh O.E. [illegible] ...P. [illegible] KD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.14b

BORING 15

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 10.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
10							ML FILL - SANDY SILT - greyish brown
			24.2	92	2		
			30.9	81	<1		Lenses of Clayey Silt
	5						ML FILL - CLAYEY SILT - greyish brown
5							Some organic matter
			40.0	80	<1		Layer of Silty Sand
			44.2	79	<1		SURFACE OF NATURAL SOIL
							ML SANDY SILT - grey
	10						
0			51.9	69	<1		MH CLAYEY SILT - light grey
							(LL = 59; PI = 20)
	15						
-5			43.9	79	<1		Brownish grey
	20						

NOTE: Water seepage encountered at a depth of 12'. Water level measured at 12-1/2' 10 minutes after completion of drilling. Caving below 12'. Hole squeezed in below 13-1/2' after drilling to 16'.

Note : The log of subsurface conditions shown hereon only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-E DATE 1/20/ F.1 TC DF mh O.E. P. KD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.15

BORING 16

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 11.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			43.6	73	1		ML	FILL - CLAYEY SILT - brownish grey
			18.4	95	5		ML	FILL - SANDY SILT - light brown
	5							
5			21.4	84	1		ML	FILL - CLAYEY SILT - brown
			18.5	110	7		ML	FILL - SANDY SILT - few Gravel, brownish grey
	10							
0			48.5	71	2		MH	SURFACE OF NATURAL SOIL CLAYEY SILT - some Sand, traces of organic matter, dark grey
	15							
-5		3						Brownish grey
	20		71.7	56	2			Few seashells, organic odor, bluish grey
-10		4						Dark grey
	25							Layer of Sandy Silt, traces of Peat, dark greyish brown
-15			26.9	97	3			
	30							
-20		23						
	35		42.8	77	2			Traces of Peat
-25		15					ML	CLAYEY SILT - bluish grey
	40							

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon : only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsu conditions at other locations and times.

IOB AE-8 ...TE 1/20/.. F.1. BC DF. .mh O.E. .. ...P. ...XD

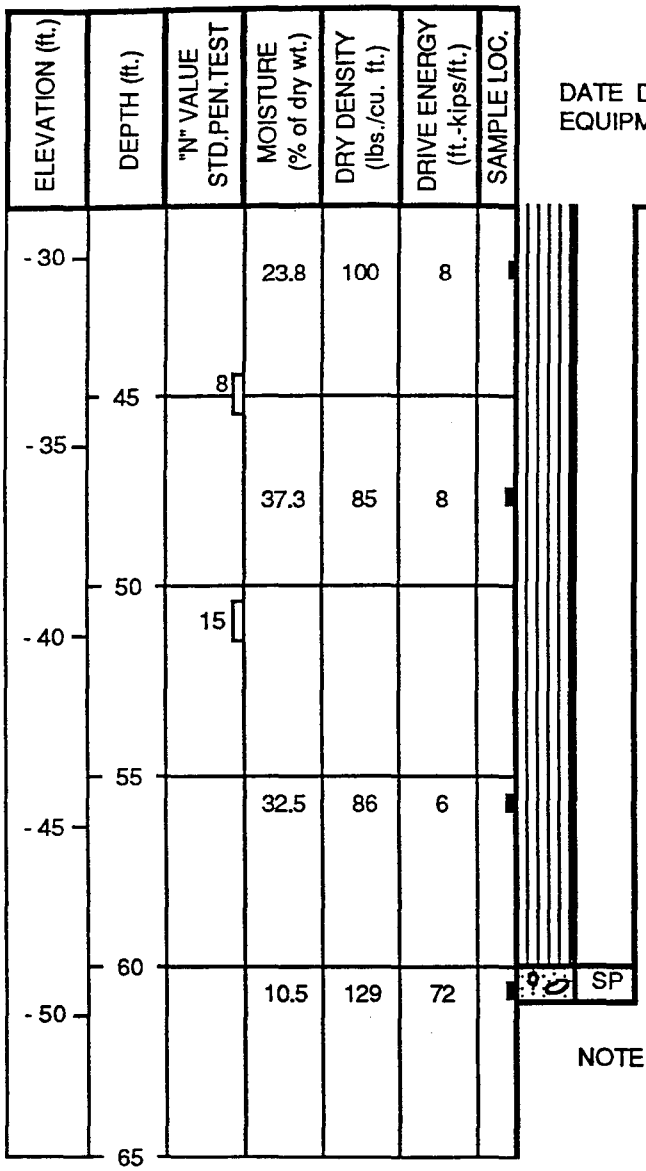
LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.16a

BORING 16 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



Some Sand

Dark grey

Traces of Peat

SAND - fine to coarse, some Gravel and Cobbles, light grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' east of Rotary Wash Boring to a depth of 13' on 1/12/89 for water level determination. Water seepage encountered at a depth of 11-1/2'. No caving.

Note : The log of subsurface conditions shown hereon , only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-88473 DATE 1/20/89 F.I. BG DR. dmh O.E. JC W.P. CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.16b

BORING 17

DATE DRILLED: December 30, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 18.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
15	5		19.3	110	14		CL	FILL - SANDY CLAY - reddish brown
			14.5	114	13			Lenses of Silty Sand, some organic matter, brown and light grey
10	10		15.3	115	5			Lenses of Clayey Silt, pieces of brick, reddish brown and brown
			20.6	107	4		ML	FILL - SANDY SILT - grey
5	15		27.0	96	7			
			35.0	86	2			
0	20		11.8	117	13		SM	FILL - SILTY SAND - fine, some vegetation, hydrocarbon odor, traces of hydrocarbon, dark brown to black
								SURFACE OF NATURAL SOIL
							MH	CLAYEY SILT - brownish grey
-5	25	6	63.8	60	3			Large amount of seashells, organic odor, grey
-10	30	3						
-15	35		28.1	94	18		SM	SILTY SAND - fine, grey
-20	40	18	46.8	77	3		MH	CLAYEY SILT - some seashells, grey

Note : The log of subsurface conditions shown hereon is only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-884/3 DATE 1/20/89 F.I. BG DR. umh O.E. JC W.P. UHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.17a

BORING 17 (Continued)

DATE DRILLED: December 30, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
		8						Bluish grey
-25							SM	SILTY SAND - fine, grey
	45		23.7	94	45			
		10					ML	CLAYEY SILT - some seashells, bluish grey
-30								
	50							
			19.9	109	16			Some Sand
-35							ML	SANDY SILT - slightly Clayey, grey
			20.6	109	5			
	55							
			27.6	94	5		ML	CLAYEY SILT - some cemented lumps, bluish grey
-40								
	60		33.4	90	5			

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 40' at completion of drilling. Water level measured at 15-1/2' 4 days after removal of mud. Boring grouted with sand and cement slurry.

Note : The log of subsurface conditions shown hereon i
It is not warranted to be representative of subsu
only at the specific boring location and at the date indicated.
conditions at other locations and times.

JOB ...E-8... DATE .../20/... F.T. ...G DR. ...nh D.E. ... ? ... D ...

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.17b

BORING 18

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0		35.4	87	2		ML	FILL - SANDY SILT - greyish brown Lenses of Clayey Silt
	5		9.0	88	1		ML	FILL - CLAYEY SILT - bluish grey
5			59.1	62	< 1			Dark grey (LL = 45; PI = 14)
	10		38.0	84	< 1			Brownish grey
0								SURFACE OF NATURAL SOIL
			56.1	66	< 1		MH	CLAYEY SILT - greyish brown
	15		38.6	84	1		ML	SANDY SILT - lenses of Clayey Silt, brown and grey
-5							MH	CLAYEY SILT - some seashells, organic odor, grey
	20		46.8	74	1			
-10								
	25		74.6	53	< 1			Brownish grey
-15								Some Sand, dark grey
	30		32.1	90	1			No Sand, bluish grey
-20								
	35		51.0	68	< 1			
-25							ML	CLAYEY SILT - bluish grey
	40		22.8	104	6			

Note : The log of subsurface conditions shown hereon only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-8[illegible] DATE 1/20/8[illegible] F.T. FH DR. smh D.E. gv W.P. [illegible] SHD Bk

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.18a

BORING 18 (Continued)

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-30							SM	SILTY SAND - fine, grey
	45		22.9	88	5		ML	CLAYEY SILT - dark grey
-35								
	50		39.4	78	3			
-40								
	55		32.0	92	2			
-45								
	60		42.6	78	2			

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' east of Rotary Wash Boring to a depth of 16' on 1/12/89 for water level determination. Water seepage encountered at a depth of 11'. Caving below 11' (to 2' in diameter).

Note : The log of subsurface conditions shown hereon only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-8[illegible] DATE 1/20/[illegible] F.I. FH DR. mh O.E. [illegible] W.P. [illegible] CKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.18b

BORING 19

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			22.1	92	6		SM	FILL - SILTY SAND - fine, lenses of Clayey Silt, brown and grey Large amount of seashells
			5.0	102	11			Light brown
10	5						ML	FILL - SANDY SILT - lenses of Clayey Silt, some seashells, grey and brown
			29.5	92	8			
5	10		43.4	81	2		ML	FILL - CLAYEY SILT - greyish brown
			43.4	76	1			Some Sand, some vegetation, grey and black
0	15		40.4	80	1			▼ SURFACE OF NATURAL SOIL
							MH	CLAYEY SILT - brownish grey
-5	20	3						
			42.1	77	1			Few seashells, organic odor, dark grey
-10	25							
		1						
-15	30						SM	SILTY SAND - fine, few seashells, organic odor, dark grey
			26.5	98	12		MH	CLAYEY SILT - brownish grey
-20	35	1						
			58.6	62	2			Few seashells
-25	40							

Note : The log of subsurface conditions shown hereon only at the specific boring location and at the date indicated. It is not warranted to be representative of subsu conditions at other locations and times.

JOB AE-1 DATE 1/20 F: BG Dr: lmh O.E. P. KD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.19a

BORING 19 (Continued)

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30	45	4	46.6	73	2	
-35	50	4	47.6	76	6	
		25				
-40	55		11.0	122	27	
-45	60		9.0	120	24	
-50	65					

Lenses of Silty Sand, traces of Peat, dark grey

SP GRAVELLY SAND - fine to coarse, about 40% Gravel and Cobbles, lenses of Sandy Silt, traces of Peat, black

GW GRAVEL - well graded, some Sand, few Cobbles, black

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon only at the specific boring location and at the date indicated. It is not warranted to be representative of subsu conditions at other locations and times.

JOB AE-[illegible] DATE 1/20[illegible] F[illegible] BC Dft. Jmh O.E. [illegible] T.P. [illegible] KD [illegible]

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.19b

BORING 20

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0						ML	FILL - SANDY SILT - light brown
			29.2	94	7			
5	5						ML	FILL - CLAYEY SILT - brownish grey
			24.0	96	3		ML	FILL - SANDY SILT - lenses of Clayey Silt, grey and brown
	10		41.1	80	1		ML	SURFACE OF NATURAL SOIL SANDY SILT - some organic matter, dark grey
0		5						
	15		32.8	90	4			Brownish grey
-5		0					MH	CLAYEY SILT - some seashells, organic odor, brown and dark grey
	20		48.7	72	<1			Dark grey
-10		0						
	25		57.4	64	<1			
-15	30	0						
-20			54.4	68	1			Grey
	35	8						
-25			20.7	109	8		SM	SILTY SAND - fine, dark grey
	40							

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon only at the specific boring location and at the date indicated. It is not warranted to be representative of subsu... conditions at other locations and times.

JOB ... DATE ... 1/20... F... Fi... DI... Jmh O.E. ... V.P. ... ...IKD ...

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.20a

BORING 20 (Continued)

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30	45	18				
			31.8	90	4	ML
-35		8				
	50					
-40						
	55		35.1	85	3	
-45						
	60		33.1	83	2	

Layers of Clayey Silt

CLAYEY SILT - lenses of Silty Sand, dark grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-[illegible] DATE 1/20[illegible] F[illegible] Fh DI[illegible] Jmh O.E. [illegible] W.P. [illegible] WKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.20b

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of material is LARGER than No. 200 sieve size)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size)	CLEAN GRAVELS (Little or no fines)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amt. of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 sieve size)	CLEAN SANDS (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amt. of fines)	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (More than 50% of material is SMALLER than No. 200 sieve size)	SILTS AND CLAYS (Liquid limit LESS than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils.

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

PARTICLE SIZE LIMITS

SILT OR CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

NO. 200 NO. 40 NO. 10 NO. 4 3/4 in. 3 in. (12 in.)

U. S. STANDARD SIEVE SIZE

UNIFIED SOIL CLASSIFICATION SYSTEM

Reference :
The Unified Soil Classification System, Corps of Engineers, U. S. Army Technical Memorandum No. 3-357, Vol. I, March, 1953. (Revised April, 1960)

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PLATE A-2