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EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS

BORINGS • TESTS • ANALYSES

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12 January 1984

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Modjeski and Masters
Consulting Engineers
John Hancock Building
1055 St. Charles Avenue
New Orleans, Louisiana 70113

Attention Mr. Barney Martin

Gentlemen:

Piezometric Data - Test Section
Sewerage and Water Board of New Orleans
Metairie Relief Canal
Station 617+50 to Station 663+00
Orleans and Jefferson Parishes, Louisiana

This report contains piezometric data obtained before, during and after excavation of a test section in the Metairie Relief Canal located in Orleans and Jefferson Parishes, Louisiana. Verbal authorization to obtain piezometric data was received from Mr. Barney Martin of Modjeski and Masters, Consulting Engineers for the project. Excavation of a test section was recommended by Eustis Engineering Company to assist the Sewerage and Water Board in obtaining a permit from the Corps of Engineers for the planned improvements to the Metairie Relief Canal between Station 617+50 and Station 663+00.

The purpose of a test section is to develop more definitive information regarding the potential for a blow-out at the

landside toe of the levee during high water conditions in the canal. Subsoil information indicated that an underlying sand stratum may be uncovered by the planned improvement along the subject reach allowing the possible development of excessive hydrostatic pressure. To obtain this information, excavation of a test section was recommended to the proposed design grades in order to observe changes in hydrostatic pressures on the landside of the levee. The recommended location of a test section is shown on Enclosure 1 and a typical cross-section is shown on Enclosure 2.

Six (6) piezometers were installed on the Jefferson Parish side of the canal at the locations shown on Enclosure 1 to closely monitor changes in the hydrostatic pressures before, during and after completion of the excavation. All of the piezometers were installed in accordance with the diagram shown on Enclosure 3. The ground surface elevation and the elevation of the bottom of each screen is shown in the following tabulation.

| No. | Station | Offset | Elevations - Cairo Datum | |
|-----|---------|---------------------|--------------------------|------------------|
| | | | Ground Surface | Bottom of Screen |
| P-1 | 642+77 | C of Levee | 32.41 | 7.91 |
| P-2 | 642+69 | Toe of Levee | 20.96 | 7.96 |
| P-3 | 642+91 | Toe of Levee | 20.31 | 8.81 |
| P-4 | 642+61 | 50' from Levee Toe | 18.54 | 8.04 |
| P-5 | 642+91 | 50' from Levee Toe | 19.06 | 8.56 |
| P-6 | 642+61 | 145' from Levee Toe | 18.80 | 4.30 |

A total of fifteen (15) borings were drilled in the area of the test section at the locations shown on Enclosure 1. One (1) undisturbed boring designated B-17 and four (4) probe borings designated B-100 through B-103 were drilled for previous investigations and the logs of these borings are shown on Enclosures 4, 5 and 6. An auger boring designated A-17 was drilled near the water's edge and the log of this boring is shown on Enclosure 7. Holes drilled for installation of the six (6) piezometers designated P-1 through P-6 were logged and the results are shown on Enclosures 8 and 9. Upon completion of the piezometric readings, three (3) borings designated E-1 through E-3 were drilled in the bottom of the test section and the logs of these borings are shown on Enclosure 10.

The water surface elevation in the canal and each piezometer was obtained on thirty (30) separate occasions including: Nine (9) occasions prior to the initiation of the excavation; twelve (12) occasions during excavation; and nine (9) occasions after completion of the excavation. The results are shown graphically on Enclosures 11 through 16.

Excavation of the test section began on or about 29 November 1983 and reached final design grade during the period 15 to 16 December 1983. Information furnished by Modjeski and Masters indicates that the excavation was accomplished in strips perpendicular to the canal centerline using a dragline bucket. The width of each excavated strip corresponded to the width of the bucket and operations proceeded in sequence from one end of the test section to the other. Furnished

information also indicates that excavation operations during the period 15 to 16 December consisted of cleaning and/or shaping of the test section to final grade and, during this sweeping operation, sand was excavated from the bottom of the test section. It is further understood that the final sweeping operation was completed in a period of approximately four hours and soundings were subsequently taken to verify the configuration of the test section. All excavation operations terminated at approximately 4:00 p.m. on 16 December.

Twelve (12) sets (a total of 72) of readings were obtained in the piezometers during the construction period. The maximum variation in the water elevation was 1.41 feet which occurred at P-6 located 145 feet from the toe of the levee. At P-2 and P-3 (located at the toe of the levee) and at P-4 and P-5 (located 50 feet from the toe) the maximum variation in the water elevation was approximately 1 foot.

After excavation operations terminated, three (3) borings designated E-1 through E-3 were drilled on 19 December 1983 in the bottom of the test section to verify exposure of the underlying sand stratum. However, these borings encountered 2.7 to 4 feet of sediment at the canal bottom which was apparently deposited after excavation operations terminated on 16 December. This sediment is underlain by medium dense gray fine sand at all three boring locations.

Nine (9) sets (a total of 54) of readings were obtained in the piezometers after completion of excavation operations. Except in P-1, the water elevation in the piezometers ranged between 13.29 and 13.59 C.D. while the water elevation in the canal ranged between

21.43 and 22.59 C.D. The water elevation in P-1 ranged between 17.59 and 17.72 C.D. during this period.

Based on the water elevations obtained in the piezometers and canal, information furnished by Modjeski and Masters, and rainfall data furnished by the Sewerage and Water Board, the following observations appear reasonable:

- 1) All six (6) piezometers functioned throughout the test period.
- 2) Variations of the water elevation in the piezometers before, during and after excavation did not respond to the variations of the water elevation in the canal but, instead, responded to the amount of rainfall in the area.
- 3) The underlying sand stratum was exposed over some portion if not over the entire bottom area of the test section on 16 December.
- 4) During the period when the underlying sand stratum was exposed on 16 December, the water elevation in the canal rose 0.41 of a foot but the water elevation in the piezometers fell slightly or remained unchanged.
- 5) Sedimentation deposits covered the bottom of the test section in a relatively short period of time.

Based on the foregoing observations, the following conclusions may be reasonable.

- 1) The water elevation in the piezometers was not affected by the water level in the canal because the surface of the underlying sand has become intermixed with fines to some depth below design grade (el 4.0 C.D.). This layer of contaminated sand acts as a seal preventing the water in the canal from influencing the hydrostatic head at and beyond the levee toe.
- 2) Upon completion of the proposed dredging to design grade in the canal, sedimentation will probably deposit on the bottom in a relatively short period of time further sealing off the water pressure in the canal from the surrounding ground water.

The preceding conclusions may be supported by the present thickness of sedimentation on the canal bottom which suggest that at one time the bottom of the canal was as deep if not deeper than the proposed design grade. Such a situation could account for the layer of contaminated sand at the surface of this stratum, and confirm that sedimentation will deposit on the canal bottom after excavation to design grade. It should also be noted that the location of the test section was selected where the surface of the underlying sand is at the highest elevation based on borings in the canal. If the surface of the sand was deeper than the design grade, there will be many areas in which the sand stratum will not be exposed by the proposed dredging.

The foregoing observations and conclusions appear to be reasonable and, therefore, it is believed that the possibility of a blow-out during high water conditions in the canal is probably slight. However, sound engineering judgment would indicate that piezometers should be installed along the entire reach in which the sand stratum may be exposed at the bottom of the canal. Readings should be taken during and subsequent to excavation operations to more definitively define the reaction of the sand strata to the water level in the canal.

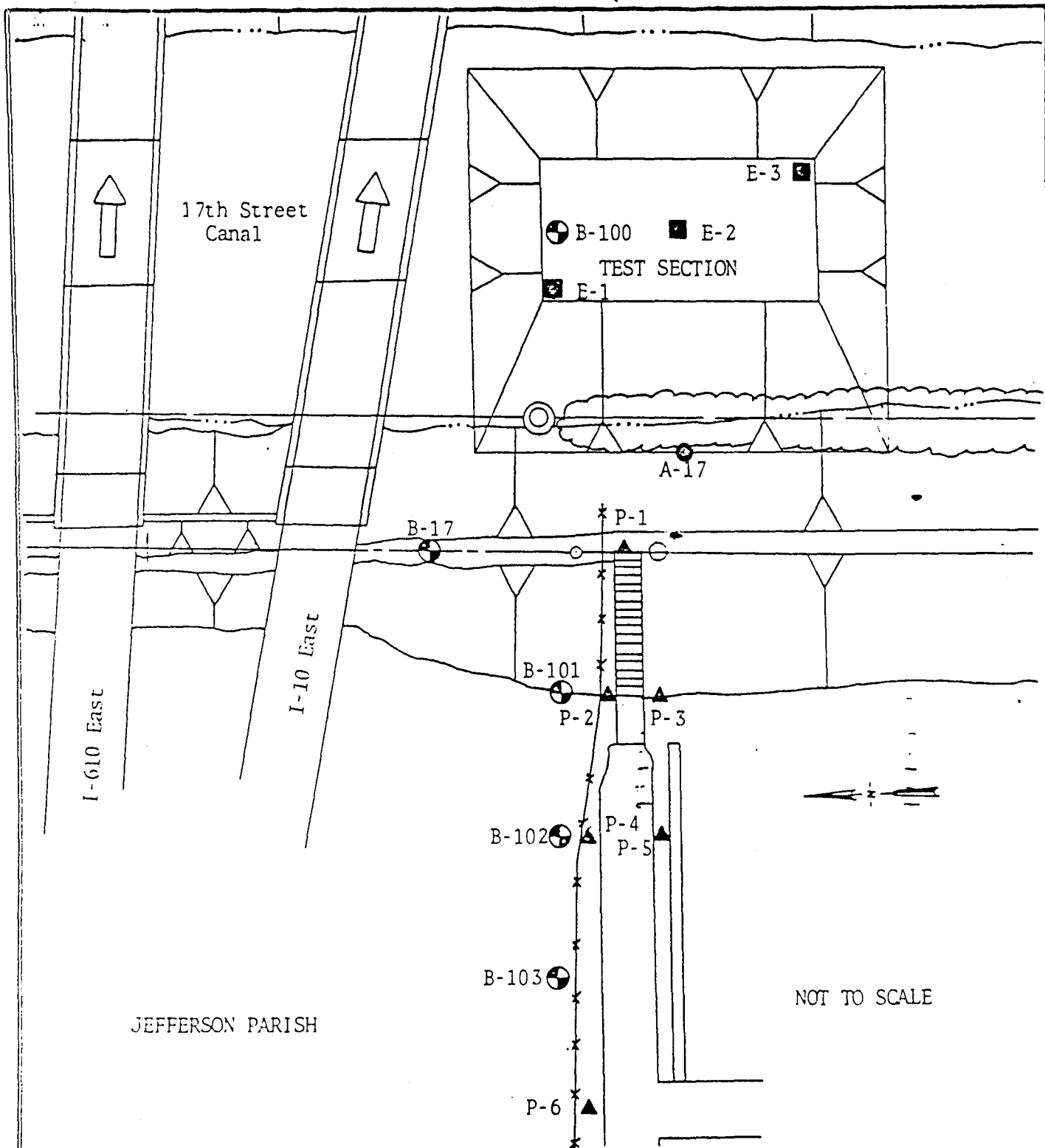
Yours very truly,

EUSTIS ENGINEERING COMPANY

By Lloyd A. Held, Jr.
Lloyd A. Held, Jr.

L. J. Napolitano:kd1

Enclosures

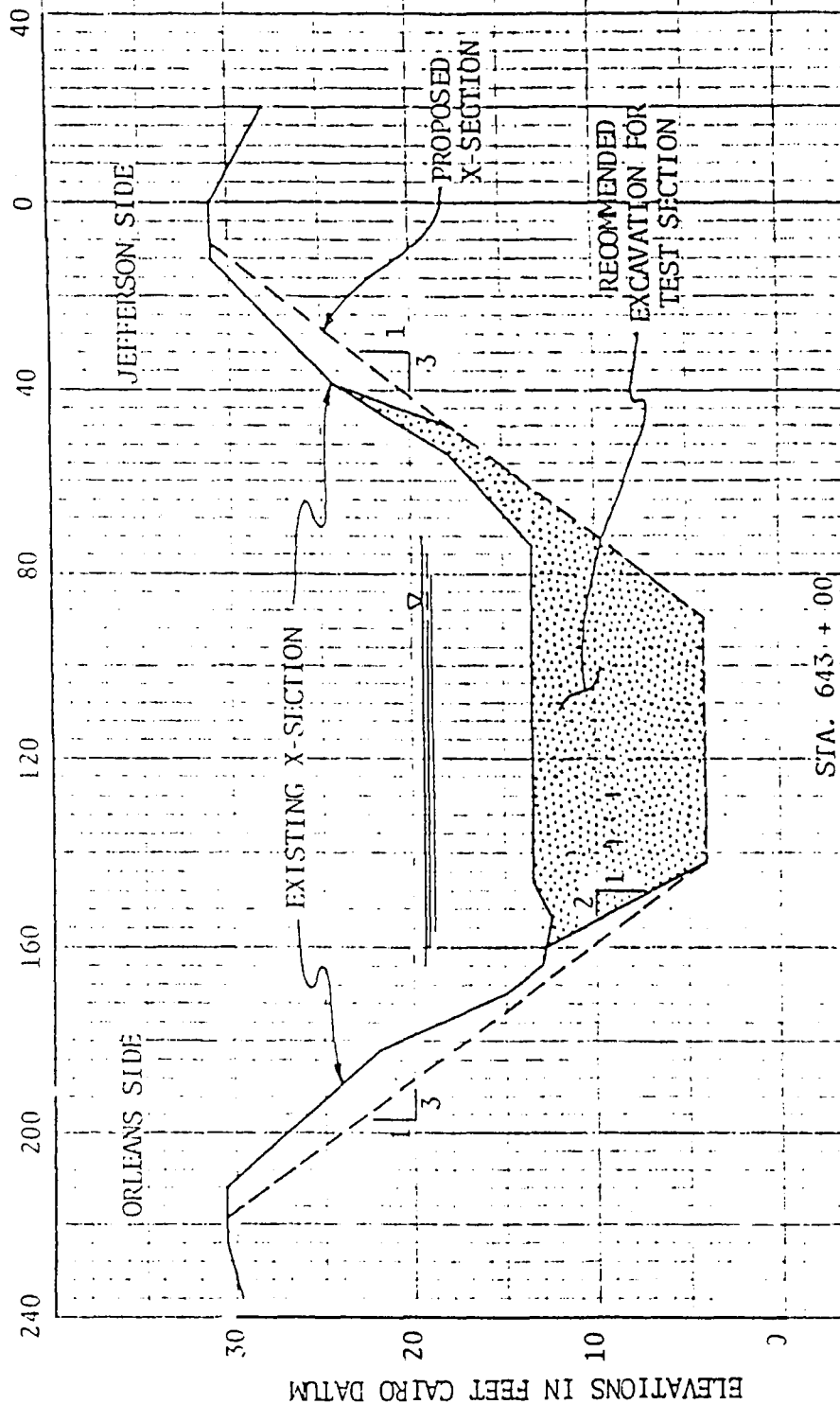


Piezometric Data-Test Section
 Sewerage and Water Board of New Orleans
 Metairie Relief Canal
 Station 617+50 to Station 663+00
 Orleans and Jefferson Parishes, Louisiana

For: Modjeski and Masters, Consulting Engineers, New Orleans, Louisiana

83
 Enc. 1

DISTANCE FROM BASELINE, IN FEET



NOTES:
 BOTTOM WIDTH OF TEST SECTION ALONG CENTERLINE OF CANAL TO BE 100 FEET
 (BETWEEN APPROXIMATELY STATIONS 642+50 AND 643+50). SIDE SLOPES
 TO BE 1 VERTICAL ON 2 HORIZONTAL.

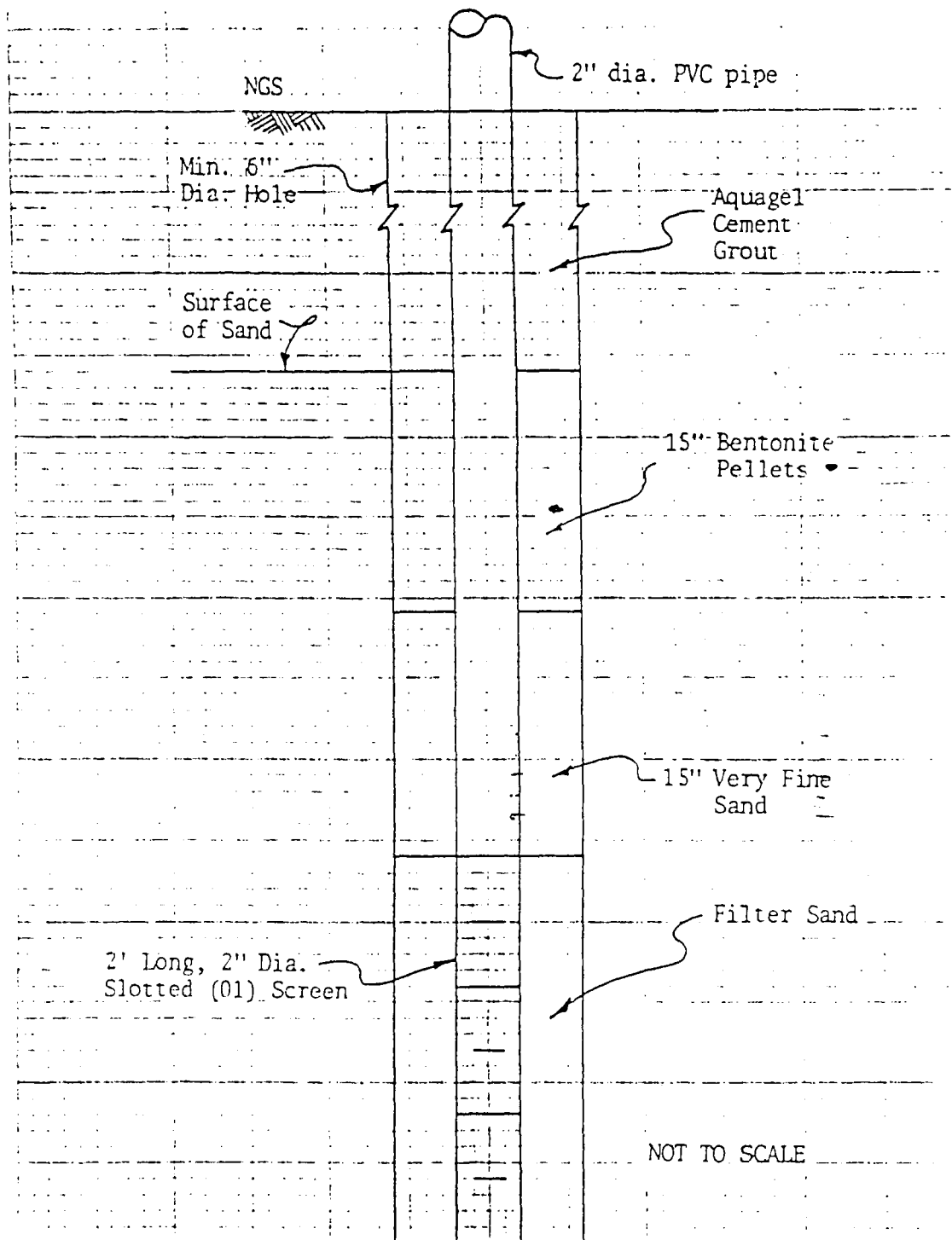
Piezometric Data - Test Section
 Sewerage and Water Board of New Orleans
 Metairie Relief Canal
 Station 617+50 to Station 663+00
 Orleans and Jefferson Parishes, Louisiana

For: Mbdjeski and Masters, Consulting Engineers, New Orleans, Louisiana

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Enc. 2

TYPICAL PIEZOMETER INSTALLATION



Piezometric Data-Test Section
 Sewerage and Water Board of New Orleans
 Metairie Relief Canal
 Station 617+50 to Station 663+00
 Orleans and Jefferson Parishes, Louisiana

For: Mbdjeski and Masters, Consulting Engineers, New Orleans, Louisiana

Enc. 3

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA

Name of Project: Sewerage & Water Board of New Orleans
Metairie Relief Canal, Station 554+00 to Station 670+00

Orleans and Jefferson Parishes, Louisiana

For: Modjeski and Masters, Inc., Consulting Engineers, New Orleans, Louisiana

Boring No. 17 Soil Technician A. J. Mayeux Date 26 May 1981

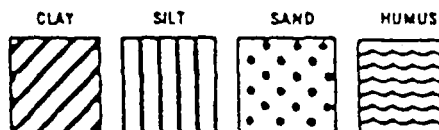
Ground Elev. 31 (Est.) Datum Cairo Gr. Water Depth See Text

| Sample No. | SAMPLE Depth — Feet | | DEPTH STRATUM Feet | | VISUAL CLASSIFICATION | *STANDARD PENETRATION TEST | |
|------------|---------------------|------|--------------------|------|--|----------------------------|-------|
| | From | To | From | To | | | |
| | | | 0.0 | 0.3 | Asphalt | | |
| | | | 0.3 | 1.0 | Fill | | |
| 1 | 2.0 | 2.5 | 1.0 | 4.0 | Medium stiff gray & tan clay w/sand lenses, pockets & roots | | |
| 2 | 5.0 | 5.5 | 4.0 | 7.5 | Stiff gray & tan silty clay w/shell fragments | | |
| 3 | 8.0 | 8.5 | 7.5 | 10.0 | Miscellaneous fill (clay, sandy clay, sand, gravel, bricks & etc.) | | |
| 4 | 11.5 | 13.0 | 10.0 | 15.5 | Loose tan silty sand | 2 | 5 |
| 5 | 15.0 | 16.5 | 15.5 | 16.5 | Loose tan sand w/clay & wood | 2 | 4 |
| 6 | 17.5 | 18.0 | 16.5 | 18.5 | Medium stiff gray clay w/wood, organic matter & roots | | |
| 7 | 18.5 | 20.0 | 18.5 | 21.0 | Medium dense gray sand w/wood | 3 | 19 |
| 8 | 21.0 | 22.5 | 21.0 | 23.5 | Dense gray sand w/shell fragments | 8 | 37 |
| 9 | 23.5 | 25.0 | 23.5 | 27.0 | Very dense gray sand w/shell fragments | 10 | 50=8" |
| 10 | 28.5 | 30.0 | 27.0 | 33.5 | Dense gray sand | 5 | 42 |
| 11 | 33.5 | 35.0 | 33.5 | 38.0 | Very dense gray sand | 7 | 50=8" |
| 12 | 38.5 | 40.0 | 38.0 | | Medium dense gray sand w/shell fragments & clay layers | 5 | 12 |
| 13 | 43.5 | 45.0 | | | Ditto | 6 | 17 |
| 14 | 48.5 | 50.0 | | 50.0 | Ditto | 7 | 22 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
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* Number in first column indicates number of blows of 140-lb hammer dropped 30 in. required to seat 2-in. O. D. split spoon sampler 6 in. Number in second column indicates number of blows of 140-lb hammer dropped 30 in. required to drive 2-in. O. D. split spoon sampler 1 ft. after seating 6 in. WHILE THIS LOG OF BORING IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT ITS RESPECTIVE LOCATION ON THE DATE SHOWN, IT IS NOT WARRANTED THAT IT IS REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

Remarks: Boring located on Westside of canal @ Sta.

No. 642+00 in crown of levee.



Predominant type shown heavy. Modifying type shown light.

Enc. 4

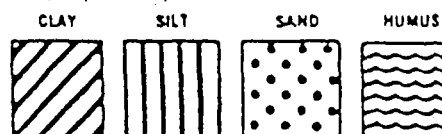
LOG OF BORING
EUSTIS ENGINEERING COMPANY
 SOIL AND FOUNDATION CONSULTANTS
 METAIRIE LA

Name of Project: Sewerage and Water Board of New Orleans
Metairie Relief Canal, Station 617+50 to Station 663+00
Orleans and Jefferson Parishes, Louisiana
 For: Modjeski and Masters, Consulting Engineers, New Orleans, Louisiana
 Boring No. _____ Soil Technician G. Hardee & R. Courtiade Date 7 & 10 May 1982
 Ground Elev. _____ Datum Cairo Gr. Water Depth _____

| Sample No | SAMPLE Depth - Feet | | DEPTH STRATUM Feet | | VISUAL CLASSIFICATION | *STANDARD PENETRATION TEST |
|-----------|---------------------|------|--------------------|------|--|----------------------------|
| | From | To | From | To | | |
| | | | | | BORING 100 (Water Surface @ el. 21.6) | |
| | | | 0.0 | 8.0 | Water | |
| 1 | 8.5 | 9.0 | 8.0 | | Loose black sand w/oil (Sediment) | |
| 2 | 10.5 | 11.0 | | 12.5 | Ditto | |
| 3 | 13.5 | 14.0 | 12.5 | 14.0 | Loose dark gray clayey sand (Sediment) | |
| 4 | 15.0 | 15.5 | 14.0 | | Soft gray clay w/organic matter | |
| 5 | 16.5 | 17.0 | | | Soft gray clay w/organic matter & wood | |
| 6 | 17.0 | 17.5 | | 17.5 | Soft gray clay w/trace of sand | |
| 7 | 17.5 | 18.0 | 17.5 | 18.0 | Medium dense gray sand w/clay layers | |
| | | | | | | |
| | | | | | NOTE: Boring located near E of canal. | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | BORING 101 (Ground Surface @ el. 19.2) | |
| | | | 0.5 | 1.5 | Miscellaneous fill | |
| 1 | 2.5 | 3.0 | 1.5 | 4.0 | Medium stiff tan & gray clay w/roots & wood | |
| 2 | 5.0 | 5.5 | 4.0 | 5.5 | Medium stiff gray clay w/roots | |
| 3 | 7.0 | 7.5 | 5.5 | 7.5 | Soft gray sandy clay | |
| | | | 7.5 | 10.0 | Medium dense gray fine sand | |
| | | | | | | |
| | | | | | NOTE: Boring located at landside toe of west sid. levee. | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

*Number in first column indicates number of blows of 140-lb hammer dropped 30 in. required to seat 2-in. O. D. split spoon sampler 6 in. Number in second column indicates number of blows of 140-lb hammer dropped 30 in. required to drive 2-in. O. D. split spoon sampler 1 ft. after seating 6 in. WHILE THIS LOG OF BORING IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT ITS RESPECTIVE LOCATION ON THE DATE SHOWN, IT IS NOT WARRANTED THAT IT IS REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

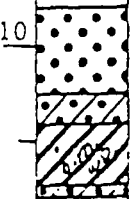
Remarks: Borings located @ Sta. 642+50.



Predominant type shown heavy. Modifying type shown light.

0 B-100

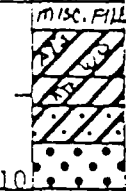
WATER



20

DEPTH IN FT

0 B-101



10

ENC. 5

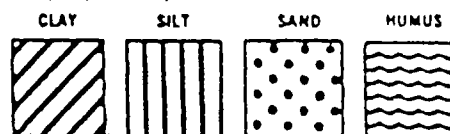
LOG OF BORING
EUSTIS ENGINEERING COMPANY
 SOIL AND FOUNDATION CONSULTANTS
 METAIRIE, LA

Name of Project: Sewerage and Water Board of New Orleans
Metairie Relief Canal, Station 617+50 to Station 663+00
Orleans and Jefferson Parishes, Louisiana
 For: Modjeski and Masters, Consulting Engineers, New Orleans, Louisiana
 Boring No. _____ Soil Technician G. Hardee Date 7 May 1982
 Ground Elev. _____ Datum Cairo Gr. Water Depth _____

| Sample No | SAMPLE Depth - Feet | | DEPTH STRATUM Feet | | VISUAL CLASSIFICATION | *STANDARD PENETRATION TEST |
|-----------|---------------------|------|--------------------|------|---|----------------------------|
| | From | To | From | To | | |
| | | | | | BORING 102 (Ground Surface @ el. 18.6) | |
| | | | 0.0 | 1.0 | Miscellaneous fill | |
| 1 | 2.5 | 3.0 | 1.0 | 5.5 | Medium stiff gray clay w/organic matter & roots | |
| 2 | 5.5 | 6.0 | 5.5 | 6.5 | Soft gray clay w/roots & sand pockets | |
| 3 | 9.5 | 10.0 | 6.5 | 10.0 | Medium dense gray fine sand | |
| | | | | | NOTE: Boring located 50' from landside toe of west side levee. | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | BORING 103 (Ground Surface @ el. 18.4) | |
| | | | 0.0 | 1.0 | Medium dense gray & tan sand w/shells & clay pockets | |
| 1 | 2.5 | 3.0 | 1.0 | 5.0 | Medium stiff gray clay w/organic matter & roots | |
| 2 | 5.5 | 6.0 | 5.0 | 6.0 | Soft gray clay w/roots & sand pockets | |
| 3 | 9.5 | 10.0 | 6.0 | 10.0 | Medium dense gray fine sand | |
| | | | | | NOTE: Boring located 100' from landside toe of west side levee. | |
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Remarks: Borings located @ Sta. 642+50.



Predominant type shown heavy Modifying type shown light