US Army Corps
of Engineers
New Orleans District

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY

HIGH LEVEL PLAN

DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN

CITRUS LAKEFRONT LEVEE
IHNC TO PARIS ROAD

62

JULY 1984

LMVED-TD (NOD 31 Jul 84) 5th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan, Design Memorandum No. 14, General Design - Citrus Lakefront Levee-IHNC to Paris Road

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, MS 39180-0080

25 JAN '85

TO: Commander, New Orleans District, ATTN: LMNED-SP

Satisfactory.

FOR THE COMMANDER:

Resta

R. H. RESTA, P.E.
Chief, Engineering Division

CF:
DAEN-ECE-B
(w 10 cy 4th & 5th Ind)

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

REPLY TO
ATTENTION OF:

LMNED-SP

31 July 1984

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan Design Memorandum No. 14 General Design - Citrus Lakefront Levee IHNC to Paris Road

Commander, Lower Mississippi Valley Division
ATTN: LMVED-TD

1. The subject design memorandum is submitted for review and approval and has been prepared generally in accordance with the provisions of Appendix A of EC 1110-2-193, dated 20 April 1979.

2. A summary of the current status of the Section 404 (b)(1) evaluation, environmental analysis, and cultural resources investigation is as follows:

a. A Section 404 (b)(1) Public Notice was issued 28 March 1984 and State Water Quality Certification was received 29 June 1984.

b. No endangered or threatened species will be affected by the recommended construction.

c. An Environmental Impact Statement (EIS), Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection project, included the levee construction and was filed with the Council on Environmental Quality in 1975. A Draft Supplement to this EIS was filed with the Environmental Protection Agency in December of 1983, and assessed the increased height for high-level protection and the use of flotation channels. The Final Supplemental EIS is scheduled to be filed with EPA in September of 1984.

d. A cultural resource survey was conducted along the project right-of-way in 1982 by New World Research, Inc., and no significant cultural resources were located. The survey included all project features except the four mobilization site flotation channels. Historical research has indicated the potential of significant historic shipwrecks in the flotation channels. Thus, a remote sensing survey of the channels will be conducted in late FY 84/early FY 85.

3. The use of water conservation measures in construction of this project has been investigated. The interdisciplinary team review of the report found that no opportunities for water conservation measures exist.

LMNED-SP 31 July 1984

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan
Design Memorandum No. 14 General Design - Citrus Lakefront
Levee IHNC to Paris Road

4. In accordance with LMVED-TS letter dated 5 February 1981, this report has been reviewed by the District Security Officer. There were no review comments to be incorporated in the report.

5. This report is being submitted as scheduled. The current program calls for construction award in January 1985; therefore, a prompt review and approval of this General Design Memorandum is required.

6. Approval of the report as a basis for preparation of plans and specifications is recommended.

LTC CE, DDE

1 Incl (16 cys fwd sep)
as

for ROBERT C. LEE
Colonel, CE
Commanding

LMVED-TD (NOD 31 Jul 84) 1st Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan
Design Memorandum No. 14 General Design - Citrus Lakefront
Levee IHNC to Paris Road

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, MS 39180-0080

11 OCT '84

TO: Commander, New Orleans District, ATTN: LMNED-SP

1. The subject DM is approved as a basis for plans and specifications subject to the satisfactory resolution of the following comments and approval of the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project Reevaluation Report.

2. Transmittal Letter para 2d, paras 51b and 55. These areas of the document indicate the potential for historic shipwrecks in the planned flotation channels locations and that a remote sensing survey of the locations will be conducted in late FY 84 or early FY 85. The Jan 85 contract award date could be impacted if mitigation is required, therefore, the remote sensing surveys should be completed as soon as possible.

3. Para 8d. This paragraph is misleading. The assurances under the deferred payment plan have not been finalized. The requirements set forth by OCE on the deferred payment must be met before the amended assurances can be approved and distributed for the High Level Plan.

4. Para 8e. We concur that Section 221, Public Law 91-611 is not applicable to construction; however, it does apply to the deferred payment plan which will be reiterated in the supplemental assurances.

5. Para 15b. This paragraph should have covered the method for draining the runoff that will collect between the railroad embankment and the proposed rock embankment or referenced the statement in Appendix A para II-1.

6. Para 27. In describing the general soil conditions at the site, this paragraph indicates that the sand deposits which extend to el -40 are underlain by Pleistocene, whereas the geologic profile on Plates 10-13 indicate that the sand deposits are generally underlain by Prodelta clays which in turn are underlain by Pleistocene clay. This discrepancy should be corrected.

7. Para 28b and Plates 18-21. In cases where clay or silt stratum exists in the foundation, it is not clear what assumptions were made for piezometric heads in the sand just below the clay or silt stratum, i.e., see wedge C-1 on Plate 18. This should be explained. In this regard it is possible that the lower sand stratum may respond rapidly to changes in water levels in Lake Pontchartrain if the sand layers are exposed in the lake, and consequently, high heads could develop in the sand just below the clay or silt stratum.

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If not previously accomplished, you should check the stability analyses for the assumption of high heads developing below the clay or silt stratum.

8. Paras 28b and 28d.

a. We understand that the seepage analyses discussed in these paragraphs were performed using a two-dimensional electrical analog model. This should have been mentioned in these paragraphs. We further understand that only the design concept for a partial cutoff through the levee was obtained from the paper by Mansur and Perret and the actual analyses to determine the head loss through the sheet pile cutoff were based on results of the 2-D electricial analog model study.

b. At the request of this office the analysis on Plate 18 was checked for the assumption of no head loss within the levee embankment on the lakeside of the sheet pile, i.e., the piezometric level on the failure surface on that side of the levee at el 11.5. The resulting factor of safety for that assumption is 1.3 which is adequate.

9. Para 29. The sections shown on the reference plates 14 and 14A, indicate silts and silty sands overlying the Pleistocene clay borrow material. The plan for removing and disposing of this material should be explained in this paragraph.

10. Para 49. It is not clear as to why local interest will be given credit for replacing the timber walkways if the camp owners are required to make this replacement at their own expense. This should be explained.

11. Para 51a. The environmental effects of dredging the clay fill material as well as removing and disposing of the overlying silts and silty sands from the north shore borrow area should also be addressed in this paragraph.

12. Table 3.

a. Cost Account No. 11.1. The amount shown for contingencies is in error. The correct amount should be $83,000 in lieu of $101,000 to agree with the percent contingencies and totals shown.

b. Cost Account No. 11.2. The figure shown for E&D should be $20,000 in lieu of $20,400 to agree with the totals shown.

13. Para 54 and Table 4. This paragraph and table should be expanded to show a comparison between the GDM cost and the latest approved PB-3 cost effective 1 Oct 84. An appropriate explanation for the change in cost should be provided.

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14. Appendix A.

a. Para I-4c(1)(a). The present Bonnet Carre operational plan is for the spillway to be open to prevent main stem downstream discharges from exceeding 1,250,000 cfs and not 20 ft on the Carrollton gage. This correction should be made in this report.

b. Para I-5c. The numbering system in this paragraph is in disarray and should be corrected.

c. Para I-5(c) (6) and Plate A-10. The methodology of the sample routing procedure discussed in this paragraph is appropriate for this project. However, the explanation of the routing procedure shown on Plate A-10 should be revised to indicate the correct reference plates and paragraphs.

d. Para I-7a. It is extremely critical to the urban area within this hurricane protection project that the crown elevation of the protective structures be correctly established. For this reason the crown elevations should be set using the revised National Geodetic Vertical Datum.

e. Para I-7e(3). This paragraph defines the stone revetment as a scheme to reduce wave runup thereby decreasing the height of the levee, however, the data presented in table A-16 do not show a reduction in the levee elevation. This should be explained.

15. Minor comments are as follows:

a. Para 22. Add "and 14A" to the last sentence.

b. Para 25. In the last sentence, insert after (see Table 1) the following: "are shown on Plates 2 through 4."

c. Para 28d. Change Underseepage to Seepage.

d. Plate 2. Note 2, the plate numbers are missing.

e. Plate 14. The legend refers to plates 2-4 for location of borings. This should be corrected to indicate plate 14A for location of borings in the North Shore Borrow area.

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f. <u>Plates 30, 31 and 32.</u> The title blocks should be corrected to correspond with the boring number and locations shown on the upper left hand side of the plate.

FOR THE COMMANDER:

Robert I Kaufman, P.E.
for R. H. RESTA, P.E.
Chief, Engineering Division

wd incl

CF:
DAEN-ECE-B
(w 10 cy Incl 1)

Rec'd 28 Nov 84
B

LMNED-SP (NOD 31 July 1984) 2nd End
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan, Design Memorandum No. 14, General Design - Citrus Lakefront Levee-IHNC to Paris Road

DA, New Orleans District, Corps of Engineers, P.O. Box 60267, New Orleans, La. 70160 16 November 1984

TO: Commander, Lower Mississippi Valley Division
ATTN: LMVED-TD

1. The proposed disposition of comments presented in the 1st indorsement of this chain of correspondence is presented in the subsequent paragraphs (paragraph numbers refer to like-numbered paragraphs of the 1st Ind.).

2. Transmittal Letter para 2d, paras 51b and 55. The remote sensing survey was completed on 14 November 1984. A shipwreck which might have potential historical significance has been located near one of the mobilization access channels. The plans and specifications for the access channel work will be modified so that the dredging activity will avoid impacting this potential historic find. The District is preparing a report to be sent to the State Historic Preservation Officer notifying him of this find.

3. Para 8d. Para. 8d should be replaced with the following:

d. The New Orleans District (NOD) has received the necessary agreements, legal opinions, and resolutions from the Orleans Levee District, jointly from the Lake Borgne Basin Levee District and the St. Bernard Parish Police Jury and from the Pontchartrain Levee District incorporating the requirements of Public Law 91-646 ("Uniform Relocation and Real Property Acquisition Policies Act of 1970"). Approval of the amended assurances was granted for the deferred payment plan subject to distribution of these assurances. Currently, distribution is underway. However, the amended assurance for St. Tammany is not currently being distributed due to the deferred status of this project in the Parish of St. Tammany. Nevertheless, NOD has received the required agreements, legal opinions, and assurances from the Louisiana Department of Transportation, Office of Public Works and the Governor of Louisiana stating that the Office of Public Works is now the local sponsor on behalf of the St. Tammany Parish Police Jury and that the Office of Public Works will lend financial assistance, when required, to the Pontchartrain Levee District. All of these agreements and assurances are being reviewed by the Government.

4. Para 8e. Noted.

5. Para 15b. Concur. The following should be added before the last sentence in paragraph 15b: "Intercepted drainage for the Citrus Lakefront reach is discussed in paragraph II-1 of Appendix A, Hydrology and Hydraulics."

6. Para 27. Concur. In line 8, replace the words "the Pleistocene surface" with "Prodelta clays which in turn are underlain by the Pleistocene deposits". Delete line 12 and replace with the following: "to elevation -40.0, the top of Prodelta clays which in turn are underlain by the Pleistocene deposits".

7. Para 28b and Plates 18-21. The assumption made in the stability analyses was to use the same piezometric head for all strata that was determined from the results of using a two-dimensional electric analog model study. This assumption was considered conservative. Any increase of piezometric heads in the sands below the clay and silt layers which are 8 to 25 ft thick would be small. The natural ground slopes gradually for a long distance into the lake and any entrance would be a long way from the levee. In para 28b, line 8, after the number "21" insert the following sentence: "The piezometric heads used in the stability analyses in all strata were the ones determined by seepage analyses."

8. Paras 28b and 28d.

a. In Para 28b, line 15, after the words "based on" insert the following words: "performing a two-dimensional electrical analog model study and using the design concept presented in".

b. In line 1 of para 28d after the word "Underseepage", insert the following words: "using the results of a two-dimensional electrical analog model study."

9. Para 29. The borrow area for the contract plans and specifications will be relocated nearer the shoreline in order to take advantage of the CH and CL materials. The borrow area will be located between soil boring no. 4 and undisturbed boring B-1U. This will eliminate the need of disposal or blending the ML materials with other less pervious materials.

10. Para 49. The last sentence in paragraph 49 should be deleted and the following sentence used in its place: "After the completion of construction procedures, all of the timber walkways will be replaced as a part of the local interest relocations item and credit for this work applied to the local interest's share of the project cost."

11. Paragraph 51a. Concur. Delete paragraph 51a and replace it with the following:

a. Biological. Historically, the shoreline in the project area was brackish marsh interlaced with tidal creeks, and vegetated with oystergrass and wiregrass. Currently, this area has been developed and is predominately a scrub-shrub community typified by eastern baccharis and marsh elder. A very small fringe of remnant marsh would be impacted by the placement of earth and stone over the present levee. Construction of the flotation channels, and disposal of the material dredged from them, would impact no more than 25 acres of lake bottom. During dredging of the channel and the underwater borrow site (Howze Beach), there would be a short-term release of suspended solids as well as possible releases of pollutants. This would impact primary productivity by reducing light penetration, smothering smaller organisms, and possibly introducing toxic materials. Benthic organisms in the bottom sediments would be smothered by the dredged material discharge or entrained in the dredge's intake. After construction, the disposal site would be degraded to backfill the channel. After the flotation channels have been backfilled and the dredging of the borrow site (Howze Beach) completed, recolonization of the affected areas is expected from the remaining peripheral benthic habitat. However, due to substrate changes the recolonization may differ in species composition from the original community. Depending on the depth to which the Howze Beach site is dredged, some temperature and D.O. stratification could occur. However, due to the absence of nearby point source discharges, lack of highly organic soil components and presence of hydraulic conditions conducive for good flushing action, the dredge site is not expected to produce water quality problems associated with anoxic conditions. In general, impacts would be minor and temporary, and would not significantly affect the surrounding environment. An Endangered Species Assessment and a Coastal Zone Management Consistency Determination have been coordinated.

12. Table 3. Concur with both items 12a and 12b. The correct amount for contingencies for account no. 11.1 is $83,000 and $20,000 for the E&D item in account no. 11.2.

13. Para 54 and Table 4. We do not concur. The comparison is correct as shown in the GDM. This GDM was submitted in July 1984, and cost data contained in the report was developed at least several months prior to submittal to LMVD. The 1 Oct 1984 PB-3 was not approved until 4 September 1984.

14. Appendix A.

a. Para I-4c(1)(a). Concur. The first sentence of Para 1-4c(1)(a) of Appendix A should be changed to "The Bonnet Carre' Spillway is operated as required during major high water seasons on the Mississippi River to divert flows through Lake Pontchartrain to insure that discharges in the river downstream of the Bonnet Carre' Spillway do not exceed 1,250,000 cfs."

b. Para I-5c. Concur. To correct the paragraph numbering system in this section, make the following changes: Page I-21 change "(d)" to "d" and "(e)" to "e"; Page I-23 change "(f)" to "f".

c. Para I-5(c)(6) and Plate A-10: Concur. Routing procedure explained on Plate A-10 should be changed as shown on Enclosure 2.

d. Para I-7a. Concur. The plans currently define levee grades in terms of NGVD with bench mark elevations based on the 1976 epoch. As you are aware, the matter is under active study and it is conceivable that a later epoch could be used. We will, however, build to the elevations which are, based on all information available at the time, most consistent with the objective of providing the degree of protection envisioned for the project.

LMNED-SP (NOD 31 July 84) 2nd End 16 November 1984
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan, Design Memorandum No. 14, General Design - Citrus Lakefront Levee-IHNC to Paris Road

e. Para I-7e(3). Table A-16 lists the elevation of the protective device selected, i.e., levee with foreshore protection. The design levee elevation is 14.5 ft. and the elevation of its companion foreshore dike, where needed for wave protection, is 13.0 ft. Without the foreshore dike, the levee crest elevation would have to be from 17.5 to 18.5 ft., depending upon the levee cross-section selected to provide SPH protection.

15. We concur with minor comments 15a. through 15e.

FOR THE COMMANDER:

FREDERIC M. CHATRY
Chief, Engineering Division

Added 1 Incl (16 cys)
2- Plate A-10

HOURS REFERENCED TO LANDFALL	EL. IN LAKE BORGNE		EL. IN LAKE PONTCHARTRAIN			FLOW INTO LAKE PONTCHARTRAIN						L. PONT. STORAGE		OVERFLOW	FLOW INTO L.MAUREPAS	EL. IN LAKE MAUREPAS		VERIFICATION: STAGES IN PASS MANCHAC						FLOW INTO LAKE MAUREPAS.			STAGE IN LAKE MAUREPAS	
																		L. PONT. SIDE		LAKE MAUREPAS SIDE								
	EL. IN L. BORGNE	AV. OF ②	AV. EL. IN L. PONT.	EL. AT HWY. 11	AV. OF ⑤	HEAD BETWEEN L. BORGNE & L. PONT.	FLOW INTO L.PONT.	VOLUME OF FLOW FOR 2 HOURS	RAIN IN L. PONT.	VOLUME OF RAIN FOR 2 HOURS	TOTAL INFLOW INTO L. PONT.	STORAGE IN L.PONT. FOR EL. IN ④	Δ STORAGE IN L.PONT.	FLOW OVER L. PONT. LEVEES FOR 2 HOUR	⑫-⑭-⑮	STORAGE IN L. MAUREPAS	AV. EL. IN L. MAUREPAS	EL. IN PASS MANCHAC	AV. OF ⑲	TILT IN L. PONT.	TILT IN L. MAUREPAS	EL. IN PASS MANCHAC	AV. OF ㉓	HEAD BETWEEN L. PONT. & L. MAUREPAS	FLOW INTO L.MAUREPAS	VOLUME OF FLOW FOR 2 HOURS	STORAGE IN L.MAUREPAS	EL. IN L.MAUREPAS
①	② FEET N.G.V.D.	③ FEET N.G.V.D.	④ FEET N.G.V.D.	⑤ FEET N.G.V.D.	⑥ FEET N.G.V.D.	⑦ FEET	⑧ 1000 C.F.S.	⑨ 1000 D.S.F.	⑩ FEET	⑪ 1000 D.S.F.	⑫ 1000 D.S.F.	⑬ 1000 D.S.F.	⑭ 1000 D.S.F.	⑮ 1000 D.S.F.	⑯ 1000 D.S.F.	⑰ 1000 D.S.F.	⑱ FEET N.G.V.D.	⑲ FEET N.G.V.D.	⑳ FEET N.G.V.D.	㉑ FEET	㉒ FEET	㉓ FEET N.G.V.D.	㉔ FEET N.G.V.D.	㉕ FEET	㉖ 1000 C.F.S.	㉗ 1000 D.S.F	㉘ 1000 D.S.F.	㉙ FEET N.G.V.D.
2	9.46		3.94	2.33					0.115			1970.6				225.1	1.12	3.54		1.21	0.24	1.00					226.2	1.13
		9.86			1.21	8.65	4214.0	351.2		13.7	364.9		346.5	2.3	16.1				4.52				0.86	3.66	165.8	13.8		
4	10.25		5.26	0.09					0.052			2317.1				241.2	1.27	5.50		5.41	1.08	0.73					240.0	1.26
		9.91			1.62	8.29	4043.2	336.9		48.0	378.9		351.7	11.6	15.6				6.02				0.90	5.12	181.6	15.4		
6	9.56		6.55	3.14					0.155			2668.8				256.8	1.41	6.55		3.41	0.68	1.07					255.4	1.40
		9.11			4.55	4.56	2310.6	192.6		49.6	242.2		202.5	25.8	13.9				6.08				1.32	4.76	180.5	15.0		
8	8.66		7.28	5.96					0.180			2871.8				270.7	1.58	5.61		-0.35	-0.07	1.57					270.4	1.53
		7.43			7.43	0.00	0.0	0.0		21.0	21.0		-47.7	54.9	13.8				5.11				1.82	3.29	160.2	13.4		
10	6.19		7.11	8.90					0.075			2823.6				284.5	1.65	4.61		-4.29	-0.86	2.08					283.8	1.64

SAMPLE ROUTING

EXPLANATION:

COLUMN ② FROM LAKE BORGNE HYDROGRAPH DERIVED BY THE METHOD DESCRIBED IN PARAGRAPH 1-5 (I) AND SHOWN ON PLATE A-13

④ ASSUMED

⑤ OBTAINED FROM WATER SURFACE CONTOURS DERIVED FROM WIND SETUP COMPUTATIONS FOR LAKE PONT., SAMPLE SHOWN ON PLATE A-15

⑦ ③ - ⑥

⑧ FROM CHEF MENTEUR PASS AND RIGOLETS RATING CURVE SHOWN BELOW

⑩ FROM RAINFALL ESTIMATES DESCRIBED IN PARAGRAPH 1-5E(A)

⑫ ⑨ + ⑪

⑬ FROM LAKE PONT. STORAGE CURVE SHOWN BELOW FOR THE ELEVATION IN ④

COLUMN ⑭ ⑬ - ⑬

⑮ BY THE PROCEDURES DESCRIBED IN PARAGRAPH 1-7E

⑰ ⑯ + ⑰

⑱ CORRESPONDING ELEVATION FOR VOLUME IN ⑰ FROM LAKE MAUREPAS STORAGE CURVE SHOWN BELOW

⑲ SAME AS EXPLANATION FOR ⑤

㉑ ⑲ - ⑤

㉒ 1/5 OF ㉑, ESTIMATED AS 1/5 OF THE TILT OF LAKE PONTCHARTRAIN SINCE LAKE MAUREPAS IS 1/5 AS WIDE.

㉓ ⑱ - $\frac{㉒}{2}$

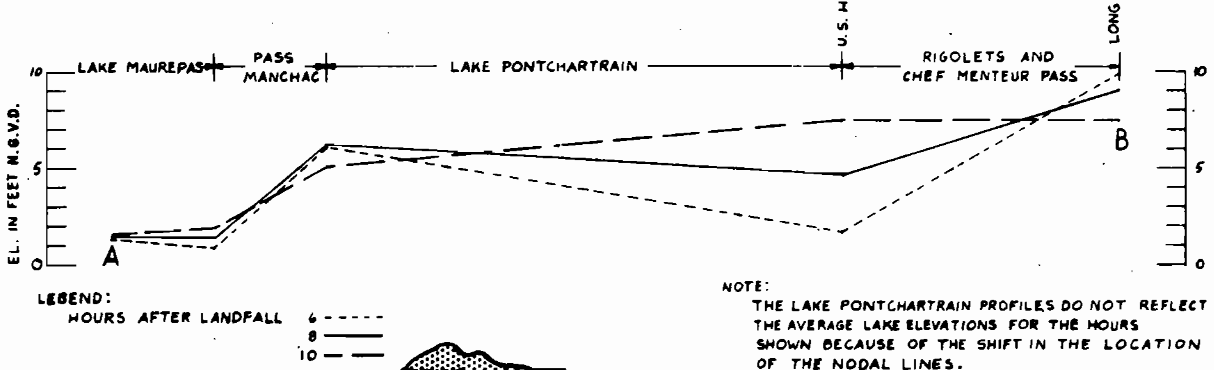
㉕ ⑳ - ㉓

㉖ FROM PASS MANCHAC RATING CURVE SHOWN BELOW

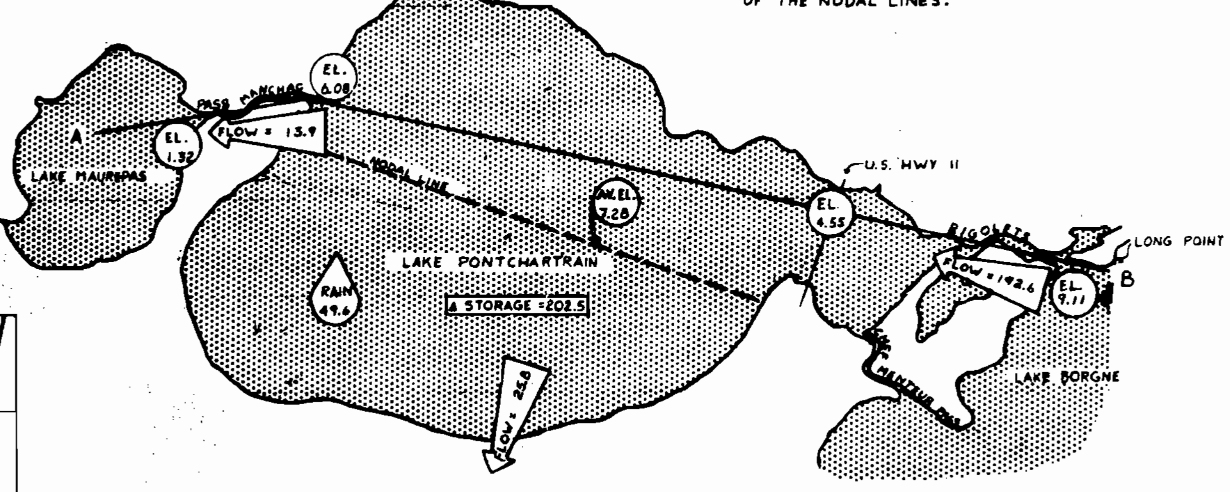
㉘ ㉗ + ㉘

㉙ CORRESPONDING ELEVATION FOR VOLUME IN ㉘ FROM LAKE MAUREPAS STORAGE CURVE SHOWN BELOW

WATER SURFACE PROFILES



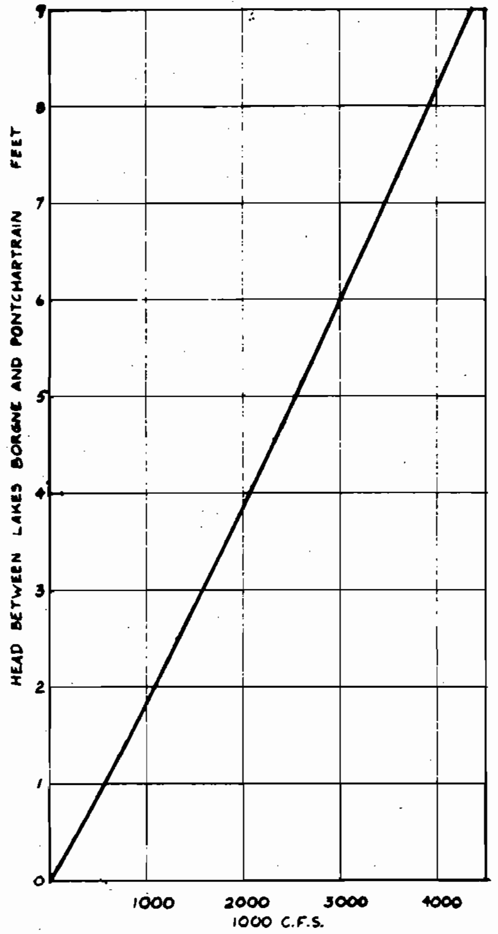
NOTE:
THE LAKE PONTCHARTRAIN PROFILES DO NOT REFLECT THE AVERAGE LAKE ELEVATIONS FOR THE HOURS SHOWN BECAUSE OF THE SHIFT IN THE LOCATION OF THE NODAL LINES.



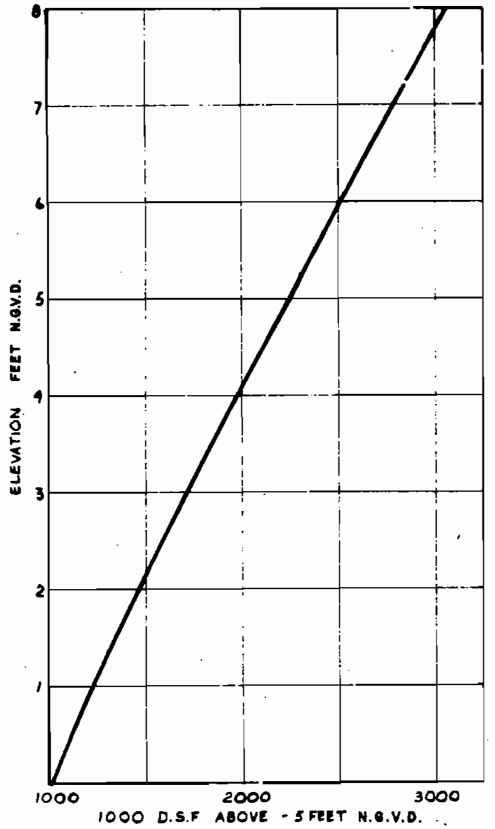
ROUTING DIAGRAM

6 TO 8 HOURS AFTER LANDFALL

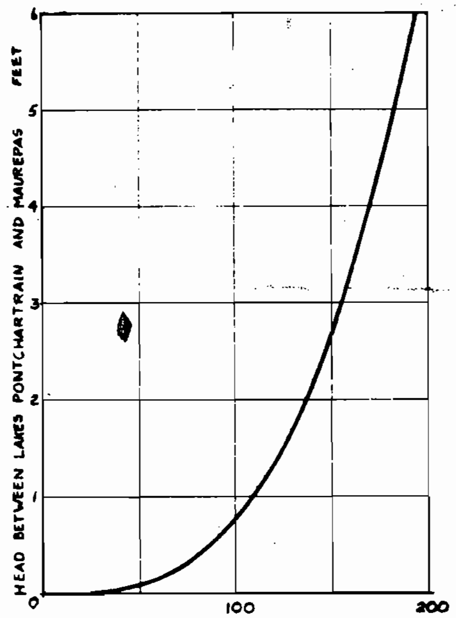
NOTE:
FLOW AND RAIN IN 1000 D.S.F.
ELEVATIONS IN FEET N.G.V.D



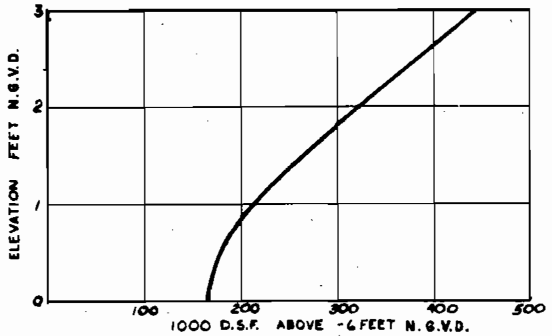
CHEF MENTEUR PASS & RIGOLETS FLOW



LAKE PONTCHARTRAIN STORAGE



PASS MANCHAC FLOW



LAKE MAUREPAS STORAGE

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 13, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE – IHNC TO PARIS ROAD

LAKE PONTCHARTRAIN ROUTING

SCALE AS SHOWN
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS, LA.
CORPS OF ENGINEERS
NOVEMBER 1984
FILE NO. H-2-29653

LMVED-TD (NOD 31 Jul 84) 3d Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan, Design Memorandum No. 14, General Design - Citrus Lakefront Levee-IHNC to Paris Road

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, MS 39180-0080

11 JAN '85

TO: Commander, New Orleans District, ATTN: LMNED-SP

Disposition of the 1st Ind comments is satisfactory except as follows:

a. Para 3. The second sentence of this paragraph is not entirely correct and, in fact, is misleading. The sentence should read: "Approval of the amended assurances was granted for the deferred payment plan subject to certain corrections in the agreement executed by the Louisiana Department of Transportation, Office of Public Works on behalf of the St. Tammany Parish Police Jury. Distribution of the assurances was authorized when the corrections had been accomplished. In view of the deferred status of this project in the parish of St. Tammany, it is not proposed to distribute this agreement at the present time. Distribution of the remaining assurances is in progress." The remainder of the paragraph following the above substitution should be deleted.

b. Para 10. It is our understanding, based on conversation with LMNRE personnel, that the fishing camp locations required a permit from the local authorities. The permit provides that relocations will be accomplished at the camp owner's expense. If this is the case, the walkways are not a part of the local interest relocations item, and no credit for the work should be allowed. This paragraph should be modified accordingly.

FOR THE COMMANDER:

wd incl

R. H. RESTA, P.E.
Chief, Engineering Division

CF:
DAEN-ECE-B
(w 10 cys 2d Ind &
Plate A-10)

LMNED-SP (NOD 31 July 84) 4th End
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan, Design Memorandum No. 14, General Design - Citrus Lakefront Levee-IHNC to Paris Road

DA, New Orleans District, Corps of Engineers, P.O. Box 60267, New Orleans, LA 70160 21 Jan 85

TO: Commander, Lower Mississippi Valley Division
ATTN: LMVED-TD

The following responses to the 3d End comments are offered by like paragraph designation:

a. Para 3. Concur. Distribution of remaining assurances has been accomplished.

b. Para 10. Concur. Credit for cost of relocations will be established by an official government audit of actual allowable expenses submitted by the local sponsor. No credit will be given for costs associated with relocations which are paid by private camp owners.

FOR THE COMMANDER:

FREDERIC M. CHATRY
Chief, Engineering Division

LMVED-TD (OCE 29 Nov 84) 5th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan, Design Memorandum No. 14, General Design - Citrus Lakefront Levee IHNC to Paris Road

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, MS 39180-0080
05 MAR '85

TO: Commander, New Orleans District, ATTN: LMNED-HC

Referred to note approval of the hydraulic design.

FOR THE COMMANDER:

for Robert J Kaufman, P.E.
R. H. RESTA, P.E.
Chief, Engineering Division

CF:
DAEN-ECE-B

Rec'd 10 Dec

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
WASHINGTON, D.C. 20314

REPLY TO
ATTENTION OF:

DAEN-ECE-B 29 November 1984

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan Design Memorandum No. 14 General Design - Citrus Lakefront Levee IHNC to Paris Road

Commander, Lower Mississippi Valley Division
ATTN: LMVED-TD

1. Reference 1st endorsement LMVED-TD, 11 October 1984, on letter LMNED-SP, 31 July 1984, subject as above.

2. The comments in the following paragraphs are furnished for appropriate action before the preparation of plans and specifications.

3. Appendix A.

a. Table A-14. The significant wave height and period in this table cannot be verified from existing shallow-water limited-fetch charts. The period appears to be unusually long for the conditions given. Accordingly, the data in the table and on the charts should be reconciled. Guidance can be found in ETL 1110-2-305.

b. Paragraph 7e(2) and Table A-16. The runup value used in the design of the structures is not clear. It is noted that the runup from the highest one percent of the waves would be 1.67 times greater than the runup from the significant wave. Runup heights should be presented for the design. In consideration of the unique configuration of the levee system, runup and overtopping should be established by physical hydraulic model studies.

c. The guidance set forth in ETL 1110-2-291 should be helpful in the design of the foreshore protection structure.

FOR THE COMMANDER:

Jack R. Thompson

wd all encl

for WILLIAM N. McCORMICK, JR.
Chief, Engineering Division
Directorate of Engineering and Construction

MRCED-TD (OCE 29 Nov 84) 1st Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan Design Memorandum No. 14 General Design - Citrus Lakefront Levee IHNC to Paris Road

DA, Mississippi River Commission, Corps of Engineers, Vicksburg, MS 39180-0080

0 7 JAN '85

TO: Commander, New Orleans District, ATTN: LMNED

Referred for appropriate action.

FOR THE PRESIDENT OF THE COMMISSSION:

R. H. RESTA, P.E.
Chief, Engineering Division

LMNED-HC (OCE/29 Nov 84) 2d End Ms. Hote/beb/2480
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan Design Memorandum No. 14 General Design - Citrus Lakefront Levee IHNC to Paris Road

DA, New Orleans District, Corps of Engineers, PO Box 60267,
New Orleans, LA 70160-0267 15 Jan 85

TO: President, Mississippi River Commission, ATTN: MRCED-TD

1. Reference para 3a and 3b. This project has been under design and construction for nearly 20 years. For calculation involving waves, we have used the wave height and period forecasting methodology contained in the first edition of Technical Report No. 4. We recognize that this yields higher significant waves and longer periods than the current "bible," i.e., Shore Protection Manual (1984). As indicated in the following table, however, the resulting differences in wave runup are not great.

Methodology*	Wind Speed MPH	Fetch Miles	Wave Height Feet	Wave Period Secs	Runup Feet
TR No. 4	83	5	7.8	7.3	3.0
SPM 1977	83	5	10.7**	5.1	2.7
SPM 1984	83	5	11.7**	4.4	3.3

* For further detail see Encl 1
** Waves breaking at toe would be of lesser height

Given the modest differences in wave runup, and their variability with methodology vintage, we have opted for consistency in design throughout the project. We will, however, carefully review future jobs to ensure that this approach is appropriate. The computations made during the preparation of the GDM which were based on wave forecasting curves from TR-4 are enclosed, along with wave heights and runup based on the (1977) and SPM (1984) editions.

The plans and specifications for this work are currently under advertisement. The levee configuration does not appear to fit the description of unique. To use a physical model to verify computed runup and overtopping would be exorbitantly expensive in both time and money and would not, in our opinion, yield a significantly higher level of confidence in the results. Given the known significant deficiency in the lakefront levee system, and the fact that we are at long last in a position to deal with that deficiency effectively, we do not believe that further delay to accommodate physical model studies is justified.

LMNED-HC (OCE/29 Nov 84) 2d End
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level
Plan Design Memorandum No. 14 General Design - Citrus
Lakefront Levee IHNC to Paris Road

2. Reference para 3c. ETL 1110-2-291 suggests a method for shore protection which involves placement of uniform small stone along the shoreline as shore protection. This method has clear advantages where the objective is to protect a shoreline. But our foreshore dike is intended rather to protect the levee which it fronts. Furthermore, the levee grade is inversely proportional to the size of the foreshore dike, since that dike will operate to limit wave runup on the levee. The levee grade and the foreshore dike dimensions have been integrated in the design to minimize overall cost.

FOR THE COMMANDER

Encl

FREDERIC M. CHATRY
Chief, Engineering Division

LMVED-TD (OCE 29 Nov 84) 3d Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan, Design Memorandum No. 14, General Design - Citrus Lakefront Levee IHNC to Paris Road

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, MS 39180-0080

17 JAN '85

TO: CDR USACE (DAEN-ECE-B) WASH DC 20314

We concur in the District's conclusion that the differences in wave runup obtained from computation based on the methodology of TR No. 4 and SPM 1984 is not of the magnitude that would warrant reanalysis for this project. Also, we do not believe that a physical model will yield a refinement in the levee configuration sufficient to justify the expense and delay that would be required to complete the testing. We, therefore, request concurrence in the hydraulic design as presented in the subject DM. As indicated in the 2d Ind, the plans and specifications have been prepared on the basis of the approved DM and are being advertised with bids scheduled to be opened on 30 Jan 85. In view of this, expeditious action is requested.

FOR THE COMMANDER:

Robert J Kaufman, P.E.
for R. H. RESTA, P.E.
Chief, Engineering Division

1 Incl
nc

CF:
LMNED

Rec'd ED-TD 26Feb

DAEN-ECE-B (DAEN-ECE-B/29 Nov 84) 4th End
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan, Design Memorandum No. 14, General Design - Citrus Lakefront Levee IHNC to Paris Road

HQ, U.S. Army Corps of Engineers, Washington, D.C. 20314-1000 15 February 1985

TO: Commander, Lower Mississippi Valley Division, ATTN: LMVED-TD

The information furnished in the 2nd Endorsement is satisfactory, subject to the comments in the 3rd Endorsement. Accordingly, the hydraulic design presented in the subject design memorandum is satisfactory.

FOR THE COMMANDER:

Jack R. Thompson

wd all encl

for WILLIAM N. McCORMICK, JR.
Chief, Engineering Division
Directorate of Engineering and Construction

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

REPLY TO
ATTENTION OF:

LMNED-SP

31 July 1984

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity High Level Plan
Design Memorandum No. 14 General Design - Citrus Lakefront
Levee IHNC to Paris Road

Commander, Lower Mississippi Valley Division
ATTN: LMVED-TD

1. The subject design memorandum is submitted for review and approval and has been prepared generally in accordance with the provisions of Appendix A of EC 1110-2-193, dated 20 April 1979.

2. A summary of the current status of the Section 404 (b)(1) evaluation, environmental analysis, and cultural resources investigation is as follows:

a. A Section 404 (b)(1) Public Notice was issued 28 March 1984 and State Water Quality Certification was received 29 June 1984.

b. No endangered or threatened species will be affected by the recommended construction.

c. An Environmental Impact Statement (EIS), Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection project, included the levee construction and was filed with the Council on Environmental Quality in 1975. A Draft Supplement to this EIS was filed with the Environmental Protection Agency in December of 1983, and assessed the increased height for high-level protection and the use of flotation channels. The Final Supplemental EIS is scheduled to be filed with EPA in September of 1984.

d. A cultural resource survey was conducted along the project right-of-way in 1982 by New World Research, Inc., and no significant cultural resources were located. The survey included all project features except the four mobilization site flotation channels. Historical research has indicated the potential of significant historic shipwrecks in the flotation channels. Thus, a remote sensing survey of the channels will be conducted in late FY 84/early FY 85.

3. The use of water conservation measures in construction of this project has been investigated. The interdisciplinary team review of the report found that no opportunities for water conservation measures exist.

4. In accordance with LMVED-TS letter dated 5 February 1981, this report has been reviewed by the District Security Officer. There were no review comments to be incorporated in the report.

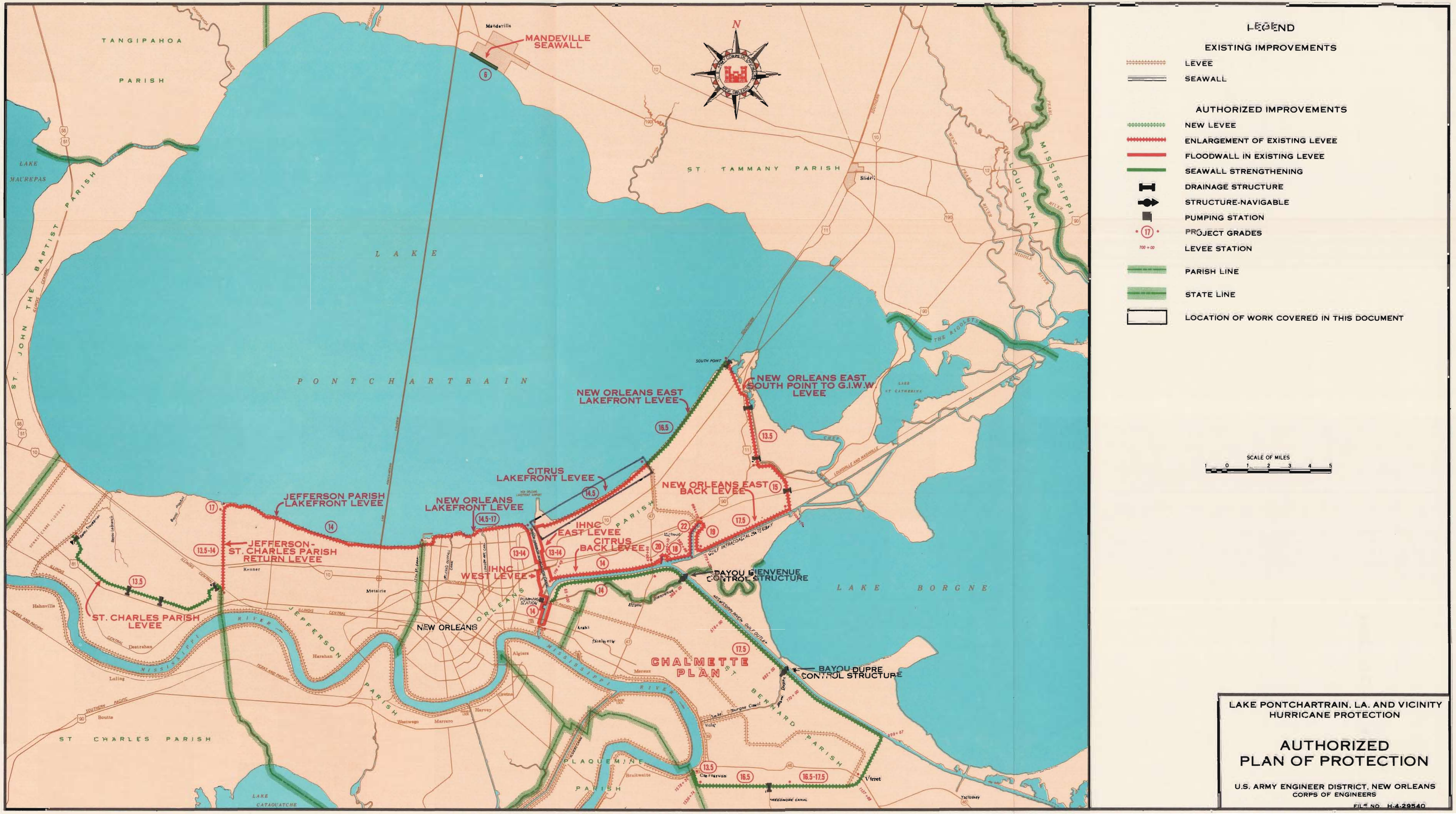
5. This report is being submitted as scheduled. The current program calls for construction award in January 1985; therefore, a prompt review and approval of this General Design Memorandum is required.

6. Approval of the report as a basis for preparation of plans and specifications is recommended.

LTC CE, DDE

1 Incl (16 cys fwd sep)
as

for ROBERT C. LEE
Colonel, CE
Commanding



LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION

AUTHORIZED PLAN OF PROTECTION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO. H-4-29540

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - IHNC TO PARIS ROAD

STATUS OF DESIGN MEMORANDUMS

Design Memo No.	Title	Status
1	Hydrology and Hydraulic Analysis	
	Part I - Chalmette	Approved 27 Oct 66
	Part II - Barrier	Approved 18 Oct 67
	Part III - Lakeshore	Approved 6 Mar 69
	Part IV - Chalmette Extension	Approved 1 Dec 67
2	Lake Pontchartrain Barrier Plan, GDM, Advance Supplement, Inner Harbor Navigation Canal Levees	Approved 31 May 67
2	Lake Pontchartrain Barrier Plan, GDM, Citrus Back Levee	Approved 29 Dec 67
2	Lake Pontchartrain Barrier Plan, GDM, Advance Supplement, Inner Harbor Navigation Canal Levees	Approved 31 May 67
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 1, Lake Pontchartrain Barrier, Rigolets Control Structure, Closure Dam, and Adjoining Levees	Approved 10 Nov 70
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 2, Lake Pontchartrain Barrier, Rigolets Lock and Adjoining Levees	Approved 19 Oct 71
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 3, Lake Pontchartrain Barrier, Chef Menteur Pass Complex	Approved 19 Sep 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 4, New Orleans East Back Levees	Approved 18 Aug 71

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Status
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5, Orleans Parish Lakefront Levees - West of IHNC	1/
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5A, Citrus Lakefront Levees - IHNC to Paris Road	Approved 12 Jul 76
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5B, New Orleans East Lakefront Levees - Paris Road to South Pass	Approved 5 Dec 72
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5C, Orleans Parish Outfall Canals - West of the IHNC	1/
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5D, Orleans Parish Lakefront Levees, Orleans Marina	Approved 24 May 78
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 6, St. Charles Parish Lakefront Levees	Approved 4 Nov 70
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 7, St. Tammany Parish, Mandeville Seawall	1/
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 8, IHNC Remaining Levees	Approved 6 Jun 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5, Orleans Parish Lakefront Levees - West of IHNC	Scheduled Mar 81
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 9, New Orleans East Levee from South Point to GIWW	Approved 1 May 73

1/ This Design Memorandum is no longer applicable due to the recommended change from a Barrier Plan of protection to a High Level Plan of protection. A High Level Plan Design Memorandum will be prepared for this project feature.

STATUS OF DESIGN MEMORANDUM (cont'd)

Design Memo No.	Title	Status
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 10, Jefferson Parish Lakefront Levees	1/
3	Chalmette Area Plan, GDM	Approved 31 Jan 67
3	Chalmette Area Plan, GDM, Supplement No. 1, Chalmette Extension	Approved 31 Jan 67
4	Lake Pontchartrain Barrier Plan, and Chalmette Area Plan, GDM, Florida Avenue Complex, IHNC	Approved 31 Oct 80
5	Chalmette Area Plan, DDM, Bayous Bienvenue and Dupre Control Structures	Approved 29 Oct 68
6	Lake Pontchartrain Barrier Plan, DDM, Rigolets Control Structure and Closure	2/
7	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Control Structure and Closure	2/
8	Lake Pontchartrain Barrier Plan, DDM, Rigolets Lock	Approved 20 Dec 73
9	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Navigation Structure	2/
10	Lake Pontchartrain Barrier Plan, Corrosion Protection	Approved 21 May 69
12	Sources of Construction Materials	Approved 30 Aug 66

1/ This Design Memorandum is no longer applicable due to the recommended change from a Barrier Plan of protection to a High Level Plan of protection. A High Level Plan Design Memorandum will be prepared for this project feature.

2/ Due to the recommendation for a change from the Barrier Plan of protection to a High Level plan of protection, this Detailed Design Memorandum is no longer applicable.

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Status
1	Lake Pontchartrain, Louisiana, and Vicinity, and Mississippi River-Gulf Outlet, Louisiana, GDM, Seabrook Lock	Approved 4 Nov 70
2	Lake Pontchartrain, Louisiana, and Vicinity, and Mississippi River-Gulf Outlet, Louisiana, DDM, Seabrook Lock	Approved 17 Apr 81
Report	Lake Pontchartrain Barrier Plan, Seabrook Lock Breakwater	3/
12	Lake Pontchartrain and Vicinity, Louisiana, Sources of Construction Materials (Revised)	Approved Apr 79
13	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Lakefront Levee West of IHNC	Scheduled Nov 84
13	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Lakefront Levee West of IHNC - Supplement No. 1 - Orleans Marina Floodwall	unscheduled
14	Lake Pontchartrain La. & Vicinity, High Level Plan, Citrus Lakefront Levee IHNC to Paris Road	Submitted Jul 84
14	Lake Pontchartrain, La. & Vicinity, High Level Plan, Citrus Lakefront Levee IHNC to Paris Road - Supplement No. 1 - New Orleans Lakefront Airport and Lincoln Beach	unscheduled

3/ Since the Seabrook Lock is a part of the Barrier Plan of protection and it has been recommended to construct a High Level Plan, the need for Seabrook Lock under the High Level Plan is not required. However, construction of Seabrook Lock under the Mississippi River Gulf Outlet project remains an unresolved issue at this time.

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Status	
15	Lake Pontchartrain, La. & Vicinity, High Level Plan, New Orleans East Lakefront Levee Paris Road to South Point	Scheduled	Feb 85
16	Lake Pontchartrain, La. & Vicinity, High Level Plan, New Orleans East Levee South Point to GIWW	unscheduled	
17	Lake Pontchartrain, La. & Vicinity, High Level Plan, Jefferson Parish Lakefront Levee and Jefferson/ St. Charles Parish Return Levee	Scheduled	Oct 86
18	Lake Pontchartrain, La. & Vicinity, High Level Plan, St. Charles Parish Levee (North of Airline Highway Alinement)	Scheduled	Sep 87
19	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Outfall Canals (London Avenue and Orleans Avenue Outfall Canals)	Scheduled	Apr 86
20	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Outfall Canal (Metairie Relief Canal)	unscheduled	
21	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Outfall Canal Detailed Design Memorandum (London Avenue Canal)	Scheduled	Nov 87
22	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Outfall Canal Detailed Design Memorandum (Orleans Avenue Canal)	Scheduled	Mar 88
23	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Outfall Canal Detailed Design Memorandum (Metairie Relief Canal)	unscheduled	

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE
IHNC TO PARIS ROAD

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HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE
IHNC TO PARIS ROAD

PERTINENT DATA

Location of Project	Southeastern Louisiana in Orleans Parish

Hydrologic Data

Temperature	
Maximum monthly	90.6 degress Fahrenheit
Minimum monthly	45.3 degress Fahrenheit
Average annual	69.5 degress Fahrenheit
Annual Precipitation	
Maximum	83.54 inches
Minimum	40.11 inches
Average	61.55 inches

Hydraulic Design Criteria - Tidal

Design Hurricane - Standard Project Hurricane (SPH) Frequency	1 in 300 years
Central Pressure Index (CPI)	27.6 inches of mercury
Maximum 5-min. Average Wind	100 miles per hour

Levee

Method of Construction	Hauled, semi-compacted clay fill
Levee Length	5.5 miles
Elevation	14.5 feet NGVD [1]
Crown Width	8 feet
Foreshore Protection	36-inch uniform stone armor layer
Height	13.0 feet NGVD
Permanent Rights-of-Way	54 Acres *

[1] Elevations contained herein are in feet referred to National Geodetic Vertical Datum unless otherwise noted.

* Already acquired for Barrier Plan construction.

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE
IHNC TO PARIS ROAD

PROJECT AUTHORIZATION

1. Authority.

a. Public Law. Public Law 298, 89th Congress, 1st Session, approved 27 October 1965, authorized the "Lake Pontchartrain, Louisiana, and Vicinity," hurricane protection project, substantially in accordance with the recommendations of the Chief of Engineers in House Document No. 231, 89th Congress, 1st Session, except that the recommendations of the Secretary of the Army in that document shall apply with respect to the Seabrook lock feature of the project.

b. House Document. The report of the Chief of Engineers dated 4 March 1964 printed in House Document No. 231, 89th Congress, 1st Session, submitted for transmission to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers and the concurring report of the Mississippi River Commission for those areas under its jurisdiction. The report of the Board of Engineers for Rivers and Harbors stated: "For protection from hurricane flood levels, the reporting officers find that the most suitable plan would consist of a barrier extending generally along US Highway 90 from the easternmost levee to high ground east of The Rigolets, together with floodgates and a navigation lock in The Rigolets, and flood and navigation gates in Chef Menteur Pass; construction of a new lakeside levee in St. Charles Parish extending from the Bonnet Carre' Spillway guide levee to and along the Jefferson Parish line; extension upward of the existing riprap slope protection along the Jefferson Parish levee; enlargment of the levee landward of the seawall along the 4.1 mile lakefront, and construction of a concrete-capped sheetpile wall along the levee west of the Inner Harbor Canal in New Orleans; raising the rock dikes and landward gate bay of the planned Seabrook lock; construction of a new levee lakeward of the Southern Railway extending from the floodwall at New Orleans Airport to South Point; enlargement of the existing levee extending from US Highway 90 to the Gulf Intracoastal Waterway, thence westward along the waterway to the Inner Harbor Canal, together with riprap slopes along the canal; construction of a concrete capped sheetpile wall along the east levee of the Inner Harbor Canal between the Gulf Intracoastal Waterway and the New Orleans Airport..."

c. BERH Recommendation. The report of the Chief of Engineers stated: " The Board (of Engineers of Rivers and Harbors) recommends authorization for construction essentially as planned by the reporting officers... I concur in the recommendation of the Board of Engineers for Rivers and Harbors."

2. Purpose and Scope. This memorandum presents the essential data, assumptions, criteria, and computations for developing the plan design and cost estimate for constructing the "High Level Plan", i.e., no barriers in the Chef Menteur and Rigolets Passes, Citrus Lakefront levee feature for the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection project. The recommended design contained in this DM reflects the least costly method of modifying the existing barrier plan levee so that a high level plan of protection can be achieved. The final levee lift for the Citrus Lakefront Barrier Plan levee was completed in November of 1981. The design information presented herein applies to the levee reach extending from B/L station 27+28.53 behind the New Orleans Airport to B/L station 331+50 near Paris Road's junction with Hayne Boulevard. Modifications to in-place barrier plan features such as floodwalls, floodgates and pumping station modifications are not covered in this design memorandum. These features will be addressed at a later date in a supplement to this design memorandum.

3. Local Cooperation.

a. Flood Control Act of 1965 (Public Law 89-298). The conditions of local cooperation pertinent to this supplement and as specified in the report of the Board of Engineers for Rivers and Harbors and concurred in by the report of the Chief of Engineers are as follows: "...That the barrier plan for protection from hurricane floods of the shores of Lake Pontchartrain... be authorized for construction,...Provided that prior to construction of each separable independent feature local interests furnish assurances satisfactory to the Secretary of the Army that they will, without cost to the United States:

"(1) Provide all lands, easements, and rights-of-way, including borrow and spoil disposal areas, necessary for construction of the project;

"(2) Accomplish all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures, and other facilities made necessary by the construction works;

"(3) Hold and save the United States free from damages due to the construction works;

"(4) Bear 30 percent of the first cost, to consist of the fair market value of the items listed in subparagraphs (1) and (2) above and a cash contribution presently estimated at $14,384,000 for the barrier plan... to be paid either in a lump sum prior to initiation of construction or in installments at least annually in proportion to the Federal appropriation prior to start of pertinent work items, in accordance with construction schedules as required by the Chief of Engineers, or, as a substitute for any part of the cash contribution, accomplish in accordance with approved construction schedules items of work of equivalent value as determined by the Chief of Engineers, the final apportionment of costs to be made after actual costs and values have been determined;

"(5) For the barrier plan, provide an additional cash contribution equivalent to the estimated capitalized value of operation and maintenance of the Rigolets navigation lock and channel to be undertaken by the United States, presently estimated at $4,092,000, said amount to be paid either in a lump sum prior to initiation of construction of the barrier or in installments at least annually in proportion to the Federal appropriation for construction of the barrier;

"(6) Provide all interior drainage and pumping plants required for reclamation and development of the protected areas;

"(7) Maintain and operate all features of the works in accordance with regulations prescribed by the Secretary of the Army, including levees, floodgates, and approach channels, drainage structures, drainage ditches or canals, floodwalls, seawalls, and stoplog structures, but excluding the Rigolets navigation lock and channel and the modified dual purpose Seabrook lock; and

"(8) Acquire adequate easements or other interest in land to prevent encroachment on existing ponding areas unless substitute storage capacity or equivalent pumping capacity is provided promptly; Provided that construction of any of the separable independent features of the plan may be undertaken independently of the others, whenever funds for that purpose are available and the prescribed local cooperation has been provided..."

b. Water Resources Development Act of 1974 (Public Law 93-251). The local interest payment procedures outlined in the original conditions of local cooperation were modified in 1974 as follows: "The hurricane-flood protection project on Lake Pontchartrain, Louisiana, authorized by Section 204 of the Flood Control Act of 1965 (Public Law 89-298) is hereby modified to provide that non-Federal public bodies may agree to pay the unpaid balance of the cash payment due, with interest, in yearly installments. The yearly installments will be initiated when the Secretary determines that the project is complete but in no case shall the initial installment be delayed more than ten years after the initiation of project construction. Each installment shall not be less than one twenty-fifth of the remaining unpaid balance plus interest on such balance, and the total of such installments shall be sufficient to achieve full payment, including interest, within twenty-five years of the initiation of project construction."

4. Project Document Investigations. Studies and investigations made in connection with the report on which authorization is based (House Document No. 231, 89th Congress, 1st Session) consisted of: research of information which was available from previous reports and existing projects in the area; extensive research in the history and records of hurricanes; damage and characteristics of hurricanes; extensive tidal hydraulics investigations involving both office and model studies relating to the ecological impact of the project on Lakes Pontchartrain and Borgne; an economic survey; and survey scope design and cost studies. A public hearing was held in New Orleans on 13 March 1956 to determine the views of local interests.

5. Investigations Made Subsequent to Project Authorization. Several comprehensive engineering studies for the Citrus Lakefront levee reach have been made subsequent to project authorization. Design Memorandum No. 2 General Design, Supplement No. 5A, entitled "Citrus Lakefront Levee IHNC to Paris Road", dated May 1976 gave detail designs for the barrier plan project protection. This report was submitted to LMV on 26 May 1976 and approved 12 July 1976. In December 1977, a Federal court injunction was issued stopping construction of portions of the authorized project. The injunction was issued on the basis that the 1975 final Environmental Impact Statement (EIS) for the Lake Pontchartrain project was inadequate. The court directed, among other things, that the EIS be rectified to include adequate development and analysis of alternatives to the then ongoing proposed action. The results of these studies are contained in a two volume report entitled "Lake Pontchartrain, Louisiana, and

Vicinity Hurricane Protection Project, Reevaluation Study", dated December 1983. The reevaluation report recommended a "tentatively selected" high level plan of protection, this recommendation necessitated the preparation of this report and the engineering and environmental studies discussed herein. Surveys and studies accomplished in preparing this GDM include the following:

a. Alternative plan studies to develop alternative methods of construction required to optimize the proposed plan of protection;

b. Aerial and hydrographic surveys;

c. Soils investigations including general and undisturbed type borings and associated laboratory investigations;

d. Detailed design studies for alternative plans including stability analysis;

e. Tidal hydraulic studies required for establishing design grades for protective works based on the latest revised hurricane parameters furnished subsequent to project authorization by the National Weather Service;

f. Real Estate requirements;

g. Detailed cost estimates for the proposed plan of protection as well as alternative plans and necessary utility relocations.

h. Environmental effects and evaluations;

i. A comprehensive public meeting for the "tentatively" selected high level plan held on 12 April 1984.

6. Planned Future Investigations. Upon satisfactory approval of this GDM, additional detailed Engineering Designs and Specifications will be prepared to support construction of this project feature. No additional soils investigations or field surveys are anticipated at this time to support these designs. Planned future investigations for completed barrier plan floodwall and floodgate features located within the Citrus project reach will be accomplished in Supplement No. 1 to this GDM. This supplement will address deficiencies associated with the barrier plan floodwalls for a high level plan of protection and recommend remedial measures to correct these deficiencies.

7. Local Cooperation Requirements. The conditions of local cooperation as specified in the authorizing laws are quoted in paragraph 3.

8. Status of Local Cooperation. The following subparagraphs capsulize the history of assurances for local cooperation on the Lake Pontchartrain barrier plan project. With the pending change to a high level plan of protection and approval of the revised EIS, amended or supplemental assurances will be requested from the local assuring agencies for this project. Final approval of the revised EIS and environmental clearance on the Lake Pontchartrain high level plan is currently estimated to be completed by the end of October 1984.

a. Assurances from the Board of Levee Commissioners of the Orleans Levee District for the Barrier Plan portion of the project, of which the Orleans Marina Floodwall is a part, were originally accepted on 10 October 1966. Because of the rising non-Federal cost of participation and the widespread benefits to be derived by surrounding parishes, the Orleans Levee District requested assistance in carrying out the assurances. Accordingly, the Governor of the State of Louisiana by Executive Order Number 80, dated 5 March 1971, designated the Louisiana Department of Public Works as the local coordinating agency. Through this procedure the Orleans Levee District, the Pontchartrain Levee District and the St. Tammany Parish Police Jury were designated the assurers of local cooperation for the portions of the subject project within their respective jurisdictions. The designation was under the authority of Section 81, Title 38, Louisiana Revised Statutes of 1950.

b. Assurances of local cooperation were received from the Orleans Levee District on 16 September 1971 and from the Pontchartrain Levee District on 7 October 1971. Due to the reluctance of the St. Tammany Parish Police Jury to furnish required assurances of local cooperation for that portion of the project within St. Tammany Parish, the Governor of the State of Louisiana executed assurances on behalf of the St. Tammany Parish Police Jury on 8 May 1972 under authority of Section 81, Title 38, Louisiana Revised Statutes of 1950.

c. Recognizing the increasing burden of providing required matching local funds, Representative F. Edward Hebert sponsored Congressional legislation to defer required local payments over an extended period of time. This legislation was enacted in March 1974 as section 92 of the Water Resources Development Act of 1974. This act modified the authorizing law by providing that non-Federal public bodies may agree to pay the unpaid balance of their required cash payment due, with interest, in annual installments in accordance with a specified formula. A plan for the application of the provisions of this legislation is now being implemented.

d. We have received the necessary agreements, legal opinions, and resolutions from the Orleans Levee District, jointly from the Lake Borgne Basin Levee District and the St. Bernard Parish Police Jury and from the Pontchartrain Levee District approving the deferred payment plan and incorporating the requirements of Public Law 91-646 ("Uniform Relocation and Real Property Acquisition Policies Act of 1970"). We have also received the required agreements, legal opinions, and assurances from the Louisiana Department of Transportation, Office of Public Works and the Governor of Louisiana stating that the Office of Public Works is now the local sponsor on behalf of the St. Tammany Parish Police Jury and that the Office of Public Works will lend financial assistance, when required, to the Pontchartrain Levee District. All of these agreements and assurances are being reviewed by the Government.

e. Section 221 of the Flood Control Act of 1970 (Public Law 91-611) is not applicable to this project since construction of the Lake Pontchartrain, Louisiana and Vicinity project commenced prior to 1 January 1972. A description of the overall plan of protection is included in the report of the Chief of Engineers dated 4 March 1964.

9. Views of Local Interests. The Orleans Levee District is the agency responsible for providing local interest assurances for this feature of the project. The plan presented herein was coordinated in detail with the Orleans Levee District engineering staff and bears the approval of that agency. The intention and capability of this sponsor to provide the required non-Federal contribution for this feature have been amply demonstrated; in fact, considerable work on other completed features of the overall project has already been accomplished by this sponsor.

LOCATION OF PROJECT AND TRIBUTARY AREA

10. Project Location. The IHNC to Paris Road levee segment of the Lake Pontchartrain, Louisiana and Vicinity hurricane protection project, as shown on Plate 1, is located in southeastern Louisiana in the eastern portion of New Orleans in an area known as Citrus. The project area covered in this memorandum is located in Orleans Parish.

11. Tributary Area. The tributary area of Lake Pontchartrain varies in character from flat tidal marsh at or near sea level to upland areas of significant relief with natural ground elevations as high as 250 feet above National Geodetic Vertical Datum (NGVD) [1]. Runoff from within the project area drains into either Lake Borgne or Lake Pontchartrain, generally by pumping from within the protected areas on the south shore of Lake Pontchartrain, although some developed areas located on alluvial ridges in St. Charles, St. Bernard, and St. Tammany Parishes are drained by gravity. In addition to runoff from the project area, Lake Pontchartrain receives the runoff of 4,700 square miles located to the north and west of the lake. During major floods on the Mississippi River and its tributaries, floodflows may be diverted from the Mississippi River to Lake Pontchartrain through the Bonnet Carre' Spillway, a controlled overbank floodway constructed under the Flood Control, Mississippi River and Tributaries project.

PROJECT PLAN

12. General. The project, as shown on the flyleaf map, consists of two separate and distinct major features--the Chalmette Area Plan and the Lake Pontchartrain High Level Plan. This memorandum is concerned only with a segment of the latter, the Citrus Lakefront levee from the IHNC to Paris Road. The overall Lake Pontchartrain High Level Plan is described in "Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project" Reevaluations Study dated December 1983.

13. Citrus Lakefront Levee, IHNC to Paris Road. This levee is located in eastern New Orleans along the Citrus Lakefront of Lake Pontchartrain and extends from a tie-in with the existing IHNC floodwall along Jourdan Road on the west end to a tie-in with the New Orleans East Lakefront levee, Paris Road to South Point, at the intersection of Hayne Boulevard and Paris Road on the east end. The project plan presented herein provides for enlargement of the existing barrier plan levee with hauled clay material. This clay will be obtained from a borrow pit on the bottom of Lake Pontchartrain in the vicinity of Howze Beach on the north shore of the lake. Drainage for the area on the protected side of the levee is provided by existing drainage facilities. These facilities include a 54-inch diameter culvert at baseline (B/L) station 33+21, and three pumping stations, namely St. Charles, Citrus, and Jahncke. Modifications to these structures were

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[1] Elevations contained herein are in feet referred to National Geodetic Vertical Datum unless otherwise noted.

accomplished under the barrier plan of protection. Modifications, if required for the high level plan, will be addressed in a supplement to this GDM. The levee from B/L station 28+31 to Paris Road is located just landward of the Southern Railway System railroad embankment and is laterally contiguous with that embankment for the majority of the reach. This plan has the approval of the Southern Railway System. Drainage was provided for the collector ditch between the railroad embankment and the levee by means of a system of culverts and catch basins spaced at 600-foot intervals for most of the reach. Floodwalls replaced the levee from the tie-in to the floodwall along Jourdan Road to B/L station 28+31 and in the vicinity of Lincoln Beach. These walls have been built to barrier plan standards. Within the floodwall reaches two steel overhead roller gates, one bottom roller gate, and three steel swing gates were also constructed. The overhead roller gates are located across Hayne Boulevard at Jourdan Road and across the entrance to Lincoln Beach. The bottom roller gate is located across the New Orleans Lakefront Airport frontage road. The swing gates are located across the Southern Railroad track near the IHNC, across the New Orleans Lakefront Airport service road near Seabrook bridge and across an entrance to the New Orleans Lakefront Airport. Modifications to the existing barrier plan floodwalls and floodgates for the high level plan of protection is to be addressed in a subsequent supplement to this GDM. The project plan also provides for riprapping of the lakeward face of the railroad embankment. The function of the riprap blanket is twofold: (1) to serve as a wave berm or breakwater thus allowing a reduction in levee height; and (2) to protect the levee indirectly by protecting the railroad embankment from daily wave erosion, thus insuring levee integrity when a hurricane strikes. Required relocations are discussed in subsequent paragraphs.

14. Departure From Project Document Plan. Departure from the project document plan are discussed in detail in paragraph 14, page 9 of GDM No. 2 Supplement No. 5A "Citrus Lakefront Levee IHNC to Paris Road". The proposed plan of protection recommended herein builds on the barrier plan of protection and does not structurally or procedurally depart from the barrier plan; i.e., alinements and methods of protection are one for one the same. The high level plan of course requires a higher levee and floodwall to protect against the design storm. Departures of the plan recommended herein from the plan recommended in the Lake Pontchartrain, Louisiana, and Vicinity, Reevaluation Report are discussed in paragraph 40, page 20 of this GDM.

HYDROLOGY AND HYDRAULICS

15. Hydrology and Hydraulics.

a. General. The Hydrology and Hydraulics Analysis Design Memorandum for the Lake Pontchartrain Barrier Plan was presented in a series of three separate reports entitled "Design Memorandum No. 1" and subtitled "Part 1 - Chalmette, Part II - Barrier, and Part III - Lakeshore". Part 1 - Chalmette was approved on 27 October 1966; Part II - Barrier was approved on 18 October 1967; and Part III - Lakeshore was approved on 6 March 1969. These documents present detailed descriptions and analyses of the tidal hydraulic methods and procedures used in the tidal hydraulic design of the features for the plan and include the essential data, assumptions, and criteria used and results of studies which provide the bases for determining surges, routing, wind tides, runup, overtopping, and frequencies. The criteria applicable to this levee feature and the hydraulic design of the drainage facilities in this levee reach are presented in Appendix A to this memorandum.

b. Surface Drainage Facilities. Detailed designs for drainage facilities which were constructed under the barrier plan for the Citrus Lakefront feature are described in detail in paragraph 40, page 24 of Design Memorandum No. 2 General Design Supplement No. 5A "Citrus Lakefront Levee IHNC to Paris Road." An additional 50 feet of length of 12-inch diameter corrugated metal pipe will be added to the existing drainage culverts which convey drainage through the railroad embankment from the collector ditch located between the levee and railroad. This additional culvert length would have also been required under the barrier plan construction if and when the barrier plan foreshore protection were installed. If any are required modifications to the existing pumping stations located in the Citrus lakefront levee reach, will be addressed in a supplement to this GDM.

GEOLOGY

16. Physiography. The project area is located within the Central Gulf Coastal Plain on the northeastern flank of the Mississippi River Deltaic Plain. The primary physiographic features of the study area include Lake Pontchartrain to the north, the Inner Harbor Navigation Canal, and ponds, lagoons, bayous, canals, abandoned distributaries, and small natural levees to the south and east. Relief in the area is very slight with elevations ranging from about 8 feet below mean sea level landward of the project alinement to about mean sea level along the lakefront.

17. General Geology. Only the geologic history since the end of the Pleistocene epoch is relevant to this project. At that time with sea level about 400-450 feet below its present level, the Mississippi River began to aggrade the final entrenchment which it had cut to the west of the project area during the last glacial period. About 5,000 years ago, as sea level approached its present stand, the Mississippi River began to migrate laterally back and forth across the alluvial valley region. Approximately 4,500 years ago the first Holocene deltaic sediments were carried into the project area when the Mississippi River occupied the Cocodrie course. About 3,800 years ago, the river shifted its course to the west and occupied the Teche course. During this period the project area was subjected to erosion and subsidence. When the Mississippi River abandoned the Teche course about 2,800 years ago, it shifted eastward to occupy the St. Bernard course and additional sediments were brought into the project area. About 1,900 years ago, the river again shifted westward to occupy the Lafourche course and the project area was again subjected to erosion and subsidence. When the Mississippi River shifted eastward about 1,200 years ago to occupy its present course, sediments were again introduced into the project area though in lesser quantities than had been carried in by previous courses. The center of deposition has shifted southward of the project area and most sediments brought into the project area consisted of clays and silts brought in by the overtopping of natural levees along the Mississippi River. Construction of artifical levees along the Mississippi River have eliminated floodwaters and presently no sediments are being introduced into the project area.

18. Subsidence and Erosion. The project area lies in a region of active subsidence and downwarping which have been occurring since the end of the Pleistocene epoch. The Pleistocene surface has been downwarped toward the south and west from zero at the Pleistocene outcropping on the northshore of Lake Pontchartrain to about 500 feet near the edge of the continental shelf, about 80 miles south of New Orleans. The over-all rate of regional subsidence has been about 0.8-foot per century. Local subsidence within the project area has been accelerated in recent years as land reclamation projects have extended eastward from New Orleans. Erosion of the Lake Pontchartrain shoreline in the project area has been at the rate of about 2 feet per year over an 18 year period.

19. Investigations Performed. General type and 5-inch undisturbed borings to a maximum depth of about 85 feet were made for this project. In addition, the logs of borings made in conjunction with other projects as well as geologic information were available for the interpretation of the subsurface and

foundation conditons of the area. Seven additional borings were made in 1983 to further define the foundation conditions and to determine the type of material in the existing levee. These new borings showed a strong correlation with the soil types and the depositional environments in the area as depicted on the Soil and Geologic profiles (Plates 10 through 13). Therefore, no changes were made to the profiles. However, the new boring logs are superimposed on the profiles to show where minor changes occur in the soil profiles.

20. Foundation Conditions. The subsurface along the project alinement is represented by the soil and geologic profiles on Plates 2 through 4. The legend on Plate 10 describes the various geologic environments of deposition and the general nature of the soils contained within each environment. Generally, the area consists of Holocene deposits varying in thickness from about 50 to 60 feet throughout the project area. The only exceptions to this depositional sequence are the three estuaries which were cut into the Pleistocene surface and subsequently filled with Holocene deposits. The approximate location of the estuaries which are estimated to be less than 1,000 feet wide and at least 30 feet deep are as follows: B/L stations 73+00, 225+00, and 289+00. The entire sequence of Holocene deposits is underlain throughout the project area by older, more durable sediments of the Pleistocene epoch. These materials, although deposited under deltaic conditions similar to the younger overlying Holocene sediments, are generally much firmer and more resistant as a result of considerable weathering and oxidation, and consequently, provide the best load bearing formation in the area.

21. Mineral Resources. Oil and gas production, common to other areas around New Orleans, is not presently found in the immediate vicinity of the project area. However, any future exploration or production of these natural resources will not be adversely affected by the project, nor will the project be adversely affected by oil and gas operations.

22. Sources of Construction Materials. Design Memorandum No. 12, Revised, Lake Pontchartrain, Louisiana and Vicinity, Sources of Construction Materials, dated December 1978, approved 18 December 1980, documents available sources of sand, gravel, shell, and stone. Suitable borrow materials for levee construction are available from the Howze Beach area borrow pit in Lake Pontchartrain near the north shoreline. The soil borings in this proposed borrow area are shown on Plate 14.

23. Conclusions. The subsurface investigations and analyses of all existing and new data indicate that geologic conditions for construction of the proposed earthen levee and concrete floodwall along the established alinement are generally favorable. The undesirable near surface organic materials normally found in this area have been previously removed and replaced with more stable granular materials (silt, silty sand, and sand).

FOUNDATION INVESTIGATION AND DESIGN

24. General. This section is a supplement to the Citrus Lakefront Levee, IHNC to Paris Road, Design Memorandum No. 2 - General Design, and covers the soils and foundation investigations and design for foreshore protection and enlargement of levee at the Citrus Lakefront - IHNC to Paris Road. See Plates 15 thru 27 for recommended foreshore protection and levee enlargement.

25. Field Exploration. Additional undisturbed borings were taken and tested by the Corps of Engineers along the centerline of the levee and 50 feet lakeside of the baseline. Borings 14-ULC, 16-ULC, and 18-ULC extend to a depth of 70 feet below the ground surface. Borings 12-ULC, 13-ULC, 15-ULC, and 17-ULC extend to a depth of 80 feet below the ground surface. The locations (see Table 1) and logs of undisturbed borings are shown on Plates 30 thru 36.

Table 1
SOIL BORING TABLE

BORING NUMBER	LOCATION	
	BASELINE STATION	DISTANCE FROM BASELINE
12ULC	43+00	C/L
13ULC	115+00	C/L
14ULC	91+59	65 ft Lakeside B/L
15ULC	217+00	C/L
16ULC	235+73	74 ft Lakeside B/L
17ULC	319+00	C/L
18ULC	318+45	60 ft Lakeside B/L

26. Laboratory Tests. Visual classifications were made on all samples obtained from the soil borings. Water content determinations were made on all cohesive soil samples. Consolidation (C) tests, Unconsolidated-Undrained (Q) shear tests and Consolidated Unconfined (R) tests were performed on samples from the undisturbed borings. Liquid and plastic limits were obtained on the undisturbed test specimens. The undisturbed test data are shown on Plates 30 thru 36. The detail shear strength data are shown in Appendix B.

27. Foundation Conditions. The soil types and stratifications along the project alinement are shown on the soil and geologic profiles on Plates 10 thru 13. In general, from B/L station 28+31 to station 64+00, the soils consist of 10 to 15 feet of artificial levee fill underlain by the deposits of clays, silts and sands which exist down to approximate elevations -12.0 to -17.0. The deposits of clays, silts and sands are underlain by a sand deposit to elevation -40.0, the top of the Pleistocene surface. From B/L station 64+00 to B/L station 331+50 the soils consist of 15 to 20 feet of artificial levee fill as shown on the geologic sections. The levee is underlain by deposits of clays, silts, sands overlying the Pleistocene surface at approximate elevation -40.0.

28. Levee.

a. General. The existing levee was built by the New Orleans Levee Board after Hurricane Betsy in 1965 and was enlarged by the Corps of Engineers in 1979. The levee will be further enlarged to serve as the main protective feature for the project from B/L stations 28+31 to 107+00 and 121+00 to 331+50. Between stations 108+00 to 120+00 a sheetpile cutoff wall with levee enlargement will be used. The levee enlargement will be constructed by placing semi-compacted clay fill on the existing levee to the design grades and sections as shown on Plates 2 thru 5.

The classification, stratification, shear strengths and unit weights of the soil used in design were based on the results of the undisturbed borings (See boring data Plates 30 thru 36) and Design Memorandum No. 2, General Design Supplement No. 5A.

b. Shear Stability. Using cross sections representative of existing conditions along the levee, the stability of the levee was investigated by the method of planes analysis, using the design Q shear strength trends assigned to the various levee sections and applying a minimum factor of safety with respect to shear strengths of 1.3. The results of the stability analyses for the recommended levee enlargement are shown on Plates 15 through 21. A sheetpile cutoff wall between sta 108+00 to sta 120+00 was necessary to improve the stability of the levee above the minimum safety factor of 1.3. The sheetpile cutoff wall improved the stability by reducing the landside seepage pressures in the sand core. The tip elevation was set to -5 N.G.V.D. in order to have complete penetration through the sand layer. This will give a partial cutoff effect which reduces the landside seepage pressure. Seepage analyses were based on a paper written by Engineer and Physicist C. I. Mansur and W.R. Perret from Soils Division, Waterways Experiment Station, title PROCEEDINGS OF THE SECOND INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND FOUNDATION

ENGINEERING, ROTTERDAM, JUNE 21 TO 30, 1948 - "Partial Cutoff for Controlling Underseepage Beneath Dams and Levees Constructed on Pervious Foundations" - (See Plate 18 for stability analysis.)

c. Settlement. Settlement analyses indicate that the gross grade levee crown will settle approximately 1 foot after construction. To compensate for this long-term settlement, the levee crown will be overbuilt or grossed 1-foot above elevation as shown on Plates 2 thru 5.

d. Underseepage. Calculations were made to investigate the amount of seepage, uplift pressures and upward exit gradient. In order to determine the values, various assumptions were taken to model the controlling conditions. The assumptions were as follows:

(1) Assumed that the 2-foot clay cover of levee material was sand.

(2) The silt layer of material between el. 5 to el. 10 was assumed to be sand material.

(3) Assumed for sand (SM), permeability of K_h = .02 ft/min.
Assumed for sand (SP), permeability of K_h = .08 ft/min
K_v was assumed equal to K_h.

This information was taken from Seabrook Lock Design Memorandum No. 2, Detail Design, Vol. 1 and 2 July 1980, Plate No. 111. The coefficients of permeability recommended in Technical Manual 5-818-5 and empirical relation between D_{10} and K were reviewed using the D_{10} obtained from the boring logs results. The coefficients determined by the above recommendation and empirical formula were not used since the above coefficients assumed will give a higher value of seepage. The results shown in Table 2 demonstrate the seepage values are in a range which causes no problems to the levee.

Table 2
SEEPAGE RATE

Stations (B/L)	i_v	Seepage (gal/hr) per ft of levee	Total (gal/hr) for each reach
75+00-108+00	.14	2.56	8,448
108+00-120+00 *	.07	1.18	1,422
121+00-154+83	.04	1.57	5,311
156+00-331+50	.06	1.57	27,620

* Sheetpile cutoff wall was considered in seepage analysis.

Upward gradient (i_v) results show values of less than .5 which are acceptable. For stations 28+31 to 75+00 a seepage analysis was not necessary due to the cohesive soil used for levee fill and existing foundation.

29. Sources of Borrow Materials. The levee will be constructed of semicompacted clay fill which will be obtained from a borrow area of Pleistocene clays in the bottom of Lake Pontchartrain along the north shore. The material will be transported to the project by barges, stockpiled, hauled and placed in the levee. See Plates 14 and 14A for location and soil boring sections of the borrow area in the lake.

30. Foreshore Structure Dike.

a. General. For stations between 63+50 to 331+50 a foreshore dike will be constructed. The material used will be a shell or crushed stone core with riprap cover and will be constructed in one lift.

b. Foreshore Structure Dike Q Shear Stability. Using cross sections representative of existing conditions along the levee floodside, the stability of the foreshore structure dike was investigated by the method of planes analysis using the design Q shear strength trends assigned to the various sections and applying a minimum factor of safety with respect to shear strengths of 1.3. The results of the stability analyses for the recommended foreshore structure are shown on Plates 22 through 27.

c. Settlement. Analyses indicate ultimate settlements of the foundation to be 1.2 feet. To compensate for this long term settlement, the foreshore structure dike crown will be overbuilt or grossed as shown on Plates 22 through 27.

31. Tie-in with Pumping Stations Outlets. The tie-in with St. Charles, Jahnke and Citrus Canal Crossing will be addressed in a supplement to this GDM.

32. Railroad Embankment.

a. Shear Stability. The foreshore dike structure and levee enlargement does not affect the railroad embankment stability. This conclusion is based on stability run results from Design Memorandum No. 2, General Design Supplement No. 5A, Citrus Lakefront Levee - IHNC to Paris Road, Plates 50 through 53.

b. Settlement. The foreshore structure dike causes the railroad foundation to have an ultimate settlement of .35 feet. The levee enlargement has no settlement effect of significant magnitude (.01 feet). Total expected settlement of the railroad is 0.36 feet for HLP foreshore dike and levee. Following construction of the foreshore dike and levee, uniform settlement of the railroad track is expected to take place over the next 15 years. Normal routine maintenance to these tracks is expected to counteract any induced project related settlement.

33. Sequence of Construction.

a. General. One contract will be utilized for the levee enlargement and construction of the foreshore protection dike as described in paragraph 55.

b. Levee. The levee will be constructed in one phase as described below:

Phase One. Clay material will be barged and truck-hauled from Howze Beach borrow site to the job site. Spreading equipment placed on the existing levee crown will proceed to construct the levee enlargement along the entire reach. Levee enlargement will not be required in the vicinity of the floodwalls located at the St. Charles, Citrus, and Jahncke Pumping Stations, plus the Lincoln Beach area. Construction of the levee will be as shown on the design sections on Plate 5.

c. Foreshore Protection Dike. The foreshore protection dike will be constructed in five phases as described below:

(1) Phase One. Construction of the flotation channel access, will consist of excavation and stockpiling of the material adjacent to the channel. Access will be perpendicular to the shoreline and the foreshore protection dike alinement.

(2) Phase Two. Mobilization site will be constructed with barged-in shell or crushed stone. Barge mounted draglines will off-load construction materials and bulldozers will shape and build the unloading pad (mob site).

(3) Phase Three. Haul roads extending from each side of the mobilization site will be constructed with the foreshore protection dike core material (shell or crushed stone).

(4) Phase Four. Construction of the typical foreshore protection dike will commence upon completion of the haul road. Construction materials will be truck-hauled from the barge off-

loading area to the furthest end of the haul road. Dragline equipment will proceed with the unloading and placement of stone material into the design section. All construction operations will progress back toward the mobilization site.

(5) Phase Five. Upon completion of the foreshore dike at the mobilization site and the demobilization of equipment, the contractor will be required to backfill the flotation access channel with available material stockpiled during the access channel's excavation.

34. Levees. The existing levee was constructed to the grades and sections outlined in the Barrier Plan Design Memorandum No. 2 - General Design Supplement No. 5A. This existing levee will be enlarged using hauled clay material. The levee enlargement will extend from B/L station 27+28.53 (just east of Downman Road) to the western edge of Lincoln Beach (B/L station 289+58.59) and continue again from the eastern edge of Lincoln Beach (B/L station 304+31.48) to the intersection with the New Orleans East Lakefront Levee, Paris Road to South Point (B/L station 331+50) at the intersection of Paris Road and Hayne Blvd. The new levee embankment will make a smooth transition into the ends of each existing I-wall located within the levee alinement. The centerline of the proposed levee enlargement will be referenced from the southernmost rail of the Southern Railway System's mainline tracks (see Plate 5 for offset distance). The net grade of the levee is 14.5 for the entire reach. The general location and alinement of the proposed levee are shown on Plate 1. The alinement plan and profile of the levee and features continguous thereto are shown on Plates 2 thru 4. Typical levee design sections are shown on Plate 5.

35. Foreshore Protection Dike. The plan presented in the above referenced Barrier Plan Design Memo called for the placement of foreshore protection from baseline station 64+00 (seawall at N.O. Lakefront Airport) to baseline station 331+50 with the exception of a no-work area between baseline station 289+58.59 and 304+31.48 (Lincoln Beach). No foreshore protection dike construction has been accomplished to date. The foreshore protection dike presented herein will extend from baseline station 74+00 to baseline station 289+58.59 and from baseline station 304+31.48 to baseline station 331+50. The Orleans Levee District has plans to construct a self-contained marina community called "South Shore Harbor" in Lake Pontchartrain and adjacent to the Lakefront Airport. This comprehensive plan will incorporate the construction of a foreshore protection dike from baseline station 64+00 to baseline station 74+00. A "no work" area will still be designated between baseline station 289+58.59 and baseline station

304+31.48 (Lincoln Beach). The foreshore protection dike design section consists of two designs. First, a modified foreshore protection dike will begin at the St. Charles Pumping Station baseline station 74+00 and extend to baseline station 77+00. This reach will compliment the portion of foreshore protection that will be constructed by the Orleans Levee District at the South Shore Harbor marina. Second, the typical design section will begin at baseline station 77+00 and extend to the end of the project limit at baseline station 331+50, excluding Lincoln Beach. The centerline of the proposed foreshore protection dike will be referenced from the southernmost rail of the Southern Railway System's mainline tracks (see Plate 6 for offset distance and design sections). The net grade of the foreshore protection dike is elevation 10.0 for the modified design section and elevation 13.0 for the typical design section. The general location and alinement of the proposed foreshore protection dike are shown on Plate 1. The alinement plan and profile of the foreshore protection dike and features continguous thereto are shown on Plates 2 thru 4.

36. Floodwalls, Gates, Ramps, and Sheetpile Cutoff Wall.

a. Sheetpile Cutoff Wall. A sheetpile cutoff wall without the concrete capping will be driven in the existing levee crown from B/L station 108+00 to 120+00 in order to provide a seepage cutoff. The elevation of the top of the sheetpile will be +12.5 and the tip elevation -5.0. The general location and alinement of the proposed sheetpile wall are shown on Plate 1. The detailed alinement plan and profile of the seepage cutoff wall are shown on Plate 2. Typical design section is shown on Plate 5.

b. Floodwalls, Gates, and Ramps. These items will not be addressed in this reporting document, but will be submitted under a Supplement General Design Memorandum.

METHOD OF CONSTRUCTION

37. Recommended Levee Construction Plan. The recommended plan of construction consists of enlarging to a gross grade the existing levee behind the New Orleans Lakefront Airport (B/L station 27+28.53 to B/L station 64+00). The remaining reach of levee from B/L station 64+00 to 331+50, excluding Lincoln Beach, will be provided by a clay cover on the levee crown only, in order to obtain the net grade. Both of these levee reaches will be constructed with semicompacted clay hauled from a borrow pit in the vicinity of Howze Beach on the north shore of Lake Pontchartrain.

38. Drainage Facilities. Approximately 50 feet of additional length of drainage culvert will be added to each existing corrugated metal pipe between B/L station 74+00 to B/L station 331+50, with the first one at B/L station 75+00 and the last one at B/L station 329+00, excluding the reach at Lincoln Beach. The drainage culverts will consist of 12-inch diameter corrugated metal pipes, sloped approximately 1 on 60 under the foreshore protection dike. Coupling of the existing pipe to the new section will be by connecting bands, either the hugger or the corrugated type. Details of these drainage culverts and the locations are shown on Plate 7.

39. Recommended Foreshore Protection Dike Construction Plan. All foreshore protection work will be accomplished from the lakeside of the railroad tracks. Construction materials, including shell or crushed stone core, graded stone and uniform stone, will be transported by barge to unloading and mobilization sites on the shoreline of Lake Pontchartrain. Shell or crushed stone will be used at the mobilization sites as required to provide a firm base for unloading and mobilizing equipment and to construct the haul road lakeside of the railroad embankment. Once the haul road is completed, equipment will commence shaping of the shell or crushed stone core and placement of the two stone layers beginning at the furthest limit from a mobilization site and progress back to the unloading site. The contract will require completion of one reach prior to initiating construction of another reach, thus minimizing disruption of access and utilities to camps.

Flotation channel plan. All material for the construction of the foreshore protection dike would be barged in and unloaded at four mobilization sites. See Plates 2 thru 4 for general location of mobilization sites. For the Flotation Access Channel typical section and dimensions, see Plate 7. The perpendicular flotation access channels and the construction of mobilization sites (unloading pads) have eliminated the removal of about 120 shoreline campsites that would otherwise be displaced, if a parallel flotation channel were to be used.

OTHER PLANS CONSIDERED

40. Other Plans Considered. Two alternative methods of protection for the Citrus levee were considered during the preparation of this GDM. The "Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project, Reevaluation Report" recommended an I-wall in levee coupled with riprap foreshore protection alternative as a "tentatively" selected plan. The designs contained in the reevaluation report were based on physical conditions that existed as of March 1979. It was further

assumed that any ongoing construction contracts at that time would be considered in place and that design of subsequent levee lifts or floodwall construction would reflect these "existing conditions". Given these assumptions, the elevation of the "existing" Citrus lakefront levee for designs developed in the Reevaluation Report was elevation 11.5 NGVD. As discussed in paragraph 2, a subsequent and final barrier plan levee lift contract was awarded in October 1979 and completed in November 1981. That levee lift raised the elevation of the Citrus levee to an approximate elevation of 14.0 NGVD. Therefore designs developed in this GDM start with a different "base" condition than those designs presented in the Reevaluation Reports. This fact coupled with cost saving modifications achieved by reducing the levee crown from 10 feet to an 8-foot width makes the use of an I-wall in levee design more costly than simply placing an additional one-foot lift on the existing levee. The foreshore protection plan required for the high level plan is an integral part of the protection system. The purpose of this feature is to break incident waves that might impend on the levee crown and hence reduce the height of wave run-up. The stone design for the Citrus foreshore protection has been sized to withstand the significant wave produced by the high level plan standard project hurricane critical to the south shore of Lake Pontchartrain. Given the substantial mass of the foreshore protection design, the 8-foot crest width recommended herein for this levee reach is considered sufficient.

ACCESS ROADS

41. Access Roads. Vehicular access to the levee construction site is available via many roads. Hayne Boulevard (La. Hwy 47) traverses parallel to the entire reach of the project. Other major thoroughfares which provide access to the project area are Lakeshore Drive, Downman Road, Paris Road, Read Boulevard, Jourdan Road, Crowder Boulevard, and Bullard Road. The foreshore protection dike site of work is accessible by water transportation from Lake Pontchartrain. The Southern Railway System parallels the entire project reach and divides the levee from the foreshore protection dike.

SOURCES OF CONSTRUCTION MATERIALS

42. Sources of Construction Materials. In addition to the information presented in this memorandum relative to borrow area locations and materials, information relating to material sources is also contained in Design Memorandum No. 12 Revised "Sources of Construction Materials" approved 23 October 1979.

REAL ESTATE REQUIREMENTS

43. General. All rights-of-way and construction easements required to construct the high level plan levee and foreshore protection described in this GDM have previously been acquired for barrier plan construction by the Local Sponsor. No additional easements are required to accomplish the proposed action detailed in this GDM. There will be no acquisitions by the United States. Right-of-way and construction easement limits are shown on Plates 2 through 13 of Design Memorandum No. 2, General Design Supplement 5A, Citrus Lakefront Levee IHNC to Paris Road, May 1976.

RELOCATIONS

44. General. Under the authorizing law, local interests are responsible for the accomplishment of "... all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures and other facilities made necessary by the construction work, ..."

45. New Orleans Lakefront Airport Utility Lines. There are utility lines (electric, gas, and sewer) that are buried within the existing levee surface. Approximately 85 feet of each line will be temporarily removed from the reach of levee between baseline station 27+28.53 and baseline station 64+00. The removed portion of each line will be replaced after the levee is constructed to design grade. The utility lines will be buried in the new semicompacted clay approximately 1 foot below the levee surface.

46. Campsite Utility Lines.

a. All known lines that cross the existing levee between baseline station 64+00 to baseline station 331+50, excluding Lincoln Beach, are small diameter lines that consist of 1-inch pipes or less, and they convey water and electricity to the lakeside campsites from Hayne Boulevard. During previous construction these lines were relocated 1 foot into the existing levee surface. Approximately 15 feet of each line will be temporarily removed between baseline station 108+00 and baseline station 120+00 in order to construct the sheet pile cutoff wall. The location of the cutoff wall in plan and profile is shown on Plate 2. The levee design section that shows the design grade and the sheet pile cutoff wall alinement is on Plate 5. After the sheet pile has been driven to elevation 12.5 (top of piling) the utilities will be replaced on the existing levee crown surface (approx. el. 13.0) prior to the levee crown being covered with semicompacted clay.

b. Approximately 96 water and electric lines pass under the existing railroad tracks in order to provide service to the existing lakeside camps. These lines are attached to the timber walkways discussed in paragraph 49. Approximately 80 feet of each line will be temporarily removed between the railroad embankment and the camps in order to construct the foreshore protection dike along the lakeshore. The removed portion of each utility line will be replaced and installed by others. The remaining campsite utilities which cross the levee between baseline stations 64+00 to 108+00 and between baseline stations 120+00 to 331+50, excluding Lincoln Beach, will not be disturbed and will remain in their present locations.

47. Telephone Utility Poles and Line. Approximately 50 feet from the south rail extending towards the lake is located an alinement of telephone utility poles. These poles are approximately parallel to the railroad embankment and within the area to receive the foreshore dike design section. Excluding Lincoln Beach there are approximately 172 telephone poles that will be removed during construction operations. The overhead telephone line will be removed by South Central Bell prior to our contractor beginning work in each specific reach. Installation and replacement of approximately 125 poles will be accomplished during construction of the foreshore protection dike. The location for each telephone pole is listed and the installation procedure is shown on Plate 8.

48. Concrete Walkways. There are 64 concrete walkways that cross over the existing levee at various locations between B/L station 64+00 and 331+50, excluding Lincoln Beach. Only that portion of the walkway that is within the new levee crown enlargement on the existing levee will be removed. The concrete platform can be replaced by permit application by the owners after the levee is completed.

49. Campsite Timber Walkways. There are approximately 96 timber walkways that lead from the lakeside campsites to the existing railroad embankment. Approximately 80 feet of each timber walkway will be removed in order to facilitate the construction of the foreshore protection dike. After the completion of construction procedures, all of the timber walkways will be replaced by the camp owners at their expense and the cost will be creditable to the local interest's share of the project cost.

COORDINATION WITH OTHER AGENCIES

50. General. As previously mentioned, the State of Louisiana, Department of Public Works, was appointed project coordinator for the State by the Governor of Louisiana. This agency has functioned to coordinate the needs, desires, and interests of state agencies and the Corps of Engineers. The Orleans Levee District will provide the local cooperation for this feature of the hurricane protection project. The project plan presented herein is acceptable to both of the above agencies. The entire Lake Pontchartrain hurricane protection project, including this project feature, has been discussed at numerous public and private meetings since its authorization. Such meetings have been held before regional, state, local, community, social, and educational organizations and have served generally to inform the public of the proposed works, to explain project functions, and to solicit the public viewpoint. The latest public meeting was held in New Orleans on 12 April 1984. The project has also been described and discussed in press and by communications media, as well as organizational and individual correspondence. This public meeting was held as part of the continuing coordination required for input to the Draft Supplemental Environmental Impact Statement (DSEIS) on the Lake Pontchartrain project as a whole. Comments received in connection with the proposed action described in this GDM are summarized in paragraphs a and b below.

a. The Board of Levee Commissioners of the Orleans Levee District. By letter dated 21 February 1984 responded to the DSEIS in connection with the Citrus Lakefront Reach by stating: "While we agree with the concept of the high level protection, we wish to comment on some of the specifics presented in the reports....page 126: Citrus - NEW ORLEANS EAST AREA - The Tentatively Selected Plan for the Citrus Lakefront provides for an earthen levee topped by a floodwall with a large berm. We understand however, that more detailed engineering analysis has proved that an all earthen levee, even though steeper than normally acceptable, will be considered in this reach." The Orleans Levee Board has indicated during our continuing coordination with them that they prefer wherever possible to use all earthen levee designs to facilitate maintenance and mowing of the levee.

b. City of New Orleans. By letter dated 22 February 1984 the City Planning Commission expressed the following opinion relative to use of I-wall in levee designs: "Wherever feasible, it is the staff's opinion that I-walls should not be constructed, in part due to esthetics..."

ENVIRONMENTAL ASSESSMENT

51. General. The project is within the Mississippi Deltaic plain and is characterized by near sea level elevations. The dominant topographic feature is Lake Pontchartrain, a large, shallow body of water lying within an extensive estuarine complex. About 3 miles of the lake edge and shoreline would be affected by this work. The impact would be both temporary and long term. Most environmental features, including biological, recreational, cultural, and socioeconomic, would return to normal after construction.

a. Biological. Historically, the shoreline in the project area was brackish marsh interlaced with tidal creeks, and vegetated with oystergrass and wiregrass. Currently, this area has been developed and is predominately a scrub-shrub community typified by eastern baccharis and marsh elder. A very small fringe of remnant marsh would be impacted by the placement of earth and stone over the present levee. Construction of the flotation channels, and disposal of the material dredged from them, would impact no more than 25 acres of lake bottom. During dredging of the channel, there would be a short-term release of suspended solids as well as possible releases of pollutants. This would impact primary productivity by reducing light penetration, smothering smaller organisms, and possibly introducing toxic materials. Benthic organisms in the bottom sediments would be smothered. After construction, the disposal site would be degraded to backfill the channel. These impacts are minor and temporary, and would not significantly affect the surrounding environment. An Endangered Species Assessment and a Coastal Zone Management Consistency Determination have been coordinated.

b. Cultural. A cultural resources survey was conducted along the project right-of-way in 1982 by New World Research, Inc., and no significant cultural resources were located. The survey included all project features except the four mobilization site flotation channels. Historical research has indicated the potential of significant historic shipwrecks in the flotation channels. Thus, a remote sensing survey of the channels will be conducted in late FY 84/early FY 85.

c. Recreation. Current recreational use along this project reach is predominantly delegated to camp-type recreational dwellings. These recreational structures, situated in Lake Pontchartrain, are used as a base for fishing, crabbing, sking, and participation in other water-oriented recreation. Project construction will temporarily disrupt activities and services to all camps. Walkways existing within the construction right-of-way would be temporarily removed.

d. Socioeconomic. The Citrus lakefront levee is an element of the overall Lake Pontchartrain Hurricane Protection Plan designed to prevent the effects of overflows from a project hurricane. The process of levee construction and drainage maintenance has historically been the method used for land development and flood protection in the New Orleans urbanized areas. Since 1964, as many as nine tropical storms reaching hurricane force have passed through Louisiana's gulf coast (including Hurricanes Betsy and Camille) causing heavy damage and loss of life in the New Orleans area. The economic life of the area is supported largely by port activities, tourist trade, regional market activities, the production of minerals (including crude petroleum, natural gas, sulfur, natural gas liquids, salt, and shell), commercial fishing, shipbuilding, and related service industries. The six parishes designated by the Bureau of the Census in 1983 as the New Orleans Metropolitan Statistical Area (MSA) include Jefferson, Orleans, St. Bernard, St. Charles, St. John the Baptist, and St. Tammany Parishes. Portions of Plaquemines Parish are also designated as part of the New Orleans Urbanized Area. The statistical designation of the Port of New Orleans also includes the entire stretch of the Mississippi River adjacent to Plaquemines Parish. The combined population of the New Orleans MSA and Plaquemines Parish in 1980 totaled 1,283,000. In February of 1984, the estimated civilian labor force in this area totaled 582,175 while employment was 532,300, resulting in an 8.6 percent unemployment rate; it was somewhat less than the 9.8 percent unemployment figure for the state. In 1981, per capita personal income for the 7-parish area was approximately $10,860, slightly higher than the $9,517 estimate for the entire state. Appendix B-2 of the evaluation study provides an assessment of socioeconomic impacts of remaining work through a brief outline of 16 social and economic parameters. In addition to the economic cost of remaining work, slight or moderate adverse impacts would probably include the following: reductions in wildlife habitat and associated leisure opportunities; increased noise from construction and development; reduced esthetic values to the extent that changes in the existing landscape would occur; and community cohesion could be adversely affected to the extent that competition for land resources could be encouraged. One of the major benefits of completing the new project, however, could also be an increase in community cohesion resulting from the improved security provided by additional flood protection. The remaining work would provide net benefits to land use, property values, and business and industrial activity, as well as benefits to employment, housing, local tax revenues, public facilities and services, and overall community and regional growth.

52. Environmental Impact Statement. An Environmental Impact Statement (EIS), Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project, included the levee construction and was filed with the Council on Environmental Quality in 1975. A Draft Supplement to this EIS was filed with the Environmental Protection Agency in December of 1983, and assessed the increased height for high-level protection and the use of flotation channels. The Final Supplement is scheduled to be filed with EPA in September of 1984.

ESTIMATE OF COST

53. General. Based on July 1984 price levels, the estimated first cost for constructing the Citrus high level plan levee and foreshore protection is $20,600,000. This estimate consists of $822,000 for relocations, $16,944,000 for levees and floodwalls, $1,060,000 for engineering and design, and $1,774,000 for supervision and administration. The detailed estimate of first cost is shown in Table 3.

Table 3
DETAILED ESTIMATE OF FIRST COST
(July 1984 Price Levels)

Cost Acct. No.	Item	Quantity	Unit	Unit Price	Cost
				$	$
11.1	Levee Embankment				
	Mob. and Demob.	Lump Sum	Lump Sum	-	12,000
	Clearing	-	Lump Sum		13,000
	Embankment (semi-compacted)	45,000	C.Y.	8.00	360,000
	Fertilizing, Seeding, and Mulch	15	Acres	800.00	12,000
	Subtotal				397,000
	Contingencies (20%±)				101,000
	Subtotal				480,000
30	Engineering and Design (6%±)				28,300
31	Supervision and Administration (10%±)				48,000
	Total				556,300
02	Relocations				
	1. Removal and Replacement of Approximately 85 Linear Feet of Utility Lines to Facilitate Levee Enlargeent				
	Sta. 32+00 - 4" Ø Gas Line	1	EA	L.S.	2,000
	Sta. 33+40 - 5" Ø Primary Voltage	4	EA	L.S.	7,000
	Sta. 43+29 - 1½" Ø Electric	1	EA	L.S.	2,000
	Sta. 44+44 - 1½" Ø Electric	2	EA	L.S.	3,500
	Sta. 45+76 - 1½" Ø Electric	1	EA	L.S.	2,000
	Sta. 46+95 - 1½" Ø Electric	2	EA	L.S.	3,500
	Sta. 47+92 - 1½" Ø Electric	1	EA	L.S.	2,000
	Sta. 54+00 - 5" Ø Conduits	4	EA	L.S.	7,000
	Sta. 55+00 - 2" Ø Gas Line	1	EA	L.S.	2,000
	Sta. 62+15 - 8" Ø Sewer or Water	1	EA	L.S.	2,000
	Sta. 63+00 - 8" Ø Sewer Line	1	EA	L.S.	2,000

Cost Acct. No.	Item	Quantity	Unit	Unit Price	Cost
				$	$
	2. Removal of Concrete Walkway on Existing Levee Crown Only				
	Concrete Platform (3' x 10' x 3" thick)	64	EA	L.S.	24,000
	Subtotal				59,000
	Contingencies (20%+)				11,800
	Subtotal				70,800
30	Engineering and Design (6%+)				4,200
31	Supervision and Administration (10%+)				7,000
	Total				82,000
11.2	Seepage Cut-Off				
	Mob. and Demob.	Lump Sum	L.S.	-	35,000
	Steel Sheet Piling PZ-22	21,000	S.F.	12.00	252,000
	Subtotal				287,000
	Contingencies (20%+)				53,000
	Subtotal				340,000
30	Engineering and Design (6%+)				20,400
31	Supervision and Administration (10% +)				34,000
	Total				394,000
	Removal and Replacement of Water and Electric Lines to Facilitate Driving Steel Sheet Piling				
02	Relocations				
	Five Campsites 5 Water 5 Electric	10	EA	500	5,000
	Contingencies (20%+)				1,000
	Subtotal				6,000
30	Engineering and Design (6%+)				400
31	Supervision and Administration (10% +)				600
	Total				7,000

Cost Acct. No.	Item	Quantity	Unit	Unit Price	Cost
				$	$
11.3	Foreshore Protection				
	Mob and Demob	Lump Sum	L.S.	-	100,000
	Clearing (41 Acres)	Lump Sum	L.S.	-	41,000
	Shell (in-place)	160,000	CY	20.00	3,200,000
	Crushed Stone (option)				
	Graded Filter Stone 12"	74,000	Ton	20.00	1,480,000
	Graded Stone 28"	203,000	Ton	22.00	4,466,000
	Uniform Stone 36"	176,400	Ton	22.00	3,880,800
	Installation of Drain Pipe-12" CMP (Approx. 2100' Total)	Lump Sum	L.S.	-	52,500
	Flotation Access (4 - Mob Sites)	Lump Sum	L.S.	-	200,000
	Subtotal				13,420,300
	Contingencies (20%±)				2,703,700
	Subtotal				16,124,000
30	Engineering and Design (6%±)				962,000
31	Supervision and Administration (10% ±)				1,610,000
	Total				18,696,000
02	Relocations				
	Removal and Replacement of Approx. 80 Feet of Timber Walkways, Waterlines, Electric Lines for Each Campsite	96	EA	Lump Sum	336,000
	Installation of Telephone Poles 1/ 121 - 35.5' poles 4 - 45.3' poles	Lump Sum	L.S.	-	260,000
	Railroad Insurance 1/	Lump Sum	L.S.	-	25,000
	Subtotal				621,000
	Contingencies (20%±)				124,200
	Subtotal				745,200
30	Engineering and Design (6%±)				44,700
31	Supervision and Administration (10% ±)				74,400
	Total				864,300

1/ These two line items will be provided as a cash contribution by local interest after bid opening.

54. Comparison of Estimates. The current estimate of $20,600,000 for the high level plan Citrus levee and foreshore protection represents an increase of $8,557,000 when compared to the remaining costs contained in the current barrier plan PB-3 estimate effective 1 Oct 1983. The PB-3 estimate is based on the detailed estimates contained in Design Memorandum No. 2, General Design Supplement No. 5A, Citrus Lakefront Levee IHNC to Paris Road, approved 12 July 1976 and escalated to October 1983 price levels. Table 4 shows a comparison by accounts of remaining costs necessary to complete the barrier plan to estimated costs required to construct the high level plan Citrus Lakefront reach. The increase in project costs shown in Table 4 can be attributed solely to added requirements necessary for the high level plan construction. The estimates shown for engineering and design and supervision and administration are based on an analysis of actual work necessary to construct the high level plan rather than applying a fixed percentage to the construction cost.

Table 4
COMPARISON OF ESTIMATES
(Remaining Costs)

	Feature	PB-3 (eff Oct 83)	GDM (July 84 Prices)	Difference GDM and PB-3
11	LEVEES & FLOODWALLS	10,354,000	16,944,000	+ 6,590,000
30	ENGINEERING & DESIGN	722,000	1,060,000	+ 338,000
31	SUPERVISION & ADMINISTRATION	563,000	1,774,000	+ 1,211,000
	SUBTOTAL	11,639,000	19,778,000	+ 8,139,000
01	LANDS & DAMAGES	0	0	+ 0
02	RELOCATIONS	404,000	822,000	+ 418,000
	SUBTOTAL	404,000	822,000	+ 418,000
	TOTAL PROJECT COST	12,043,000	20,600,000	+ 8,557,000

SCHEDULE FOR DESIGN AND CONSTRUCTION

55. Schedule for Design and Construction. The schedule is as follows:

Contract
Levee & Foreshore Protection
from Sta. 27+28.53 to Sta. 289+58.59,
and from Sta. 304+31.48 to sta. 331+50

Plans & Specs

Start	Complete
May 84	Aug 84

Construction

Advert.	Award	Complete
Nov 84	Jan 85	July 86

Est. Constr. Costs Include 20% for
Cont., 10% for S&I
$18,636,000

56. Funds Required by Fiscal Year. To maintain the schedule for design and construction of the Citrus Lakefront Levee - IHNC to Paris Road and Foreshore Protection, Federal funds will be required by fiscal years as follows:

Funds Required FY 85	$ 5,000,000
Funds Required FY 86	15,100,000
TOTAL	$20,100,000

OPERATION AND MAINTENANCE

57. General. The Citrus Lakefront levee will be maintained and operated at the expense of local interests as a feature of local cooperation for the project. The estimate of the annual operation and maintenance costs for the levee and foreshore protection features which are detailed in this GDM are as follows:

levee	- $18,000
foreshore protection	- $ 2,000

Maintenance for other features within the Citrus Lakefront reach will be addressed in a supplement to this GDM.

ECONOMICS

58. Economic Justification. The current economic analysis for the entire Lake Pontchartrain, Louisiana and Vicinity hurricane protection project is contained in the Reevaluation Study entitled Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project, dated December 1983. Based on October 1983 price levels and at the project interest rate of 3 1/8 percent, the benefit-cost ratio for the project as a whole is 4.2 to 1. The Reevaluation Study also breaks out the separable economic areas of the project for incremental justification. The Citrus Lakefront reach is a part of the New Orleans East economic area. The computed benefit-cost ratio for the New Orleans East area is also 4.2 to 1.

FEDERAL AND NON-FEDERAL COST BREAKDOWN

59. Federal and Non-Federal Cost Breakdown. The breakdown of the high level plan construction cost for the work described in this GDM are shown in Table 5 below:

Table 5
FEDERAL AND NON-FEDERAL COST BREAKDOWN
JULY 1984 PRICE LEVELS

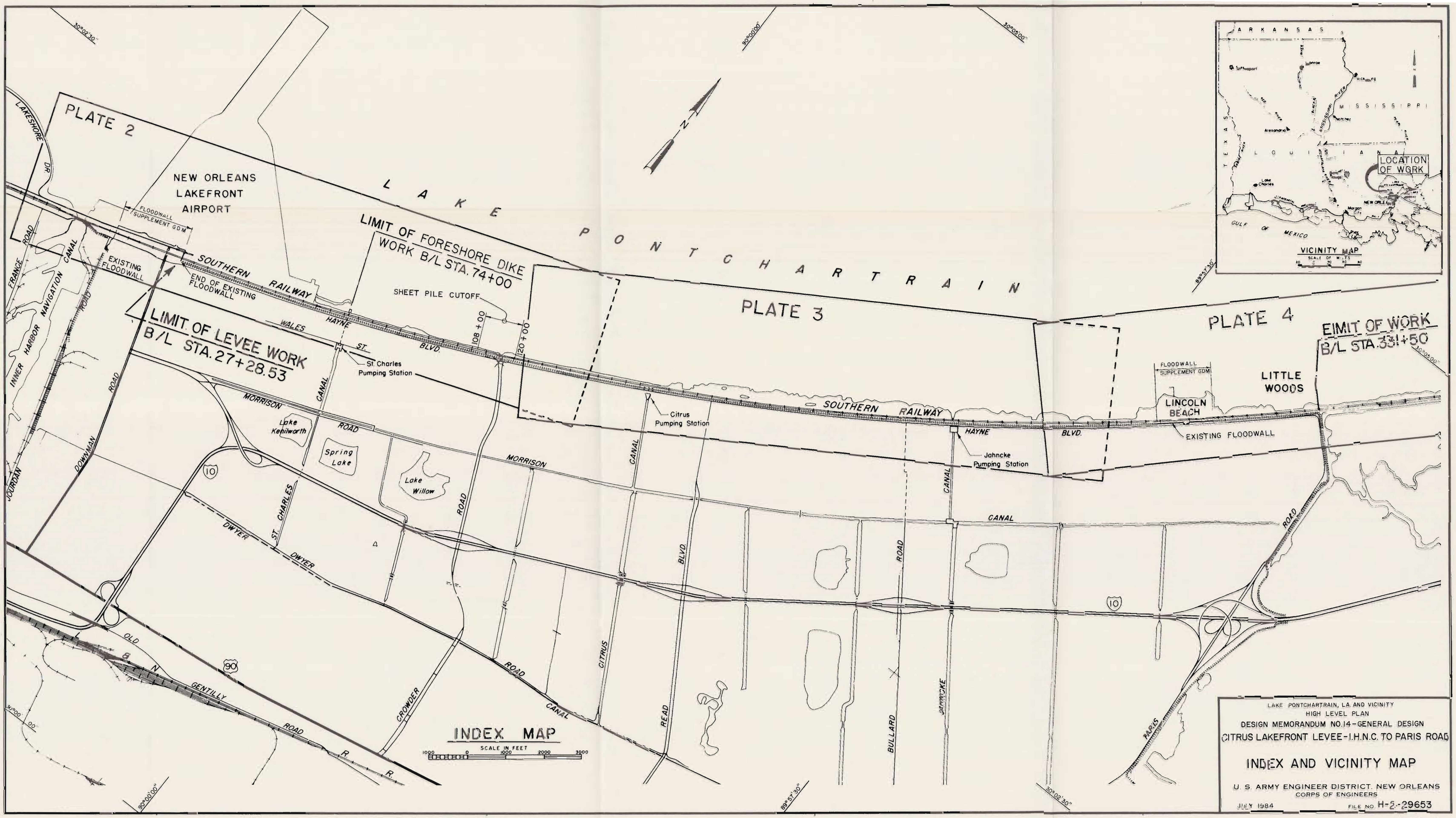
Item	Federal	Non-Federal	Total
Levees & Foreshore Protection	14,400,000	5,378,000	19,778,000
Relocations	-	822,000	822,000
TOTAL	14,400,000	6,200,000	20,600,000

WATER CONSERVATION MEASURES

60. General. The use of water conservation measures in the construction and operation of work covered by the GDM were investigated during the preparation of this report. Because of the nature of the construction activity planned for the Citrus Lakefront reach, it was concluded that the required construction does not afford the opportunity to use these measures. Furthermore, land use activities for the lands protected by this levee reach are not expected to change materially over the project life. The area in question is a highly developed urbanized area containing industrial, commercial, and residential development. Usage of potable water is not expected to increase as a result of project construction.

RECOMMENDATIONS

61. Recommendations. The plan of improvement for the high level plan presented herein consists of 5.5 miles of levee enlargement along the Citrus lakefront from IHNC to Paris Road. This plan includes suitable provisions for erosion protection and necessary relocations. This plan is considered to be the most economical means of providing high level plan, SPH - project protection and is recommended for approval as a basis for preparing plans and specifications for this project reach.

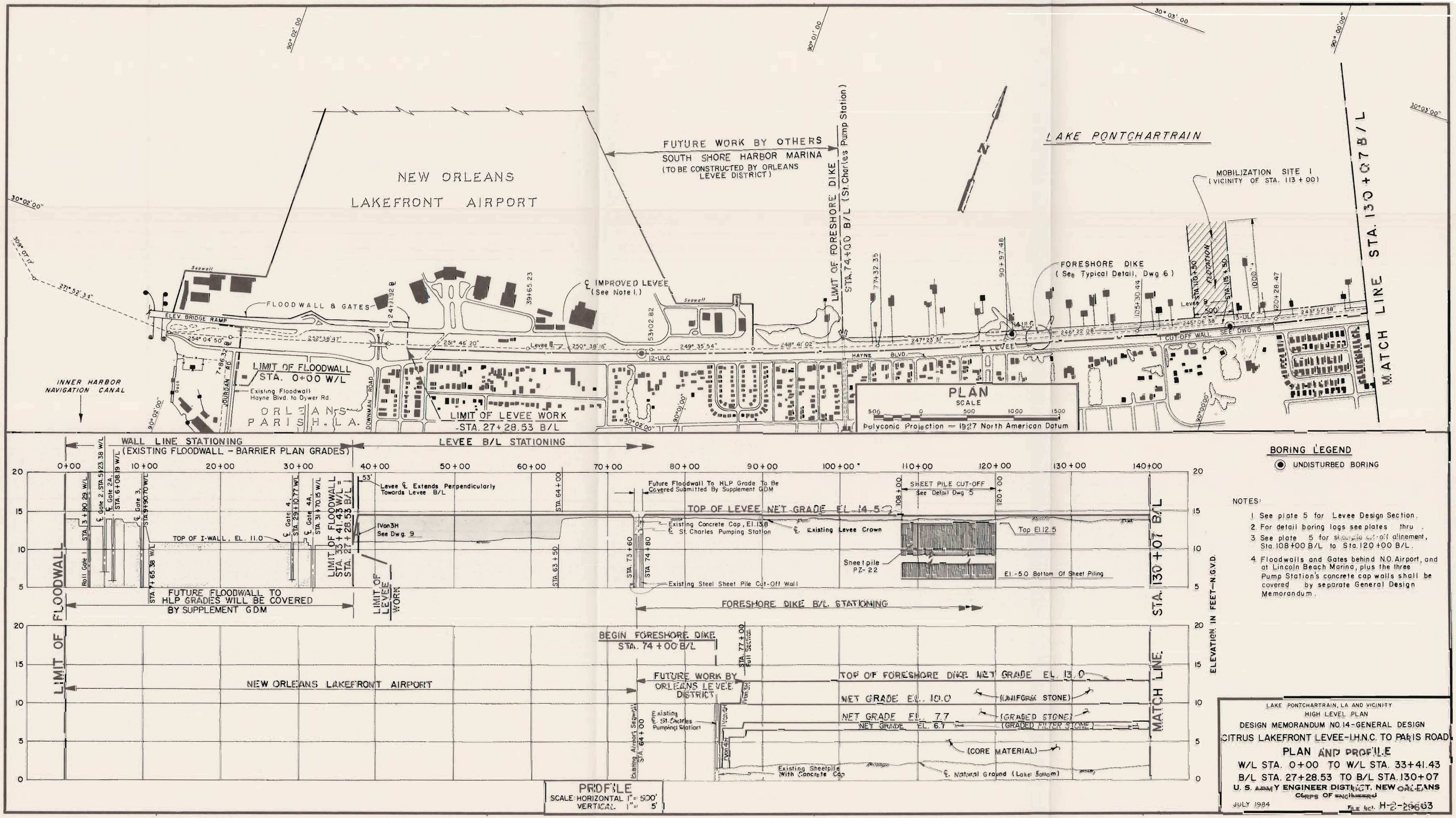


LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD

INDEX AND VICINITY MAP

U. S. ARMY ENGINEER DISTRICT. NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984 FILE NO. H-2-29653

PLATE 1



BORING LEGEND

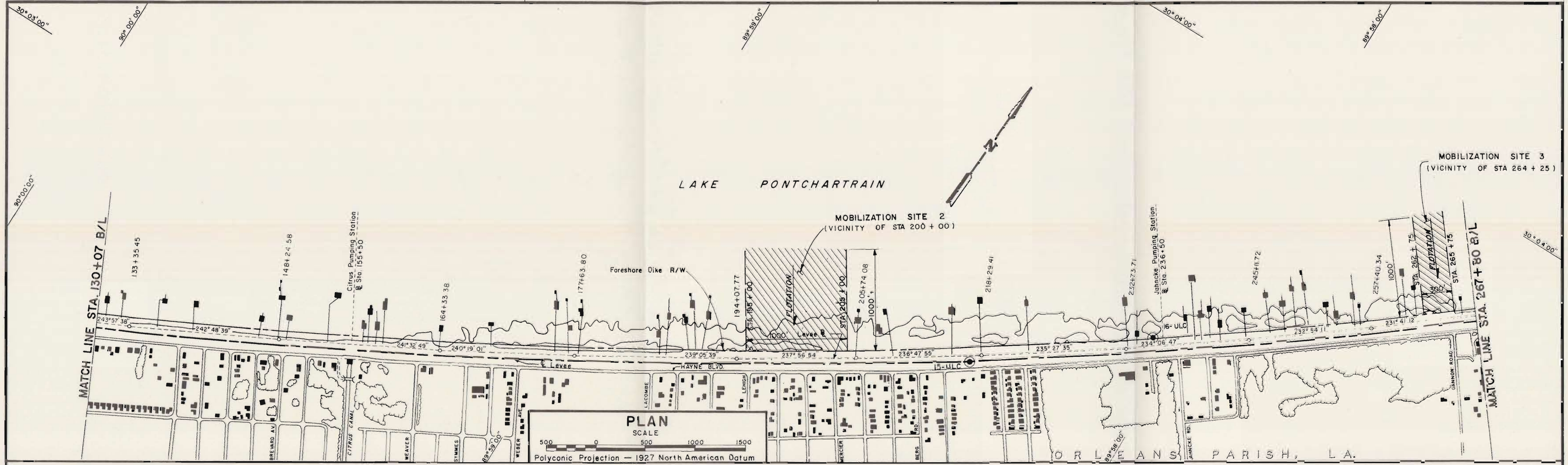
◉ UNDISTURBED BORING

NOTES:

1. See plate 5 for Levee Design Section.
2. For detail boring logs see plates thru .
3. See plate 5 for sheetpile cut-off alinement, Sta. 108+00 B/L to Sta. 120+00 B/L.
4. Floodwalls and Gates behind N.O. Airport, and at Lincoln Beach Marina, plus the three Pump Station's concrete cap walls shall be covered by separate General Design Memorandum.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - I.H.N.C. TO PARIS ROAD
PLAN AND PROFILE
W/L STA. 0+00 TO W/L STA. 33+41.43
B/L STA. 27+28.53 TO B/L STA. 130+07
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984 FILE NO. H-2-29653

PLATE 2



PLAN

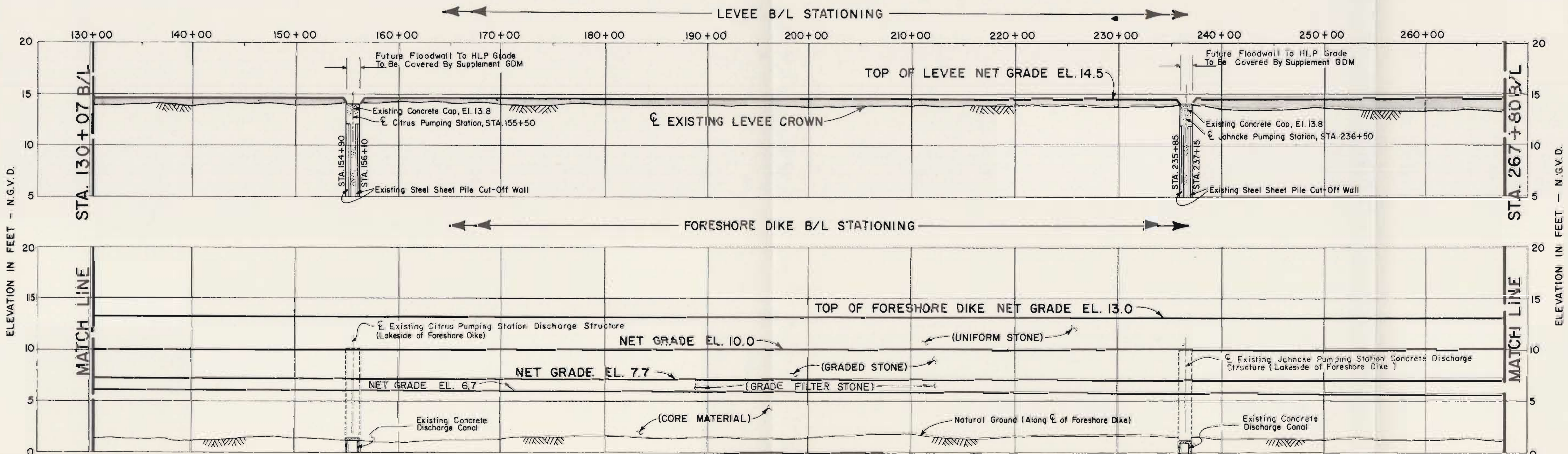
SCALE

500 0 500 1000 1500

Polyconic Projection — 1927 North American Datum

BORING LEGEND

● UNDISTURBED BORING



PROFILE

SCALE: HORIZONTAL 1" = 500'
VERTICAL 1" = 5'

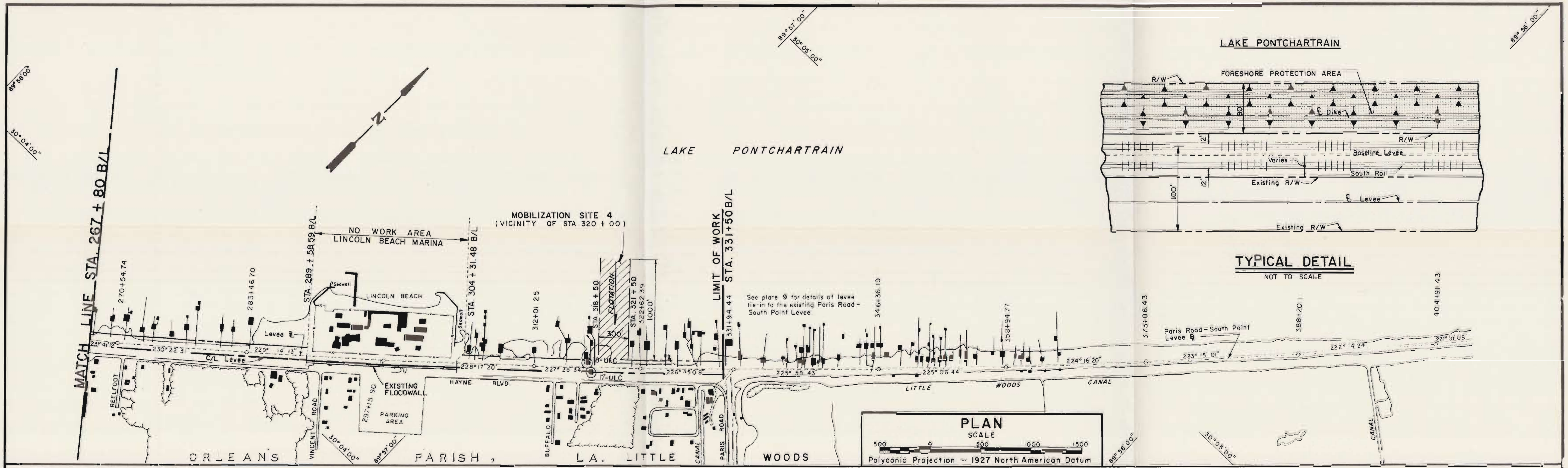
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - I.H.N.C. TO PARIS ROAD

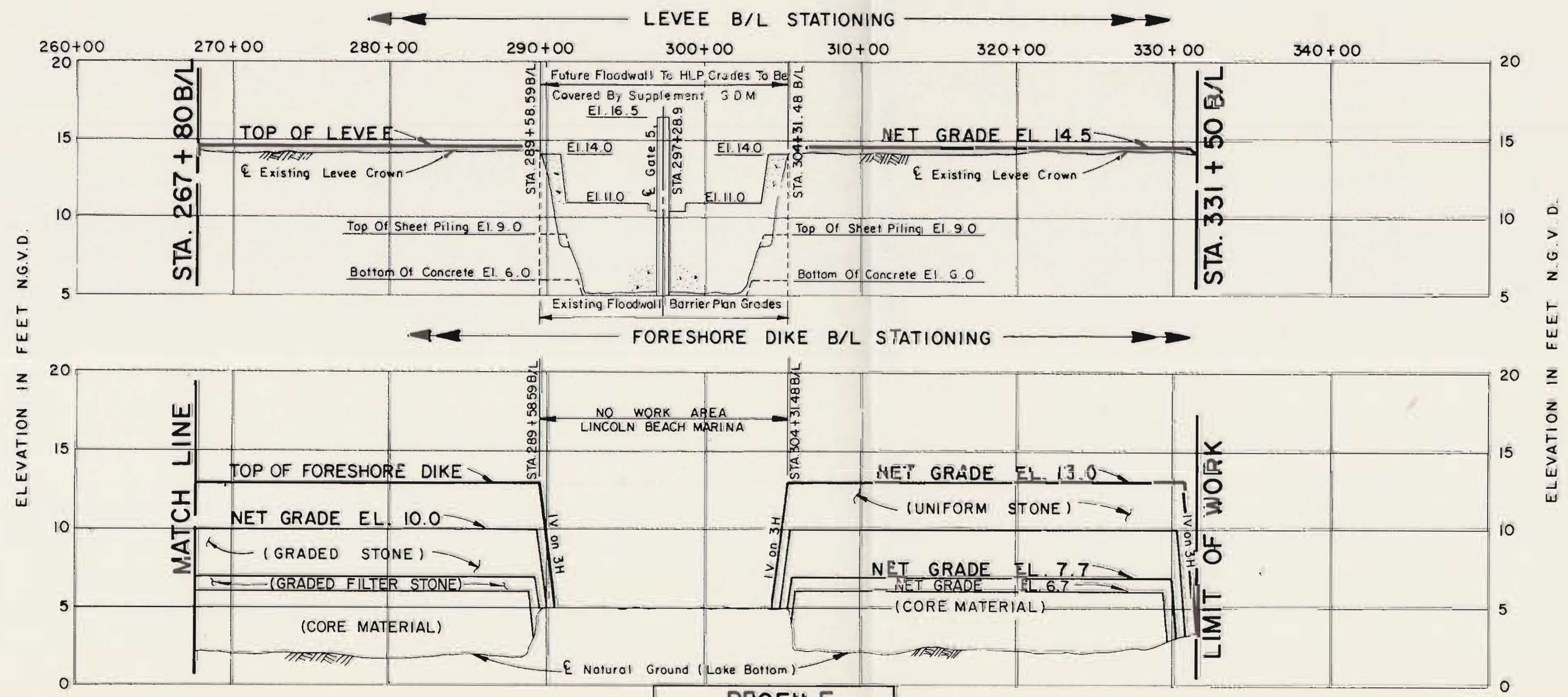
PLAN AND PROFILE

STA. 130+07 TO STA. 267+80

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984 FILE NO. H-2-29653





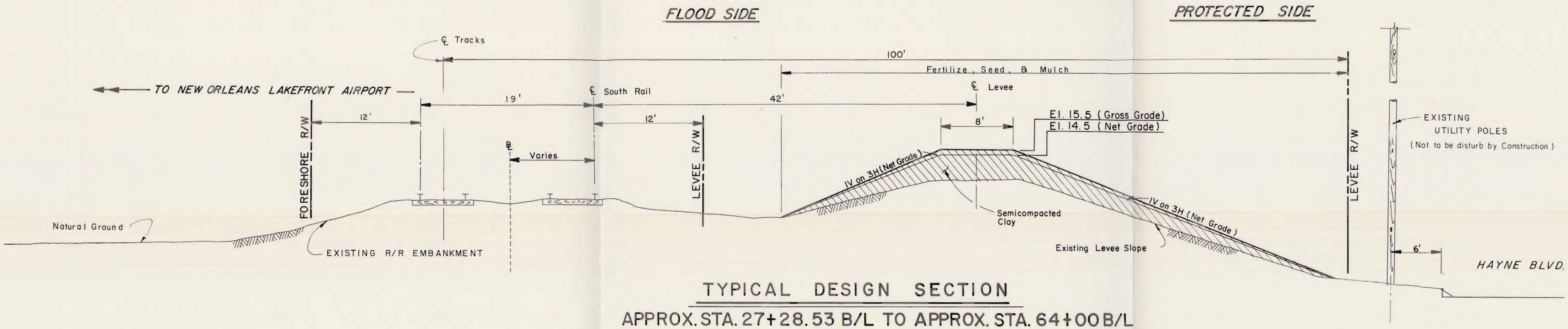
PROFILE
SCALE HORIZONTAL 1" = 500'
VERTICAL 1" = 5'

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - I.H.N.C. TO PARIS ROAD

PLAN AND PROFILE

STA. 267 + 80 TO STA. 331 + 50

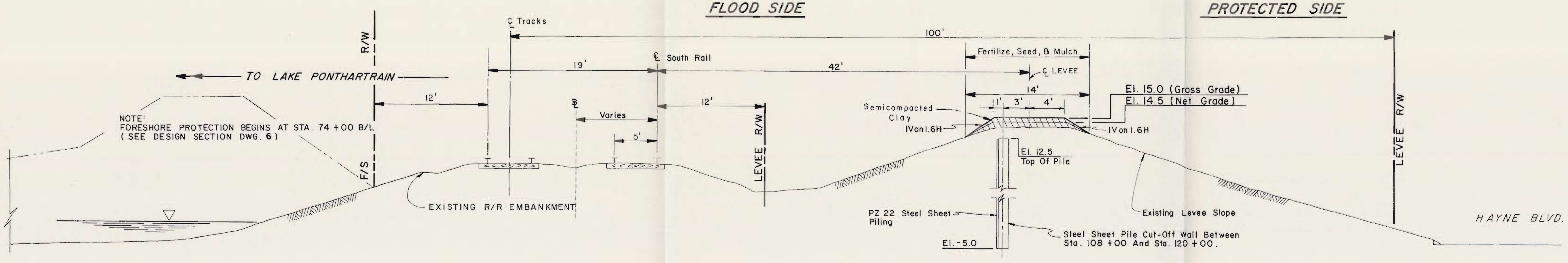
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



TYPICAL DESIGN SECTION

APPROX. STA. 27+28.53 B/L TO APPROX. STA. 64+00 B/L

NOT TO SCALE



TYPICAL DESIGN SECTION

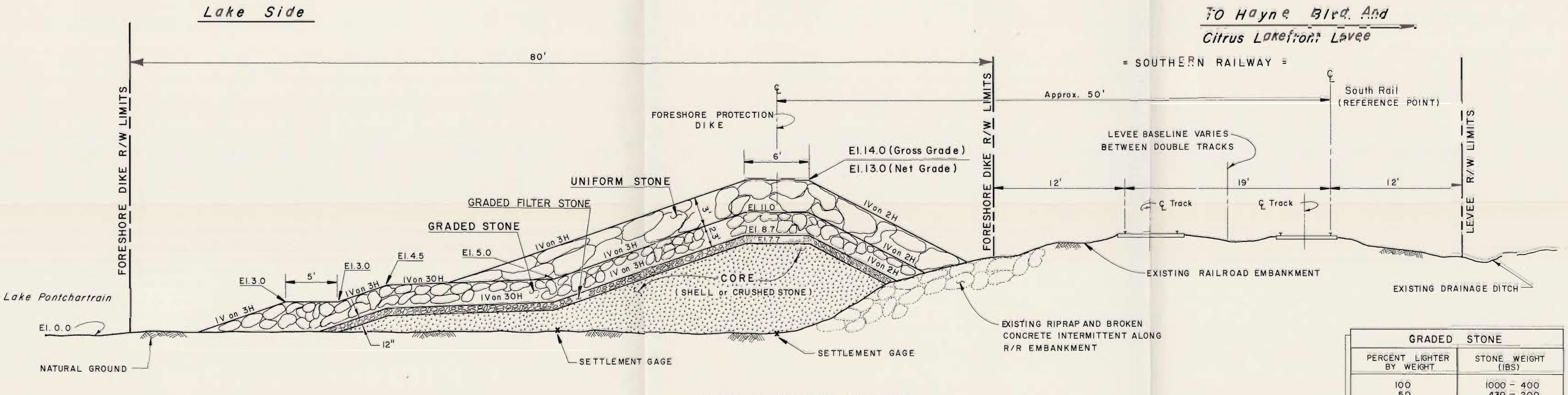
APPROX. STA. 64+00 B/L TO APPROX. STA. 108+00 B/L
APPROX. STA. 120+00 B/L TO APPROX. STA. 289+58.59 B/L
APPROX. STA. 304+31.48 B/L TO APPROX. STA. 331+50 B/L

NOT TO SCALE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE I.H.N.C. TO PARIS ROAD

LEVEE DESIGN SECTIONS

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



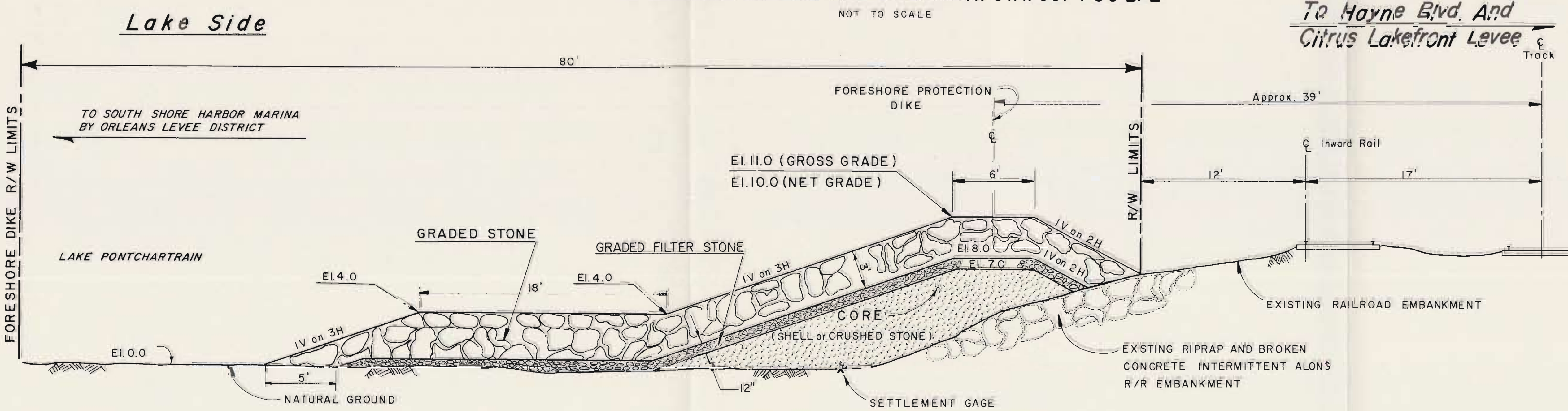
TYPICAL DESIGN SECTION

APPROX. STA. 77 + 00 B/L TO APPROX. STA. 289 + 58 B/L
APPROX. STA. 304 + 31 B/L TO APPROX. STA. 331 + 50 B/L
NOT TO SCALE

GRADED STONE	
PERCENT LIGHTER BY WEIGHT	STONE WEIGHT (IBS)
100 50 15	1000 - 400 430 - 200 210 - 60

UNIFORM STONE	
PERCENT LIGHTER BY WEIGHT	STONE WEIGHT (IBS)
100 25 0	2100 1660 1250

GRADED FILTER STONE	
PERCENT LIGHTER BY WEIGHT	STONE WEIGHT (LBS)
100 50 15	50 - 20 20 - 10 10 - 5



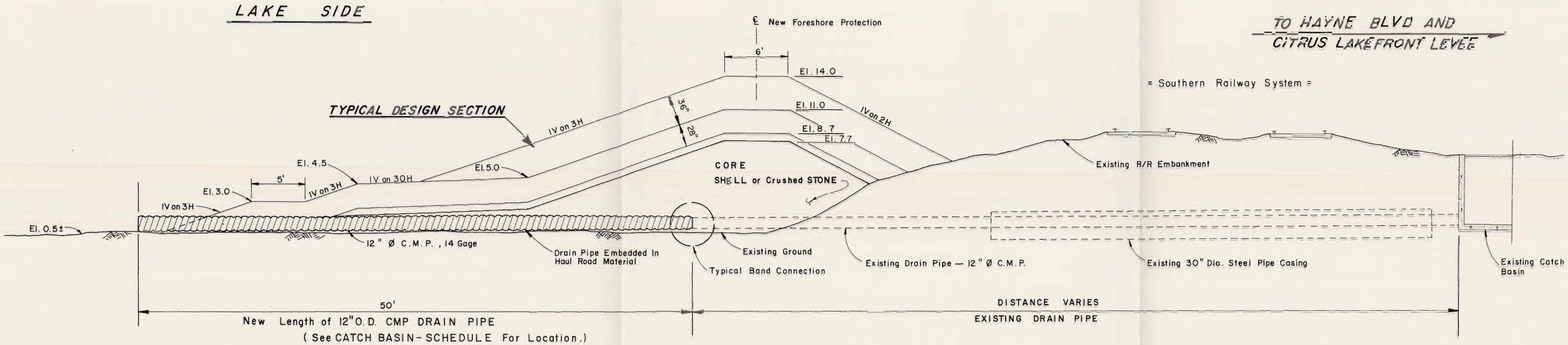
MODIFIED DESIGN SECTION

APPROX. STA. 74 + 00 B/L TO APPROX. STA. 77 + 00 B/L
NOT TO SCALE

LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE I.H.N.C. TO PARIS ROAD

FORESHORE DIKE DESIGN
SECTIONS

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



TYPICAL SECTION AT DRAIN PIPE

NOT TO SCALE

CATCH BASIN SCHEDULE

APPROX. B/L STATIONS

75 + 00
80 + 00
86 + 00
92 + 00
98 + 00
104 + 00
110 + 00
116 + 00
122 + 00
128 + 00
134 + 00
140 + 00
146 + 00
152 + 00
160 + 00
166 + 00
172 + 00
178 + 00
184 + 00
190 + 00
196 + 00
202 + 00
208 + 00
214 + 00
220 + 00
226 + 00
232 + 00
238 + 00
244 + 00
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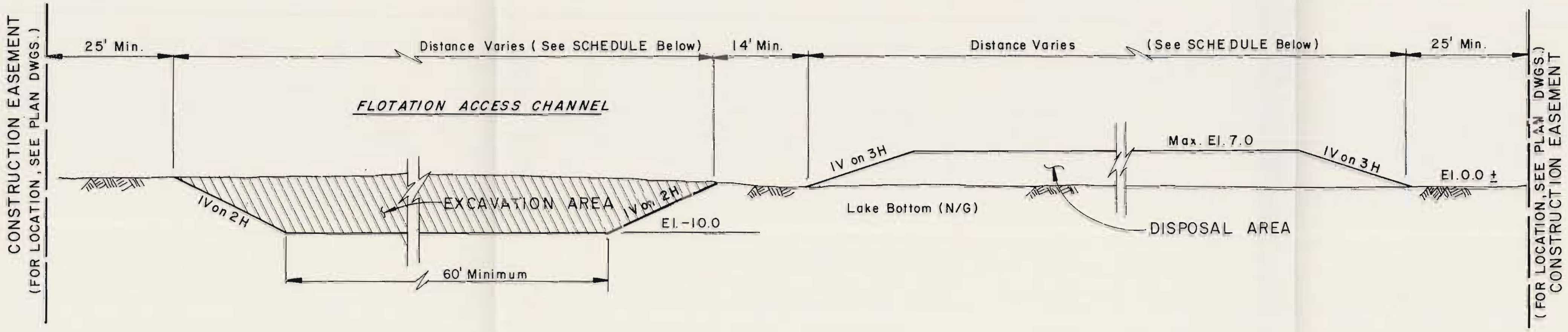
305 + 50
311 + 00
317 + 00
323 + 00
329 + 00



FLOTATION ACCESS CHANNEL TYPICAL SECTION

NOT TO SCALE

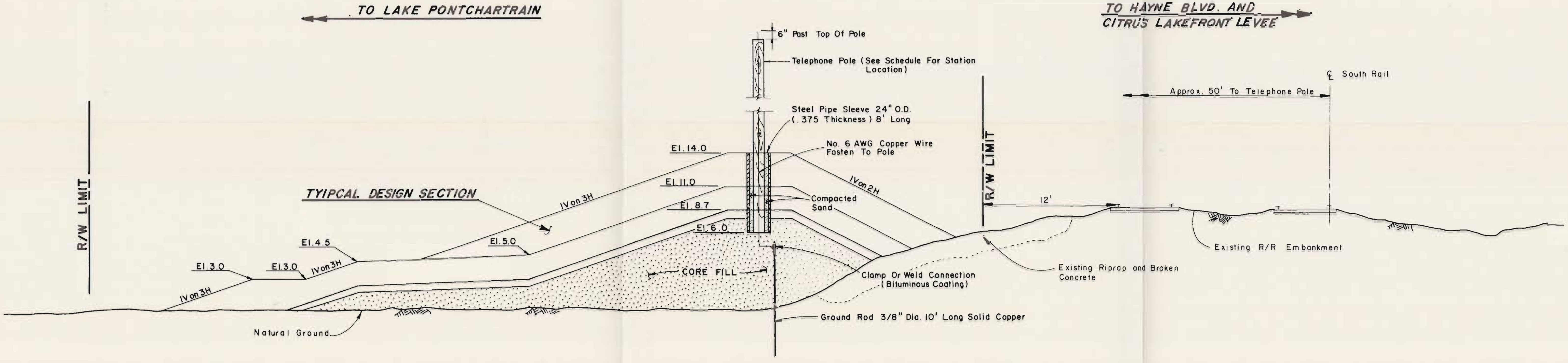
VICINITY OF MOBILIZATION SITES				
STATION		MAXIMUM PERMISSIBLE DIMENSIONS		
		TOTAL WIDTH	CHANNEL	SPOIL
1	113 + 00	500'	218'	218'
2	200 + 00	1000'	468'	468'
3	264 + 75	300'	118'	118'
4	320 + 00	300'	118'	118'

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD

DRAIN PIPE AND FLOTATION ACCESS CHANNEL SECTIONS

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984 FILE NO.



TYPICAL POLE INSTALLATION-DETAIL

NOT TO SCALE

POLE INSTALLATION SCHEDULE

GR 77 + 30	GR 127 + 30	173 + 30	223 + 30	273 + 30
79 + 30	129 + 30	175 + 30	225 + 30	275 + 30
81 + 30	131 + 30	GR 177 + 30	GR 227 + 30	GR 277 + 30
83 + 30	133 + 30	179 + 30	229 + 30	279 + 30
85 + 30	135 + 30	181 + 30	231 + 30	281 + 30
GR 87 + 30	136 + 70	183 + 30	233 + 30	283 + 30
89 + 30	GR 138 + 12 *	185 + 30	235 + 30	285 + 30
91 + 30	139 + 30	GR 187 + 30	GR 237 + 30	287 + 30 *
93 + 30	141 + 30	189 + 30	239 + 30	GR 289 + 26.59
95 + 30	143 + 30	191 + 30	241 + 30	GR 304 + 40
GR 97 + 30	145 + 30	193 + 30	243 + 30	306 + 40
99 + 30	GR 147 + 30	195 + 30	245 + 30	308 + 40
101 + 30	149 + 30	GR 197 + 50	GR 247 + 30	310 + 20
103 + 30	151 + 30	199 + 70 *	249 + 30	312 + 10
105 + 30	153 + 30	201 + 30	251 + 30	313 + 60
GR 107 + 30	154 + 60	203 + 30	253 + 30	GR 315 + 30
109 + 30	156 + 00	205 + 30	255 + 30	317 + 30
111 + 30	GR 157 + 30	GR 207 + 30	GR 257 + 30	319 + 10
113 + 30	159 + 30	209 + 30	259 + 30	320 + 80
115 + 30	161 + 30	211 + 30	261 + 30	322 + 60
GR 117 + 30	163 + 30	213 + 30	263 + 30	324 + 00
119 + 30	165 + 30	215 + 30	265 + 30	GR 325 + 50 ●
121 + 30	GR 167 + 30	GR 217 + 30	GR 267 + 30	GR 327 + 00 ●
123 + 30	169 + 30	219 + 30	269 + 30	GR 328 + 50 ●
125 + 30	171 + 30	221 + 30	271 + 30	GR 330 + 00 ●

POLE LEGEND

*	CABLE CROSSING POLES
GR	GROUND ROD & WIRE
●	45' CLASS 3 POLES

NOTES:

1. TELEPHONE POLE - Removal of approximately 169 poles and the installation of approximately 125 as indicated on Pole Installation Schedule.

2 TREATMENT - All poles shall be Southern Pine Treated with Pentachlorophenol in Petroleum.

3 CLASS & SIZE - Req'd 4 each, Class 3, 45 ft. length
Req'd 121 each, Class 5, 35 ft. length

4 PIPE SLEEVES - Required 125 each Steel Pipe Sleeve, 24" O.D (.375 Thickness) 8 ft. long. Steel Pipe Sleeves shall be centered on pole and set 2 ft into the core materal. Void between the pole and the inside wall of pipe shall be fill with compacted sand

5 GROUND ROD & WIRE - Required 28 each Ground Rod 3/8" dia Solid Copper, 10' long shall be placed at the bottom of the pipe sleeve and electrically connected either by clamping (Requiring Bituminous Coating) or welding to a number 6 AWG Copper wire which will be fastened to the pole and extending to a height of 6" above the top of pole. Location of poles with ground rod and wire is indicated by the symbol "GR" on the Pole Installation Schedule.

6 IDENTIFICATION - Contractor should request from pole supplier that all poles meet SCB specifications and that each pole be branded 10' from the butt, with the following information.

Example:

TYPE POLE & TREATMENT
SIZE & CLASS
YEAR
MANUFACTURE

South Central Bell's suggested source of inspected type pole is COLFAX CREOSOTEING COMPANY PINEVILLE, LA.

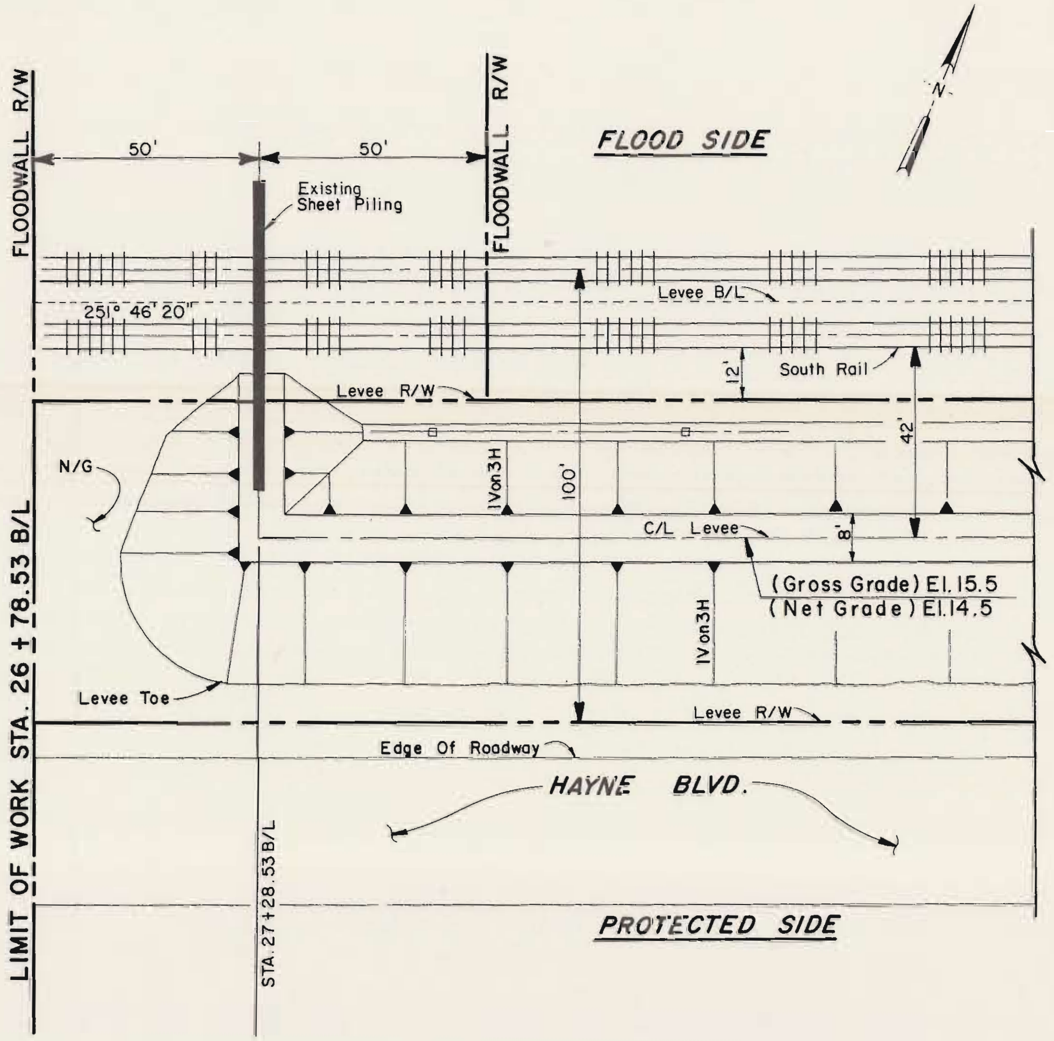
7 CABLE CROSSING - Contractor must contact South Central Bell representative shown below before installation of any cable crossing pole designated by asterisk on pole installation schedule.

RONALD R. RIEGER, ENGR.
SOUTH CENTRAL BELL
4101 PAUGER ST.
NEW ORLEANS, LA. 70122
PHONE (504) 245-5420

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - I.H.N.C. TO PARIS ROAD

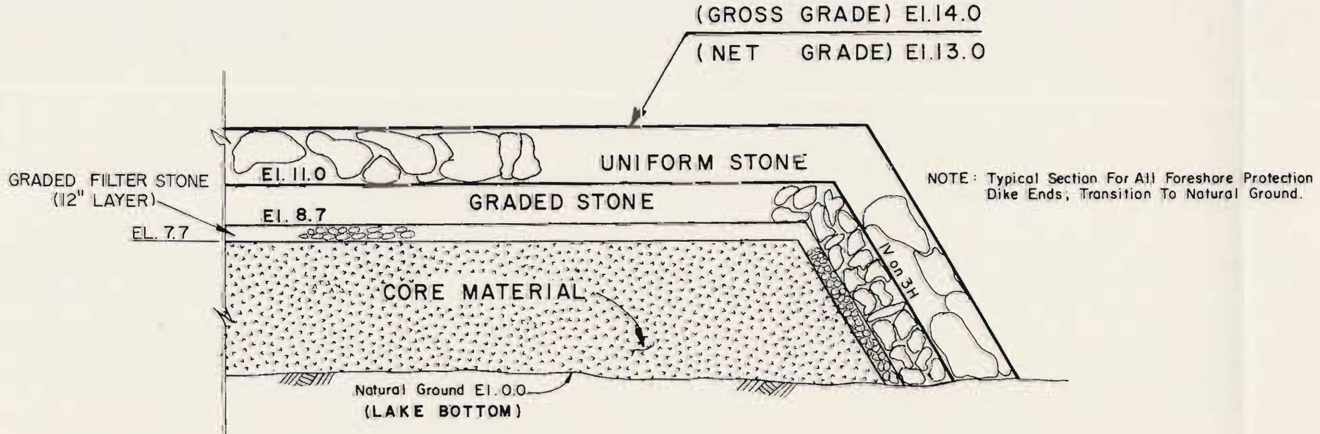
TYPICAL POLE INSTALLATION-DETAIL

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-20653



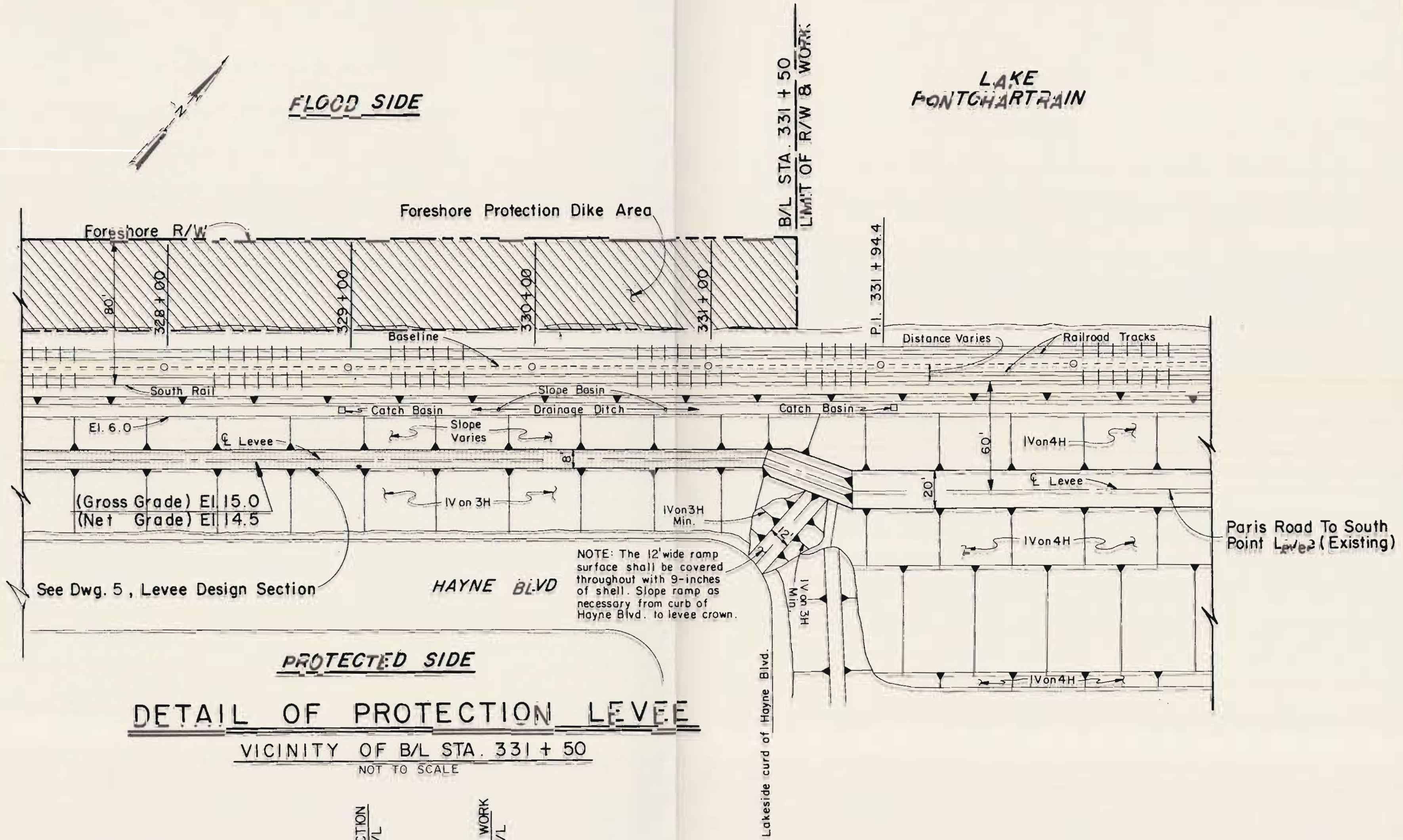
DETAIL OF PROTECTION LEVEE

VICINITY OF B/L STA. 27+28.53
NOT TO SCALE



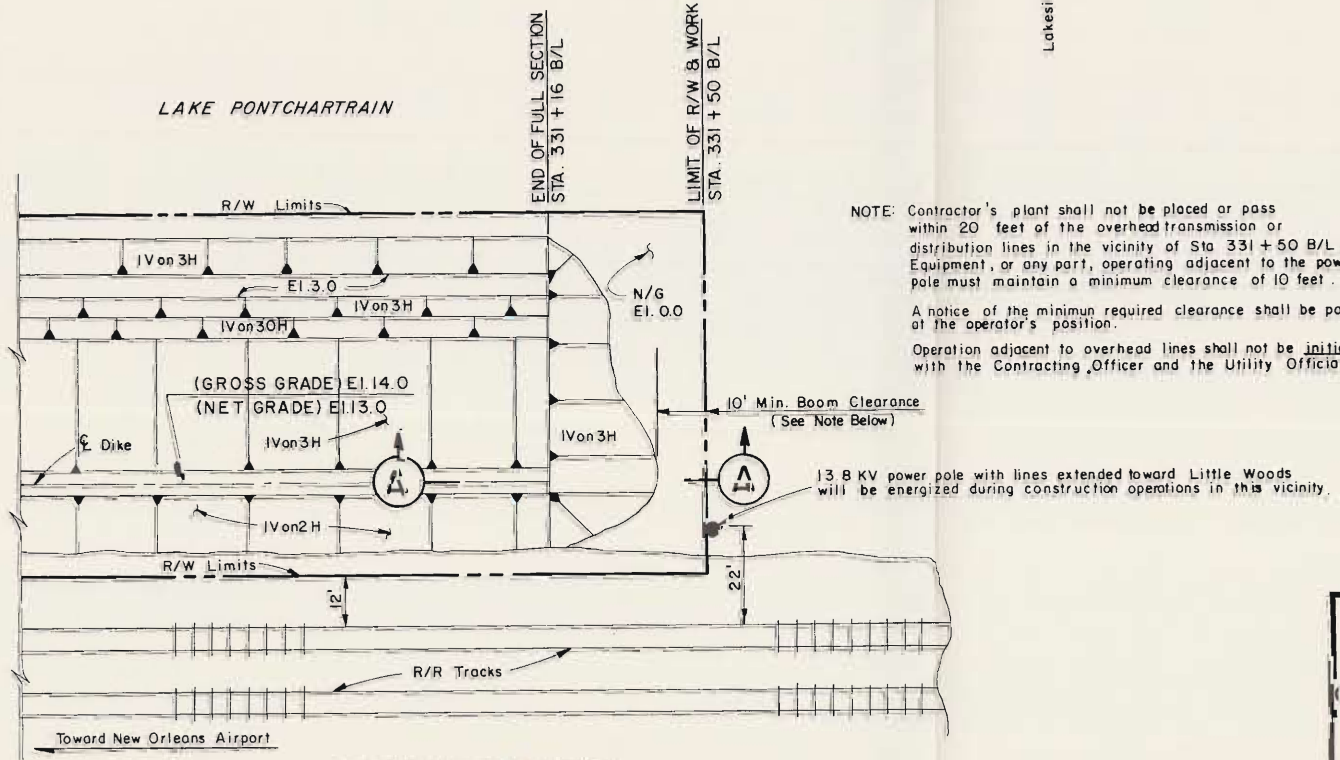
SECTION (A)

NOT TO SCALE



DETAIL OF PROTECTION LEVEE

VICINITY OF B/L STA. 331 + 50
NOT TO SCALE



NOTE: Contractor's plant shall not be placed or pass within 20 feet of the overhead transmission or distribution lines in the vicinity of Sta 331 + 50 B/L. Equipment, or any part, operating adjacent to the power pole must maintain a minimum clearance of 10 feet.

A notice of the minimun required clearance shall be posted at the operator's position.

Operation adjacent to overhead lines shall not be initiated until coordinated with the Contracting Officer and the Utility Officials.

Vicinity Sta. 331+50 B/L

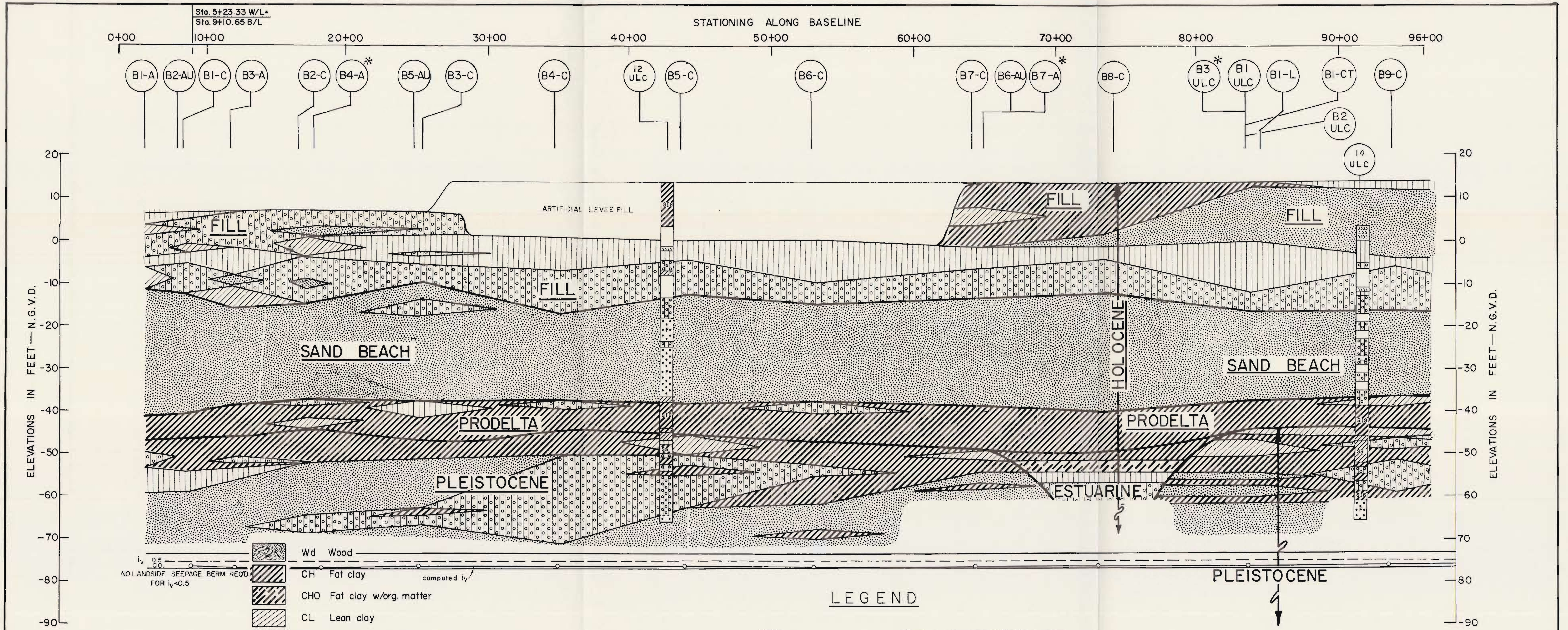
DETAIL OF FORESHORE DIKE END

NOT TO SCALE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE I.H.N.C. TO PARIS ROAD

MISCELLANEOUS DETAILS

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



▨ Wd Wood

▨ CH Fat clay

▨ CHO Fat clay w/org. matter

▨ CL Lean clay

▨ CLO Lean clay w/org. matter

▨ SI Shells

▥ ML Silt

▥ MLO Silt w/org. matter

▨ SM Silty sand

▨ Sp Fine sand

Boring omitted in developing profile stratification

(B6-AU) Soil Boring No. 6-AU

LEGEND

	FILL –	Medium to very stiff clays, silts, silty sands & sands
HOLOCENE	INTERDISTRIBUTARY –	soft to medium clays w/SIS, ss & slf
	SAND BEACH –	Fine to medium sand w/cs, sl, & slf
	PRODELTA –	Medium to stiff clays w/slf
	ESTUARINE –	Soft to medium clays, silts, silty sands & sands, w/wd & slf.
PLEISTOCENE		stiff to very stiff clays, silt & large layers of silty sand & sand

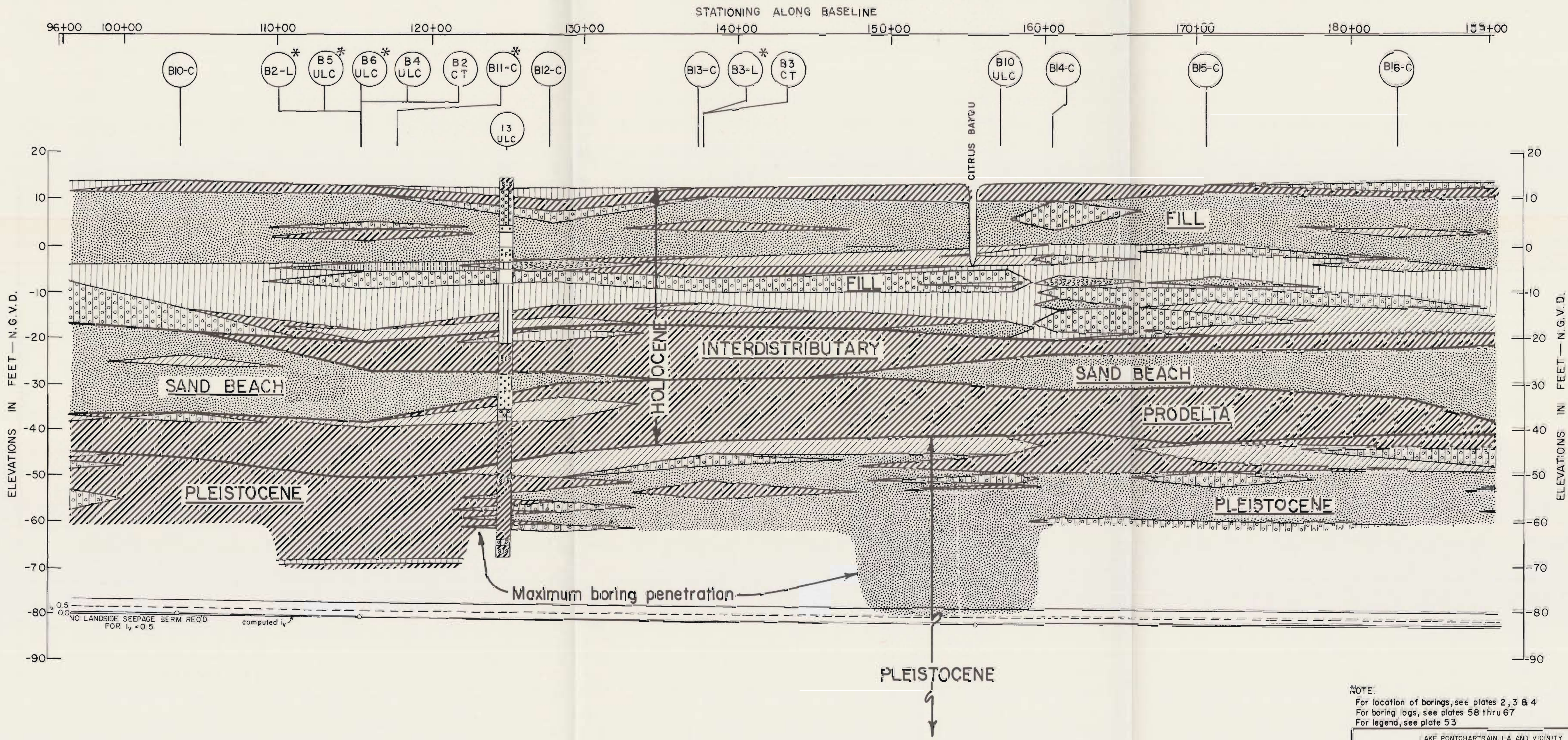
NOTE:
For location of borings, see plates 2, 3 & 4
For boring logs, see plates 58 thru 67

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 – GENERAL DESIGN
CITRUS LAKEFRONT LEVEE I.H.N.C. TO PARIS ROAD

SOIL AND GEOLOGIC PROFILE

STA. 0+00 B/L TO STA. 96+00 B/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653

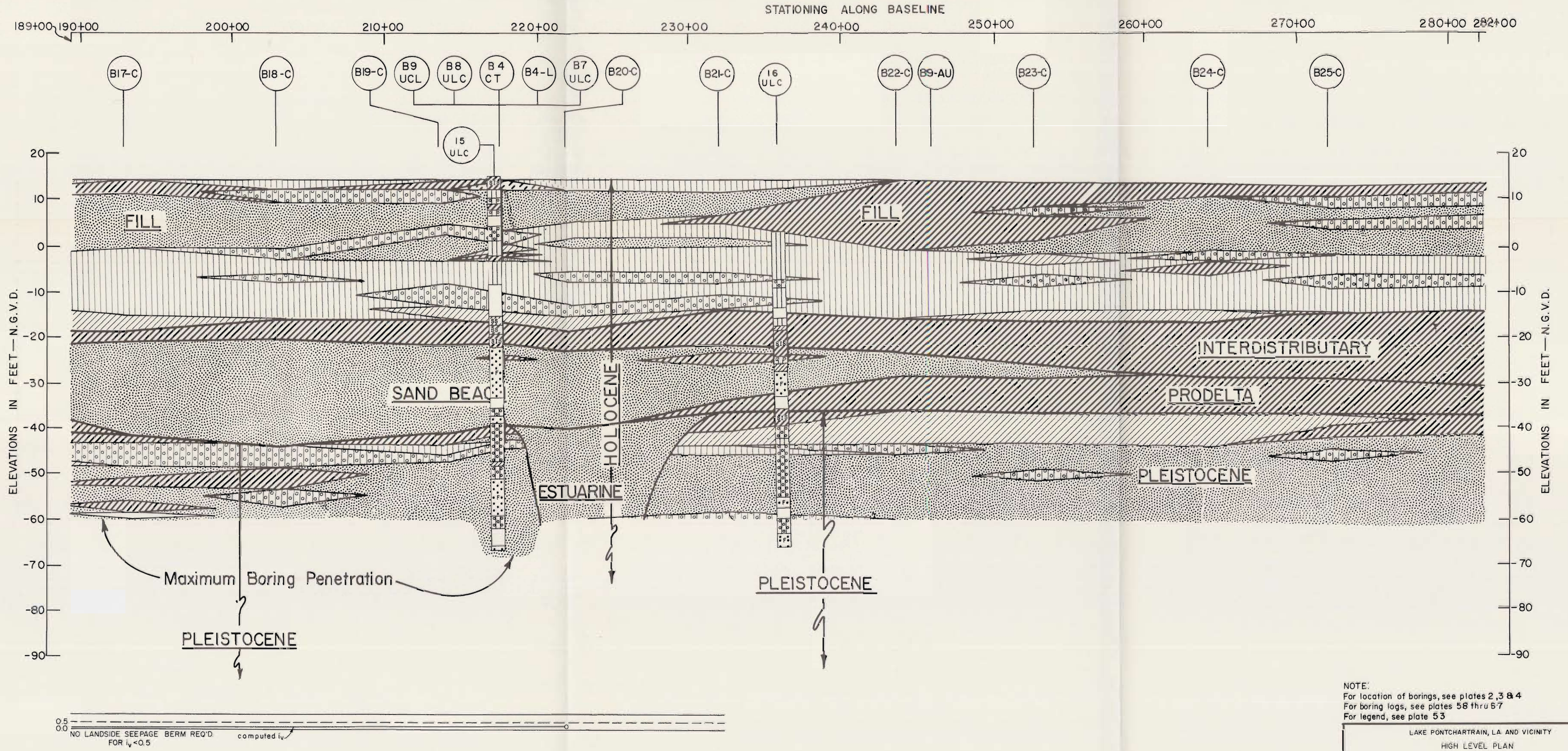


NOTE:
For location of borings, see plates 2, 3 & 4
For boring logs, see plates 58 thru 67
For legend, see plate 53

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE I.H.N.C. TO PARIS ROAD

SOIL AND GEOLOGIC PROFILE

STA. 96+00 B/L TO STA. 189+00 B/L
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



NOTE:
For location of borings, see plates 2,3 & 4
For boring logs, see plates 58 thru 67
For legend, see plate 53

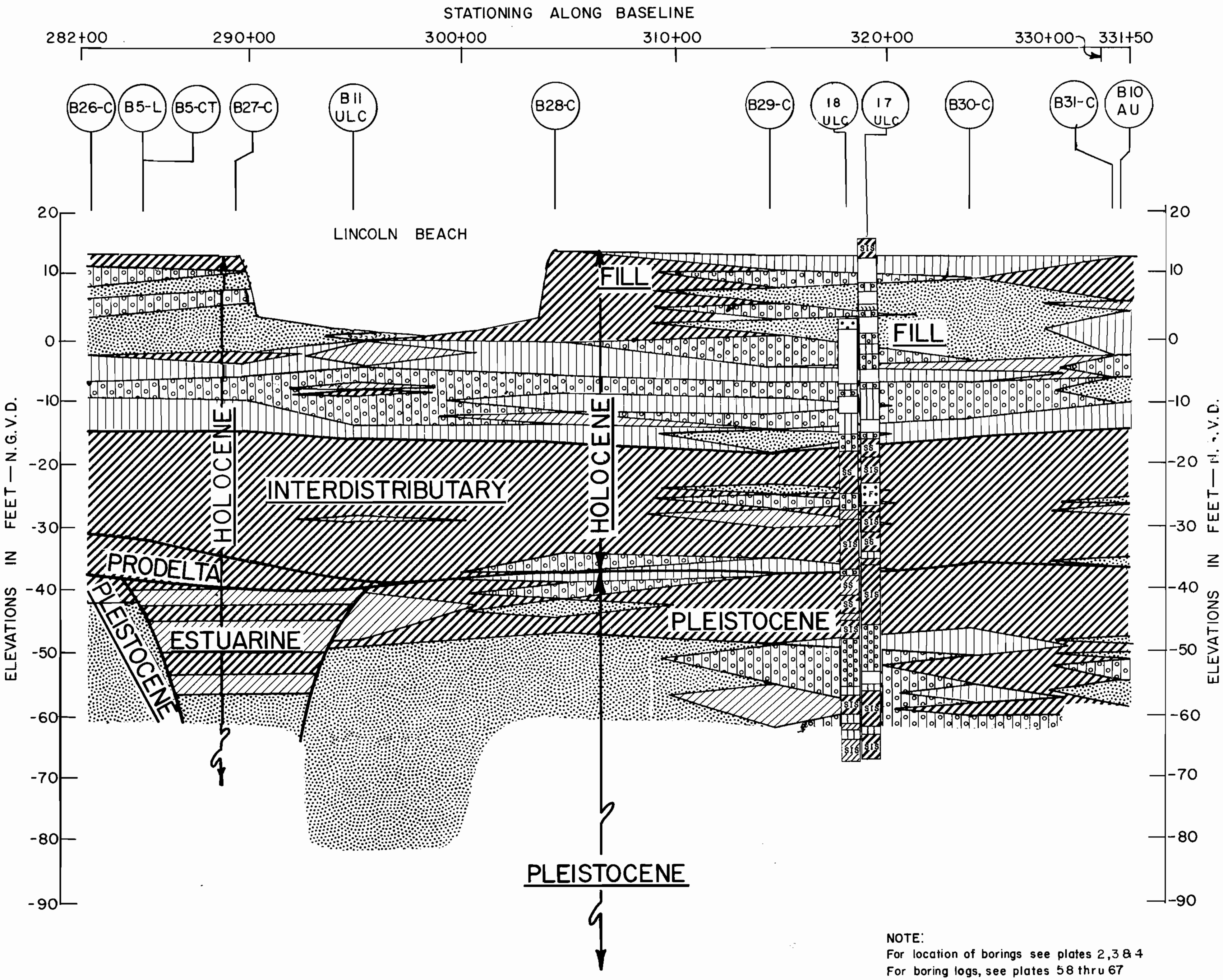
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN

DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD

SOIL AND GEOLOGIC PROFILE

STA. 189+00 B/L TO STA. 282+00 B/L
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653

PLATE 12



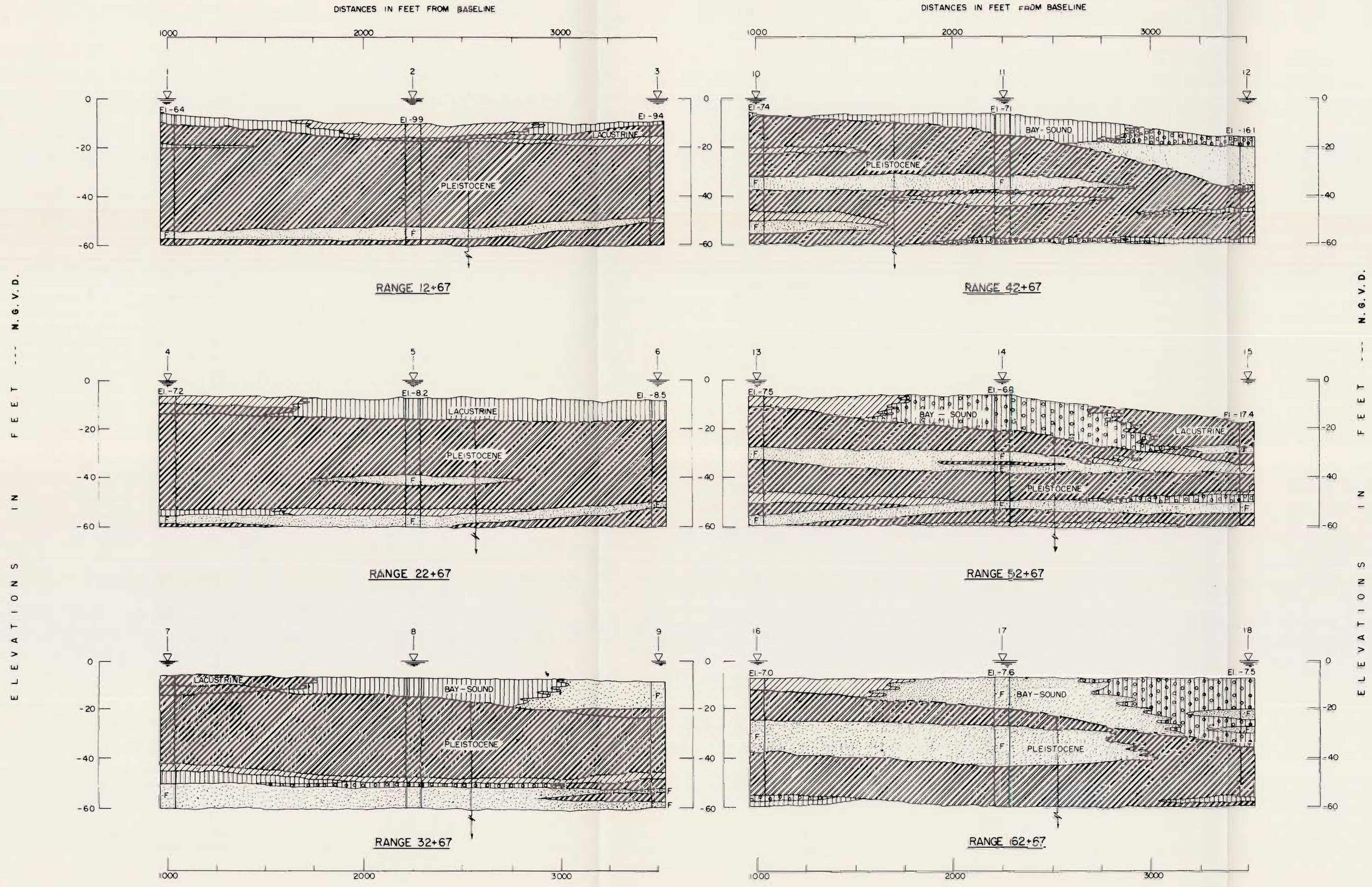
NOTE:
For location of borings see plates 2,3 & 4
For boring logs, see plates 58 thru 67
For legend, see plate 53

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 14 – GENERAL DESIGN
CITRUS LAKEFRONT LEVEE–I.H.N.C. TO PARIS ROAD

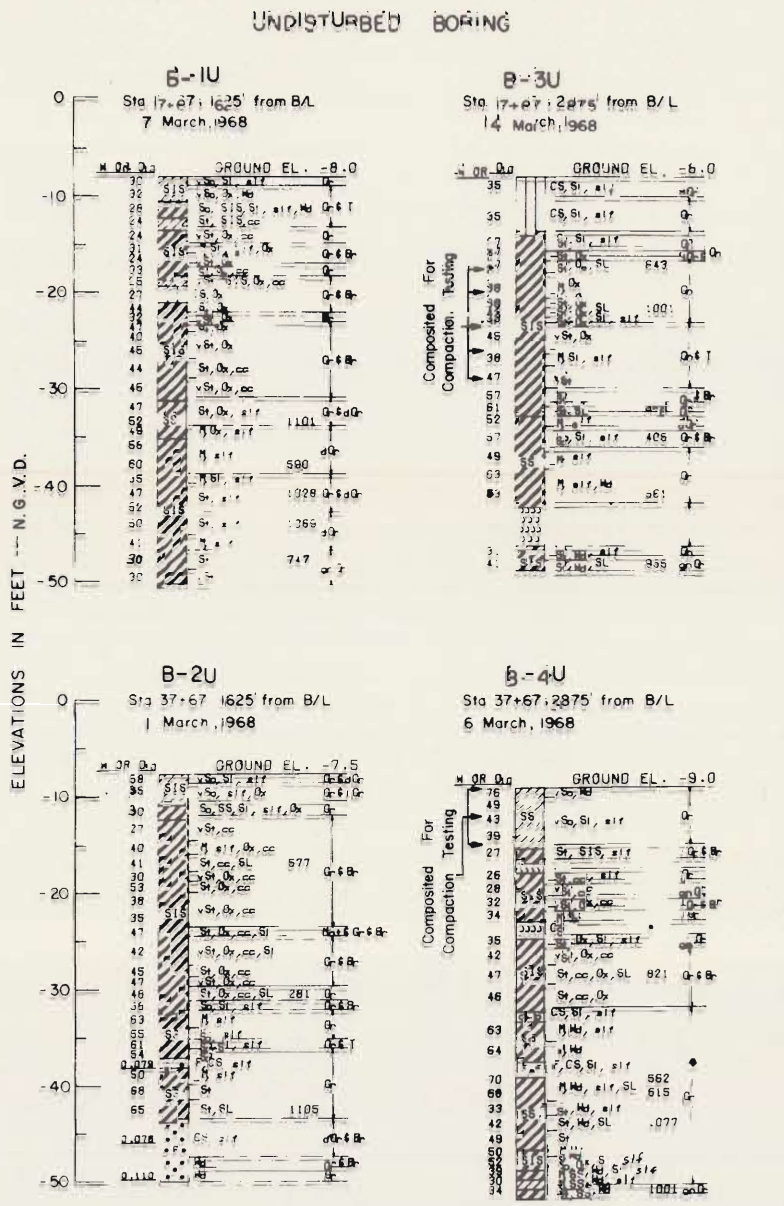
SOIL AND GEOLOGIC PROFILE

STA. 282+00 B/L TO STA. 331+50 B/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



SOIL BORING SECTIONS



LEGEND (Soil Boring Sections)

▨ CH - Fat Clay
▨ CL - Lean Clay
▥ ML - Silt
▦ SM - Silty Sand
░ SP - Fine Sand

RECENT
- Lacustrine - soft to very soft lean clay and fat clay with silty sand and sand, and with shell and shell fragments.
- Bay-Sound - silt, silty sand and sand with shell and shell fragments.

PLEISTOCENE - stiff to very stiff clays with layers and lenses silt and sand

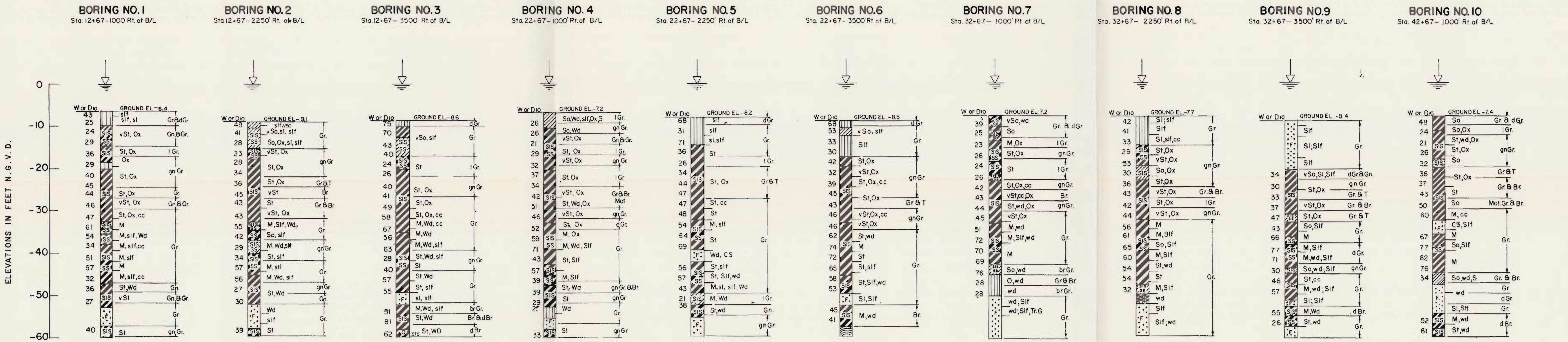
Soil samples taken with 1 7/8 inch I.D. core barrel.
See PLATE A for soil boring legend.
See PLATE 2-4 for location of borings.

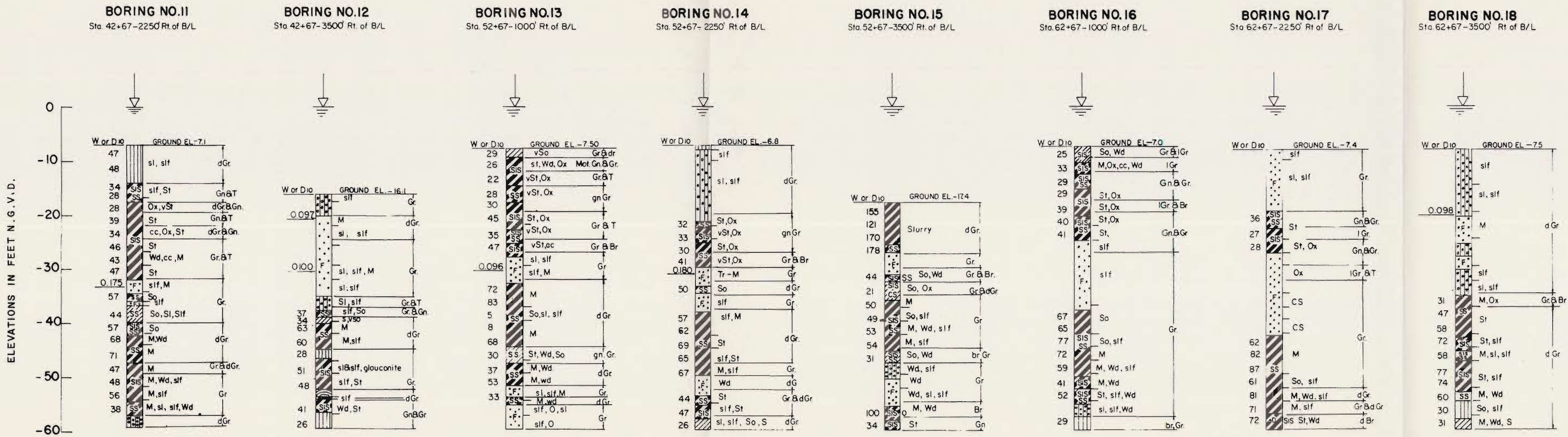
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD

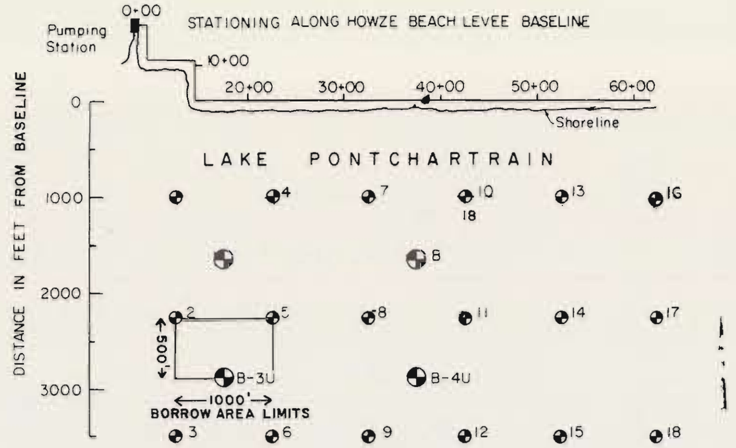
BORROW DATA
PIT AREA IN LAKE PONTCHARTRAIN
ALONG NORTH SHORE
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984
FILE NO. H-2-29653

PLATE 14







PROSPECTIVE BORROW AREAS
LAKE PONTCHARTRAIN ALONG NORTH SHORE
● INDICATES BORING LOCATIONS

GENERAL NOTES:
FOR SOIL BORING LEGEND SEE PLATE A.
SOIL SAMPLES TAKEN WITH 1 7/8" I.D. CORE BARREL SAMPLER. (BORINGS 1 THRU 18)
BORINGS B-1II THRU B-4U WERE TAKEN WITH A 5" DIAMETER STEEL TUBE PISTON TYPE SAMPLER.

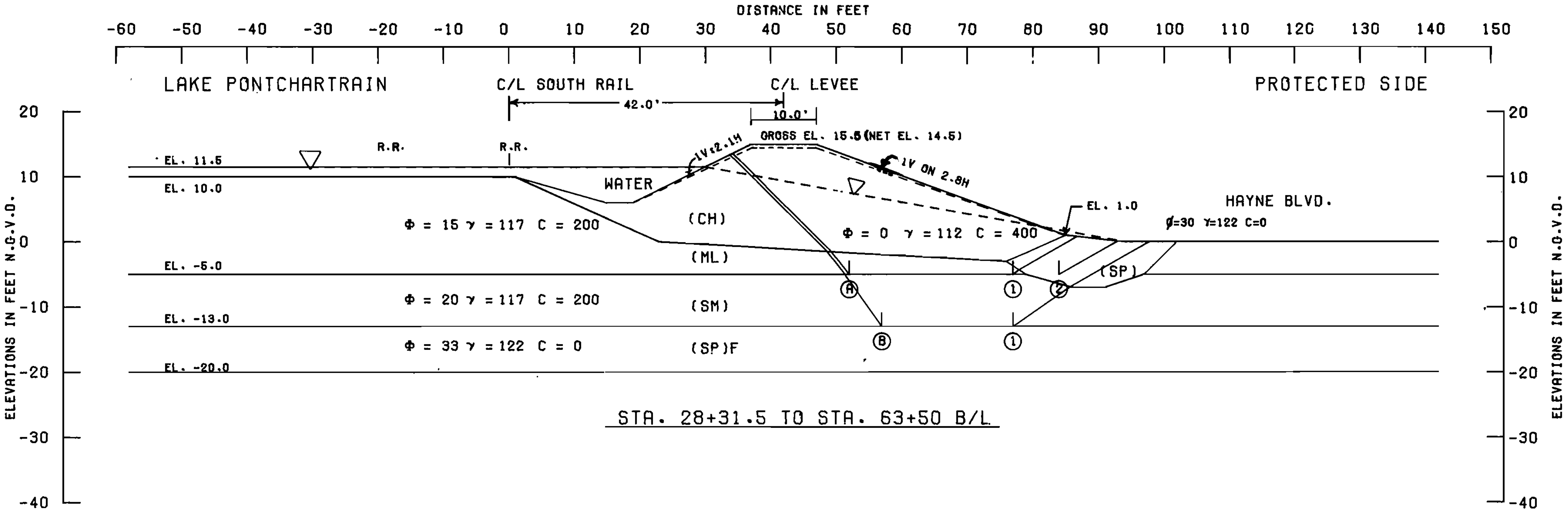
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
NEW ORLEANS EAST LEVEE
SOUTH POINT TO G.I.W.W.

BORROW DATA
PIT AREA IN LAKE PONTCHARTRAIN ALONG NORTH SHORE

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984
FILE NO. H-2-29653

PLATE 14A



ASSUMED FAILURE SURFACE NO.	ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	RESISTING FORCES R_B	RESISTING FORCES R_P	DRIVING FORCES D_A	DRIVING FORCES $-D_P$	SUMMATION OF FORCES RESISTING	SUMMATION OF FORCES DRIVING	FACTOR OF SAFETY
Ⓐ ①	-5.0	14903	10943	2615	21461	2907	28461	18554	1.530
Ⓐ ②	-5.0	14903	12759	1632	21461	1917	29294	19544	1.500
Ⓑ ①	-13.0	22791	13061	10553	40912	12009	46425	28903	1.610

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES, BORING 12 ULC,

AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING.

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

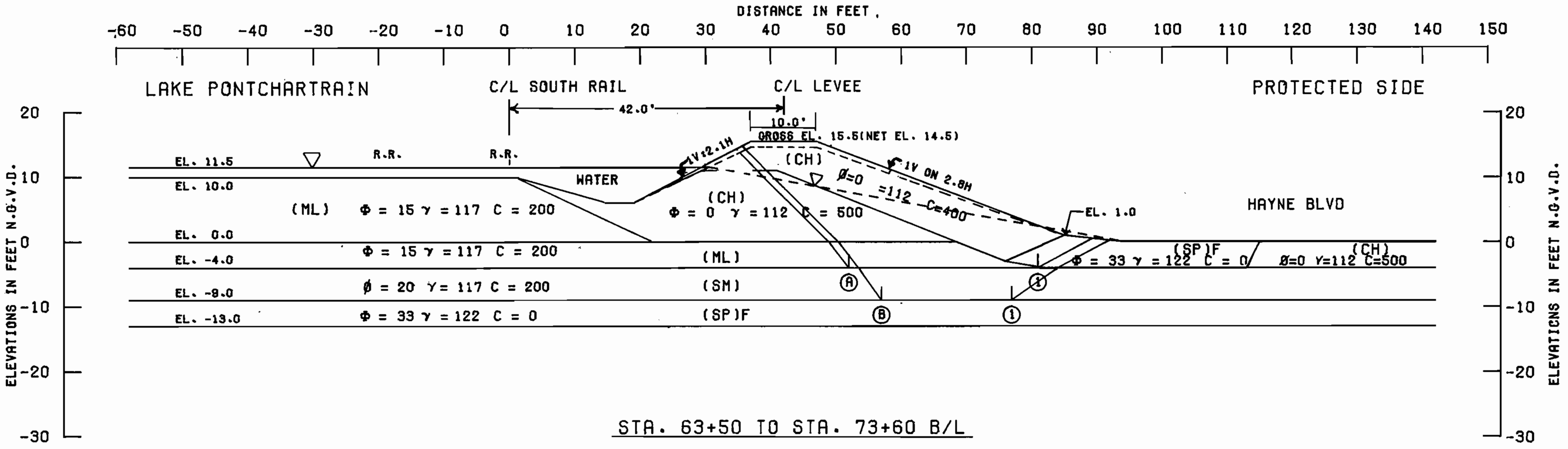
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD

STABILITY ANALYSIS
PROTECTED SIDE
STA. 28+31.5 TO STA. 63+50 B/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984
FILE NO. H-2-29653



STA. 63+50 TO STA. 73+60 B/L

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-4.0	16820	11975	1596	20412	1615	30391	18797	1.620
Ⓑ ①	-9.0	21864	11728	6797	30864	6671	40389	24193	1.670

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORINC DATA PLATES, BORING 12 ULC,

AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING.

NOTES

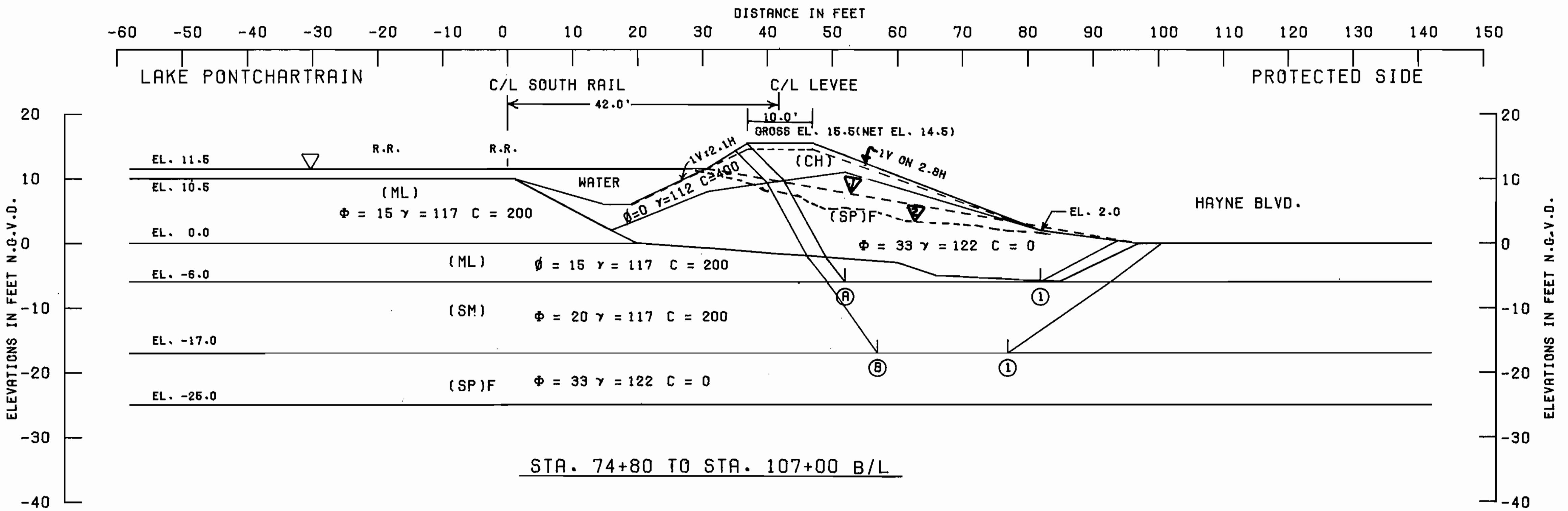
Φ -- ANGLE OF INTERNAL FRICTION. DEGREES
C -- UNIT COHESION. P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT. REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT. REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT. REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD

STABILITY ANALYSIS
PROTECTED SIDE
STA. 63+50 TO STA. 73+60 B/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



STA. 74+80 TO STA. 107+00 B/L

ASSUMED FAILURE NO.	ASSUMED SURFACE ELEV.	RESISTING FORCES R_A	RESISTING FORCES R_B	RESISTING FORCES R_P	DRIVING FORCES D_A	DRIVING FORCES $-D_P$	SUMMATION OF FORCES RESISTING	SUMMATION OF FORCES DRIVING	FACTOR OF SAFETY
Ⓐ ①	-6.0	16748	13722	3270	26416	3146	33740	23270	1.450
Ⓑ ①	-17.0	28744	15362	18564	59004	19740	62670	39264	1.600

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES.

AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING

NOTES: ▽ ASSUMED PIEZOMETRIC HEAD

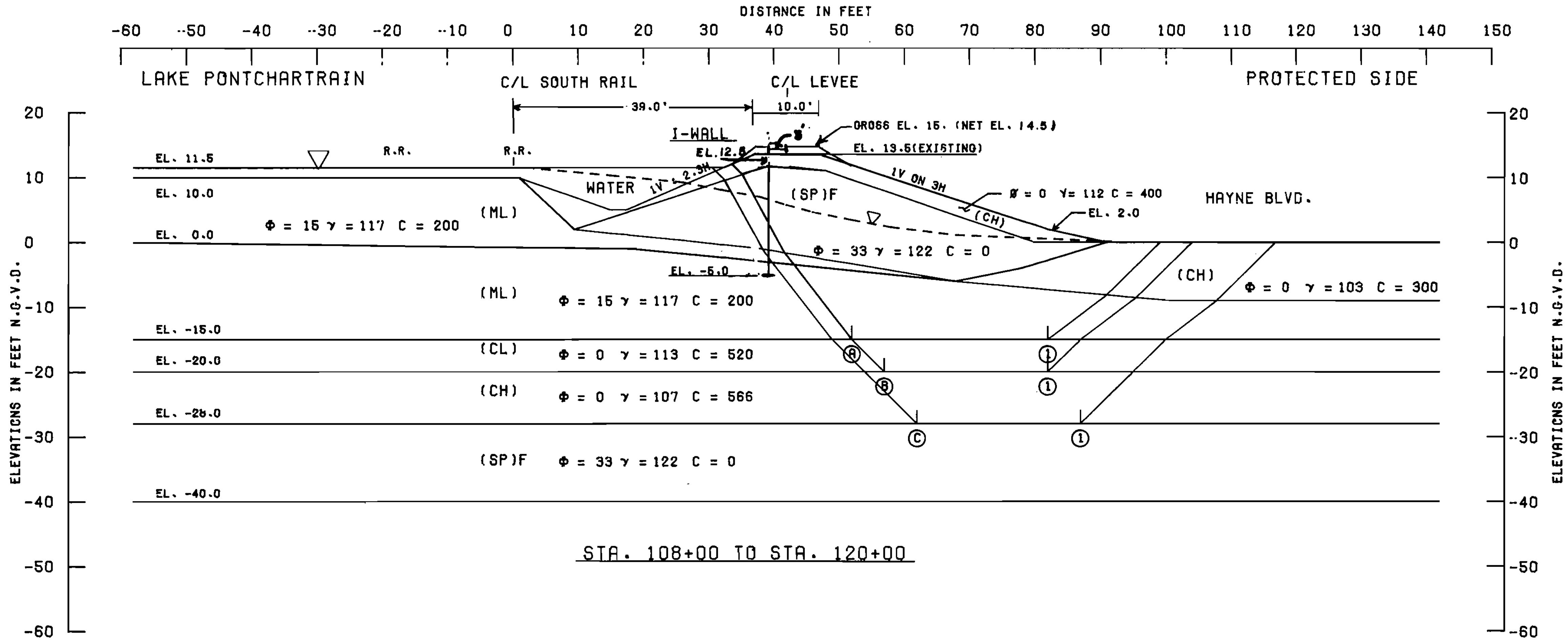
▼ PIEZOMETRIC HEAD DETERMINED BY SEEPAGE ANALYSIS

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD
STABILITY ANALYSIS
PROTECTED SIDE
STA. 74+ 80 TO STA. 107+00 B/L
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



STA. 108+00 TO STA. 120+00

NOTE: PIEZOMETRIC HEAD DETERMINED BY SEEPAGE ANALYSIS

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-15.0	22753	15425	11540	47444	12915	49718	34529	1.440
Ⓑ ①	-20.0	27953	13000	16168	64341	22767	57121	41574	1.370
Ⓒ ①	-28.0	35632	14150	24996	95875	42742	74778	53133	1.410

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES, BORING 13 ULC,

AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING.

NOTES

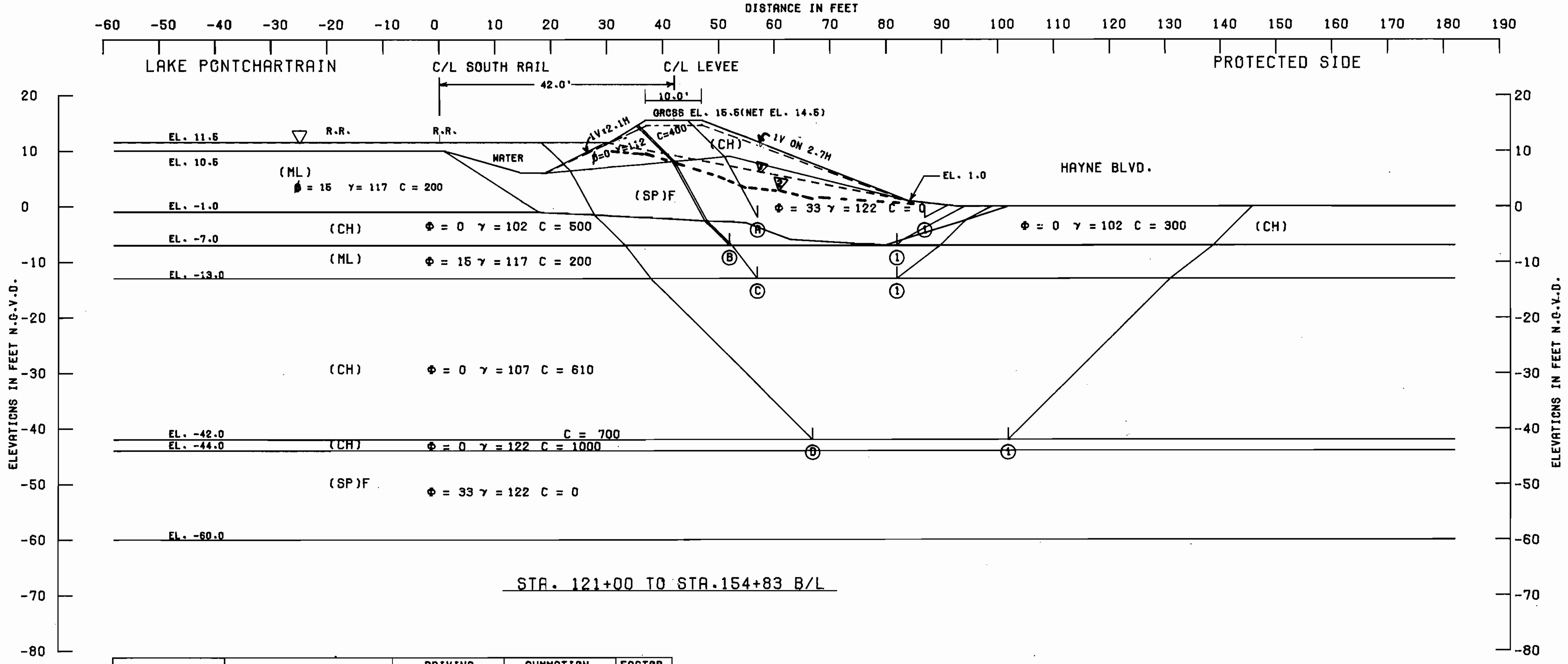
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS, LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD

STABILITY ANALYSIS
PROTECTED SIDE
STA. 108+00 TO STA. 120+00 B/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



STA. 121+00 TO STA.154+83 B/L

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-2.0	11977	11556	420	13954	360	23953	13594	1.760
Ⓑ ①	-7.0	17924	13665	3546	28654	3546	35135	25108	1.400
Ⓒ ①	-13.0	23769	13585	8776	44253	10544	46130	33709	1.370
Ⓓ ①	-42.0	49658	24500	44551	167455	94943	118709	72512	1.640

NOTES: ▽ **ASSUMED PIEZOMETIC HEAD**

▼ **PIEZOMETIC HEAD DETERMINED BY SEEPAGE ANALYSIS**

GENERAL NOTES

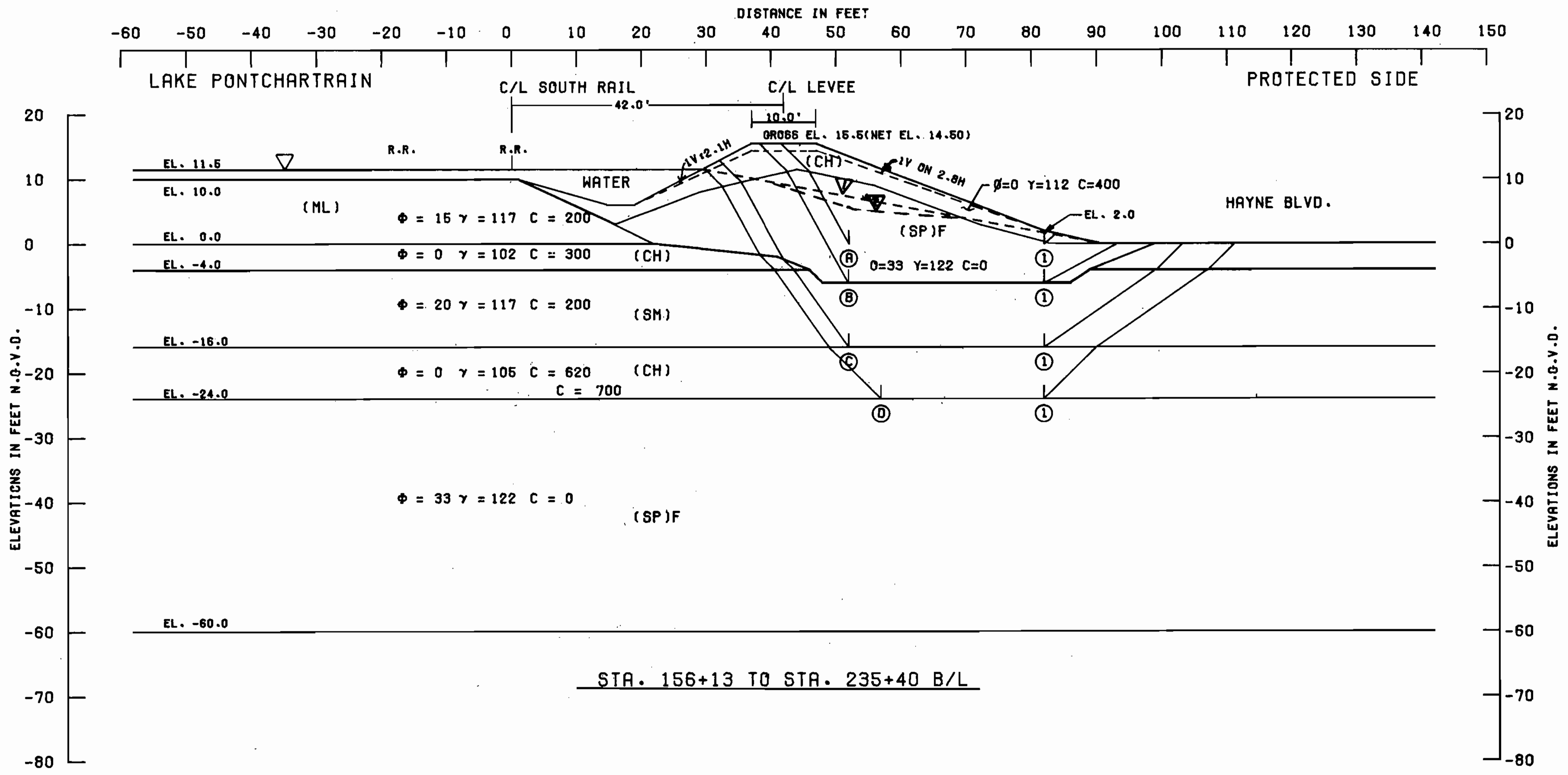
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES. AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING.

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD
STABILITY ANALYSIS
PROTECTED SIDE
STA. 121 +00 TO STA. 154+83 B/L
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



STA. 156+13 TO STA. 235+40 B/L

ASSUMED FAILURE NO.		SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
			R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ	①	0.0	10629	12498	1190	13000	177	24317	12823	1.900
Ⓑ	①	-6.1	17050	17047	3194	26549	2817	37291	23732	1.570
Ⓒ	①	-16.0	26372	19684	15115	56010	14611	61171	41399	1.480
Ⓓ	①	-24.0	34236	17500	24265	84508	31597	76001	52911	1.440

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES, BORINGS 13 ULC, 15 ULC,

AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING.

NOTES ▽ ASSUMED PIEZOMETRIC HEAD

▼ PIEZOMETRIC HEAD DETERMINED BY SEEPAGE ANALYSIS

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
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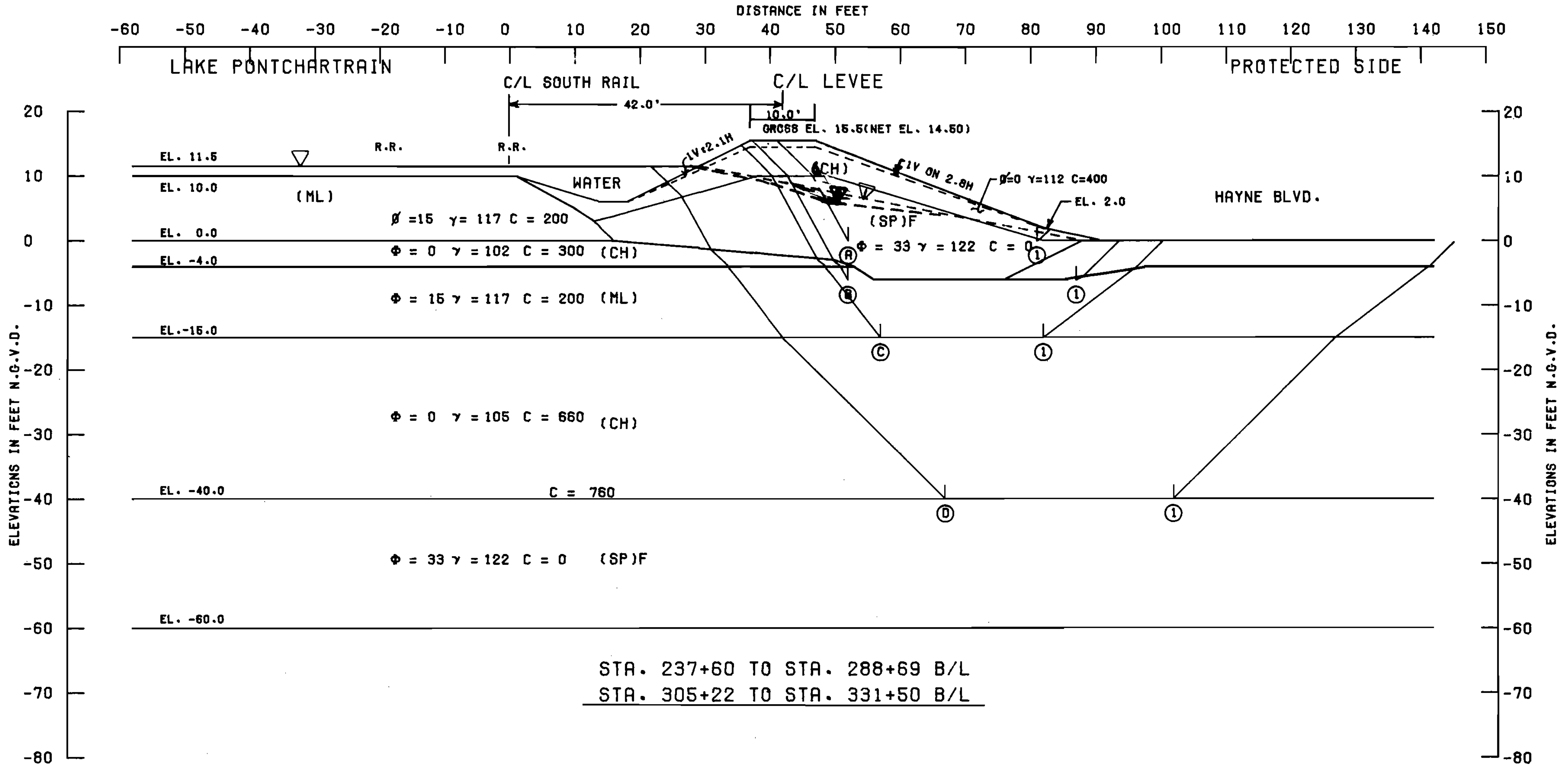
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - I.H.N.C. TO PARIS ROAD

STABILITY ANALYSIS
PROTECTED SIDE
STA. 156+13 TO STA. 235+40 B/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



NOTES: ▽ ASSUMNED PIEZOMETIC HEAD

▼ PIEZOMETRIC HEAD DETERMINED BY SEEPAGE ANALYSIS

ASSUMED FAILURE NO.		SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
			R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ	①	0.0	11101	12757	1354	12929	226	25212	12703	1.980
Ⓑ	①	-6.1	17173	19695	3753	26495	2060	40621	24435	1.660
Ⓒ	①	-15.0	25285	14486	11827	51843	13082	51598	38761	1.330
Ⓓ	①	-40.0	50262	26600	44457	159804	87535	121319	72269	1.680

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES, BORINGS 17 ULC,

AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING.

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
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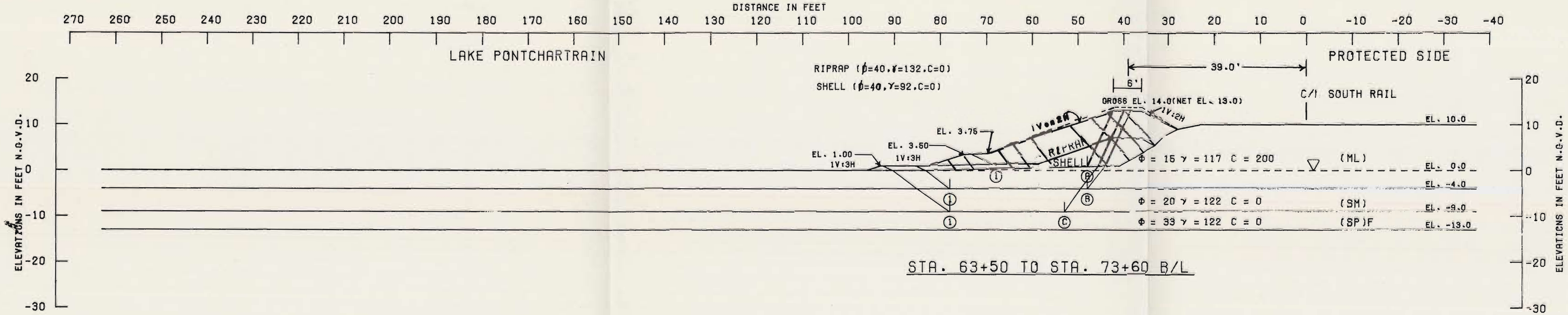
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD

STABILITY ANALYSIS-PROTECTED SIDE
STA.237+60 TO STA.288+69 B/L
STA.305+22 TO STA.331+50 B/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



STA. 63+50 TO STA. 73+60 B/L

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	1.0	5808	13799	1819	7422	505	21426	6917	3.100
Ⓑ ①	-4.0	11187	10676	3050	16155	1090	24913	14465	1.720
Ⓒ ①	-9.0	14760	10819	5518	25308	5985	31097	19323	1.610

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES, BORING 14 ULC,

AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING.

THE FORESHORE DIKE WILL BE OVERBUILT TO EL. 14.0 FOR SETTLEMENT. THIS SECTION SATISFIES 1.3 F.S. FOR STABILITY.

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
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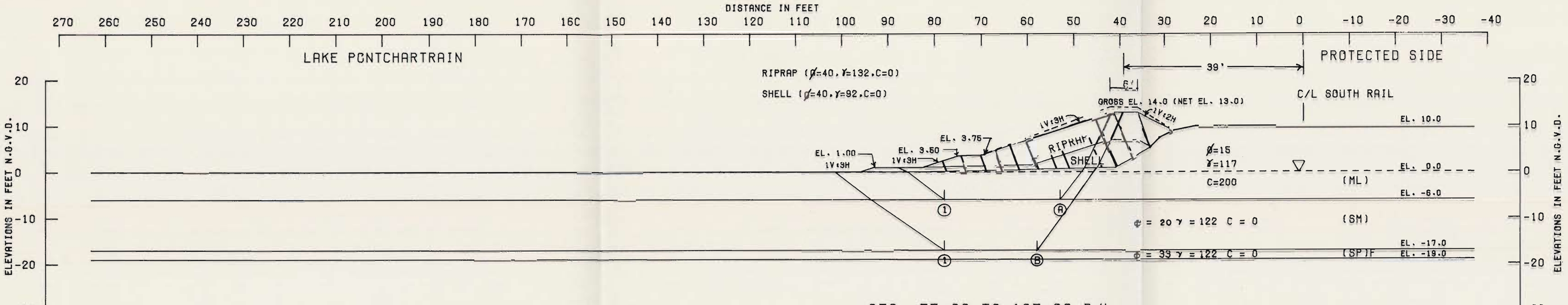
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - I.H.N.C. TO PARIS ROAD
STABILITY ANALYSIS
FLOODSIDE
STA. 63+50 TO STA. 73+60 B/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984
FILE NO. H-2-29653



STA. 75+00 TO 107+00 B/L

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-6.0	11918	9104	4601	17996	3044	25623	14952	1.710
Ⓑ ①	-17.0	22576	11394	12705	46447	18273	46675	28174	1.680

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES.

AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING

THE FORESHORE DIKE WILL BE OVERBUILT TO EL. 14.0 FOR SETTLEMENT. THIS SECTION SATISFIES 1.3 F.S. FOR STABILITY.

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
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∇ -- STATIC WATER SURFACE
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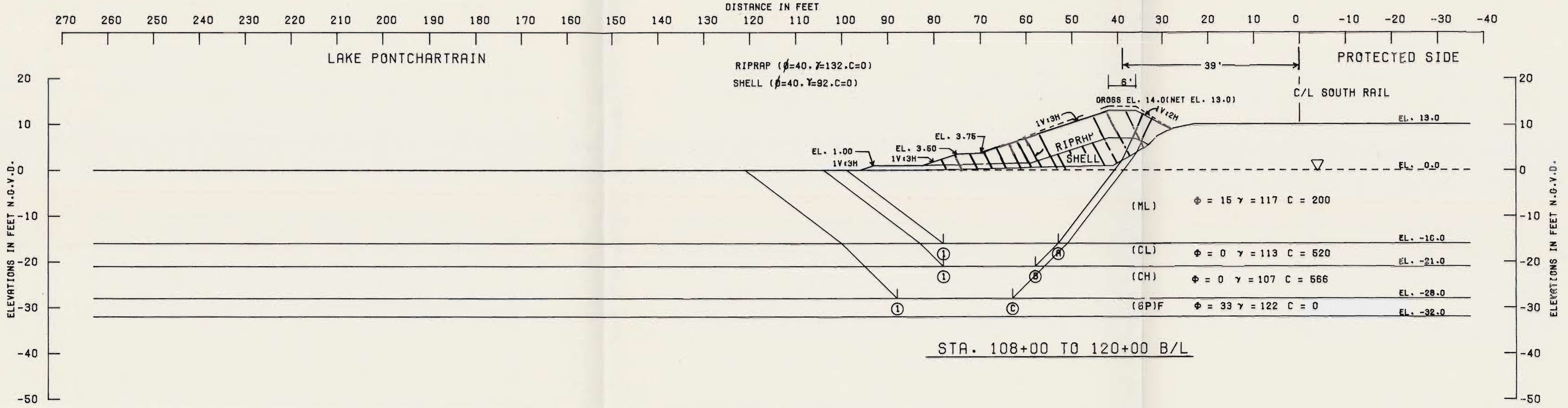
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD
STABILITY ANALYSIS
FLOODSIDE
STA. 75+00 TO STA. 107+00 B/L
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



STA. 108+00 TO 120+00 B/L

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-16.0	23775	12997	14263	45828	16480	51035	29348	1.740
Ⓑ ①	-21.0	28975	10400	18978	61763	27462	58353	34301	1.700
Ⓒ ①	-28.0	36339	14150	26336	88055	46024	76825	42031	1.830

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES.

AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING

THE FORESHORE DIKE WILL BE OVERBUILT TO EL. 14.0 FOR SETTLEMENT. THIS SECTION SATISFIES 1.3 F.S. FOR STABILITY.

NOTES

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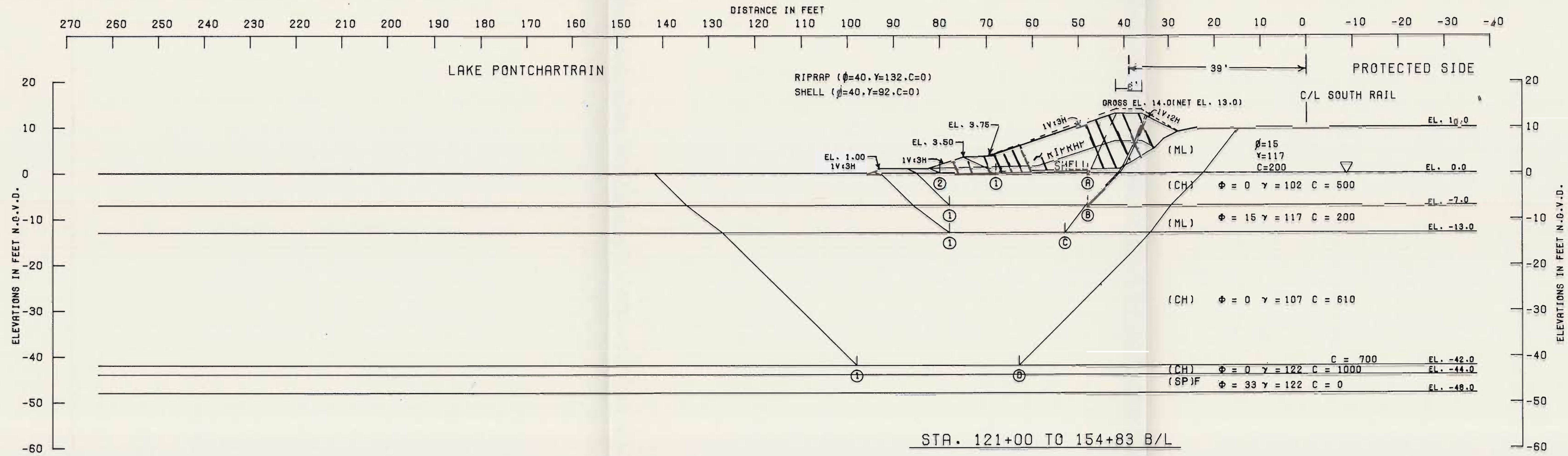
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD
STABILITY ANALYSIS
FLOODSIDE
STA.108+00 TO STA.120+00 B/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984
FILE NO. H-2-29653



STA. 121+00 TO 154+83 B/L

AND DESIGN MEMORANDUM NO.2
GENERAL DESIGN SUPPLEMENT NO. 5A

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	0.0	6896	8883	2877	8975	888	18656	8087	2.310
Ⓐ ②	0.0	6896	12543	395	8975	111	19834	8864	2.240
Ⓑ ①	-7.0	14514	13565	7165	22201	3633	35244	18568	1.900
Ⓒ ①	-13.0	20489	13554	12702	35692	10454	46745	25238	1.850
Ⓓ ①	-42.0	54056	24500	47351	152087	94944	125907	57143	2.200

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES.
AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING

THE FORESHORE DIKE WILL BE OVERBUILT TO EL. 14.0 FOR SETTLEMENT. THIS SECTION SATISFIES 1.3 F.S. FOR STABILITY.

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
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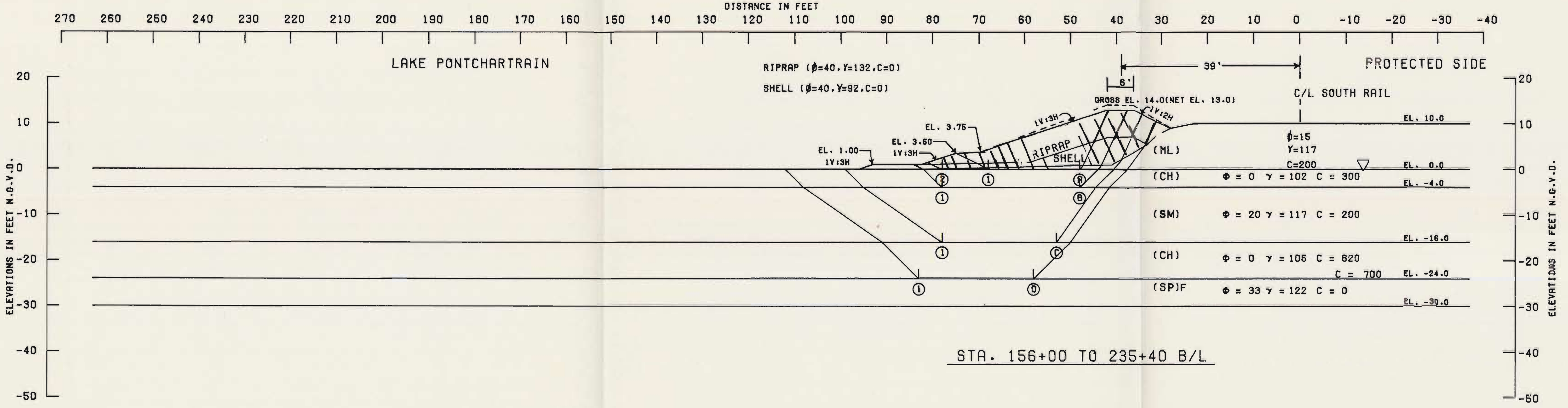
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD
STABILITY ANALYSIS
FLOODSIDE
STA. 121+00 TO STA. 154+83 B/L
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



STA. 156+00 TO 235+40 B/L

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	0.0	6896	6000	2877	8975	888	15773	8087	1.950
Ⓐ ②	0.0	6896	8978	771	8975	223	16645	8752	1.900
Ⓑ ①	-4.0	10104	9000	2580	16231	1671	21684	14560	1.490
Ⓒ ①	-16.0	23709	16983	16724	44760	15511	57416	29249	1.960
Ⓓ ①	-24.0	32834	17500	25459	71209	32951	75793	38258	1.980

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES, BORINGS 13 ULC, 15 ULC,

AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT. NO. 5A BORING.

THE FORESHORE DIKE WILL BE OVERBUILT TO EL. 14.0 FOR SETTLEMENT. THIS SECTION SATISFIES 1.3 F S. FOR STABILITY.

NOTES

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C -- UNIT COHESION, P.S.F.
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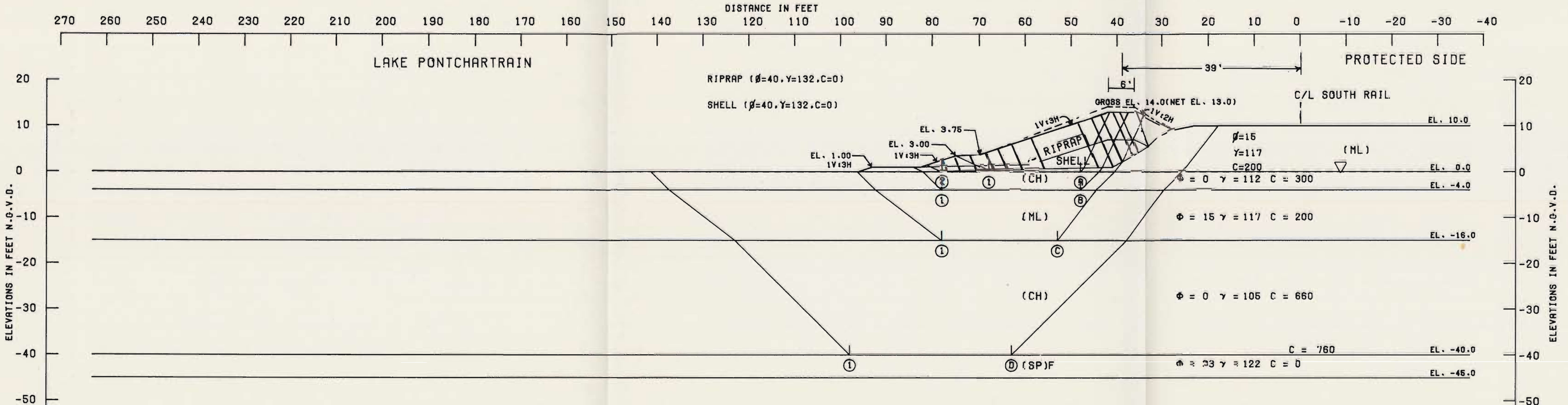
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD
STABILITY ANALYSIS
FLOODSIDE
STA. 156+00 TO STA. 235+40 B/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984
FILE NO. H-2-29653

PLATE 26



STA. 237+60 TO 331+50 B/L

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	0.0	6896	6000	2877	8975	888	15773	8087	1.950
Ⓐ ②	0.0	6896	8978	771	8975	223	16645	8752	1.900
Ⓑ ①	-4.0	10104	9000	2580	16311	1751	21684	14560	1.490
Ⓒ ①	-15.0	21014	14854	12902	42281	14452	48770	27829	1.750
Ⓓ ①	-40.0	52866	26600	44958	144279	89087	124424	55192	2.250

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES, BORING 18 ULC,
AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING.
THE FORESHORE DIKE WILL BE OVERBUILT TO EL. 14.0 FOR SETTLEMENT. THIS SECTION SATISFIES 1.3 F.S. FOR STABILITY.

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
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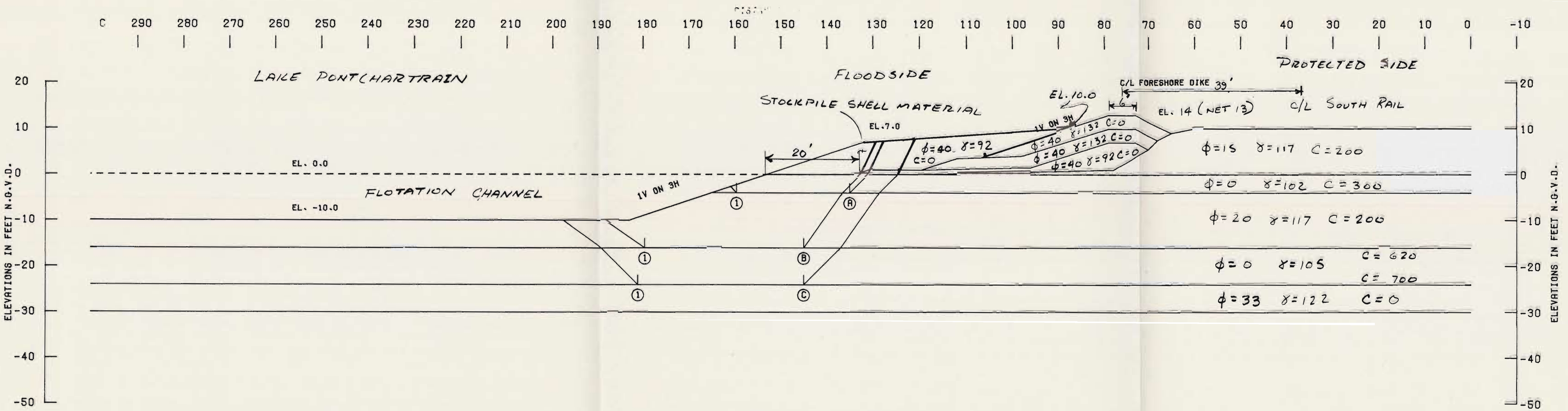
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD
STABILITY ANALYSIS
FLOODSIDE
STA.237+60 TO STA.331+50 B/L
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653



NOTE: STABILITY ANALYSES TO DETERMINE MAX. HEIGHT TO WHICH SHELL MATERIAL COULD BE STOCKPILED.
BORINGS 13ULC, 15ULC & 18ULC COMBINED WITH BORINGS FROM DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPP. NO. 5A WERE USE FOR THE STABILITY ANALYSES

ASSUMED FAILURE NO.	SURFACE ELEV.	RESISTING FORCES R_A	 R_B	 R_P	DRIVING FORCES D_A	 $-D_P$	SUMMATION OF FORCES RESISTING	 DRIVING	FACTOR OF SAFETY
Ⓐ ①	-4.0	4164	6905	814	5507	125	11883	5382	2.210
Ⓑ ①	-16.0	12768	13568	3428	23119	2265	29764	20854	1.430
Ⓒ ①	-24.0	24070	17424	13347	46941	11155	54841	35786	1.530

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES.

AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING

NOTES

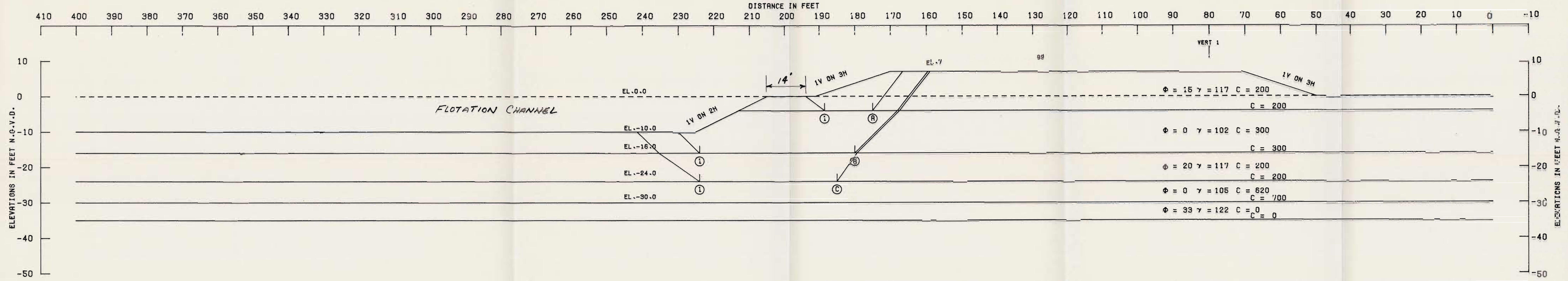
ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD
STABILITY ANALYSIS
FOR
STOCKPILED CONSTRUCTION MATERIAL

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984
FILE NO. H-2-29653



NOTE:ASSUMED ALL SPOIL MATERIAL IS SLIT(ML)

STABILITY TO DETERMINE DISTANCE FROM EXCAVATION AND ELEVA.

BORINGS 13 ULC, 15ULC & 18 ULC COMBINED WITH BORINGS FROM DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPP. NO. 5A WERE USE FOR THE STABILITY ANALYSES

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-4.0	5818	4037	2457	6439	1033	12312	5406	2.280
Ⓑ ①	-16.0	13279	17771	3600	27909	1861	34650	26048	1.330
Ⓒ ①	-24.0	20629	21338	8170	48160	10494	50137	37666	1.330

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORING, SEE BORING DATA PLATES.

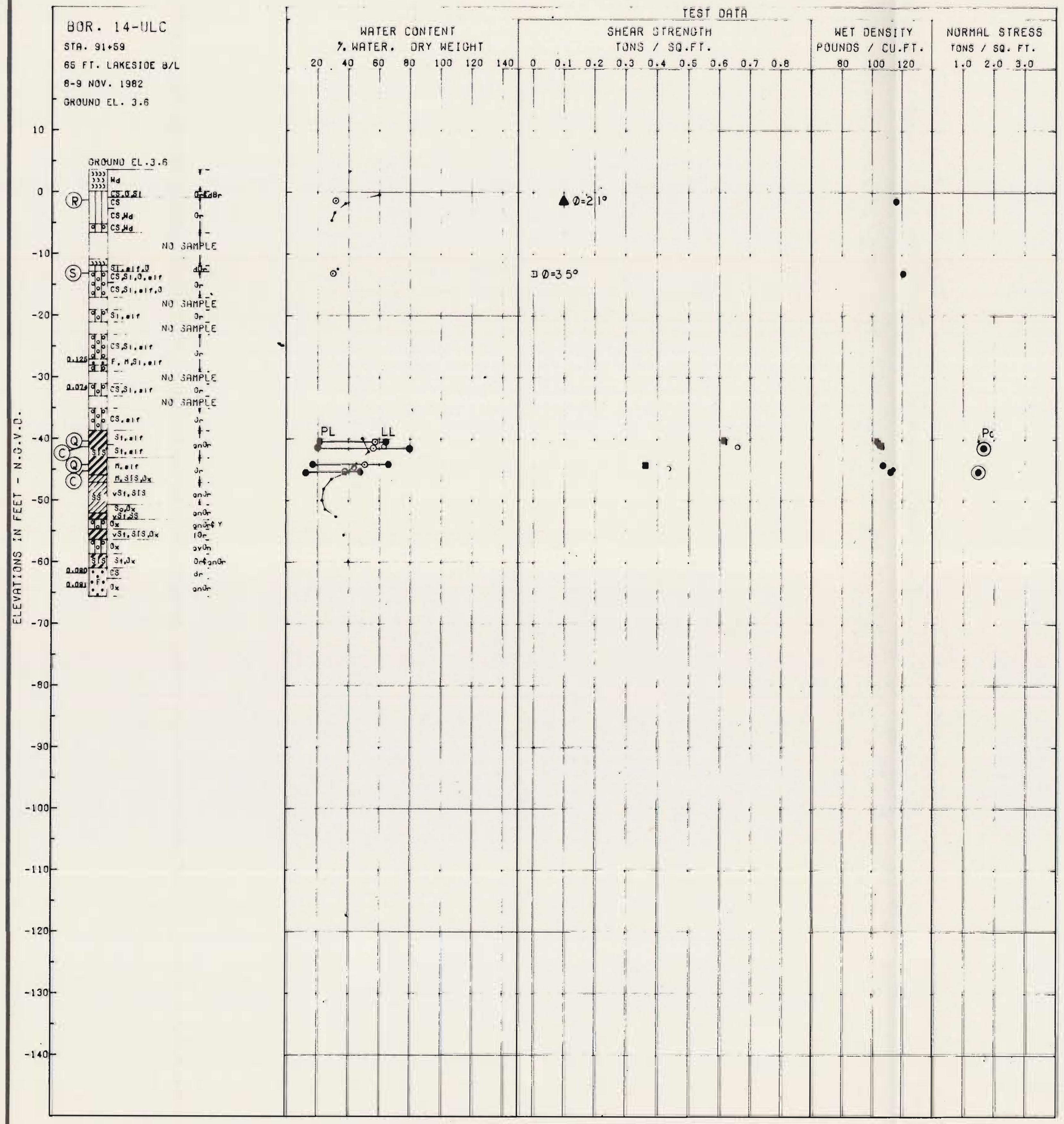
AND DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT NO. 5A BORING

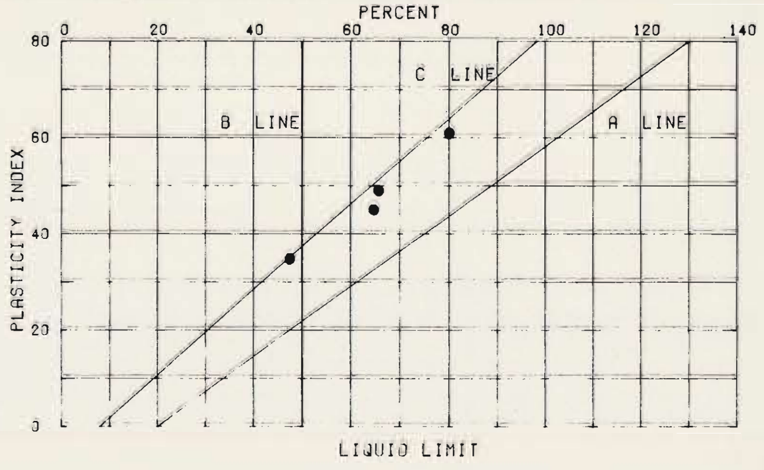
NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - I.H.N.C. TO PARIS ROAD
STABILITY ANALYSIS
FOR FLOTATION CHANNEL
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1964
FILE NO. H-2-29653





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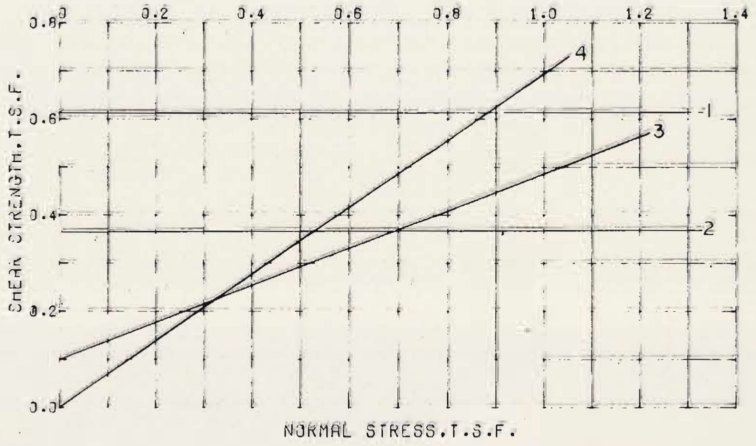
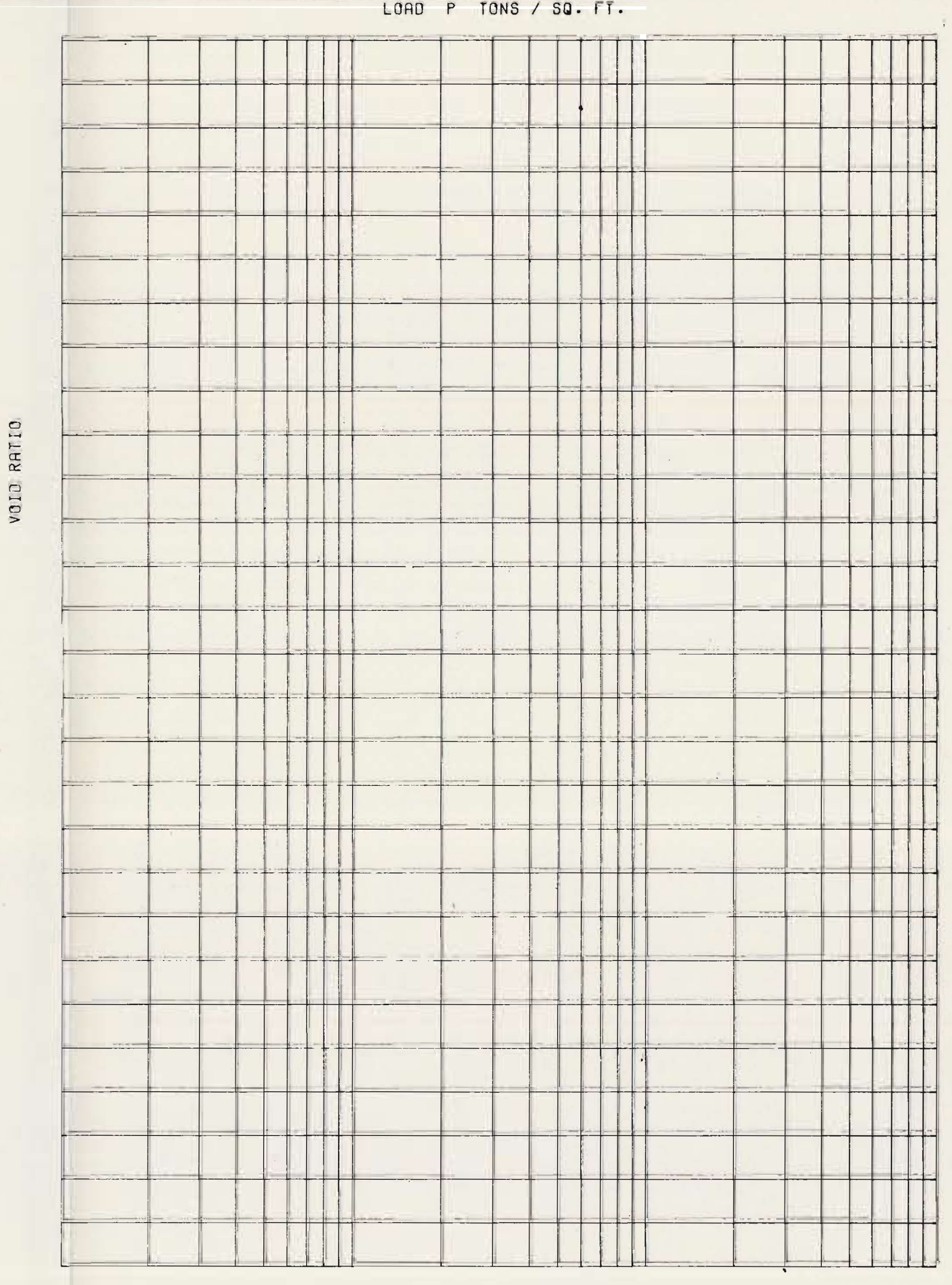


SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	-40.5	Q	0°	0.615	CH
2	-44.3	Q	0°	0.363	CH
3	-1.3	R	21°	0.10	ML
4	-13.1	S	35°	0.0	SM



CONSOLIDATION DATA

○ - (UC) UNCONFINED COMPRESSION TEST
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

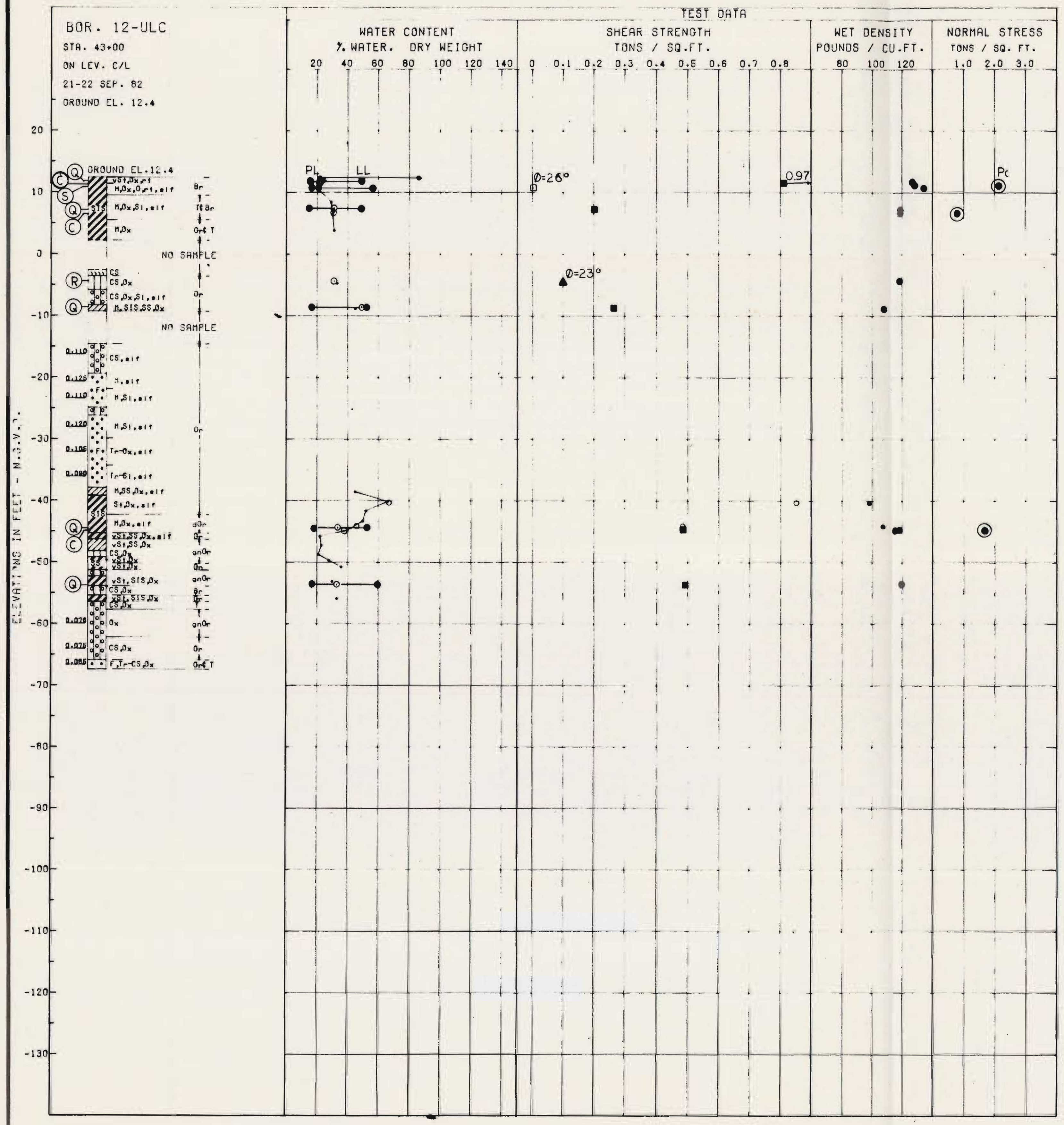
FOR SOIL BORING LEGEND SEE PLATE A

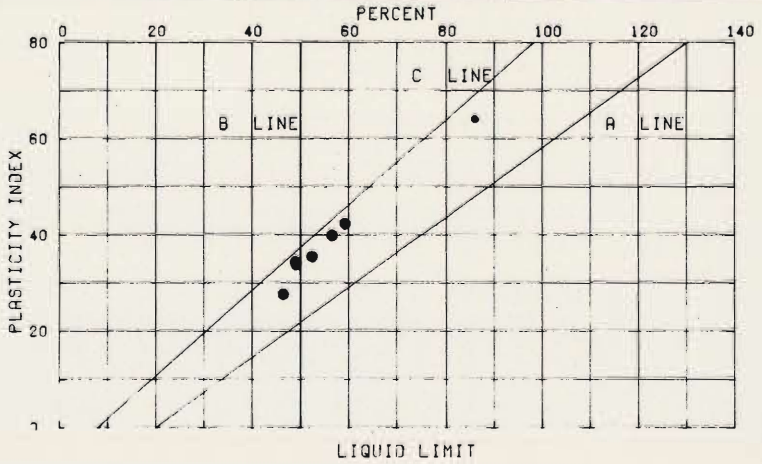
FOR LOCATION OF BORING SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD

UNDISTURBED BORING 12-ULC
STA. 43+00 ON LEVEE C/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 198[illegible]
FILE NO. H-2-29653





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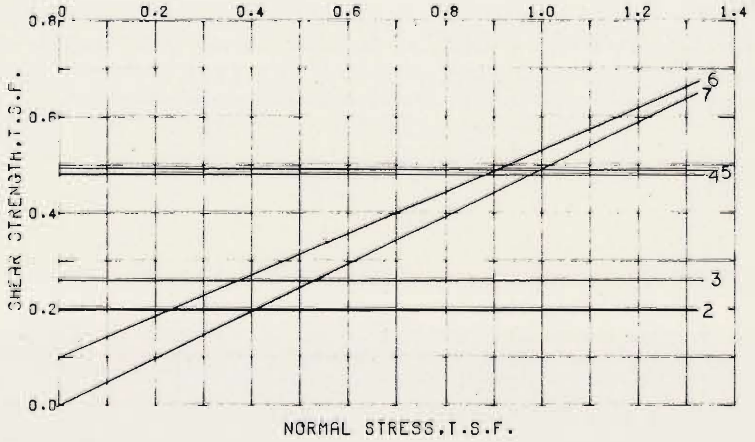

SHEAR STRENGTH DATA

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NO.	EL.		Φ	C - TSF	
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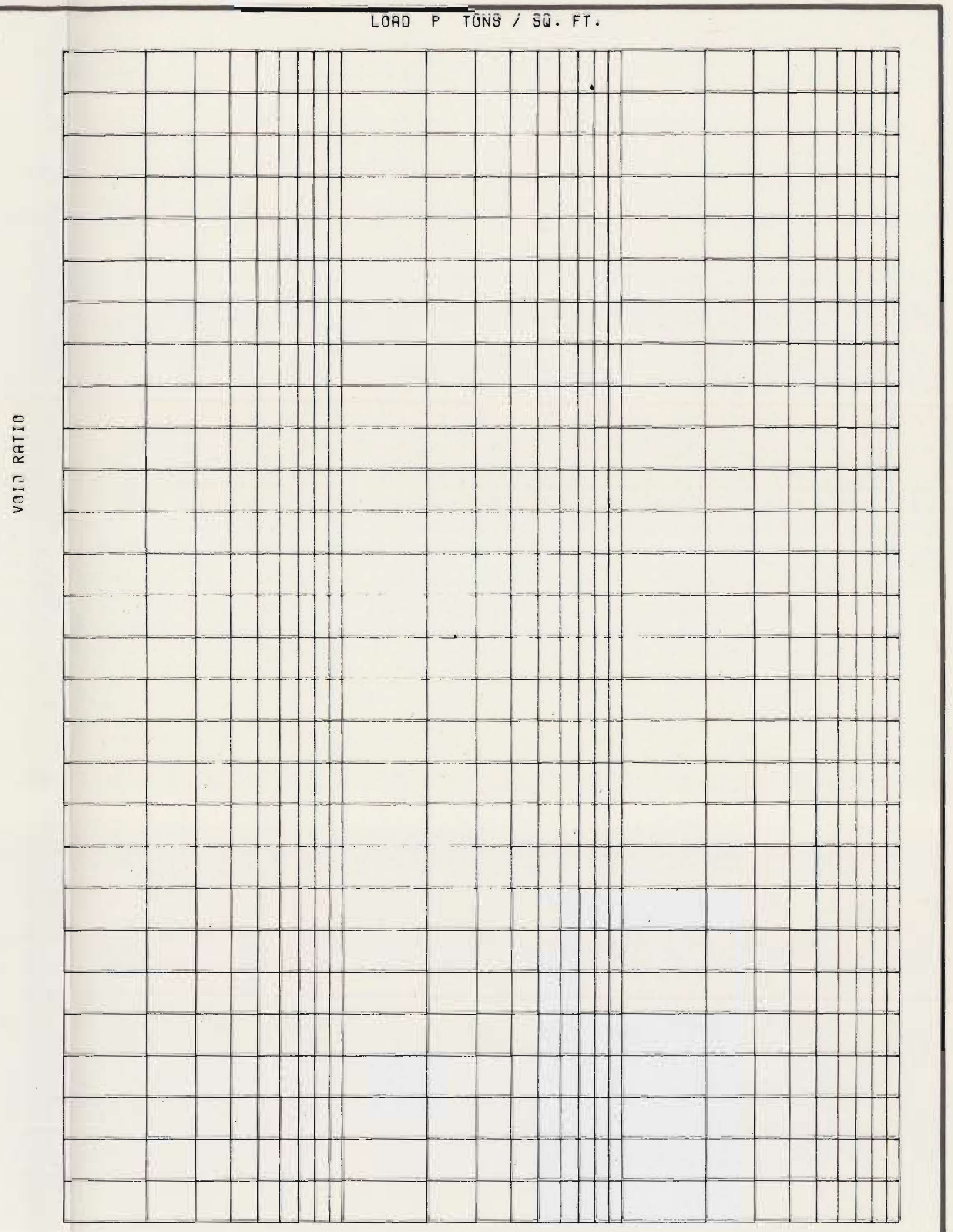
2	7.2			0.20	CL
3	- 8.8			0.26	CH
4	-44.5			0.48	CL
5	-53.9	Q	0°	0.49	CH
6	-4.3	R	23°	0.10	ML
7	10.8	S	26°	0.0	CH



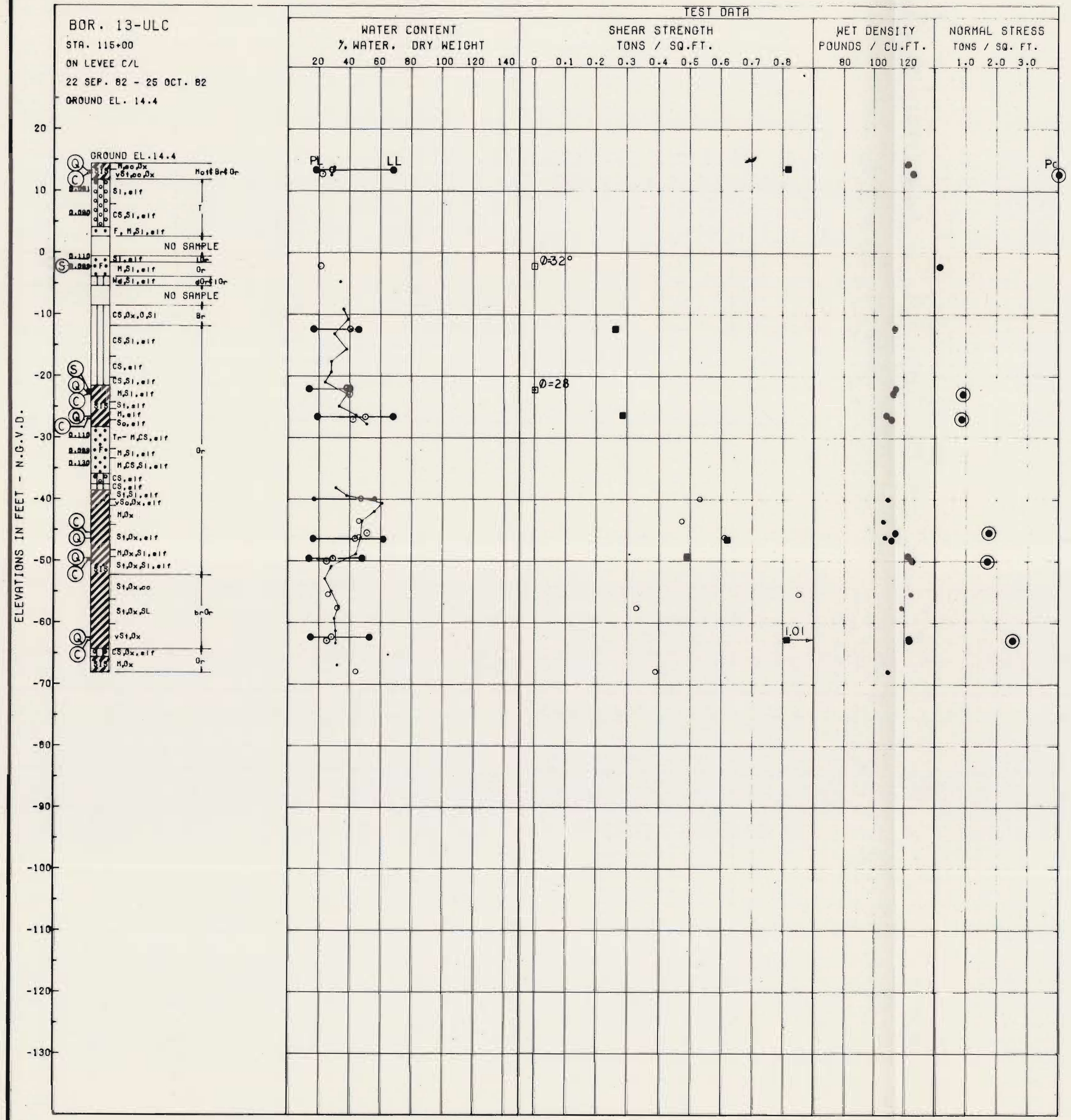
CONSOLIDATION DATA

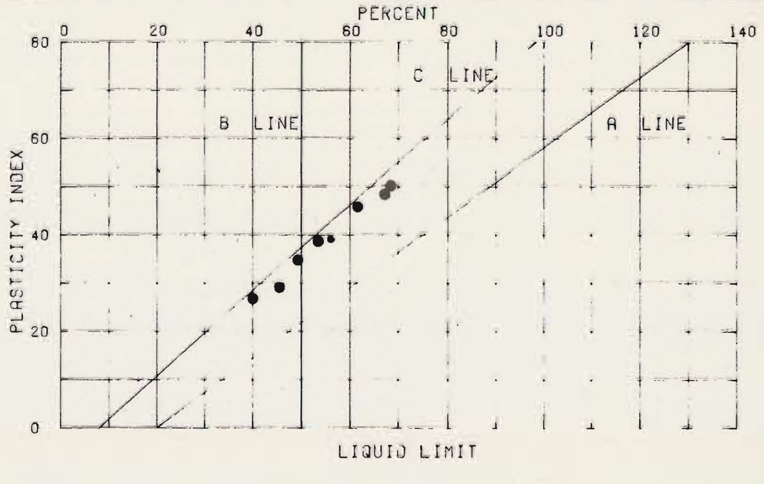
○ - (UC) UNCONFINED COMPRESSION TEST
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER
STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD

UNDISTURBED BORING 13-ULC
STA. 115+00 ON LEVEE C/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653





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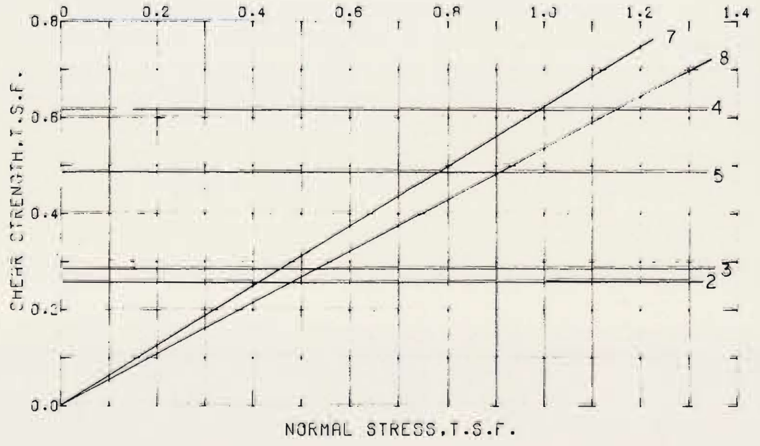
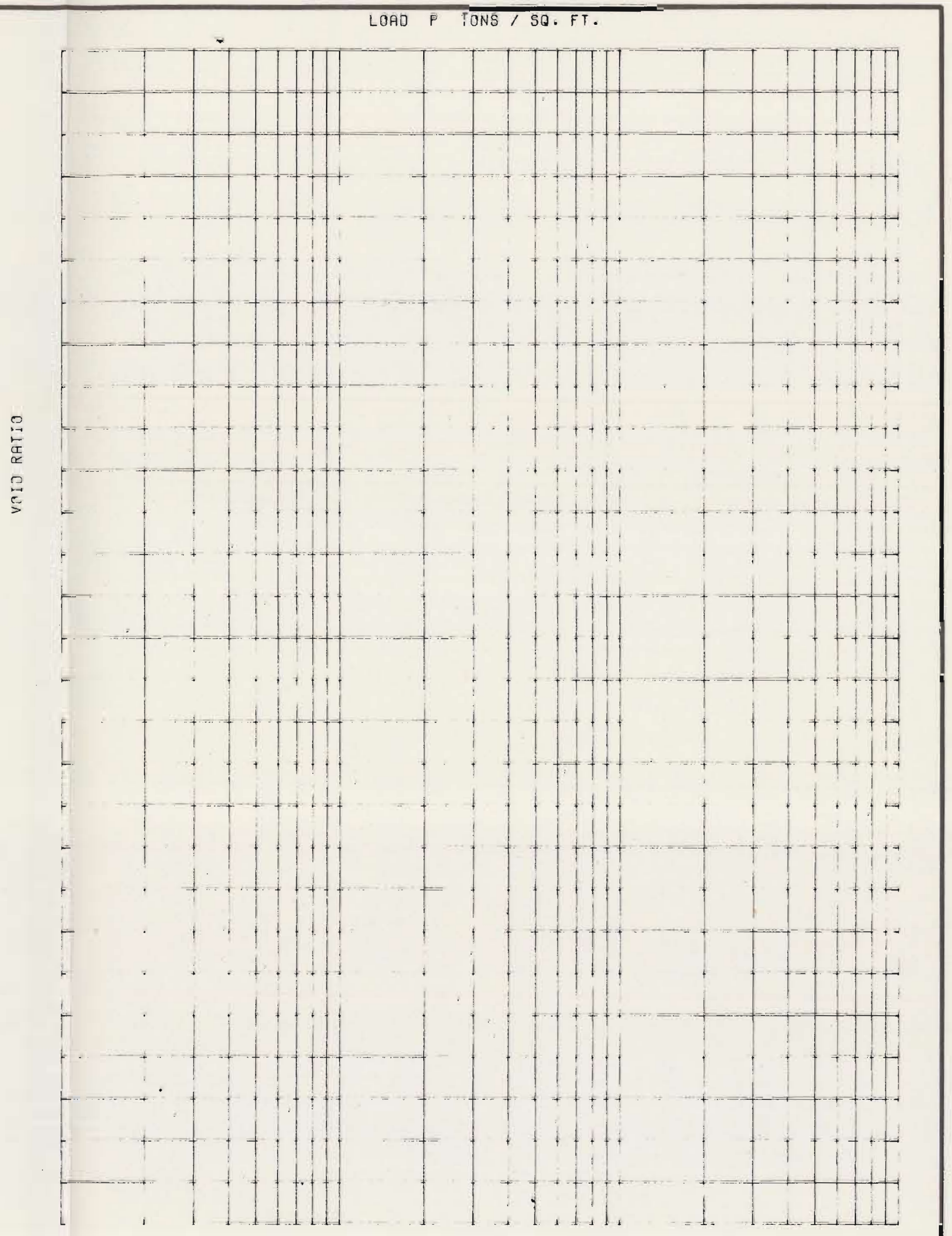


SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	13.4	Q	0°	0.81	CH
2	-22.5			0.26	
3	-26.5			0.28	
4	-46.5			0.62	CH
5	-49.6			0.48	CL
6	-62.5	Q	0°	1.01	CH
7	-2.1	S	32°	0.0	SM
8	-22.1	S	28°	0.0	CL



CONSOLIDATION DATA

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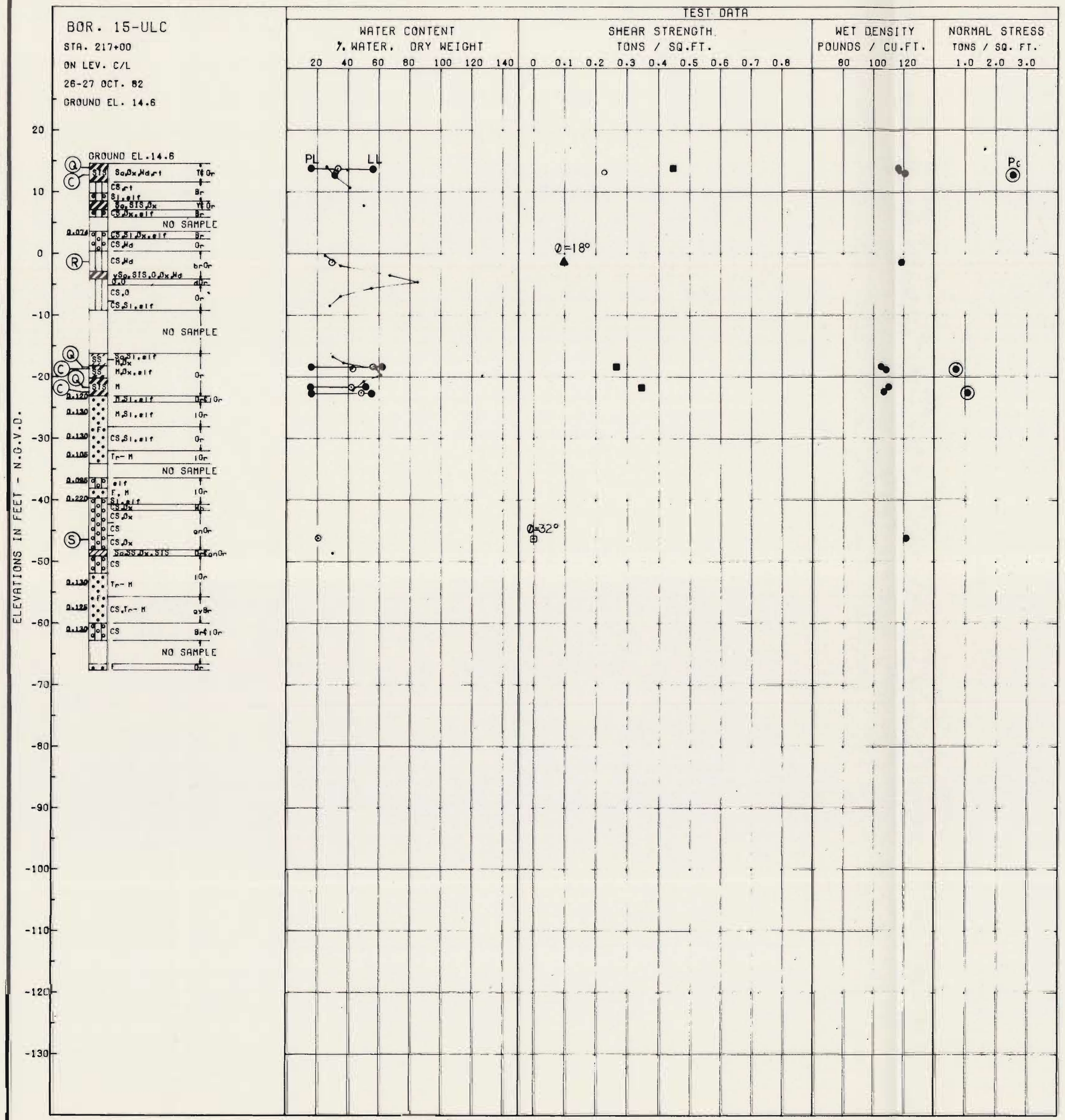
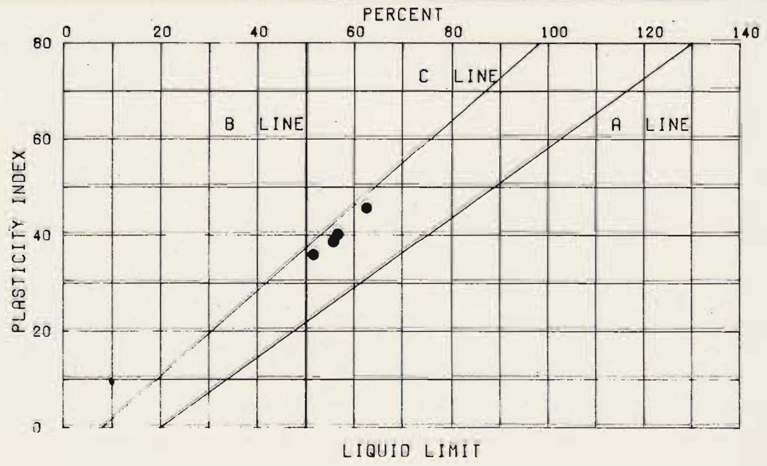
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER
STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 - GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - I.H.N.C. TO PARIS ROAD
UNDISTURBED BORING 14-ULC
STA. 91+59 B/L
65 FT. LAKESIDE B/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984
FILE NO. H-2-29653





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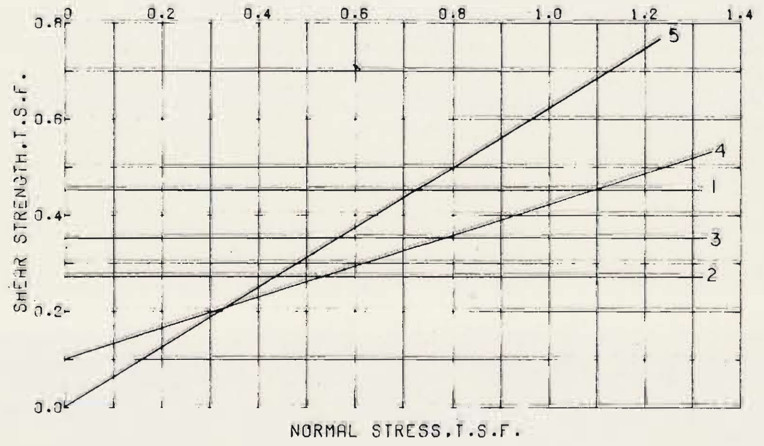
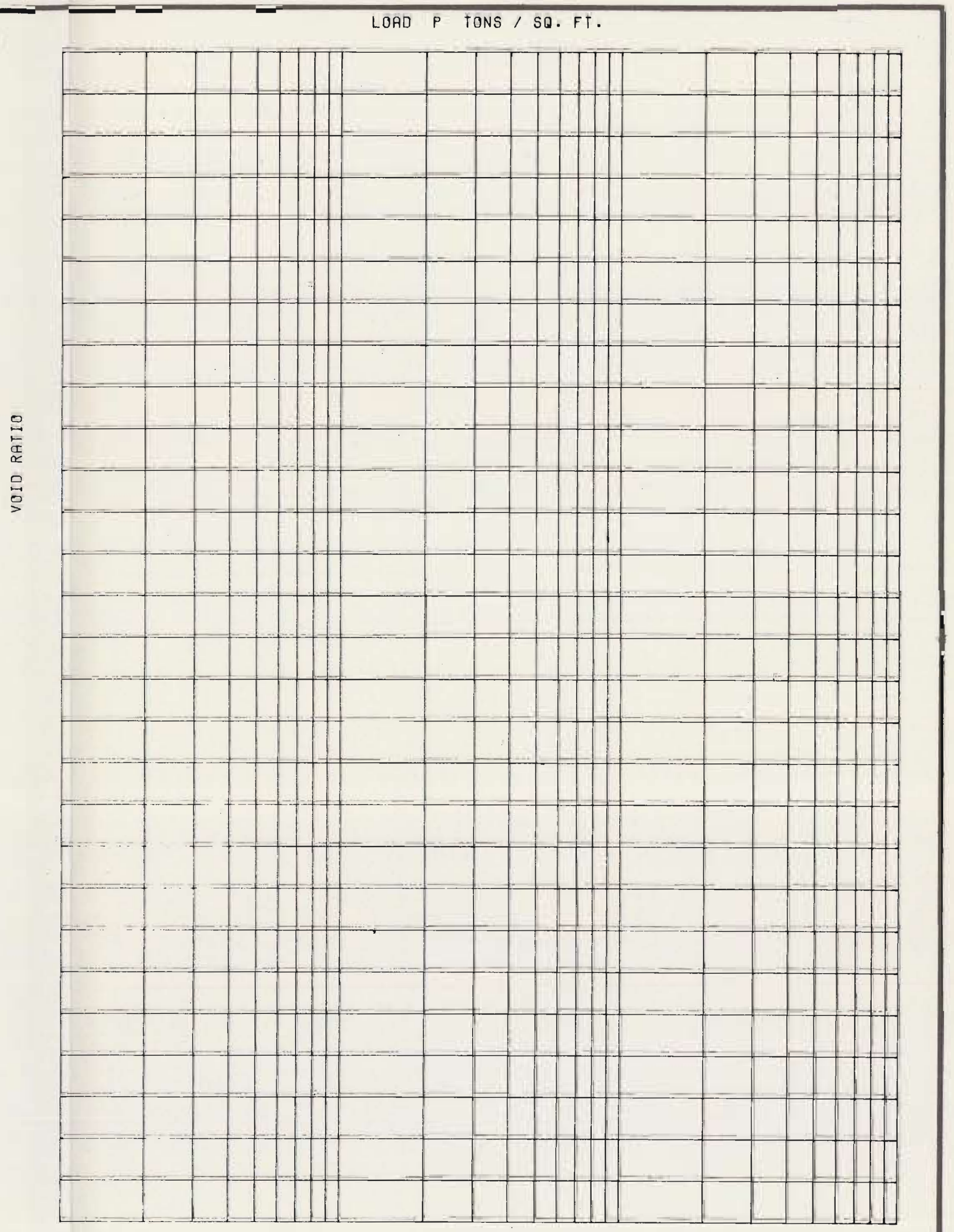


SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	13.8	Q	0°	0.45	CH
2	-18.4	Q	0°	0.27	CH
3	-21.7	Q	0°	0.35	CH
4	-1.3	R	18°	0.10	CL
5	-46.5	S	32°	0.0	SM



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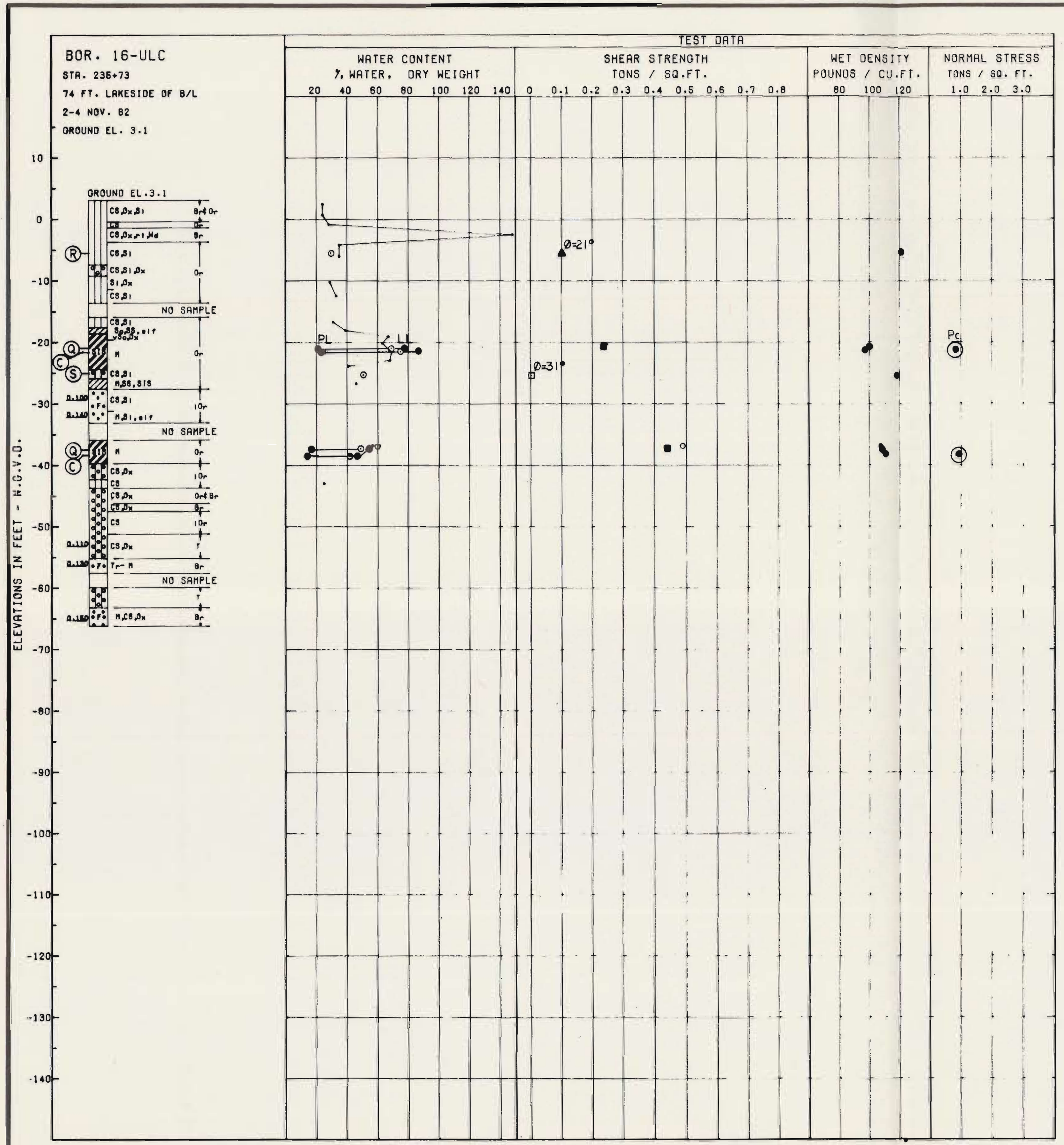
- ■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
- □ - (S) CONSOLIDATED - DRAINED SHEAR TEST

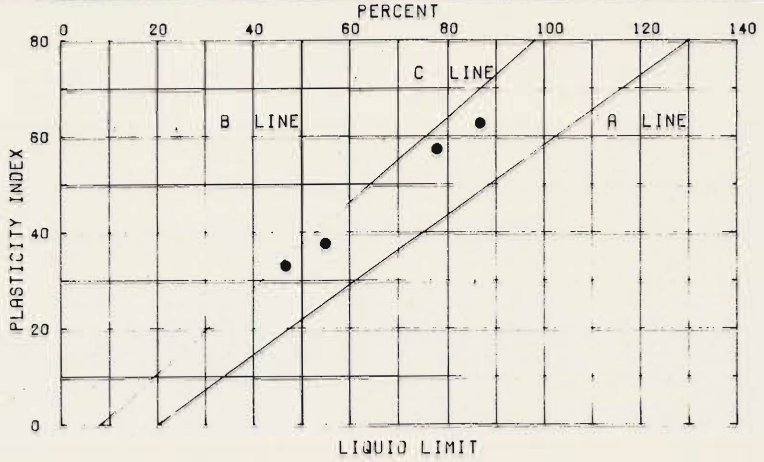
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER
STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

FOR LOCATION OF BORING SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14- GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - I.H.N.C. TO PARIS ROAD
UNDISTURBED BORING 15-ULC
STA. 217+00 ON LEVEE C/L
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653





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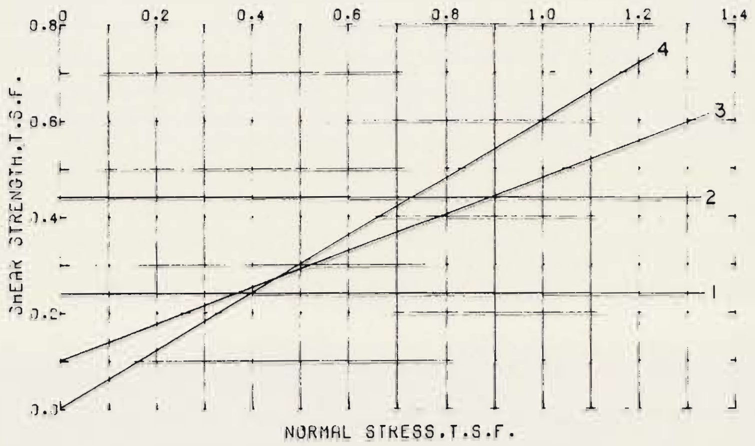
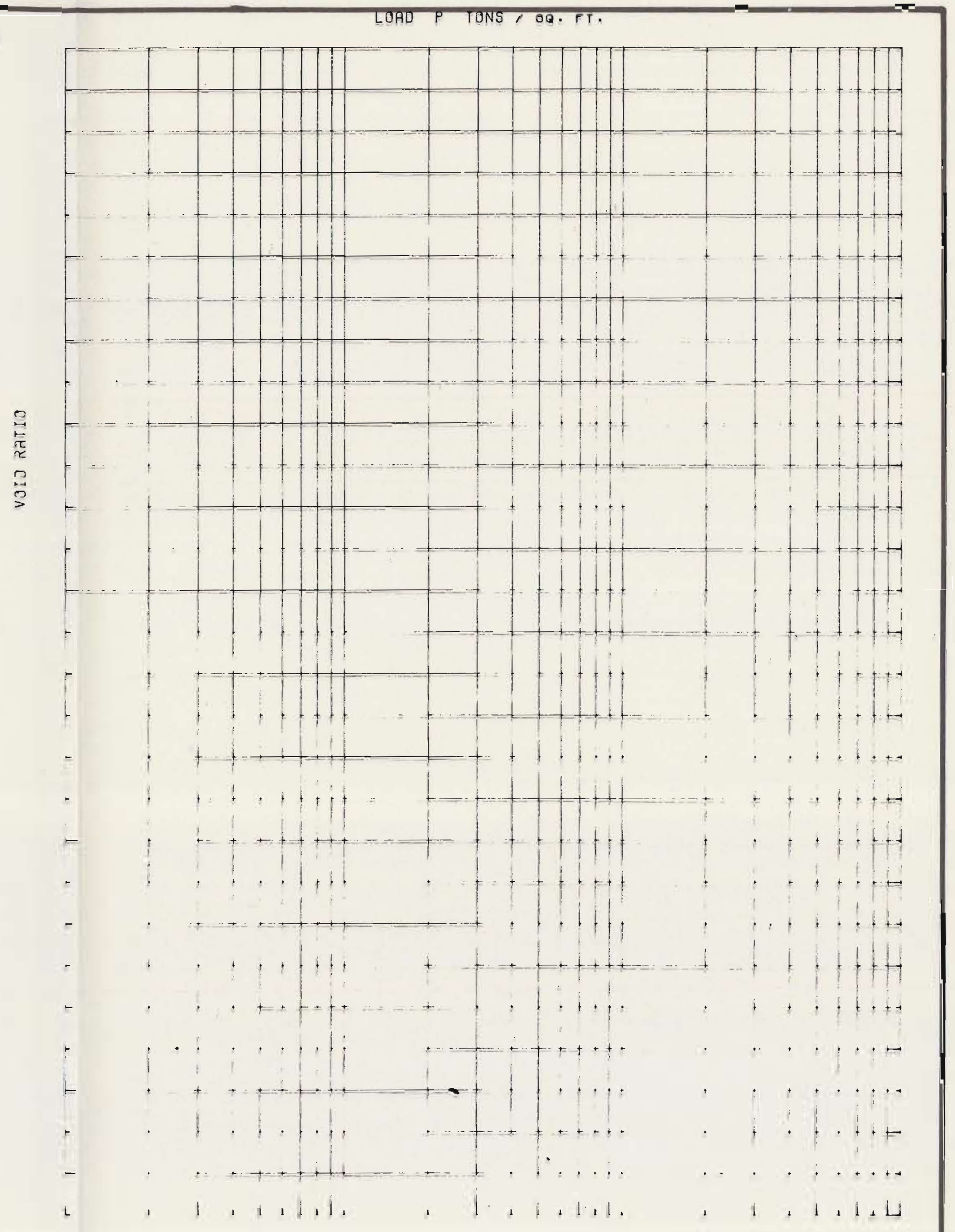


SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	-20.9	Q	0°	0.24	CH
2	-37.5	Q	0°	0.44	CH
3	-5.4	R	21°	0.10	SM
4	-25.6	S	31°	0.0	CH



CONSOLIDATION DATA

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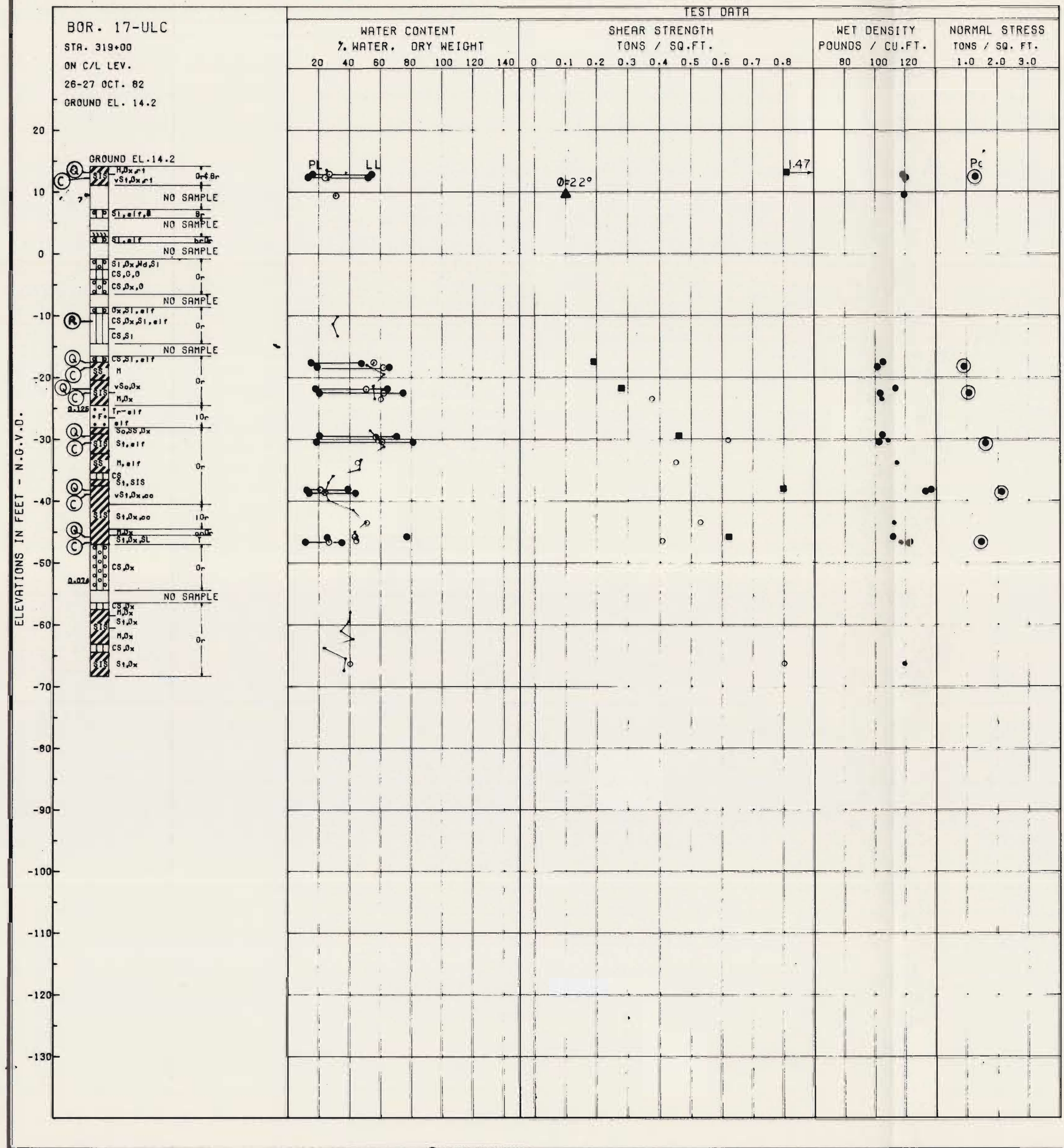
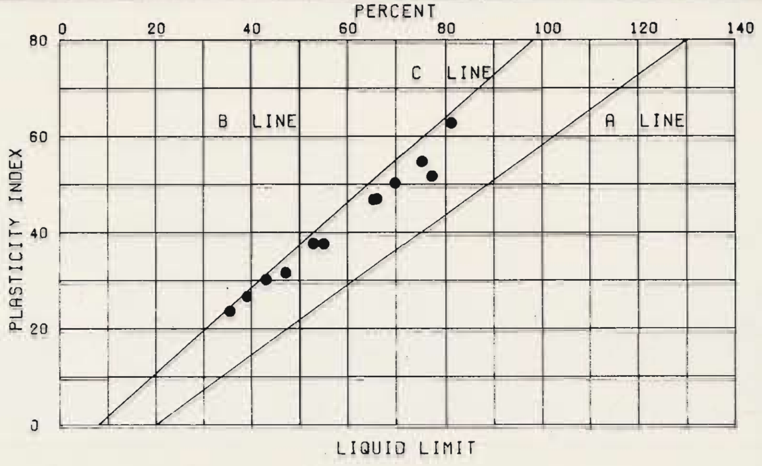
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER
STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD
UNDISTURBED BORING 16-ULC
STA. 236+73 B/L
74 FT. LAKESIDE B/L
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653





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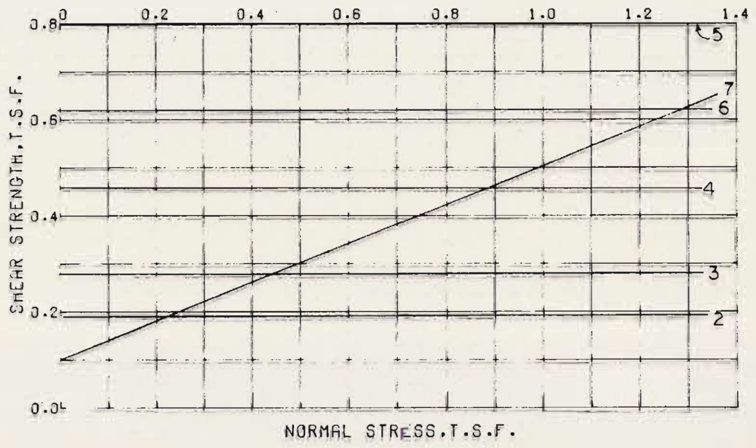
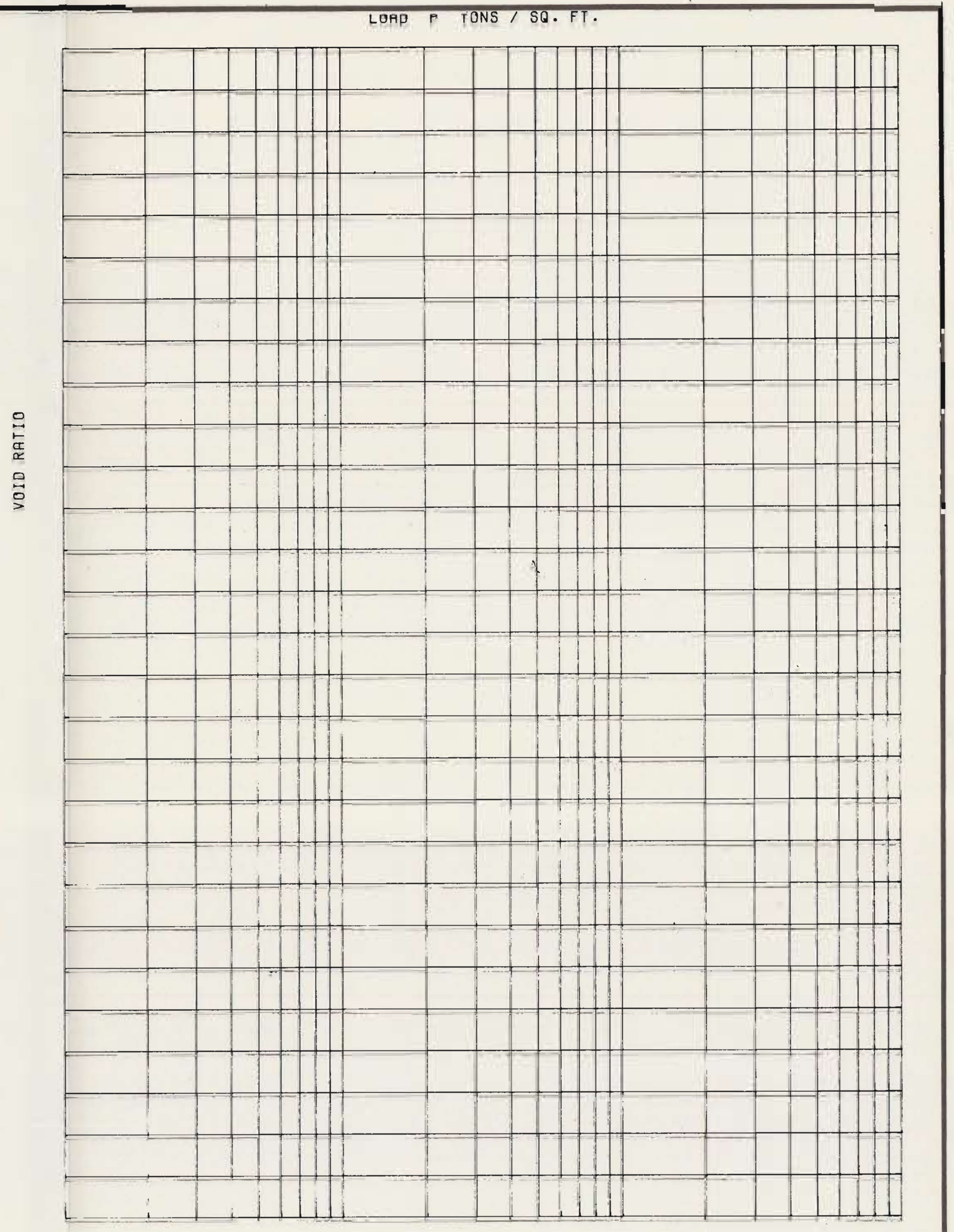


SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	13.4	Q	0°	1,47	CH
2	-17.5			0,19	
3	-21.8			0,28	
4	-29.4			0,46	CH
5	-38.1			0.80	CL
6	-45.9	Q	0°	0,62	CH
7	-10.3	R	22°	0.10	ML



CONSOLIDATION DATA

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■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

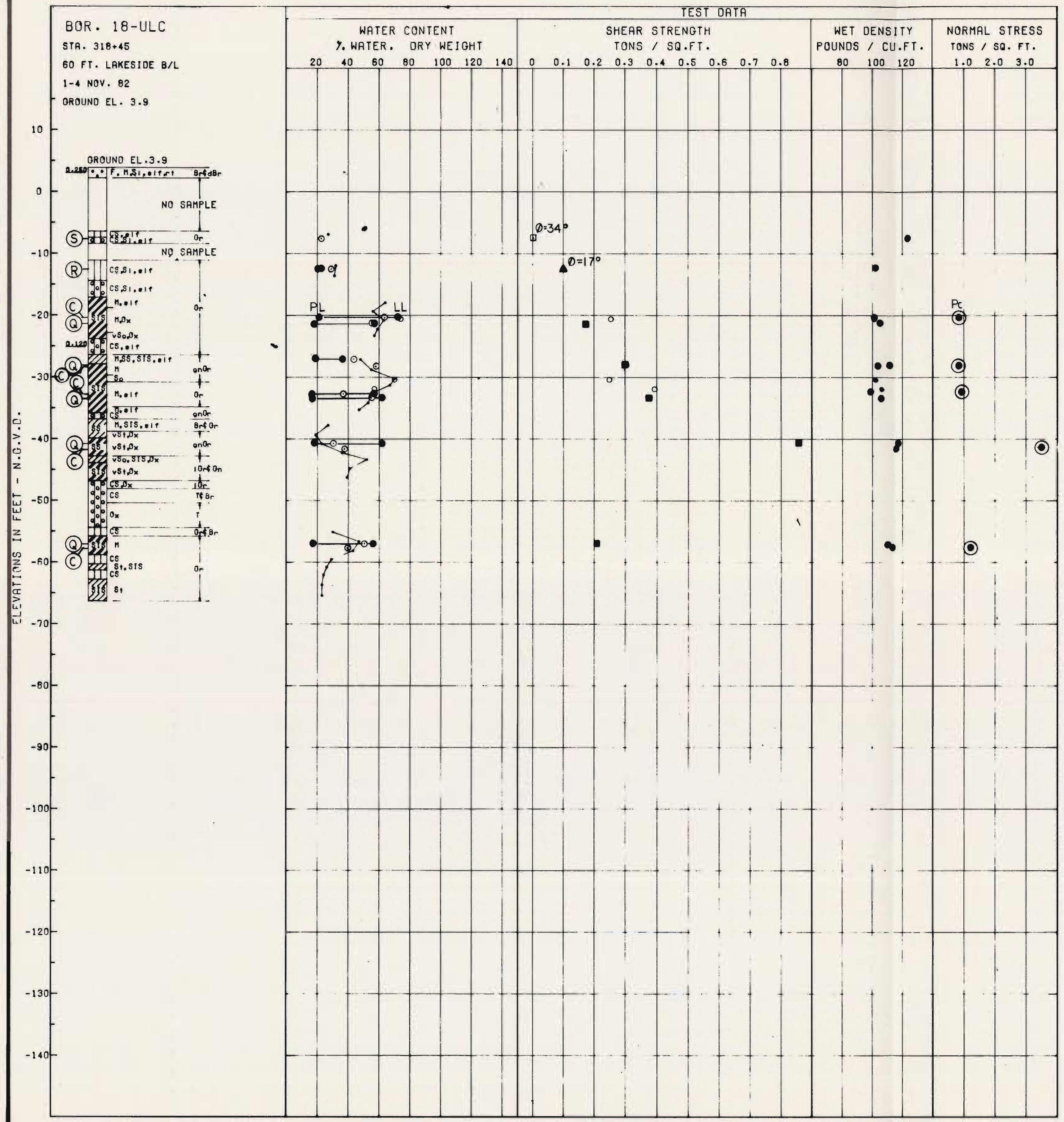
FOR SOIL BORING LEGEND SEE PLATE A

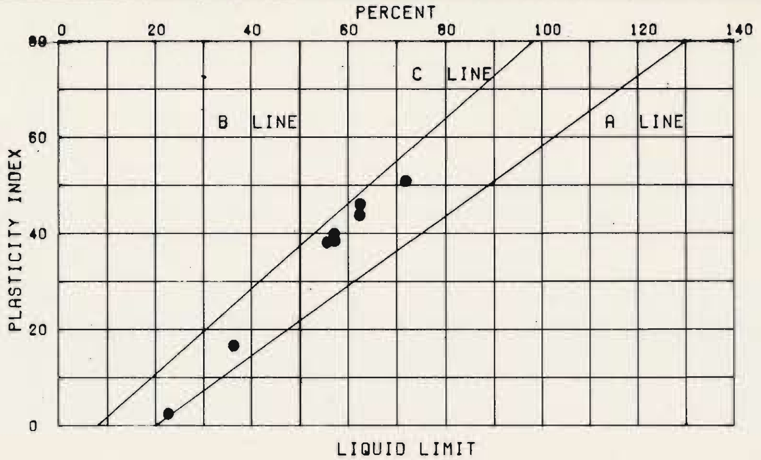
FOR LOCATION OF BORING SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD

UNDISTURBED BORING 17-ULC
STA. 319+00 B/L ON C/L LEV.

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653





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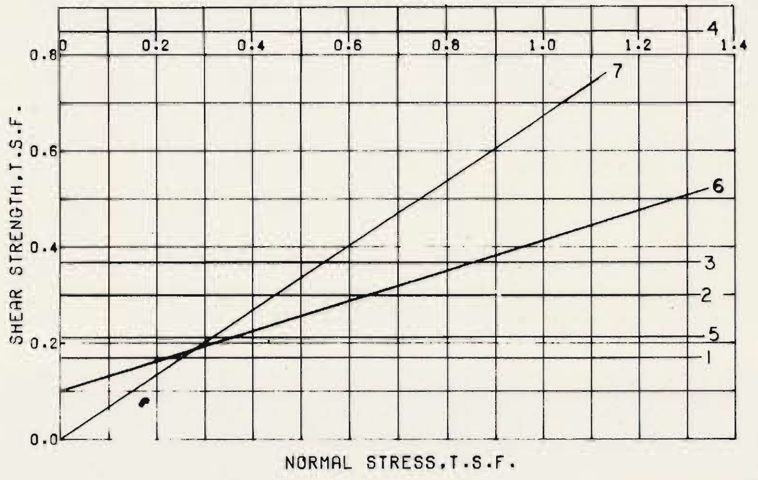
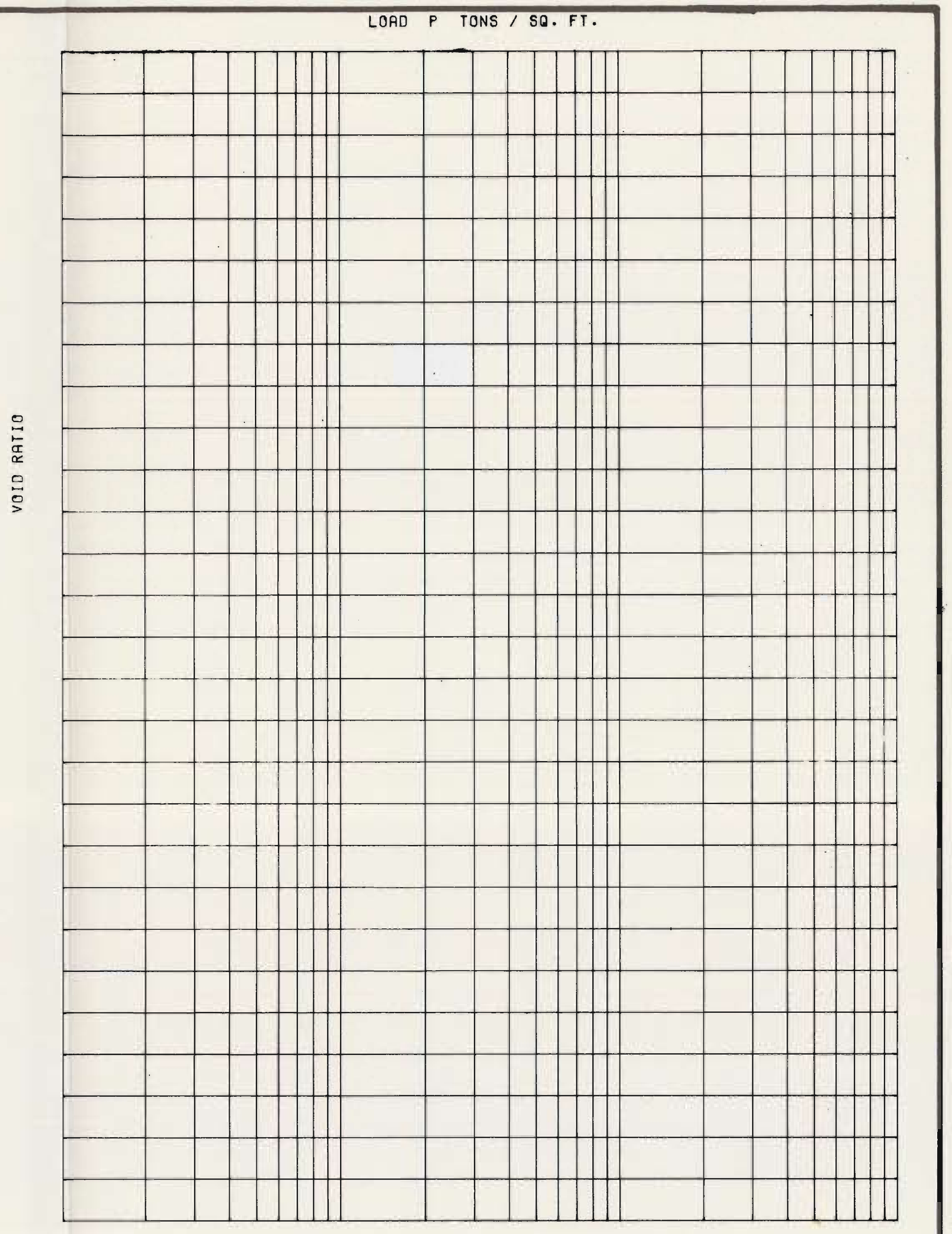


SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	-21.3	Q	0°	0.17	CH
2	-28.0			0.30	CL
3	-33.5			0.37	CH
4	-40.9			0.85	CH / CL
5	-57.1	Q	0°	0.21	CH
6	-12.6	R	17°	0.10	CL
7	-7.6	S	34°	0.0	ML



CONSOLIDATION DATA

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■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

FOR LOCATION OF BORING SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14-GENERAL DESIGN
CITRUS LAKEFRONT LEVEE-I.H.N.C. TO PARIS ROAD

UNDISTURBED BORING 18-ULC
STA. 318+45 60FT. LAKESIDE B/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE No. H-2-29653

LAKE PONTCHARTRAIN, LOUISIANA & VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 GENERAL DESIGN
CITRUS LAKEFRONT LEVEE
IHNC TO PARIS ROAD

APPENDIX A

HYDROLOGY AND HYDRAULICS

Lake Pontchartrain, Louisiana & Vicinity
High Level Plan
Design Memorandum No. 14 General Design
Citrus Lakefront Levee
IHNC to Paris Road
Hydrology and Hydraulics

Appendix A

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CITRUS LAKEFRONT LEVEE
IHNC TO PARIS ROAD

APPENDIX A
HYDROLOGY AND HYDRAULICS

SECTION I - ANALYSIS

I-1. General. This appendix presents all hydrologic and hydraulic design criteria and analyses associated with the Citrus Lakefront levee. The overall plan of improvement is described in detail in the main body of this memorandum and references to the main text are cited where appropriate.

I-2. Description. The project area is located in southeastern Louisiana within the city limits of New Orleans. The dominant topographic feature is Lake Pontchartrain, a shallow tidal basin approximately 640 square miles in area and 12 feet in depth. Lake Pontchartrain is connected to the Gulf of Mexico through the Rigolets and Chef Menteur Passes, Lake Borgne, and Mississippi and Chandeleur Sounds, and is connected with lesser Lake Maurepas to the west by Pass Manchac.

The Citrus area is comprised mainly of developed and developable land. The area is relatively flat ranging in elevation from -8.0 to 0.0 national geodetic vertical datum of 1929 (N.G.V.D.). Drainage is provided by six pumping stations. Three of these are located near the new levee alinement and discharge into Lake Pontchartrain. Of these three pumps on the landside of Hayne Boulevard, the one at St. Charles Canal has a capacity of 1,000 cubic feet per second (cfs); the one at Citrus Canal, 460 cfs; and the one at Jahncke Canal, 1,000 cfs. Of the other three, one is located on the Dwyer Canal and discharges 120 cfs into the IHNC; one is at Elaine Street and discharges 90 cfs into the MRGO, and one at Grant Street and discharges 32 cfs into the MRGO.

The new hurricane protection levee will not interfere with the operation of these pumping stations. The entire area is subject to periodic inundation from hurricane surges and rainfall flooding. The study area is depicted on Plate A-1.

I-3. Climatology.

a. Climate. The project area is located in a subtropical latitude having mild winters and hot, humid summers. During the summer, prevailing southerly winds produce conditions favorable for convective thundershowers. In the colder seasons, the area experiences frontal passages which produce squalls and sudden temperature drops. River fogs are prevalent in the winter and spring when the temperature of the Mississippi River is somewhat colder than the air temperature. Climatological data for the area are contained in monthy and annual publications by the U. S. Department of Commerce, Weather Bureau, titled "Climatological Data for Louisiana," and "Local Climatological Data, New Orleans, La." Table A-1 lists active meteorolgical stations in and adjacent to the study area. These stations are also shown on the map in Plate A-2.

TABLE A-1
METEOROLOGIC STATIONS

MAP INDEX		LENGTH OF RECORD (YRS)	
NO. (PLATE 2)	PRECIPITATION AND TEMPERATURE STATIONS	Precipitation	Temperature
1	NEW ORLEANS - AUDUBON - PARK	92	92
2	NEW ORLEANS - MOISANT AIRPORT	28	92
3	RESERVE (NR)	80	80
4	SLIDELL	25	25
5	DONALDSONVILLE (NR)	92	93
6	LOUISIANA NATURE CENTER	2	2
7	PARADIS (NR)	67	27
OMS	HAMMOND (NR)	85	86
OMS	ST. BERNARD (NR)	16	16
OMS	COVINGTON	88	88
OMS	CARVILLE (NR)	43	42
OMS	BATON ROUGE AIRPORT	113	93
	RECORDING PRECIPTATION STATIONS		
8	NEW ORLEANS ALGIERS	82	—
9	NEW ORLEANS DPS 14 - CITRUS	27	—
10	NEW ORLEANS WATER PLANT - DUBLIN	88	—
11	NEW ORLEANS DPS 5 - JOURDAN	48	—
12	NEW ORLEANS DPS 3 - LONDON	88	—
13	NEW ORLEANS DPS 6 - METAIRIE	33	—
14	GONZALES	4	—
	NON-RECORDING PRECIPTATION STATIONS		
15	NEW ORLEANS CITY HALL	4	—
OMS	BATON ROUGE CENTRAL	3	—
OMS	ABITA SPRINGS FIRE TOWER	9	—

LEGEND: NR NON-RECORDING
OMS - OFF MAP STATION

b. Temperature. New Orleans has temperature records extending as far back as 1871. From temperature normals over the period 1951-1980, the mean annual temperature is 69.5°F. Extremes over the period of record are 7°F and 102°F. The average temperature in summer is 82.4°F and in the winter is 55.3°F. Temperature normals (1951-1980) for the New Orleans gage at Audubon Park Station are shown in Table A-2. Station locations are provided on the map in Plate A-2.

TABLE A-2
MONTHLY TEMPERATURE (°F)
NEW ORLEANS AT AUDUBON PARK
30-YEAR NORMALS (1951-80)

MONTH	MEAN	MAXIMUM	MINIMUM
JAN	53.6	61.8	45.3
FEB	56.1	64.6	47.6
MAR	62.6	71.0	54.1
APR	69.8	78.3	61.2
MAY	76.0	84.2	67.7
JUN	81.3	89.4	73.2
JUL	83.0	90.6	75.3
AUG	82.8	90.3	75.3
SEP	79.8	87.0	72.6
OCT	70.8	79.5	62.1
NOV	61.6	70.1	53.1
DEC	56.2	64.5	47.8
ANNUAL	69.5		

EXTREME MINIMUM: 7°F, 13 February 1899
EXTREME MAXIMUM: 102°F, 30 June 1954 (also other dates)

c. Rainfall. Precipitation is generally heavy in two fairly definite rainy periods. Summer showers occur from about mid-June to mid-September, and heavy winter rains generally occur from mid-December to mid-March. The drainage area tributary to Lake Pontchartrain is served by 34 precipitation stations of the U. S. Weather Bureau, with periods of record ranging from 2 to 113 years. Based on the 30-year normals for the period 1951-1980 and from the U. S. Weather Bureau station New Orleans at Audubon, the annual normal preciptation is 61.6 inches, with variations of plus or minus 50 percent. Extreme monthly rainfalls exceeding 12 inches are not uncommon, and as much as 25 inches have been recorded in a single month. Average monthly normal rainfalls range from a normal 7.2 inches in July to a normal of 2.52 inches in October. Several stations have experienced calendar months in which no rainfall was recorded. Snow occurs infrequently in the area. An 8.2-inch snowfall occurred in New Orleans on 14-15 February 1895. The last measurable snowfall occurred on 31 December 1963 when 4.5 inches fell in New Orleans. Table A-3 gives the 30 year normals for the New Orleans at Audubon station along with the monthly maximum and minimum totals during the normal period. Location of the precipitation stations are shown on Plate A-2.

TABLE A-3
MONTHLY RAINFALL (INCHES)
NEW ORLEANS AT AUDUBON
30-YEAR NORMALS (1951-1980)

MONTH	NORMAL	MAXIMUM	MINIMUM
JAN	4. 9	12.69	0.99
FEB	5.19	12.44	0.54
MAR	4.68	10.17	T
APR	4.68	20.24	0.58
MAY	5.06	12.61	0.62
JUN	5.39	16.98	0.39
JUL	7.17	20.30 a/	2.37
AUG	6.67	17.82	2.67
SEP	5.98	16.91	0.80
OCT	2.52	8.18	0. 0 b/
NOV	4.01	10.15	0.49
DEC	5.30	8.93	1.40
ANNUAL	61.55	83.54 c/	40.11 d/

Legend: T - Trace
a/ - Jul 1959
b/ - Oct 1952, Oct 1963
c/ - 1961
d/ - 1968

d. Wind. The U. S. Weather Bureau anemometer coverage at Moisant Airport in Kenner, Louisiana, was installed in 1949. This anemometer provides the longest record available adjacent to the lake. Table A-4 shows the average monthly wind speeds and its resultant direction for the years 1966-1982. The average wind velocity over this period is 7.8 mph, but winds over 100 mph are experienced occasionally in hurricanes. The predominant wind directions are north-northeast from September through February and south-southeast from March through June. Plate A-3 is a wind rose for New Orleans at Moisant based on the period of record of 1949-1978. The frequency of wind speeds and direction from this wind rose is summarized in Table A-5.

I-4. Hydrologic Regimen.

a. General. The water level in Lake Pontchartrain is subject to variations from direct rainfall, tributary inflow, wind-driven water movements, and flow through the Rigolets and Chef Menteur passes and the Inner Harbor Navigation Canal caused by tidal variations originating in the Gulf of Mexico. Infrequently, lake level is influenced by diversion of Mississippi River floodflow through Bonnet Carre' Spillway. Combinations of these factors determine the salinity regimen in the lake. Locations and periods of record of hydrologic stations are shown in Table A-6.

b. Runoff and Streamflow. Runoff from the 4,700 square miles north and west of Lakes Pontchartrain and Maurepas, estimated to average five million acre-feet annually, drains into the lakes via the Amite, Tickfaw, Natalbany, Tangipahoa, and Tchefuncta Rivers, and Bayous Lacombe, Bonfouca, and Liberty. Streamflow records are available at six locations on these streams and four locations on Pearl River for the periods of record listed in Table A-7. New Orleans and adjacent parishes are drained by outfall canals that discharge directly into Lake Pontchartrain. Yearly fresh water inflow records show considerable variations, as shown in Table A-7.

TABLE A-4
WIND SUMMARIES, NEW ORLEANS AT MOISANT AIRPORT (1966-1982)
AVERAGE WIND SPEED

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1966	9.6	10.5	9.7	10.7	8.7	7.3	6.2	6.4	5.7	7.6	7.4	8.6	8.2
1967	8.3	9.5	9.0	9.3	9.1	6.8	6.2	5.9	7.0	7.4	8.0	9.8	8.0
1968	9.2	10.0	9.3	9.1	8.4	5.6	5.7	5.2	6.4	6.8	8.9	9.3	7.8
1969	9.7	9.8	10.0	8.6	7.3	7.2	6.5	6.8	6.8	9.7	8.0	9.1	8.3
1970	9.5	9.2	9.8	9.9	8.5	6.8	5.4	6.0	6.7	7.7	8.0	7.4	7.9
1971	8.4	9.8	9.8	8.5	7.9	5.3	5.7	5.0	6.5	4.8	8.0	8.7	7.4
1972	8.9	8.6	9.1	10.2	7.3	9.3	7.5	6.4	7.0	8.3	9.9	9.4	8.5
1973	9.6	10.2	12.0	11.5	10.0	6.7	6.7	6.3	7.9	7.0	9.6	11.4	9.1
1974	9.2	11.0	10.8	10.7	8.2	7.4	5.0	5.2	8.6	7.4	8.5	8.5	8.4
1975	9.4	8.6	11.0	10.0	7.4	6.5	6.5	4.9	6.3	6.4	8.0	7.8	7.7
1976	9.6	8.8	10.5	7.6	8.4	6.9	5.4	5.7	6.0	8.5	7.9	8.2	7.8
1977	9.8	8.5	8.5	7.3	5.7	5.3	4.4	5.5	5.4	6.6	8.1	8.8	7.0
1978	9.1	8.9	8.5	8.6	7.9	5.9	5.5	5.3	6.3	6.1	6.7	10.0	7.4
1979	10.5	9.0	9.3	8.0	7.2	6.5	6.7	4.4	8.0	6.7	8.1	6.3	7.6
1980	7.6	8.0	9.8	8.8	7.5	7.4	5.6	5.7	5.3	5.9	6.4	5.9	7.0
1981	7.6	8.3	7.7	7.3	7.8	6.9	5.7	4.8	5.7	7.0	7.3	8.6	7.1
1982	9.8	8.3	8.9	9.4	6.5	6.2	4.6	4.4	7.1	7.5	7.6	10.0	7.5
AVERAGE	9.2	9.2	9.6	9.1	7.9	6.7	5.8	5.5	6.6	7.1	8.0	8.7	7.8

TABLE 4 (cont'd)

WIND SUMMARIES, NEW ORLEANS AT MOISANT AIRPORT (1966-1982)
RESULTANT DIRECTION*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1966	02	04	07	16	07	07	23	15	02	03	03	05	05
1967	03	02	13	15	16	11	21	02	05	06	05	08	09
1968	03	35	12	16	15	19	12	05	06	04	04	06	07
1969	07	02	02	13	09	18	24	09	04	05	36	01	05
1970	03	03	08	17	10	21	20	12	08	03	32	06	09
1971	02	12	13	15	13	23	20	01	07	04	04	12	09
1972	07	07	12	15	04	20	14	34	12	06	02	06	08
1973	02	36	16	16	20	18	24	04	10	07	13	20	12
1974	12	24	16	13	16	16	25	13	05	06	06	16	12
1975	09	21	14	11	15	18	25	17	03	05	08	04	10
1976	04	19	15	15	15	13	25	01	04	02	02	02	07
1977	01	09	13	14	13	21	20	12	15	03	10	13	11
1978	01	01	28	15	16	12	19	11	08	03	08	07	07
1979	01	04	15	14	13	15	17	13	04	11	03	03	08
1980	06	06	09	20	15	22	27	13	09	04	02	02	08
1981	02	02	21	15	13	16	22	11	05	06	10	04	09
1982	11	01	12	10	13	22	21	21	06	06	06	10	NA

* Wind Direction - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm, 09 east, 18 south, 27 west, 36 north. Resultant wind is the vector sum of wind directions and speed divided by number of observations.

NA - Not Available

TABLE A-5
WINDSPEED
NEW ORLEANS AT MOISANT AIRPORT
PERCENTAGE FREQUENCY (1949-1978)

SPEED GROUPS (MPH)

DIRECTION	0-3	4-13	14-19	20-25	26-32	32+	TOTAL
N	0.0	4.9	2.1	0.3	0.1	0.0	7.4
NNE	0.0	4.0	1.5	0.2	0.0	0.0	5.7
NE	0.0	5.0	1.6	0.2	0.0	0.0	6.8
ENE	0.0	4.9	1.4	0.1	0.0	0.0	6.4
E	0.0	4.3	1.0	0.1	0.0	0.0	5.4
ESE	0.0	3.6	0.7	0.1	0.0	0.0	4.4
SE	0.0	4.0	0.9	0.1	0.0	0.0	5.0
SSE	0.0	4.5	1.6	0.2	0.0	0.0	6.3
S	0.0	6.2	2.1	0.3	0.1	0.0	8.7
SSW	0.0	4.0	0.8	0.2	0.0	0.0	5.0
SW	0.0	3.0	0.4	0.0	0.0	0.0	3.4
WSW	0.0	2.1	0.4	0.0	0.0	0.0	2.5
W	0.0	2.4	0.5	0.1	0.0	0.0	3.0
WNW	0.0	2.0	0.5	0.1	0.0	0.0	2.6
NW	0.0	2.0	0.8	0.2	0.1	0.0	3.1
NNW	0.0	2.7	1.4	0.3	0.1	0.0	4.5
CALM	20.0	-	-	-	-	-	20.00
TOTAL	20.0	59.6	17.7	2.5	0.4	0.0	100.00

TABLE A-6
HYDROLOGIC STATIONS

MAP INDEX NO. (PLATE A-2)	PERIODS OF RECORD			STAGE EXTREMES (NGVD)			
	STATION	TYPES OF WATER LEVEL GAGE	RECORDS AVAILABLE THRU 1982	MAXIMUM	DATE	MINIMUM	DATE
16	Amite River at Port Vincent	Auto Recorder and Staff	Gage Heights, Dec 1954 to Jun 1974 and Jun 1975 to date. Discharge, last observation - Apr 1980	12.87	Apr 77	-0.93	Mar 81
17	Amite River at French Settlement	Auto Recorder and Staff	Gage Heights, intermittent 1947-1951 and daily. Dec 1954 to date. Discharge, last observation - 8 in 1977	7.4	Apr 78	-1.5	Dec 54
18	Petite Amite River NR St. Paul	Auto Recorder and Staff	Gage Heights, intermittent Mar 1950 to May 1951 and daily Oct 1951 to date	4.72	Apr 73	-1.6	Dec 56
19	Reserve Canal near Lake Maurepas	Auto Recorder and Staff	Gage Heights, Jan 1979 to date	3.21	Sep 79	-1.14	Mar 81
20	Tickfaw River near Springfield	Auto Recorder and Staff	Gage Heights, May 1947 to date. Discharge, last observation - 7 in 1977	5.57	Apr 79	-1.43	Dec 54
21	Pass Manchac near Ponchatoula	Staff	Gage Heights, July 1955 to date	4.80	Apr 79	-2.0	Jan 61
22	Bayou Bonfouca at Slidell	Staff	Gage Heights, Aug 1962 to date	6.8 (affected by Hurricane)	Aug 69	-0.6	Feb 63
23	Lake Pontchartrain at Frenier	Auto Recorder and Staff	Gage Heights, Sep 1931 to Sep 1965 and Jan 1969 to date	12.09 * (watermark)	Sep 65	-2.1	Jan 38

* Caused by hurricane

TABLE A-6
HYDROLOGIC STATIONS
(cont'd)

MAP INDEX NO. (PLATE A-2)	STATION	PERIODS OF RECORD		STAGE EXTREMES (NGVD)			
		TYPES OF WATER LEVEL GAGE	RECORDS AVAILABLE THRU 1982	MAXIMUM	DATE	MINIMUM	DATE
24	Lake Pontchartrain at Mandeville	Auto Recorder and Wire Weights	Gage Heights, Sep 1931 to date	6.95*	Sep 47	-2.25	Jan 38
25	Lake Pontchartrain at Midlake near New Orleans	Auto Recorder and Wire Weights	Gage Heights, Aug 1957 to date	5.53*	Sep 65	-1.28	Mar 65
26	Lake Pontchartrain at West End	Auto Recorder and Staff	Gage Heights, Sep 1931 to Nov 1946 and Mar 1949 to date	5.37*	Sep 65	-2.2	Jan 38
27	Lake Pontchartrain (Irish Bayou) near South Shore	Auto Recorder and Staff	Gage Heights, May 1949 to date	7.16*	Aug 69	-1.30	Jul 54
28	Rigolets near Lake Pontchartrain	Auto Recorder and Staff	Gage Heights, Sep 1931 to date	9.0*	Aug 69	-1.90	Jan 38
29	Lake Borgne at Rigolet	Auto Recorder and Staff	Gage Heights, Dec 1957 to Sep 1965 and Jul 1967 to date	12.25* (watermark)	Aug 69	-2.04	Feb 78
30	Chef Menteur Pass near Lake Borgne	Auto Recorder and Staff	Gage Heights, Apr-Jun 1945, Feb & Mar 1950, Jul 57-Sep 65 and Oct 67 to date. Discharge, 1937 and 1945	9.07*	Sep 65	-1.69	Feb 78

* Caused by hurricane

TABLE A-6
HYDROLOGIC STATIONS
(cont'd)

MAP INDEX NO. (PLATE A-2)	STATION	PERIOD OF RECORD		STAGE EXTREMES (NGVD)			
		TYPE OF WATER LEVEL GAGE	RECORDS AVAILABLE THRU 1982	MAXIMUM	DATE	MINIMUM	DATE
31	Mississippi River - Gulf Outlet at Shell Beach	Auto Recorder and Staff	Gage Heights, Jun 1961 to date	11.06	Aug 69*	-2.7	Mar 65
32	Bayou Dupre at Floodgate (west)	Auto Recorder and Staff	Gage Heights, Aug 1975 to date	3.14	Apr 79	-1.94	Jan 79
33	Bayou Dupre at Floodgate (east)	Auto Recorder and Staff	Gage Heights, Aug 1975 to date	4.51	Jul 79**	-1.78	Feb 78
34	Bayou Bienvenue at Paris Road	Auto Recorder and wire height	Gage Heights, Dec 1974 to date	4.82	May 78	-1.78	Jan 77
35	Bayou Bienvenue at Floodgate (west)	Auto Recorder and Staff	Gage Heights, May 1975 to date	3.55*	Sep 77	-2.03**	May 78
36	Bayou Bienvenue at Floodgate (east)	Auto Recorder and Staff	Gage Heights, Dec 1974 to date	4.62	Jul 79	-1.89	Jan 79
37	Intracoastal Waterway near Paris Road Bridge	Auto Recorder and Staff	Gage Heights, Apr 1948 to date	10.04*	Sep 65	-2.19	Mar 65
38	Inner Harbor Navigation Canal near Seabrook Bridge	Auto Recorder and Staff	Gage Heights, Daily, Aug 1962 to date	6.47*	Aug 69	-1.53	Mar 65

* Caused by hurricane.
** From incomplete record.

TABLE A-6
HYDROLOGIC STATIONS
(cont'd)

MAP INDEX NO. (PLATE A-2)	STATION	HYDRAULIC STATIONS		STAGE EXTREME (NGVD)			
		TYPES OF WATER LEVEL GAGE	RECORDS AVAILABLE THRU 1982	MAXIMUM	DATE	MINIMUM	DATE
39	Inner Harbor Navigation Canal (IWW) at Florida Ave. Bridge	Auto Recorder and wire weight	Gage Heights, July 1944 to date	9.82*	Aug 69	-1.45	Jan 81
40	Inner Harbor Navigation Canal (IWW) at New Orleans	Staff	Gage Heights, May 1922 to date	10.61* (Highwater mark)	Sep 65	-1.85	Jan 75
41	Intracoastal Waterway at Harvey Lock	Wire Weight	Gage Heights, Jan 1925 to date	4.21	Apr 73	-1.28	Jan 40
42	Intracoastal Waterway at Algier's Lock	Auto Recorder and Wire Weight	Gage Heights, May 1956 to date	4.31	Apr 73	-1.64*	Sep 65

* Caused by hurricane

TABLE A-7
PERTINENT STREAMFLOW DATA (1938-1983)

INFLOW POINT	TOTAL DRAINAGE AREA MI ^{2}	GAGED LOCATION*	GAGED DRAINAGE AREA MI ^{2}	PERIOD OF RECORD	AVERAGE DISCHARGE (cfs)	MAXIMUM DISCHARGE		MINIMUM DISCHARGE	
						RATE (cfs)	DATE	RATE (cfs)	DATE
Amite River	2,373	NR Denham Springs	1,280	9/38 to date	1,966	120,000	4/8/83 10/18/56	271	10/17/56
Tickfaw River	735	At Holden	247	10/40 to date	366	22,400	4/8/83	65	10/1-4/69
		Natalbany River At Baptist	79.5	8/43 to date	114	9,640	4/7/83	1.8	11/2-5/63
Tangipahoa River	885	At Robert	646	10/38 to date	1,129	86,000	4/8/83	245	10/30/68 thru 11/3/68
Tchefunta River	459	NR Folsom	95.5	1/43 to date	159	33,000	4/6/83	26	9/4/68 and 9/15/68
		Bogue Falaya At Covington	88.2	1964 to date	-	12,700**	4/8/83	-	-
Pearl River	8,689	At Bogalusa	6,573	10/38 to date	9,599	129,000	4/24/79	1,020	10/29/63 thru 11/1/63
		Bogue Chitto NR Bush	1,213	10/37 to date	1,916	131,700	4/8/83	366	10/22, 23, 26, 29/68
		At Pearl River	3,494	10/63-9/70 10/75 to date	9,470 (1964-70)	230,000	4/9/83	1,580	10/24/63 and 11/10/63
		Bogue Lusa Creek At Bogalusa	72.7	10/63 to date	116	15,000	4/7/83	5	10/27-28/67

* U.S. Geological Survey Gage Stations
** Previous Flood Discharge - 8,610 CFS 4/27/64

c. Stages, Salinities, Waves, and Tides.

(1) Lake stages.

(a) The Bonnet Carre' Spillway is operated as required during major high water seasons on the Mississippi River to divert flows through Lake Pontchartrain in order to insure that a stage of 20 feet on the Carrollton gage is not exceeded at New Orleans. Studies indicate that the operations of the spillway produced maximum increases in lake level of about 0.8 foot in 1937, 1.5 feet in 1945, 1.0 foot in 1950, and 0.7 foot in 1973 and again in 1979. The effects Bonnet Carre' operation on stages in Lake Pontchartrain were evaluated as part of a physical model study made by the U. S. Army Engineer Waterways Experiment Station in Vicksburg, Mississippi, in 1963 (1). The report indicates that for the passage of flows at or near the design discharge of 250,000 cfs, the operation of the spillway would increase stages in Lake Pontchartrain by about 0.7 foot for average high water stages in Lake Borgne. An analysis of the effects of Bonnet Carre' on lake stages during the 1973 and 1979 operations indicates that these model results are generally valid.

(b) The maximum recorded stage in Lake Pontchartrain of 13.0 feet occurred at Frenier on 29 Septmeber 1915. The minimum of minus 2.2 feet occurred at New Orleans (West End) on 26-27 January 1938. The mean lake stage for the period from 1953 through 1971 was 1.2 feet.

(c) Maximum stages occur in Lake Pontchartrain during hurricane activity in the vicinity. A list of high stages recorded during hurricanes is presented in Table A-8.

TABLE A-8
MAXIMUM STAGES - LAKE PONTCHARTRAIN

LOCATION	DATE	STAGE - FT N.G.V.D	
Mandeville	20 Sep 1909	8.0	
West End	20 Sep 1909	6.2	
Frenier	20 Sep 1915	13.0	
West End	29 Sep 1915	6.0	
West End	19 Sep 1947	5.4	
Mandeville	19 Sep 1947	6.8	
New Orleans	4 Sep 1948	4.9	
Frenier	24 Sep 1956	6.8)	"Flossy"
Little Woods	24 Sep 1956	7.0)	
West End	24 Sep 1956	5.3)	
Mandeville	27 Jun 1957	4.1*	"Audrey"
Frenier	9 Aug 1957	3.3	"Bertha"
Frenier	18 Sep 1957	4.5	"Esther"
Mandeville	10 Sep 1961	5.5	"Carla"
Frenier	17 Sep 1963	4.0	"Cindy"
Mandeville	4 Oct 1964	6.4	"Hilda"
Frenier	10 Sep 1965	12.1	"Betsy"
Frenier	Aug 1969 (watermark)	4.6	"Camille"
Mandeville	18 Aug 1969	4.6	
West End	17 Aug 1969	5.2	
Irish Bayou	18 Aug 1969	7.2**	
Rigolets	18 Aug 1969	9.0**	
Shell Beach	17 Aug 1969	11.1**	
Mandeville	8 Sep 1974	5.0	"Carmen"
Frenier	8 Sep 1974	4.5	
West End	8 Sep 1974	5.2	
Frenier	5 Sep 1977	4.2	"Babe"
Little Woods	4 Sep 1977	4.5	

* Possibly higher, gage failed during storm.

** New record established.

(2) Salinities. Diluted saline gulf water enters Lake Pontchartrain from Lake Borgne via the Rigolets and Chef Menteur Pass and the Mississippi River - Gulf Outlet and Inner Harbor Navigation Canal in large quantities and mixes with the fresh water inflow. The salinity in the eastern portion of Lake Pontchartrain averages about 4.5 parts per thousand with a low of 01.1 part per thousand, and a high of 16.5 parts per thousand. The salinity in the western portion of the lake averages about 1.5 parts per thousand with a low of 0.05 part per thousand, and a high of 8.0 parts per thousand. Salinity is subject to considerable variation with respect to location, seasonal trends, and short-term fluctuations. More intensive data on salinities, tides, and currents in Lake Pontchartrain and vicinity are shown in U.S. Army Waterways Experiment Station Report of January 1982 entitled "Lake Pontchartrain and Vicinity Hurricane Protection Plan - Prototype Data Acquisition and Analysis."(2)

(3) Waves. In August 1957, two wave gages were installed on the east side of the Greater New Orleans Expressway Bridge, Station Ten at the north end, and Station Four on the south end. Both are approximately one-quarter mile from shore. In 1958, Station Nine was established at Frenier, with the gage on a tower approximately 1,200 feet from shore. Locations are shown on Plate A-2. Pertinent observed data are listed in Table A-9.

TABLE A-9

WAVE DATA

Station	Significant Waves		Maximum Waves	
	Range ft.	Wind m.p.h	Height ft.	Date
4	0.1 to 4.9	30	8.3	9 October 1958
9	0.1 to 4.9	29	7.8	9 October 1958
10	0.1 to 5.3	40	9.0	10 May 1959

(4) Tides. The normal tide has general range of one-half foot in Lake Pontchartrain and is diurnal in nature. However, wind effects usually mask the daily ebb and flood variations. Because of the annual volume of freshwater inflow (estimated to average 5 million acre-feet), tides and storm surges, enormous volumes of water pass in both directions through the Rigolets, Chef Menteur Pass, Lake Borgne, Mississippi Sound, Inner Harbor Navigation Canal, and Mississippi River-Gulf Outlet. With so many variables operating on the several elements of the system, the current patterns are continually changing.

I-5. Description and Verification of Procedures.

a. Hurricane Memorandums. The Hydrometeorological Section (HMS), U. S. Weather Bureau, cooperated in the development of hurricane criteria for experienced and potential hurricanes in the study area. The HMS memorandums provided frequency data, isovel and rainfall patterns, pressure profiles, hurricane paths, and other parameters required for the hydraulic computations. Those relative to experienced hurricanes are based on reevaluation of historic meteorologic and hydrologic data. Those relative to potential hurricanes contain generalized estimates of hurricane parameters that are based on the latest research and concept of hurricane theory. Memorandums pertinent to the study area are lised in Section III, Bibliography.

b. Historical Storms used for Verifications. Three observed storms, with known parameters and effects, were used to establish and verify procedures and relationships for determining surge heights, wind tide levels (WTL's), inflow into Lake Pontchartrain, overtopping flows, and ultimately, flooding elevations that would result from synthetic hurricanes. These three storms occurred in September of 1915 (4) and September 1947 (5) are shown on Plates A-4 and -5.

(1) The hurricane of 29 September 1915 had a central pressure index (CPI) of 27.87 inches, an average forward speed of 10 knots, and a maximum wind speed of 99 mph at a radius of 29 nautical miles. This hurricane approached the mainland from the south. At the Lake Borgne entrance to the Rigolets, a high water elevation of about 10 feet was experienced and the average elevation in Lake Pontchartrain rose to 6 feet. This storm was not used for verification of levee overtopping because the present lakefront levee system was not in existence in 1915.

(2) The 19 September 1947 hurricane had a CPI of 28.57 inches, an average forward speed of 16 knots, and a maximum windspeed of 72 mph at a radius of 33 nautical miles. The direction of approach of this hurricane was approximately from the east. In Lake Borgne, at the entrance to the Rigolets, the maximum water surface elevation was 10 feet and in Lake Pontchartrain, the maximum elevation was 5 feet. However, because of the rapid forward speed of this storm, the average water elevation in Lake Pontchartrain did not reach its maximum at the time that the winds were critical to the south shore. The step-type seawall was in place along the New Orleans lakefront during this storm, and a fairly reliable flood line of overtopping flows was available for verification.

(3) Tropical storm Esther occurred on 16 September 1957, and the resultant elevations were accurately registered by stage recording gages at many locations within the study area. These records were available for verification of routing procedures. This storm was not severe enough to cause flooding.

c. Synthetic storms. Computed flood elevations, resulting from synthetic storms, are necessary for frequency and design computations. Parameters for certain synthetic storms and methods for derivation of others were furnished by the U. S. Weather Bureau. The standard project hurricane (SPH) for the entire Louisiana coast was used for all locations in the study area with changes only in path and forward speed.

(1) SPH for the Louisiana coast was derived by the U. S. Weather Bureau from a study of 42 hurricanes that occurred in the region over a period of 57 years (6) SPH paths critical to different locations in the study area and isovel patterns at critical hours are shown on Plates A-6 and A-7. Based on subsequent studies of more recent hurricanes, the U. S. Weather Bureau has revised the SPH wind field patterns and other characteristics over the years. Wind field patterns were revised after Hurricane Betsy in 1965 to reflect the intensified wind

speeds (7), (8), (9). After Hurricane Camille in 1969, the Weather Service completely revised hurricane characteristics for the SPH, including the wind speeds, central pressure and radii. (10) In their latest publication (11) NOAA has expanded and generalized the latest SPH characteristics. For design of the Lake Pontchartrain and Vicinity Hurricane Protection Project High Level Plan, the SPH, as defined after Hurricane Betsy, was used. To assure that all the segments of the project would be compatible, SPH parameters have not been changed since construction began. Modifications and adjustments of these parameters subsequent to Hurricane Betsy have not significantly changed the characteristics of the SPH.

(a) The SPH for the Louisiana coastal region has a frequency of once in 100 years. The CPI that corresponds to this frequency is 27.6 inches. CPI probabilities are based on the following relationship. (12):

$$P = \frac{100 \quad (M-0.5)}{Y}$$

Where P = percent chance of occurrence per year
M = number of the event (rank)
Y = number of years of record

(b) Radius of maximum winds is an index of hurricane size. The average radius of 12 hurricanes occurring in the New Orleans area is 36 nautical miles. From relationships of CPI and radius of maximum winds of gulf coast hurricanes (12), a radius of 30 nautical miles is considered representative for an SPH having a CPI of 27.6 inches.

(c) Different forward speeds are necessary to produce SPH effects at various locations within the study area. In Lake Pontchartrain, the forward speed is a particularly critical factor and may be as important as the track itself. Sufficient time must elapse between the time of maximum elevation at the entrances to Chef Menteur Pass and the Rigolets and the time of maximum critical winds at the Lake Pontchartrain shore in question to allow for maximum inflow into the lake. The SPH for the south shore, patterned after the September 1915 hurricane, has an average forward speed of 6 knots. An average forward speed of 11 knots was used for the SPH along the west shore of Lake Borgne at the entrance to the passes into Lake Pontchartrain.

(d) Maximum theoretical gradient wind (12) is expressed as:

$$V = 73 \sqrt{P_n - P_0} - R\ (0.575\ f)$$

where V_{gx} = maximum gradient wind speed in miles per hour
P_n = asymptotic pressure in inches
P_0 = central pressure in inches
R = radius of maximum winds in nautical miles
f = coriolis parameter in units of hour $^{-1}$

The estimated wind speed (30 feet above ground level) (V_x) (13) in the region of highest speeds is obtained as follows:

$$V_x = 0.885\ V_{gx} + 0.5T$$

where T = forward speed in miles per hour.

From these relationships, a wind speed of approximately 100 mph was obtained.

(2) Other synthetic storms of different frequency and CPI are derived from SPH. Other CPI's for desired frequencies are obtained from the graph shown on Plate A-8. V_{gx}'s corresponding to any other CPI are determined similarly by use of the method described for the SPH. Variations in CPI's of historic storms were accomplished by the same procedure (12). Characteristics of synthetic storms and some historic storms are listed in Table A-10.

TABLE A-10
HURRICANE CHARACTERISTICS

Hurricane *	CPI inches	Radius of max. winds nautical miles	Forward speed knots	V_x m.p.h.
Sep 1915	27.87	29	10	99
Sep 1947	28.57	33	16	72
Sep 1956	28.76	30	10	80
Sep 1965	27.79	32	20	122
Track A PMH	26.90	30	6	114
Track A SPH	27.60	30	6	100
Track A Mod H	28.30	30	6	83
Track F PMH	26.90	30	11	114
Track F SPH	27.60	30	11	100
Track F Mod H	28.36	30	10	80

* Tracks are shown on Plate A-9.

(d) Surges.

Maximum hurricane surge heights along the western shores of Lake Borgne at the entrances to Lake Pontchartrain were computed by use of a one dimensional steady-state wind tide formula. A detailed description of the formula and its verification is contained in Design Memorandum No. 1, Hydrology and Hydraulic Analysis, Part I-Chalmette (14).

(e) Routing.

Since the major hurricane damage in the study area results from storm induced effects on Lake Pontchartrain, it was necessary to establish a method to determine the hydraulic regimen in the lake at any time during the hurricane occurrence. This procedure involves the construction of a stage hydrograph for Lake Borgne, and the simultaneous hourly calculations of flows through Lake Pontchartrain's natural inlet and outlet passes, tilt and stage-volume relationships in Lake Pontchartrain and Lake Maurepas, accumulated rainfall, and overflow from the lake to the land areas.

(1) Prerequisite to any routing is the choice of an actual or hypothetical hurricane of known or designated characteristics. It is then possible to develop surge heights for any point in Lake Borgne for selected storm. For routing purposes, Long Point, which is east of the mouth of the Rigolets, was selected as the critical point for a hydropgraph. The hydrograph for Long Point reflects stages at the mouths of both the Rigolets and Chef Menteur Pass. Construction of such a hydrograph of hourly stages at the mouth of the two passes was based on a method developed by R. O. Reid (15) that was modified by using the maximum surge elevation computed by the incremental setup method as the peak of the hydrograph for the critical period. A comparison of the rising portion of the hydrograph thus derived, with one obtained by computing surge elevations at hourly intervals, indicated agreement between the two methods. Final stages for the recession portion of the hydrograph could not be computed by the incremental setup method because of the offshore wind directions prevailing after the peak stage. The recession produced by Reid's method (15), obtained by rotating the hydrograph about the peak ordinate, indicated stages considerably lower than corresponding stages for the 1947 hurricane surge. The observed stages of the 1957 storm surge also indicated that the recession was somewhat slower at intermediate stages in Lake Borgne. It was therefore necessary to estimate the recession portion of the hydrograph to verify routing procedures. Storm surge hydrographs for Long Point for each storm investigated were determined by identical procedures.

(2) Storms tides flow in and out of Lake Pontchartrain through three major natural passes and an artificial canal. Rating tables, derived by reverse routing of observed storms, were developed for use in routing through the passes and canal. The elevation of Lake Borgne at Long Point was determined from the average of records obtained from automatic tide gage recorders located at the mouths of the passes and at Shell Beach. Elevations of Lake Pontchartrain were determined from records of the automatic tide gages located in Lake Pontchartrain at U. S. Highway 11 and at West End. Although there was a fairly consistent relationship between head and flow, there was no consistency when a parameter of stage was introduced.

(a) The combined rating of the Rigolets, Chef Menteur Pass, flow over U. S. Highway 90 in vicinity of the passes, and Inner Harbor Navigation Canal was based on the period 25 July to 11 August 1957, during which time a minor storm accompanied by moderate stages was experienced. The empirical relationship, $Q = 560 H^{\circ} .935$ was derived from plots of the data, and used to compute a rating table.

(3) Storage tables for the range of stages were made for Lake Pontchartrain. The storage amounts include the volumes contained in the adjacent marsh areas when the stages exceed the surface elevations of these marshes.

(4) Cumulative amount of rainfall that is coincident with the storm significantly affects the lake elevations and hence the routing procedure. The amount of this rainfall was calculated by the methods described in U. S. Weather Bureau memorandums (16), (17), using a moderate rainfall that would be coincident with a tropical storm. For routing purposes, rainfall was considered as additional inflow into Lake Pontchartrain. The effect of cumulative rainfall is to raise the lake level.

(5) Stages, wind tide elevations, and waves induce flow over the shore protective structures. Adjustments were made in the routing procedure to account for the quantities that overtopped these structures.

(6) With the above-mentioned items resolved, the routing procedure was reduced to the successive approximation type problem in which the variable factors were manipulated until a condition of balance between flows and storages was obtained for the incremental time intervals. A typical routing computation is illustrated on Plate A-10. The 1947 and 1915 hurricanes were routed by this procedure. Routed average stages for Lake Pontchartrain were found to be in reasonable agreement with the observed average stages for the two hurricanes. The degree of agreement between the observed and computed stages that were obtained by use of the routing procedure verifies the methods and rating tables used. Observed and computed average stages for the 1947 and 1957 hurricanes are shown on Plates A-11 and A-12. All other hurricanes studied were routed using similar procedures. The resultant stage hydrograph for the SPH critical to the south shore of Lake Pontchartrain is shown on Plate A-13.

(f) Wind tides. The storms under consideration are accompanied by strong winds. The effect of strong winds blowing over a shallow inclosed body of water, such as Lake Pontchartrain, is to drive large quantities of water ahead of the winds. It was necessary for purposes of routing and overflow computations to determine the windtide levels for Lake Pontchartrain. This was accomplished by dividing the lake into four or five segments that are roughly parallel to the wind directions, and by calculating setup and setdown for each of the segments. The average windspeed and average depth in each segment were determined from isovel and hydrographic charts for each wind tide computation. The storm isovel patterns were furnished by the U. S. Weather Bureau (18), (19). The computation of wind along each zone was based on the segmental integration method (20) and was calculated by use of the step-method formulas (21) that were modified as follows:

$$\text{Setup} = d_t \left(\sqrt{\frac{0.00266\ u^2\ FN}{d_t^2} + 1} - 1 \right)$$

$$\text{Setdown} = d_t \left(1 - \sqrt{\frac{1 - 0.0026u^2 \quad FN}{d_t^2}} \right)$$

Where: Setup or setdown in feet is measured above or below mean water level (m.w.l.) of the surge in the lake.

d_t = av. depth of fetch in feet below m.w.l.
u = windspeed in m.p.h over fetch
F = fetch length in miles, node to shoreline
N = planform factor, equal generally to unity

(1) Graphs were constructed from the above formulas to determine setup and setdown quickly about any nodal elevation, Plate A-15. Volumes of water along the zones, represented by the setup and setdown with respect to a nodal elevation, were determined and the water surface profiles adjusted until the setup and setdown volumes balanced within 5 percent. Water surface contours were then drawn for several even-foot nodal elevations,

and the tilt and WTL's were determined from the contour sketch. In the routing of surges, pertinent wind tides and tilts for other nodal elevations were interpolated from the contour sketches for the even-foot nodes. Typical wind tide computations are illustrated Plate A-15.

(2) Maximum computed and observed setup elevations for the 1947 hurricane, were 4.9 feet and 5.4 feet at West End. Computed stages for the 1915 hurricane compared favorably with observed high water marks. Wind tide levels for all hurricanes studied were computed by applying the same methods and procedures described above. Maximum surge height contours in the Lake Borgne area and maximum WTL contours in the Lake Pontchartrain area were developed for the SPH. These contours are shown on Plate A-16. The contours represent the maximum elevations that would be experienced for the occurrance of a hurricane in the SPH catagory for the most critical storm path.

I-6. Frequency estimates.

(a) Procedure.

(1) The area along the south shore of Lake Pontchartrain was used in developing a procedure for making frequency estimates since more historical hurricane data were available for this area than for any other location. The maximum WTL or stage for a specific area is a measure of the character of storm that produces it. In order to use data from early hurricanes which caused high wind tides along the south shore of Lake Pontchartrain, it was necessary to analyze meteorologic factors and to adjust the observed data to represent stages that would have occurred had presently existing protective works then been in place. It was found that adjustments were required for the 1893 and 1901 hurricanes. Along the south shore of Lake Pontchartrain, determinations of maximum WTL's were from the adjusted historical data from the locus of points through which a representative WTL-frequency curve would pass in the low-stage, high-frequency region. Probabilities for historical data on the curve shown on Plate A-17 were calculated by means of the formula:

$$P = \frac{100 \quad (M-0.5)}{Y}$$

The WTL for the PMH, which has an infinite return period, establishes another limit for the frequency curve in the high-stage, low frequency region. However, because of the lack of historical data for the region of the curve between these two extremes, the synthetic WTL-frequency relationships were developed to show the shape of the curve in this region. In the process of formulating such relationships, it was necessary to correlate the following hurricane parameters: central pressure index, paths of approach, wind velocities, radii to maximum winds, and forward speeds of translation.

(2) Prior to 1900, information of record dealt primarily with loss of life and damage in the more densely populated areas, with practically no reference to water surface elevations caused by hurricanes. Only since 1900 has detailed information been available on flooding in coastal Louisiana and adjacent areas. Subsequent to the widely destructive September 1915 hurricane, Charles W. Oakey, Senior Drainage Engineer, Office of Public Roads and Rural Engineering, U. S. Department of Agriculture, made a thorough survey of the coastal areas between Biloxi, Mississippi, and Palacios, Texas. The 1915 investigation is the only known area-wide study containing reliable stages until the investigation of hurricane "Flossy", September 1956, was completed. The data indicate that there is no locality along the Louisiana coast which is more prone to hurricane attack than other localities.

(3) The first requirement in the development of synthetic frequency relationships for localities within the study area was to select representative critical hurricane paths of approach for the particular locale in question. For the passes into Lake Ponthchartrain, track F is the critical path for the design hurricane. For the south shore of Lake Pontchartrain, track A was selected to represent the hurricane situation that would produce critical conditions. These tracks are shown on Plate A-9.

(4) After hurricane paths were selected, surge heights and wind tides were developed, as described previously, for at least three storms of different CPI values for each track. Each hurricane selected for the representative paths were assumed to have the same radius of maximum winds, the same forward speed of translation, and the same adjustment for any land effects. Only CPI's and wind velocities were adjusted to develop these three storms. Results of these computations for the New Orleans reach of Lake Pontchartrain are shown in Table A-11. Wind tide elevations for storms with other CPI values were obtained graphically by plotting the above data and reading from the resulting curves.

TABLE A-11

CENTRAL PRESSSURE INDEX VS. WIND TIDE LEVEL
LAKE PONTCHARTRAIN REACH - NEW ORLEANS

PATH A		PATH F	
Central pressure index (CPI) inches	Max. wind tide level n.g.v.d.	Central pressure index (CPI) inches	Max. wind tide level n.g.v.d.
26.9	12.7	27.6	7.7
27.6	11.2	27.87	6.6
28.5	8.2	28.57	4.8

(5) Hurricane characteristics of area-representative storms were developed in cooperation with U. S. Weather Bureau. This agency has made a generalized study of hurricane frequencies for a 400-mile zone along the central gulf coast, Zone B, from Cameron, La., to Pensacola, Fla., and has presented the results in a memorandum. (12) Frequencies for hurricane central pressure indexes that were presented in the report, as shown on Plate A-8, reflect the probability of hurricane recurrence from any direction in the midgulf coastal area. In order to establish frequencies for the localities under study, it was assumed that a hurricane whose track is perpendicular to the coast will ordinarily cause high tides and inundation for a distance of about 50 miles along the coast. Thus, the number of occurrences in the 50-mile subzone would be 12.5 percent of the number of occurrences in the 400-mile zone, provided that all hurricanes traveled in a direction normal to the coast. However, the usual hurricane track is oblique to the shoreline as shown in table 2 of the HMS memorandum. (12) The average projection along the coast of this 50-mile swath for the azimuths of 42 Zone B hurricanes is 80 miles. Since this is 1.6 times the width of the normal 50-mile strip affected by a hurricane, the probability of occurrence of any hurricane in the 50-mile subzone would be 1.6 times the 12.5 percent, or 20 percent of the probability for the entire midgulf Zone B. Thus, 20 percent of the Zone B frequencies shown on Plate A-8 was used to represent the CPI-frequencies in the 50-mile subzone that is critical for each study locality.

(6) The azimuths of track observed in the vicinity of landfall were divided into quadrants corresponding to the four cardinal points. In Zone B, 24 tracks were from the south, 14 from the east, 3 from the west, and 1 from the north. Hurricanes with tracks having major components from the south or east are

more critical relative to WTL's within the study area than hurricanes from other directions. Approximately two-thirds of all experienced hurricanes have come from a southerly driection, whereas about one-third have come from the east. The average azimuth of tracks from the south are 180°. Tracks from the east had an average azimuth of 115°. Approximately these azimuths were used in computing WTL's. Further adjustment of the probability of occurrence was made by using two-thirds of the probability for WTL's computed for hurricanes approaching from the south and one-third of the probability for WTL's computed for hurricanes approaching from the east. The probabilities of equal stages for both groups of tracks were then added arithmetically to develop a curve representing a synthetic probability of recurrence of maximum wind tide levels for hurricanes from all directions. Table A-12 presents these computatins and those of the previous paragraph for the New Orleans reach.

TABLE A-12

STAGE-FREQUENCY
SOUTH-SHORE - LAKE PONTHCHARTRAIN

	New Orleans Reach			PATH A Freq.*		PATH F Freq.
CPI	ZONE B	80-mi. subzone	WTL	(67% Col. 3)	WTL	(33% Col. 3)
1	2	3	4	5	6	7
in.	occ/100	years	n.g.v.d.	occ/100 yrs.	ft. n.g.v.d	occ/100 - yrs.
27.6	1	0.2	11.5	0.13	8.0	0.07
27.8	2	0.4	10.9	0.27	7.0	0.13
28.1	5	1.0	9.8	0.67	6.1	0.33
28.3	10	2.0	9.1	1.34	5.6	0.66
28.6	20	4.0	8.0	2.68	4.9	1.32
29.0	40	8.0	6.5	5.36	4.1	2.64

$$*\text{Freq.} = \frac{100}{\text{Return period years}}$$

(7) Using the shape of the synthetic stage-frequency curve as a guide, it was then possible to complete a final curve for the New Orleans reach between the predetermined limits mentioned previously.

(8) Lack of historical data prevented the similar development of WTL-frequency relationships for other localities within the study area. For the remaining reaches, wind tide levels were calculated for Zone B hurricanes of different frequencies by using different combinations of critical paths and distribution of azimuths of incidence. It followed that a Zone B

hurricane of a particular frequency would have the same recurrence period for any locale in the study area since all are within the same subzone. Therefore, the final stage - frequency curves for the remaining areas were developed by plotting the computed stages for several different Zone B hurricanes at the corresponding frequencies indicated for the south shore of Lake Pontchartarain. Only two-thirds of the hurricanes from the south or east are most critical relative to WTL's along the south shore of Lake Pontchartrain, while all of the hurricanes from the south or east are equally critical to the area affected by Lake Borgne. Therefore, the most critical WTL along the south shore of Lake Ponchartrain for a Zone B hurricane of given frequency occurs only two-thirds as often as the most critical WTL along the shores of Lake Borgne for the same hurricane.

b. Relationships. Based on the above described procedures, stage-frequency relatinships were established for the south shore of Lake Pontchartrain and the passes into Lake Pontchartrain from Lake Borgne. Stage-frequency curves are shown on Plate A-18.

7. Design Hurricane

a. Selection of the design hurricane. The standard project hurricane was selected as the design hurricane (Des H) due to the urban nature of the study area. A design hurricane of lesser intensity which would indicate a lower levee grade and an increased frequency would expose the protected areas to hazards to life and property that would be disastrous in event of the occurrence of a hurricane of the intensity and destructive capability of the standard project hurricane.

b. Characteristics. The characteristics of the Des H for the proposed plan of protection are identical to the standard project hurricane described in detail in paragraph 5. However, due to transposition of the regional SPH to the smaller study area the design hurricane would have a probability of recurrence of only once in about 300 years in the study area. The path of the Des H's was located successively to produce maximum hurricane tides along the entire length of the proposed structure. The Des H is a theoretical hurricane but ones of similar intensity have been experienced in the area. Table A-13 is a summary of the Des H characteristics.

TABLE A-13
DESIGN HURRICANE CHARACTERISTICS

Location	CPI (inches)	Max. winds (m.p.h)	Radius of max. winds (miles)	Forward speed (knots)	Direction of approach	Track (plate A-7)
Lake Pontchartrain						
South shore	27.6	100	30	6	South	A

c. Normal predicted tides. The average tidal range in Lake Pontchartrain is 0.5 foot. Lake Pontchartrain has an average elevation of about 1.0 foot. In determining the elevation of design surges and wind tide levels, the mean normal predicted tide was assumed to occur at the critical period.

d. Design tide. The hurricane tide is the maximum still water surface elevation experienced at a given location during the passage of a hurricane. It reflects the combined effects of the hurricane surge and wind tide. Design hurricane tides were computed for conditions reflecting the proposed protective works. The resulting elevations, which are identical to those for an SPH, are the same for existing or project conditions.

TABLE A-14
DATA USED TO DETERMINE WAVE CHARACTERISTICS
DESIGN HURRICANE

F	Length of fetch, miles	5
U	Windspeed, mph	83
SWL	Stillwater elevation, feet	11.5
d	Average depth of fetch, feet	24.4
d_t	Depth at toe of structure, feet	14.5

TABLE A-15
WAVE CHARACTERISTICS
DESIGN HURRICANE

H_s	Significant wave height, feet	7.8
T	Wave Period, seconds	7.3
L	Deepwater wave length, feet	273
d/L	Relative depth	.0894
$H_s / H_0 '$	Shoaling coefficient	.9426
$H_0 '$	Deepwater wave height, feet	8.2
$H_0 '/T$	Wave Steepness	.154

e. Maximum runup and overflow.

(1) Hurricanes approaching on paths critical to the south shore of Lake Pontchartrain create conditions whereby shore protective structures are overtopped. It was necessary to calculate the magnitude of the heights of wave runup and quantities of this overflow by use of procedures to develop improved protective structure designs and to determine damages. This determination was divided into two significant parts for convenience of calculation, namely maximum runup and wave overtopping. Common factors which must be resolved in all types of calculations are the WTL, and the geometry and crown elevation of the protective structure.

(2) Wave runup on a protective structure depends upon the physical characteristics (i.e. configuration and surface roughness), the depth of water at the structure, and the wave characteristics. Computation of maximum runup was necessary in order to determine the heights to which existing shore protective structures would have to be raised to prevent all overflow for the significant wave accompanying the SPH. Wave runup was considered to be the ultimate height to which water in a wave ascended on the proposed slope of a protective structure. This condition occurred when the WTL was at a maximum, and was calculated by the interpolation of model study data developed by Saville (22), (23), (24) which relates runup (R/H_0'), wave steepness (H_0'/T_2), relative depth (d/H_0'), and structure slope. The technique for computing wave runup is explained in detail in the Shore Protection Manual (SPM). (25)

(3) Protective structures exposed to wave runup will be constructed to an elevation and cross-section that is sufficient to prevent all overtopping from the significant wave and waves smaller than the significant wave accompanying the SPH. Waves larger than the significant wave will be allowed to overtop the protective structures; however, such overtopping will not endanger the security of the structure or cause material interior flooding. In the case of the Citrus levee, the stone revetment on the floodside of the levee reduces wave runup; this permits the levee crest height to remain lower than if no rock was used. The elevation of protective structures not exposed to wave runup is approximately 3 feet higher than the maximum WTL for the SPH. Wave data, runup elevations, and required elevations of protective structures are shown in Table A-16.

TABLE A-16
WAVE RUNUP AND PROPOSED ELEVATION OF PROTECTIVE STRUCTURES
STANDARD PROJECT HURRICANE
ALONG CITRUS LAKEFRONT

LOCATION	AVE			WTL	ELEVATION OF STRUCTURES	
STATIONS B/L	DEPTH	H	T	ELEVATION	LEVEE	FORESHORE ROCK
(ft)	(ft)	(ft)	(ft)	(ft n.g.v.d.)	(ft n.g.v.d.)	
28+31 to 64+00	24.4	7.8	7.3	11.5	14.5	-
64+00 to 331+50	24.4	7.8	7.3	11.5	14.5	13.0

f. Residual flooding. The procedures described in the SPM (25) are used to determine wave runup and wave overtopping for the significant wave that would be experienced during hurricane occurrences. However, 14 percent of the waves in a spectrum are higher than the significant wave and the maximum wave height to be expected is about 1.87 times the significant wave height. Thus a structure designed to prevent all overtopping by a significant wave would be overtopped by that portion of the spectrum that is higher than the significant wave. It was therefore necessary to assure that this residual overtopping would not produce flooding and subsequent damage to the extent that only partial protection was afforded to an area for the design hurricane. A determination of the residual overtopping was made for the Citrus area and it was concluded that no material flooding results if the design cross-section is overtopped by waves higher than the significant wave. It was therefore concluded that the use of the significant wave runup would result in design grades for protective structrues that would permit residual flooding only to a negligible degree.

I-8. Embankment design.

a. General. The design cross-section presented in Plate A-19 was selected as the best choice for protection of the Citrus Area. It consists of an inside levee, railroad embankment and rock embankment located lakeward of the other two structures. The rock embankment serves to reduce wave activity and runup on the railroad embankment and levee, thus reducing the required height of the levee. In reaches where the levee is afforded adequate protection by an existing complex, such as the reach behind the New Orleans Lakefront Airport, the rock embankment is not required.

b. Rock Revetment. The rock revetment consists of a shell core, graded filter rock layer, graded rock layer and uniform cover stone. Rock sizes were determined using the wave characteristics of the design hurricane in the formula:

$$W = \frac{w_r \quad H^3}{K_D \ (S_r \ - 1)^3 \cot \emptyset}$$

W	is the weight in lbs of an individual stone.
w_r	is the unit weight of stone (in this case 155 lbs/ft_3).
H	is the design wave height at the structure ($H = 6.5$).
S_r	is the specific gravity of the stone relative to water. ($S_r = Wr/Ww$)
W_w	is the unit weight of water (64 lbs/ft^3).
$\emptyset$	is the angle of the structure slope from the horizontal in degrees.
K_D	is the stability coefficient (K_D = 3.0 for this case).

This formula, known as Hudson's formula, values for K_D and techniques used to determine the stone gradations are explained in detail in the SPM. (25) Design stone sizes are large enough to insure that the stone will not be displaced during the occurrence of the Des H or a lesser intensity storm. Rock gradations required for the design cross-section at the Citrus Lakefront are given in Table A-17.

TABLE A-17
CITRUS LAKEFRONT LEVEE
ROCK EMBANKMENT

PERCENT LIGHTER BY WEIGHT		WEIGHT (LBS.)
	UNIFORM COVER STONE	
100		2,100
25		1,660
0		1,250
	GRADED ROCK	
100		1,000-400
50		430-200
15		210-60
	GRADED ROCK FILTER	
100		50-20
50		20-10
15		10-5

II-1. Intercepted Drainage. The only runoff that will be intercepted by this levee work is that which will flow between the levee and the rock embankment. The runoff between the levee and railroad embankment is collected in a ditch that runs between the two and is discharged into the lake via drainage culverts through the railroad and rock embankments. Catch basins collect the flow from each culvert. A description of this drainage plan and techniques used to design it are contained in the barrier plan general design memorandum for the Citrus Lakefront Levee. (26) Modifications to this design for the high level plan are not required. Runoff between the railroad and rock embankments can drain easily through the large voids in the cover stone of the rock embankment. No structural methods are required to release runoff from this portion of the levee complex.

SECTION III - BIBLIOGRAPHY

(1) U. S. Army Corps of Engineers Waterways Experiment Stations, "Effects on Lake Pontchartrain, La., of Hurricane Surge Control Structures and Mississippi River-Gulf Outlet Channel," Technical Report No. 2-636, November 1963.

(2) U. S. Army Corps of Engineers Waterways Experiment Station, "Lake Pontchartrain and Vicinity Hurricane Protection Plan - Prototype Data Acquisition and Analysis," Technical Report No. HL-82-2, January 1982.

(3) U. S. Weather Bureau, "Characteristics of United States Hurricanes Pertinent to Levee Design for Lake Okeechobee, Florida," Hydrometeorological Report No. 32, March 1954.

(4) U. S. Weather Bureau, "Revised Wind Fields Vicinity of Lake Pontchartrain, Hurricane of September 29, 1915," Memorandum HUR 7-39, August 16, 1957.

(5) U. S. Weather Bureau, "Wind Speed and Direction Charts for the Lake Pontchartrain, Chandeleur and Breton Sounds and Mississippi Delta Regions, Hurricane of September 19, 1947," Memorandum HUR 7-37, June 12, 1957.

(6) U. S. Weather Bureau, "Meteorological Considerations Pertinent to Standard Project Hurricane, Atlantic and Gulf Coasts of the United States," Hydrometeorological Report No. 33, November 1959.

(7) U. S. Weather Bureau, "Standard Project Hurricane Wind Field Patterns (revised) to replace Existing Patterns in NHRP Report No. 33, for Zones B and C," Memorandum HUR 7-84, August 17, 1965.

(8) U. S. Weather Bureau, "Adjustments to SPH isovel patterns in Memoranda HUR 7-62, 7-62A, 7-63, 7-64, and 7-65," Memorandum HUR 7-85, November 3,1965.

(9) U. S. Weather Bureau, "Ratio Chart to adjust Isovel Patterns in HUR 7-40 to Level of Updated SPH Patterns," Memorandum HUR 7-85A, February 17, 1966.

(10) National Weather Service, "Revised Standard Project Hurricane Criteria for the Atlantic and Gulf Coasts of the United States," Memorandum HUR 7-120, July 31, 1972.

(11) National Weather Service, "Meteorological Criteria for Standard Project Hurricane and Probable Maximum Hurricane Windfields, Gulf and East Coasts of the United States," NOAA Technical Report NWS23, September 1979.

(12) U. S. Weather Bureau, "Hurricane Frequency and Correlations of Hurricane Characteristics for the Gulf of Mexico Area, P. L. 71," Memorandum HUR 2-4, August 30, 1957.

(13) U. S. Weather Bureau, "SPH Parameters and Isovels, Mid-Gulf Coast U. S. Zone B, and SPH Lake Pontchartrain, La.," Memorandum HUR 7-42, October 11, 1957.

(14) U. S. Army Corps of Engineers, New Orleans District, "Lake Pontchartrain, Louisiana and Vicinity, Design Memorandum No, 1 Hydrology and Hydraulic Analysis, Part 1 - Chalmette," August 1966.

(15) Reid, Robert O. "Approximate Response of Water Level on a Sloping Shelf to a Wind Fetch Which Moves Towards Shore," Beach Erosion Board, Technical Memorandum No. 83, June 1956.

(16) U. S. Weather Bureau, "Hurricane Rainfall Estimates Applicable to Middle Gulf Standard Project Hurricanes, Tracks A, C, F, D, and B, New Orleans Study, Zone B," Memorandum HUR 3-5, November 30, 1959.

(17) U. S. Weather Bureau, "Estimates of Moderate Hurricane Rainfall Applicable to Middle Gulf Standard Project Hurricanes," Memorandum HUR 3-5a, December 11, 1959.

(18) U. S. Weather Bureau, "Louisiana Hurricane of September 29, 1915, Transposed to a Critical Track," Memorandum HUR 7-40, September 6, 1957.

(19) U. S. Weather Bureau, "SPH Wind Fields for Track F with Forward Speed 5 Knots Critical for Area I," Memorandum HUR 7-63, September 21, 1959.

(20) U. S. Army Engineer District, Jacksonville, "Design Memorandum, Wind Tides Produced by Hurricanes," Partial Definite Project Report, Central and Southern Florida Project, for Flood Control and Other Purposes, Part IV, Supplement 2, Section 3, July 26, 1956.

(21) Bretschneider, C. L. "Prediction of Wind Waves and Set-up in Shallow Water, with Special Application to Lake Okeechobee, Florida," Unpublished Paper, Texas A & M College, August 1954.

(22) Saville, Thorndike, Jr., "Wave Run-up on Shore Structures," Journal of the Waterways Division of the American Society of Civil Engineers, Vol. 82, No. WW 2, April 1956.

(23) Saville, Thorndike, Jr., "Laboratory Data on Wave Run-up and Overtopping on Shore Structures," Beach Erosion Board, Technical Memorandum No. 64, October 1955.

(24) Saville, Thorndike, Jr., Inclosure to letter from Beach Erosion Board to U. S. Army Engineer District, New Orleans, 1 July 1958.

(25) U. S. Army Coastal Engineering Research Center, "Shore Protection Manual," Vols I-III, 1977.

(26) U. S. Army Corps of Engineers, New Orleans District, "Lake Pontchartrain, Louisiana, and Vicinity, Lake Pontchartrain Barrier Plan, Design Memorandums No. 2 - General Design, Supplement No. 5A, Citrus Lakefront Levee, IHNC to Paris Road," May 1976.

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE – IHNC TO PARIS RD.

VICINITY MAP

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984 FILE NO. H-2-29553

PLATE A-1

NOTE:
Figures adjacent to symbols refer to stations listed in tables A-4 thru 6

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE – IHNC TO PARIS RD.

METEOROLOGIC AND HYDROLOGIC STATIONS

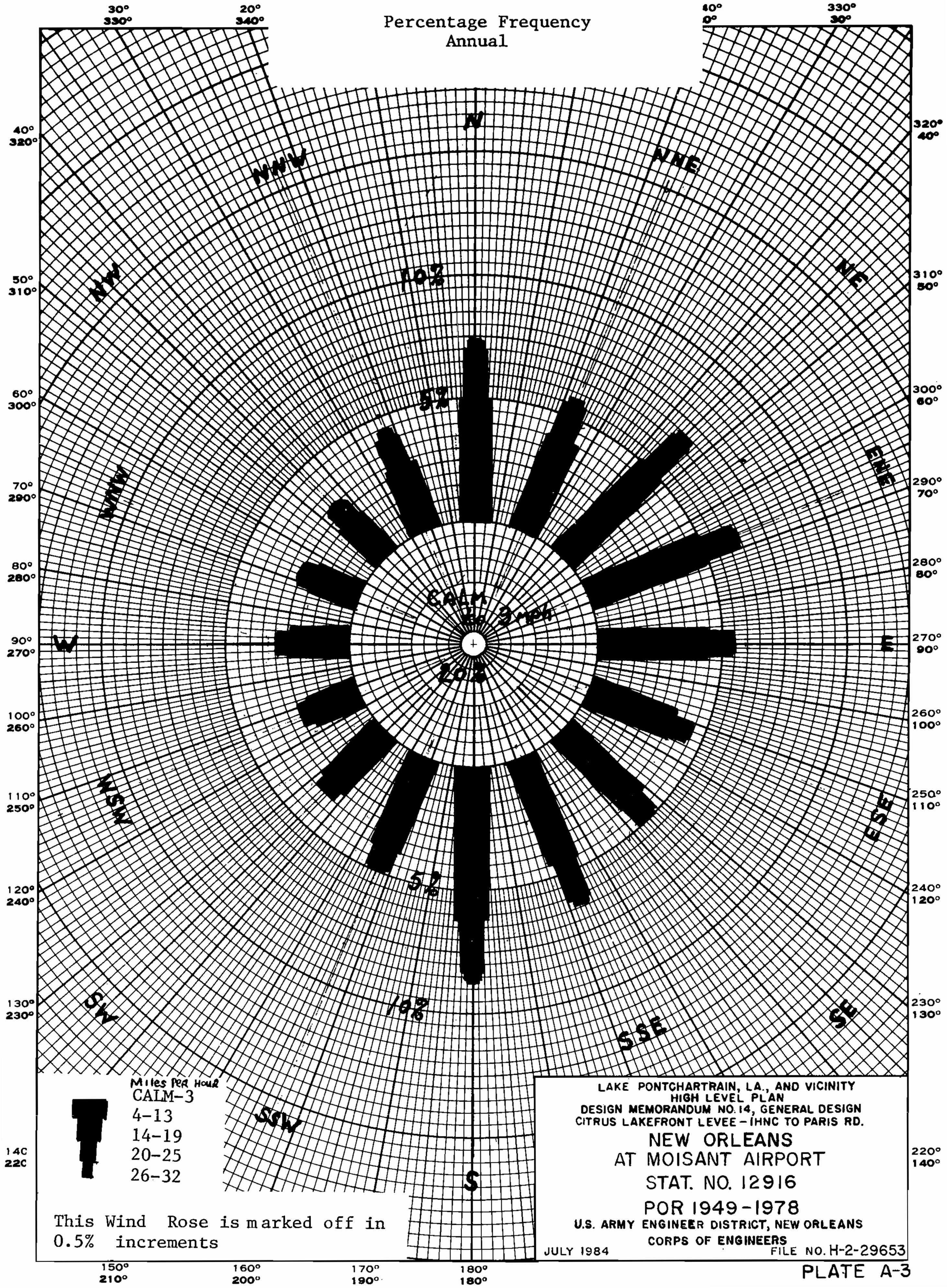
SCALES AS SHOWN
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984
FILE NO H-2-29653

PLATE A-2

WIND ROSE

Percentage Frequency
Annual



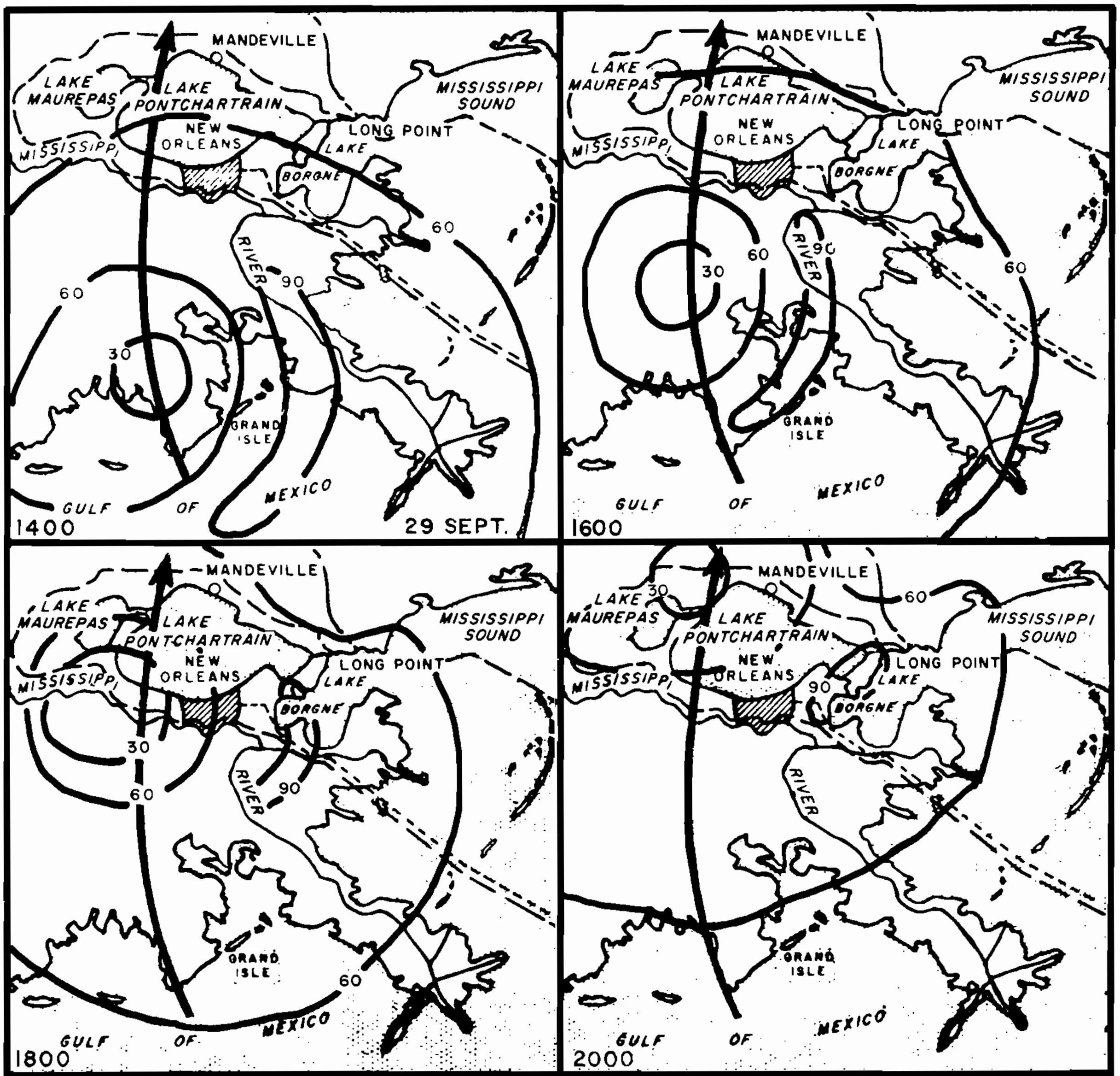
This Wind Rose is marked off in 0.5% increments

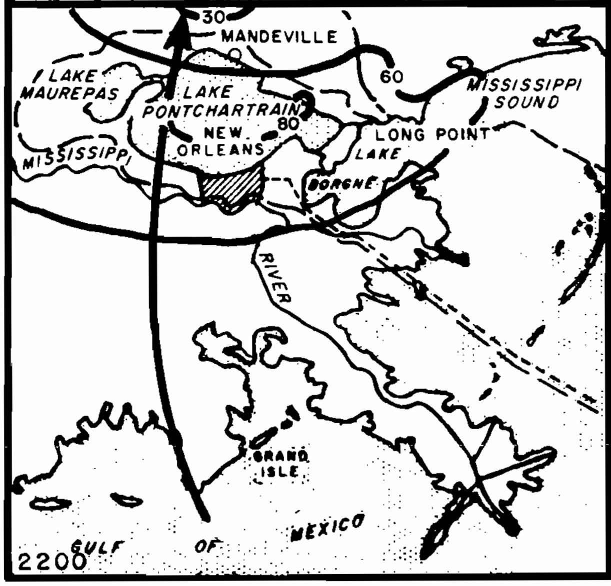
LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - IHNC TO PARIS RD.

NEW ORLEANS
AT MOISANT AIRPORT
STAT. NO. 12916
POR 1949-1978

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984 FILE NO. H-2-29653





LEGEND

Study area

30 Average wind velocity

Hurricane path

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE – IHNC TO PARIS RD.

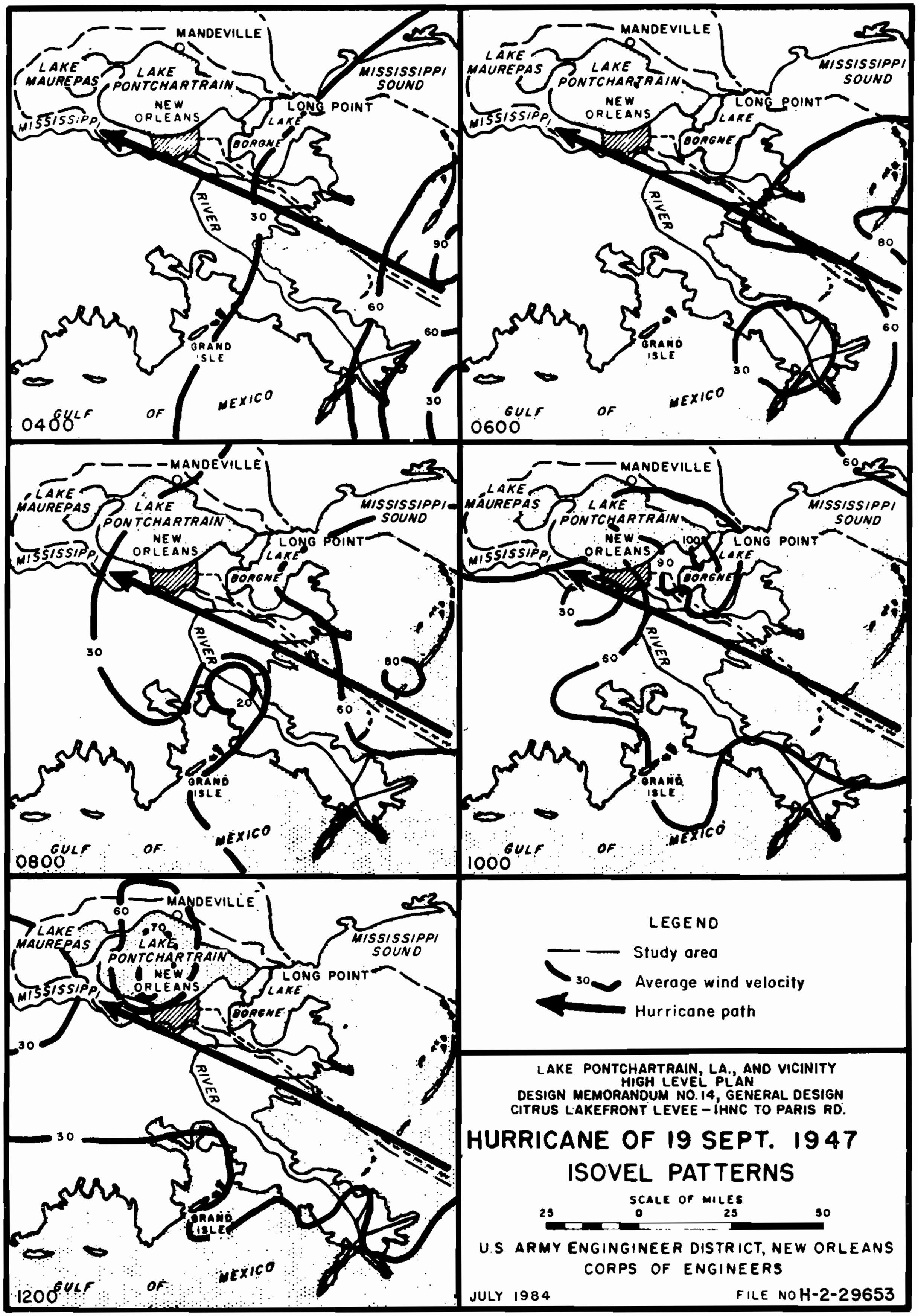
HURRICANE OF 28 SEPT. TO 1 OCT. 1915 ISOVEL PATTERNS

SCALE OF MILES
25 0 25 50

U.S. ARMY ENGINGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984 FILE NO H-2-29653

PLATE A-4



LEGEND

— — Study area

30 Average wind velocity

◄— Hurricane path

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE – IHNC TO PARIS RD.

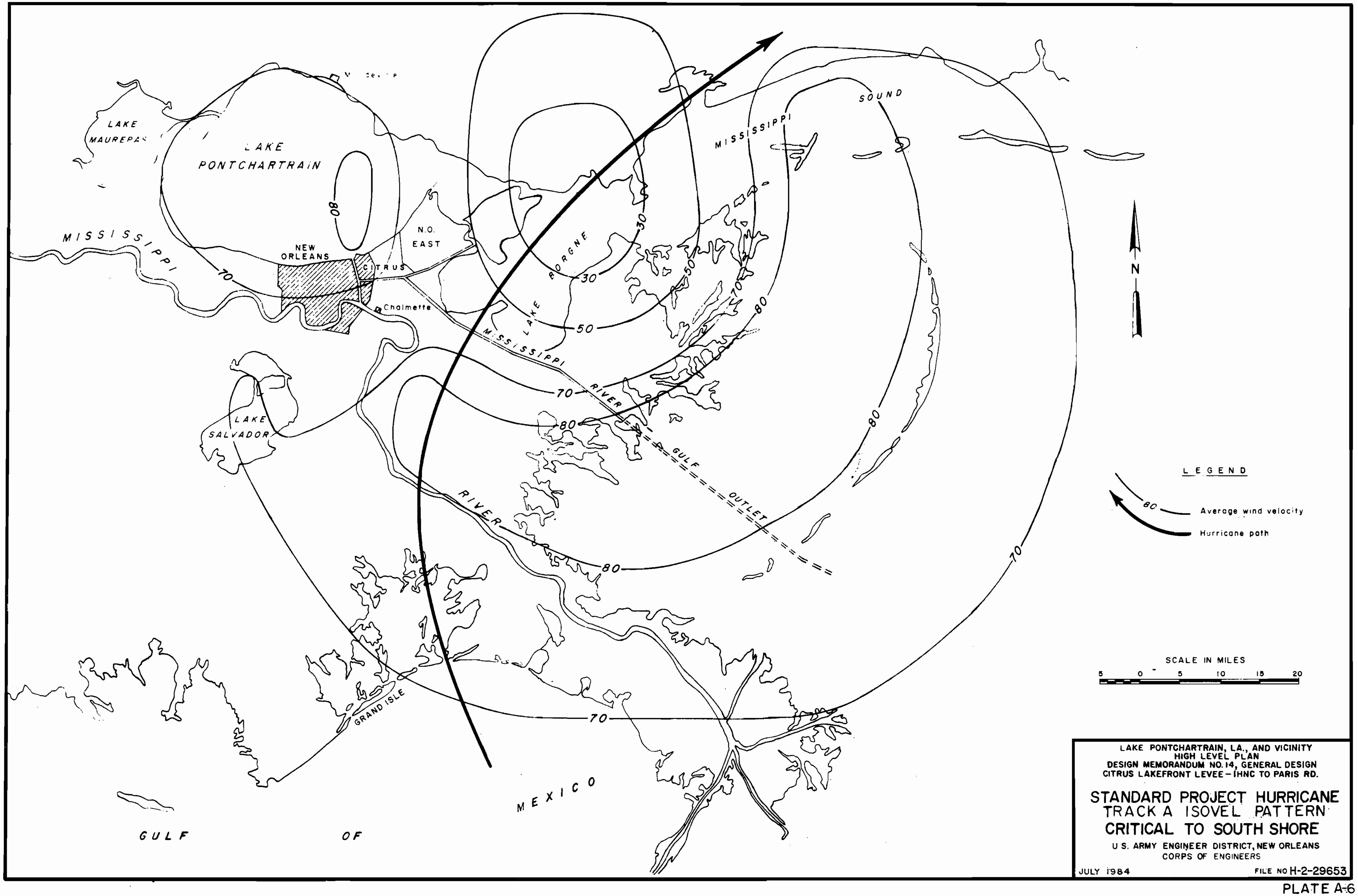
HURRICANE OF 19 SEPT. 1947
ISOVEL PATTERNS

SCALE OF MILES
25 0 25 50

U.S. ARMY ENGINGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984 FILE NO H-2-29653

PLATE A- 5



LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE – IHNC TO PARIS RD.

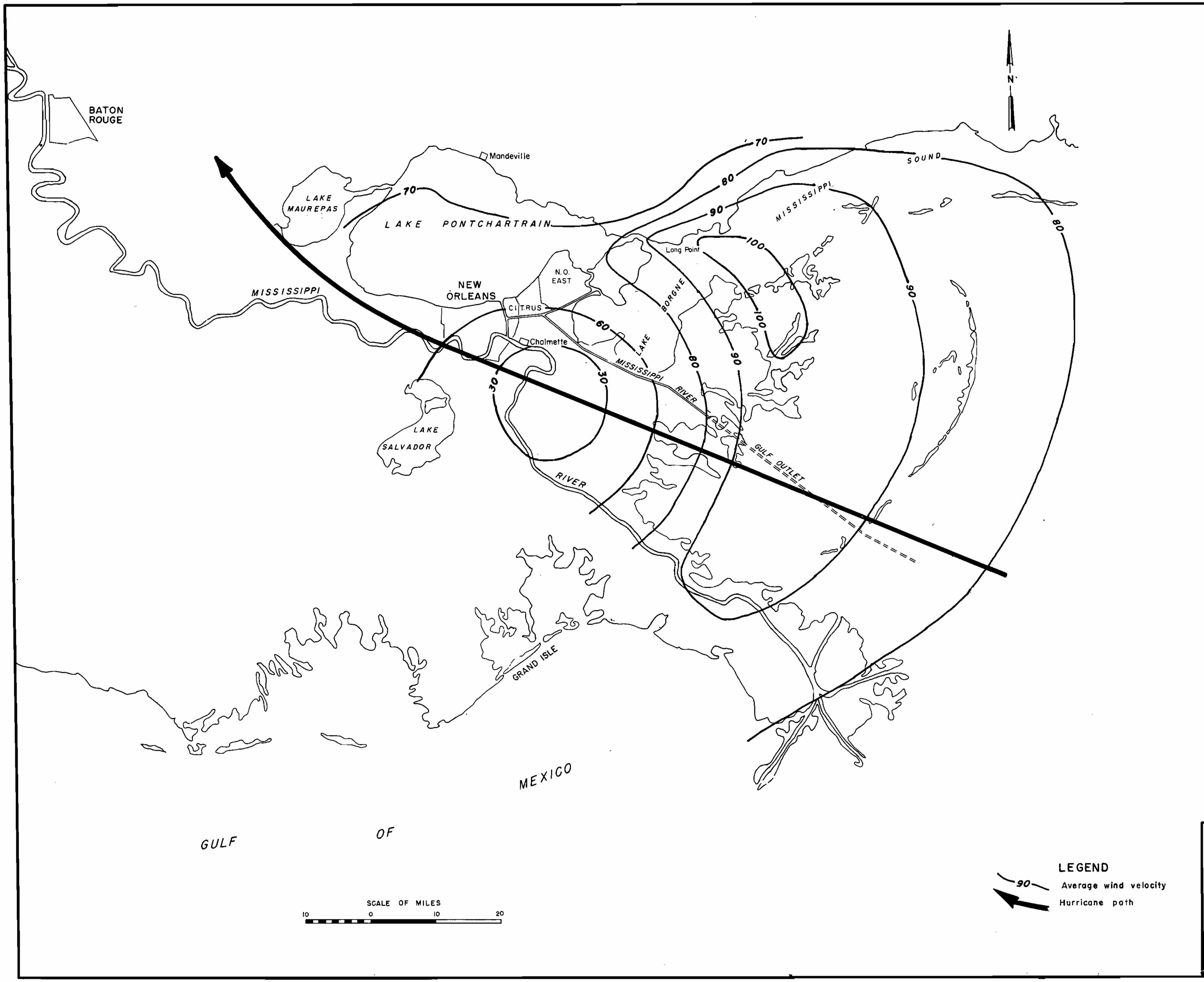
STANDARD PROJECT HURRICANE
TRACK A ISOVEL PATTERN
CRITICAL TO SOUTH SHORE

U S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984

FILE NO H-2-29653

PLATE A-6

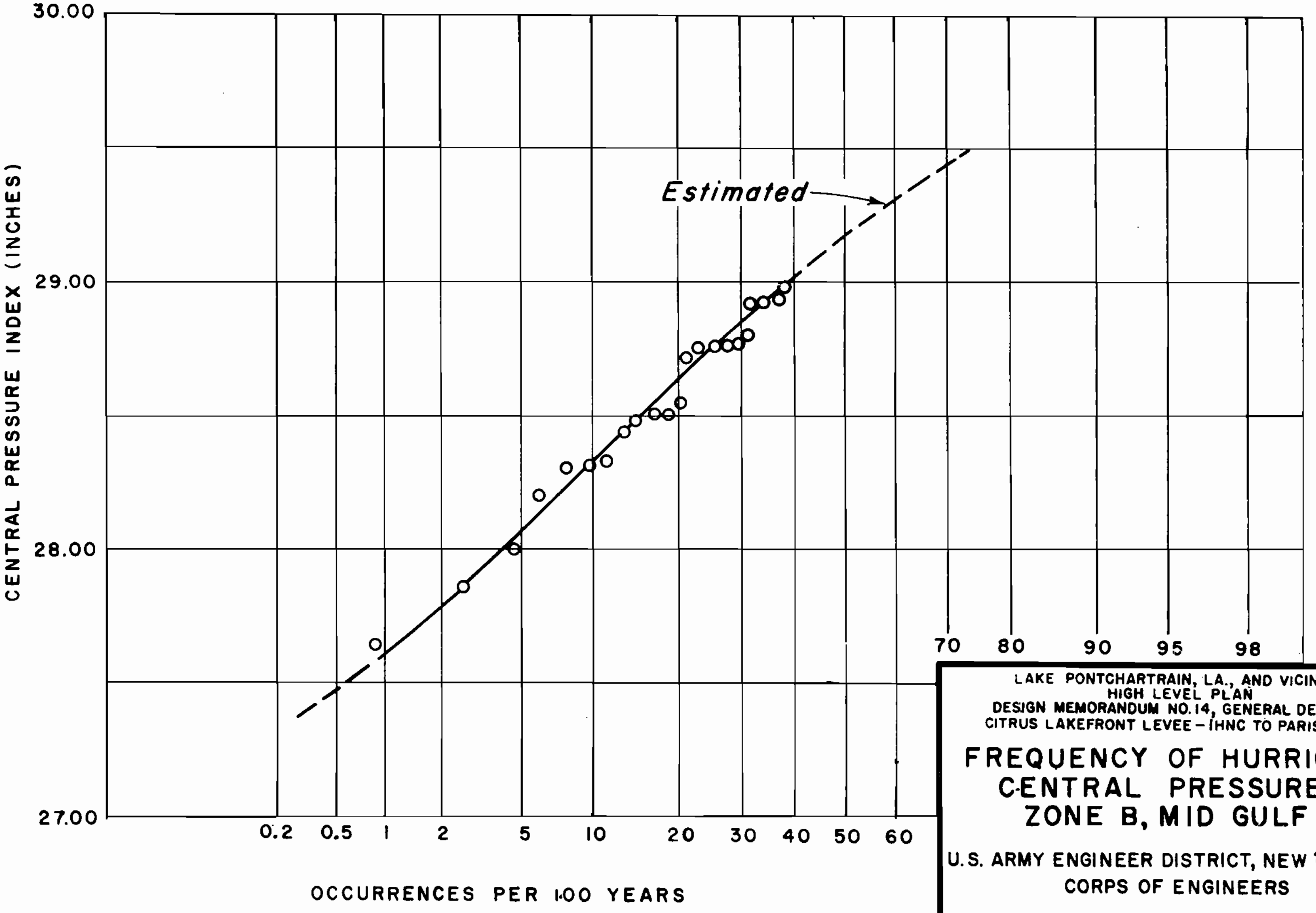


LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE – IHNC TO PARIS RD.

STANDARD PROJECT HURRICANE
ISOVEL PATTERN
TRACK F

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS. OF ENGINEERS

JULY 1984
FILE NO. H-2-29653

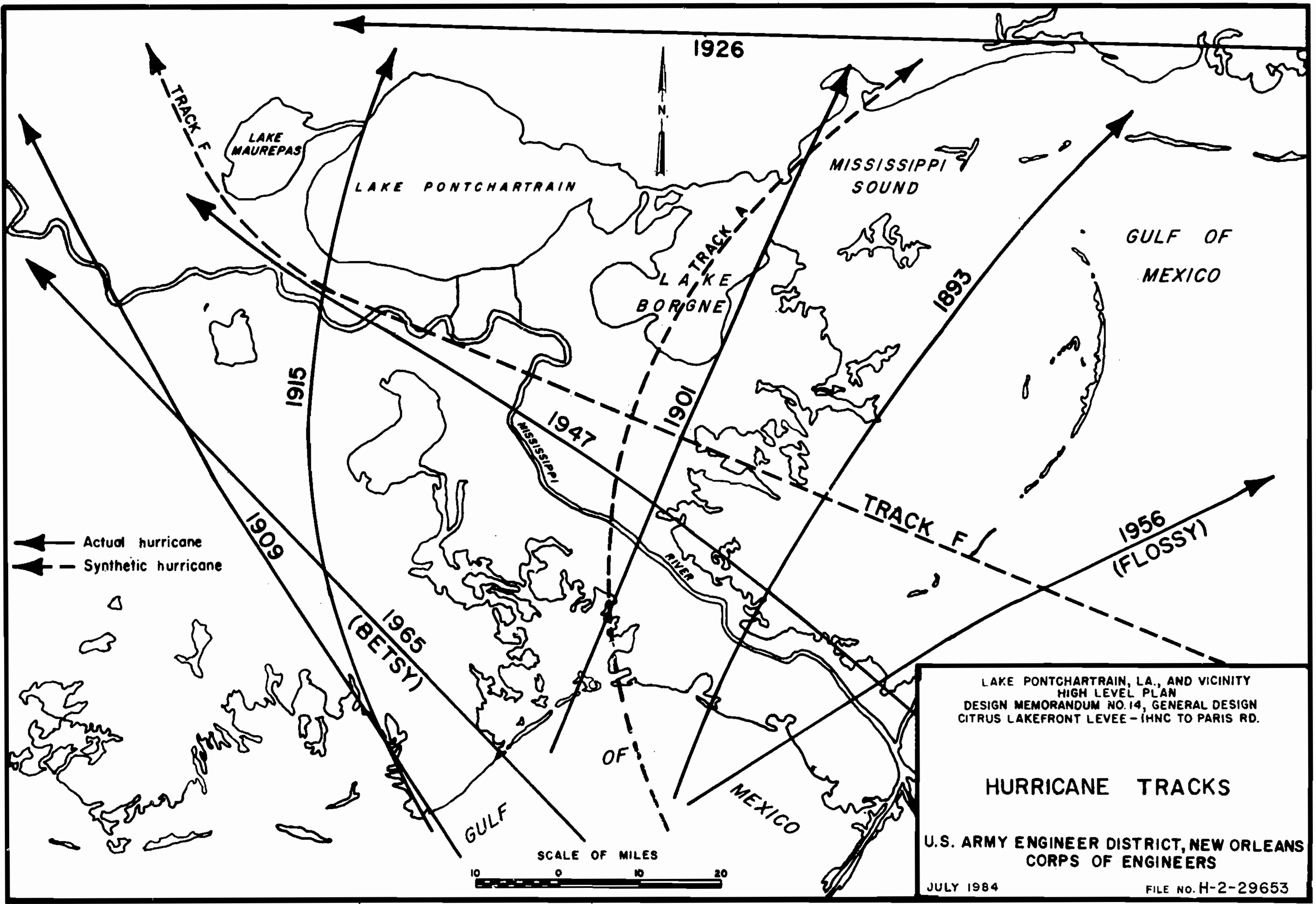


LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - IHNC TO PARIS RD.

FREQUENCY OF HURRICANE CENTRAL PRESSURES ZONE B, MID GULF

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984
FILE NO. H-2-29653



LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - IHNC TO PARIS RD.

HURRICANE TRACKS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984

FILE NO. H-2-29653

SAMPLE ROUTING

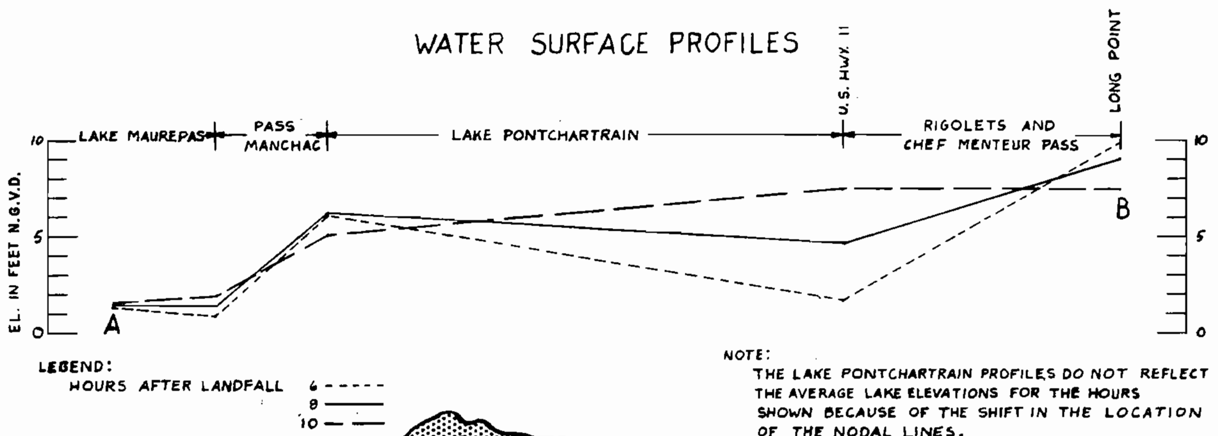
																		VERIFICATION										
	EL. IN LAKE BORGNE		EL. IN LAKE PONTCHARTRAIN			FLOW INTO LAKE PONTCHARTRAIN						L. PONT. STORAGE		OVERFLOW	FLOW INTO L.MAUREPAS	EL. IN LAKE MAUREPAS		STAGES IN PASS MANCHAC						FLOW INTO LAKE MAUREPAS.			STAGE IN LAKE MAUREPAS	
																		L. PONT. SIDE		LAKE MAUREPAS SIDE								
HOURS REFERENCED TO LANDFALL	EL. IN L. BORGNE	AV. OF ②	AV. EL. IN L. PONT.	EL. AT HWY. 11	AV. OF ⑤	HEAD BETWEEN L. BORGNE & L. PONT.	FLOW INTO L.PONT.	VOLUME OF FLOW FOR 2 HOURS	RAIN IN L. PONT.	VOLUME OF RAIN FOR 2 HOURS	TOTAL INFLOW INTO L. PONT.	STORAGE IN L.PONT. FOR EL. IN ④	Δ STORAGE IN L.PONT.	FLOW OVER L. PONT. LEVEES FOR 2 HOUR	⑫-⑭-⑮	STORAGE IN L. MAUREPAS	AV. EL. IN L. MAUREPAS	EL. IN PASS MANCHAC	AV. OF ⑲	TILT IN L. PONT.	TILT IN L. MAUREPAS	EL. IN PASS MANCHAC	AV. OF ㉓	HEAD BETWEEN L. PONT. & L. MAUREPAS	FLOW INTO L.MAUREPAS	VOLUME OF FLOW FOR 2 HOURS	STORAGE IN L.MAUREPAS	EL. IN L.MAUREPAS
①	② FEET N.G.V.D.	③ FEET N.G.V.D.	④ FEET N.G.V.D.	⑤ FEET N.G.V.D.	⑥ FEET N.G.V.D.	⑦ FEET	⑧ 1000 C.F.S.	⑨ 1000 D.S.F.	⑩ FEET	⑪ 1000 D.S.F.	⑫ 1000 D.S.F.	⑬ 1000 D.S.F.	⑭ 1000 D.S.F.	⑮ 1000 D.S.F.	⑯ 1000 D.S.F.	⑰ 1000 D.S.F.	⑱ FEET N.G.V.D.	⑲ FEET N.G.V.D.	⑳ FEET N.G.V.D.	㉑ FEET	㉒ FEET	㉓ FEET N.G.V.D.	㉔ FEET N.G.V.D.	㉕ FEET	㉖ 1000 C.F.S.	㉗ 1000 D.S.F	㉘ 1000 D.S.F.	㉙ FEET N.G.V.D.
2	9.46		3.94	2.33					0.115			1970.6				225.1	1.12	3.54		1.21	0.24	1.00					226.2	1.13
		9.86			1.21	8.65	4214.0	351.2		13.7	364.9		346.5	2.3	16.1				4.52				0.86	3.66	165.8	13.8		
4	10.25		5.26	0.09					0.052			2317.1				241.2	1.27	5.50		5.41	1.08	0.73					240.0	1.26
		9.91			1.62	8.29	4043.2	336.9		42.0	378.9		351.7	11.6	15.6				6.02				0.90	5.12	184.6	15.4		
6	9.56		6.55	3.14					0.155			2668.8				256.8	1.41	6.55		3.41	0.68	1.07					255.4	1.40
		9.11			4.55	4.56	2310.6	192.6		49.6	242.2		202.5	25.8	13.9				6.08				1.32	4.76	180.5	15.0		
8	8.66		7.28	5.96					0.180			2871.3				270.7	1.58	5.61		-0.35	-0.07	1.57					270.4	1.53
		7.43			7.43	0.00	0.0	0.0		21.0	21.0		-47.7	54.9	13.8				5.11				1.82	3.29	160.2	13.4		
10	6.19		7.11	8.90					0.075			2823.6				284.5	1.65	4.61		-4.29	-0.86	2.08					283.8	1.69

EXPLANATION:

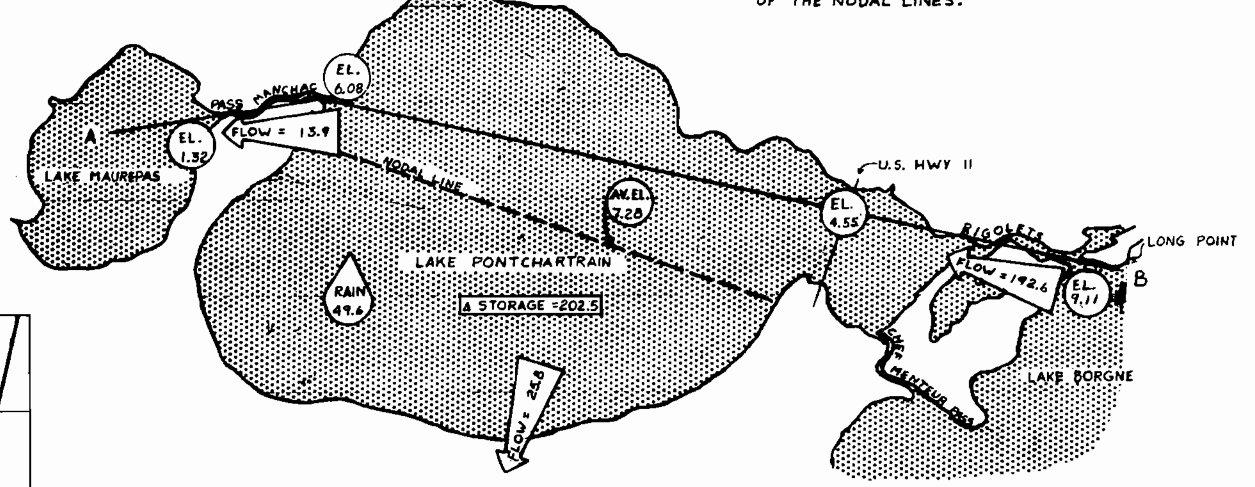
COLUMN ② FROM LAKE BORGNE HYDROGRAPH DERIVED BY THE METHOD DESCRIBED IN PARAGRAPH A-3e(1) AND SHOWN ON PLATE A-14
④ ASSUMED
⑤ OBTAINED FROM WATER SURFACE CONTOURS DERIVED FROM WIND SETUP COMPUTATIONS FOR LAKE PONT., SAMPLE SHOWN ON PLATE A-16
⑦ ③ - ⑥
⑧ FROM CHEF MENTEUR PASS AND RIGOLETS RATING CURVE SHOWN BELOW
⑩ FROM RAINFALL ESTIMATES DESCRIBED IN PARAGRAPH A-3i AND MASS RAINFALL CURVES SHOWN ON PLATE A-24
⑫ ⑨ + ⑪
⑬ FROM LAKE PONT. STORAGE CURVE SHOWN BELOW FOR THE ELEVATION IN ④

COLUMN ⑭ ⑬ - ⑬
⑮ BY THE PROCEDURES DESCRIBED IN PARAGRAPH A-3g
⑰ ⑯ + ⑰
⑱ CORRESPONDING ELEVATION FOR VOLUME IN ⑰ FROM LAKE MAUREPAS STORAGE CURVE SHOWN BELOW
⑲ SAME AS EXPLANATION FOR ⑤
㉑ ⑲ - ⑤
㉒ 1/5 OF ㉑, AS DESCRIBED IN PARAGRAPH A-3e(3)
㉓ ⑱ - ㉒/2
㉕ ⑳ - ㉔
㉖ FROM PASS MANCHAC RATING CURVE SHOWN BELOW
㉘ ㉗ + ㉘
㉙ CORRESPONDING ELEVATION FOR VOLUME IN ㉘ FROM LAKE MAUREPAS STORAGE CURVE SHOWN BELOW

WATER SURFACE PROFILES

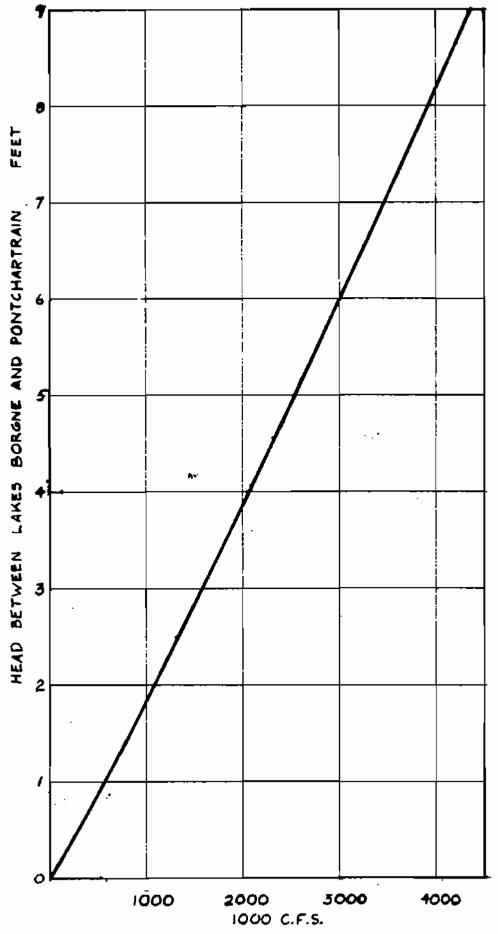


NOTE:
THE LAKE PONTCHARTRAIN PROFILES DO NOT REFLECT THE AVERAGE LAKE ELEVATIONS FOR THE HOURS SHOWN BECAUSE OF THE SHIFT IN THE LOCATION OF THE NODAL LINES.

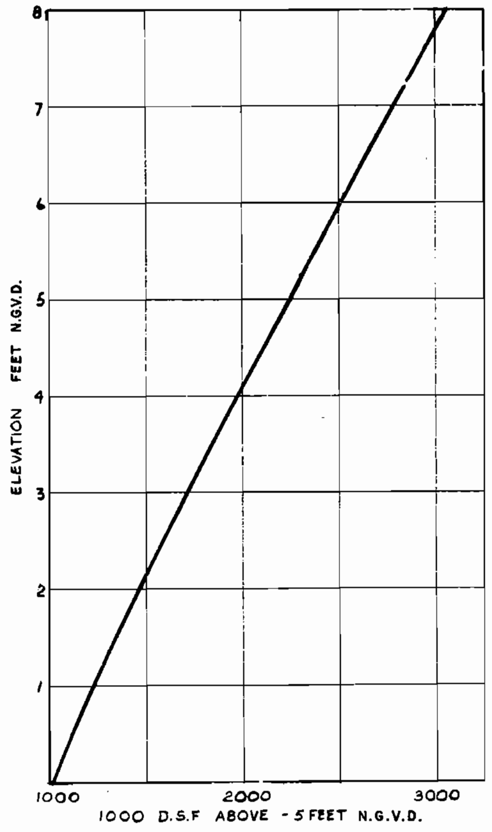


ROUTING DIAGRAM

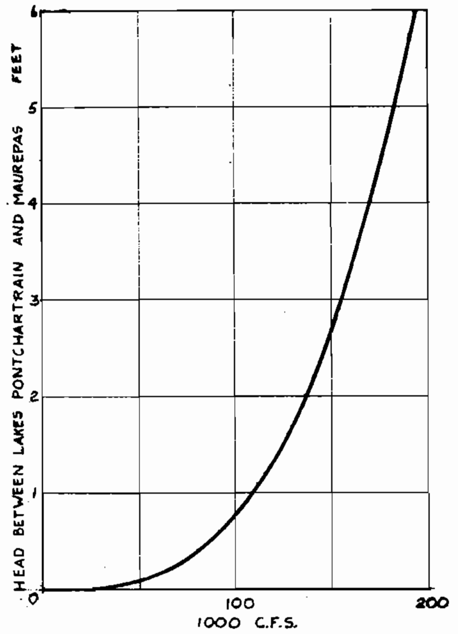
6 TO 8 HOURS AFTER LANDFALL



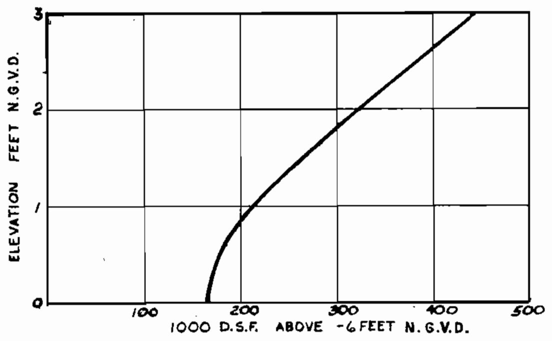
CHEF MENTEUR PASS & RIGOLETS FLOW



LAKE PONTCHARTRAIN STORAGE



PASS MANCHAC FLOW



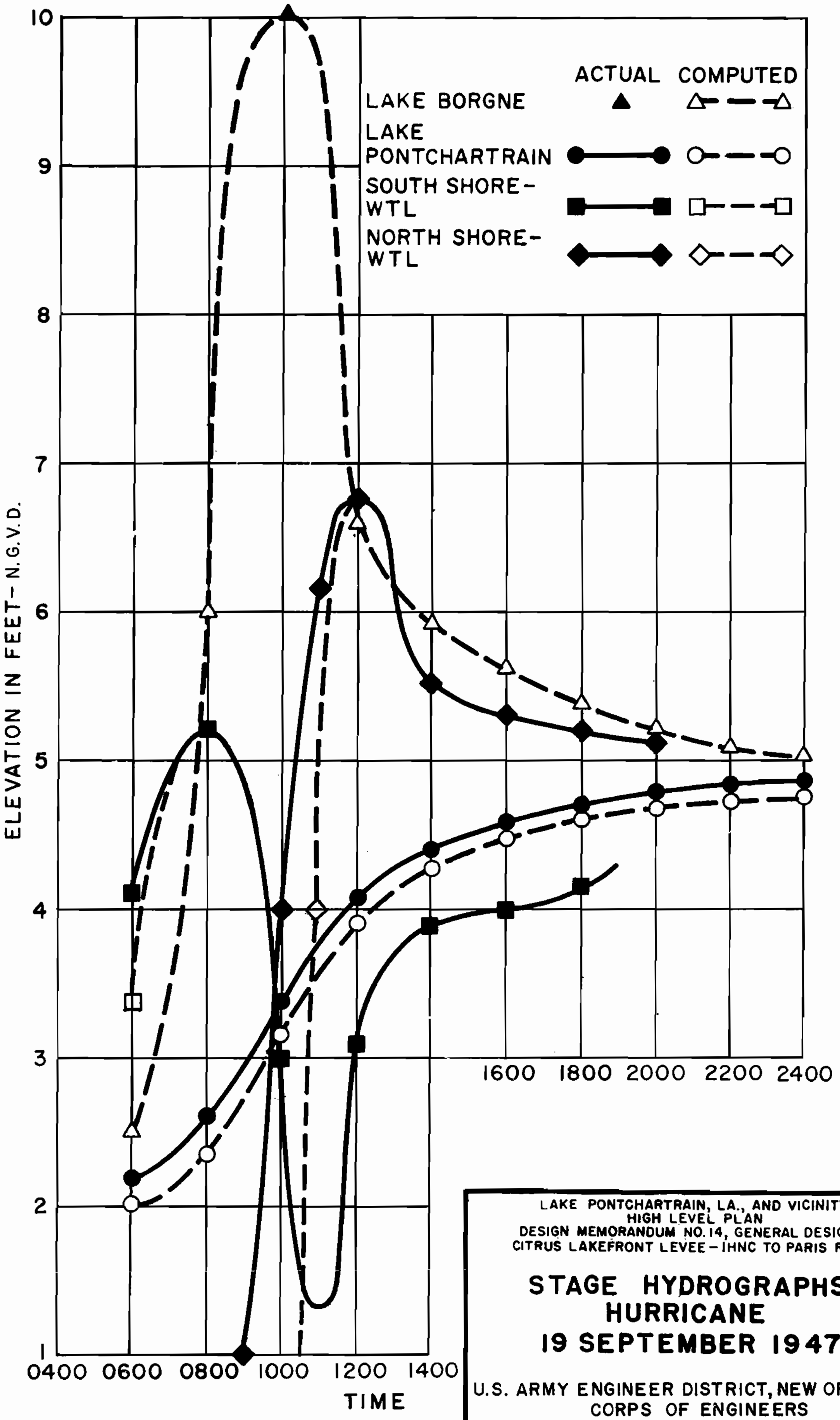
LAKE MAUREPAS STORAGE

NOTE:
FLOW AND RAIN IN 1000 D.S.F.
ELEVATIONS IN FEET N.G.V.D

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE – IHNC TO PARIS RD.

LAKE PONTCHARTRAIN ROUTING

SCALE AS SHOWN
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS, LA.
CORPS OF ENGINEERS
DATE: JULY 1984
FILE NO. H-2-29653

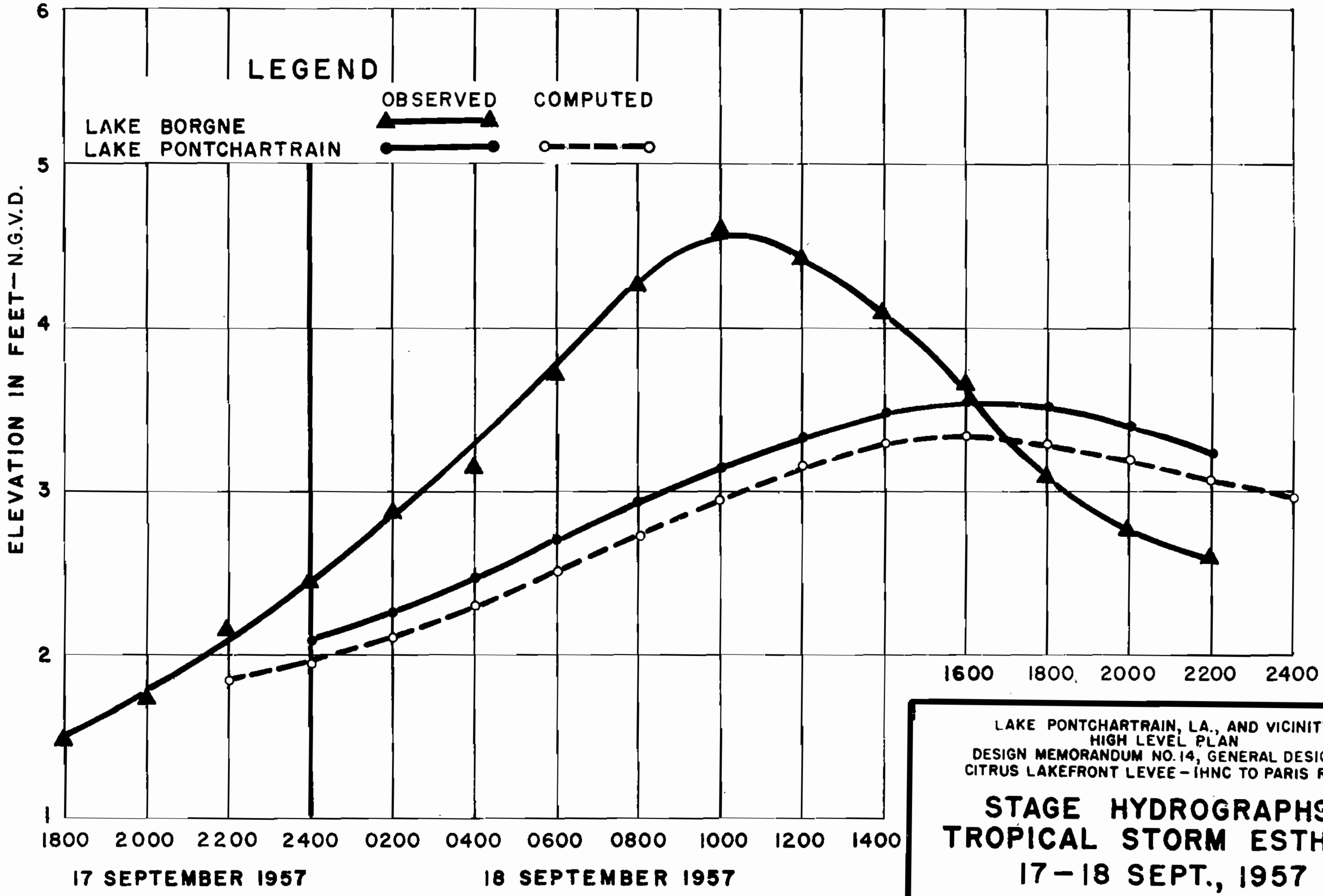


LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE – IHNC TO PARIS RD.

STAGE HYDROGRAPHS
HURRICANE
19 SEPTEMBER 1947

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984
FILE NO. H-2-29653

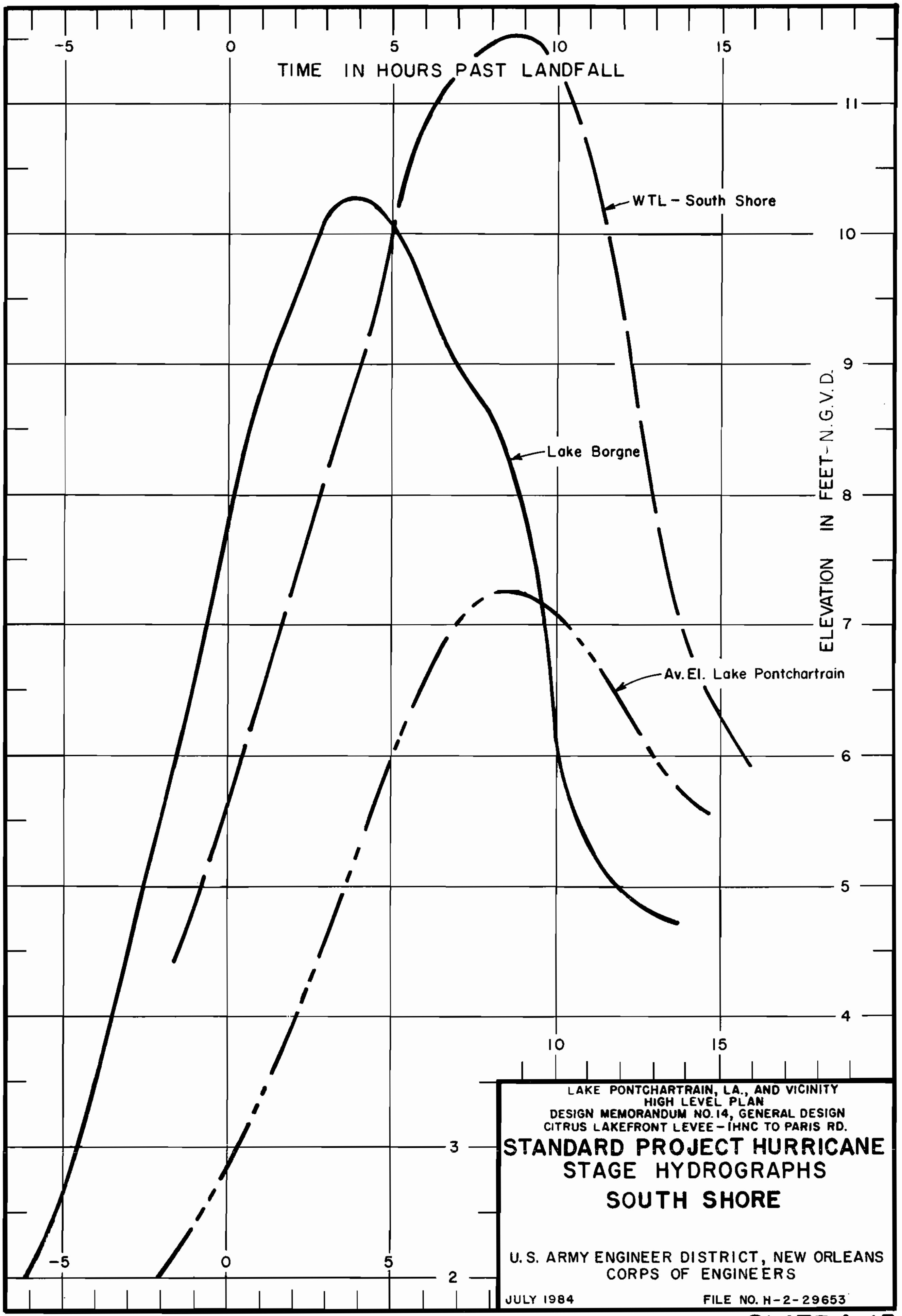


LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - IHNC TO PARIS RD.

STAGE HYDROGRAPHS
TROPICAL STORM ESTHER
17 – 18 SEPT., 1957

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984 FILE NO. H-2-29653



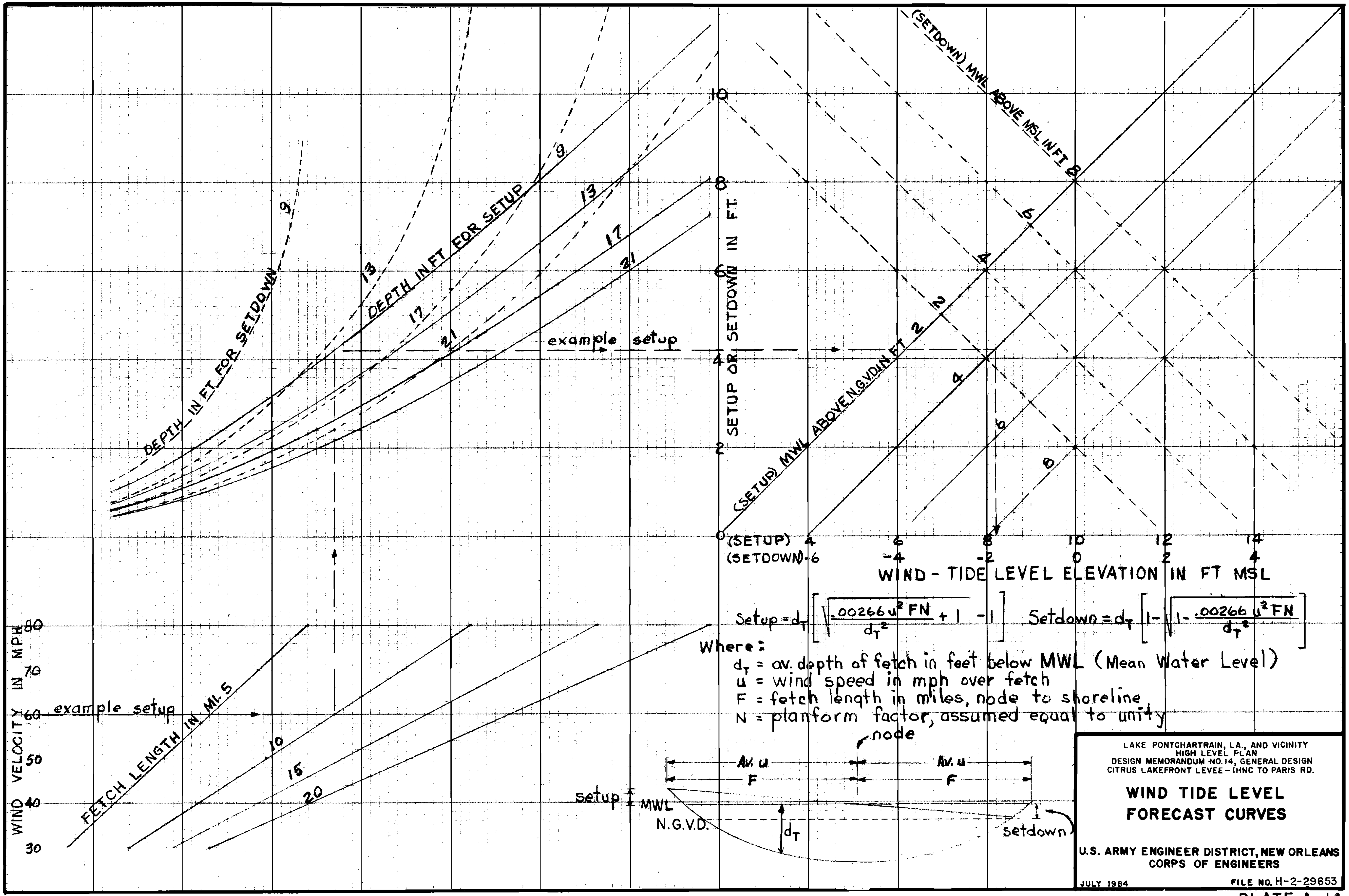
LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - IHNC TO PARIS RD.

STANDARD PROJECT HURRICANE STAGE HYDROGRAPHS SOUTH SHORE

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984 FILE NO. H-2-29653

PLATE A-13



$$\text{Setup} = d_T\left[\sqrt{\frac{.00266\,u^2 FN}{d_T^2}+1}\;-1\right] \qquad \text{Setdown} = d_T\left[1-\sqrt{1-\frac{.00266\,u^2 FN}{d_T^2}}\right]$$

Where:

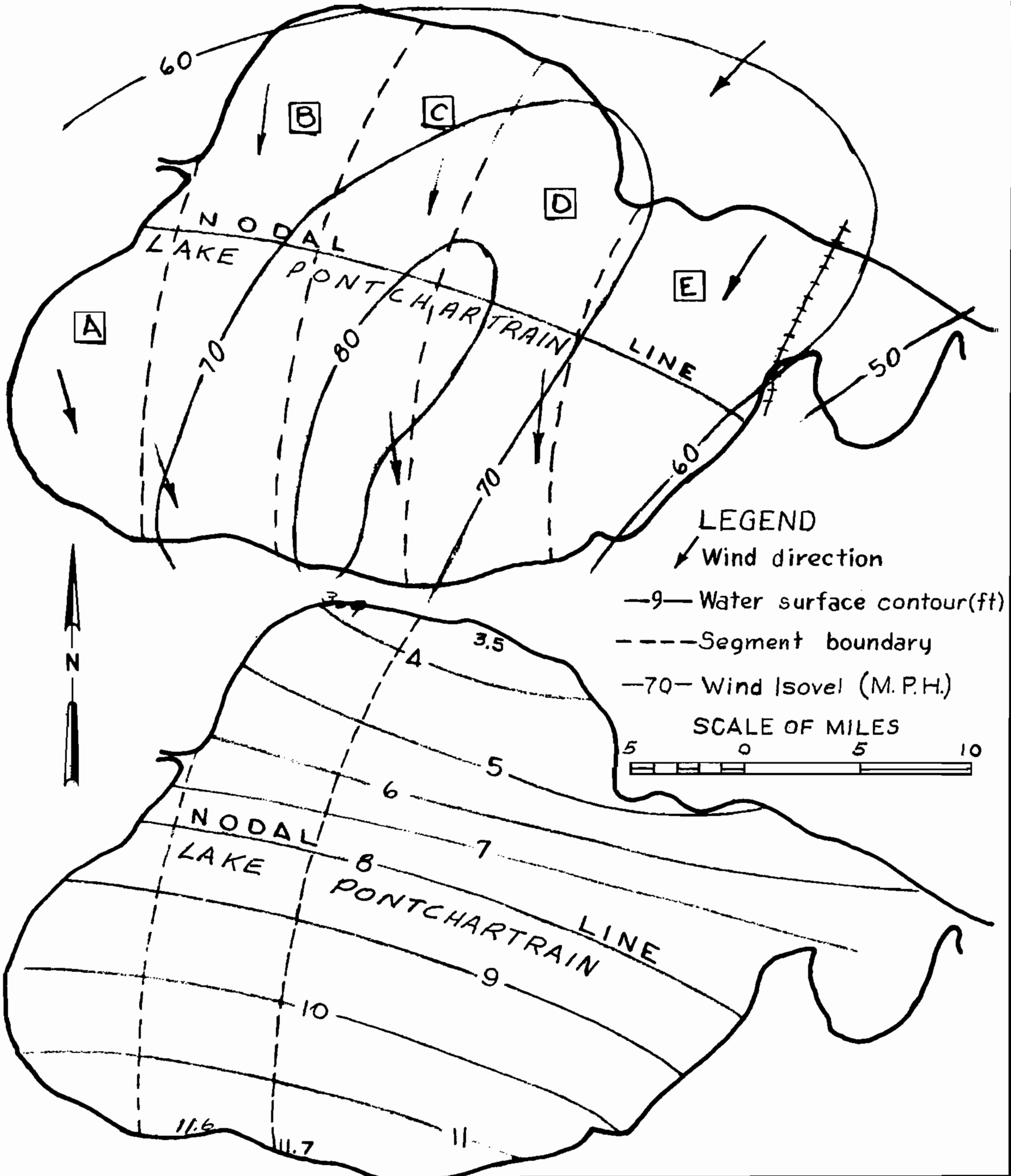
d_T = av. depth of fetch in feet below MWL (Mean Water Level)
u = wind speed in mph over fetch
F = fetch length in miles, node to shoreline
N = planform factor, assumed equal to unity

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE – IHNC TO PARIS RD.

WIND TIDE LEVEL FORECAST CURVES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984
FILE NO. H-2-29653



<u>Sample</u>: 8 hours after landfall-Track A-SPH

<u>Setdown</u>:

$$S=19.2\left[1-\sqrt{1-\frac{0.00266(66)^2(12.5)(1.0)}{(19.2)^2}}\right]=\begin{array}{r}+8.0=\text{MWL}\\ \underline{-4.1}\\ +3.9=\text{WTL}\end{array}$$

<u>Setup</u>:

$$S=20.5\left[\left(\sqrt{\frac{0.00266(70)^2(12.5)(1.0)}{(20.5)^2}}+1\right)-1\right]=$$

$$\begin{array}{r}+3.6'\\ \underline{8.0=\text{MWL}}\\ +11.6'=\text{WTL}\end{array}$$

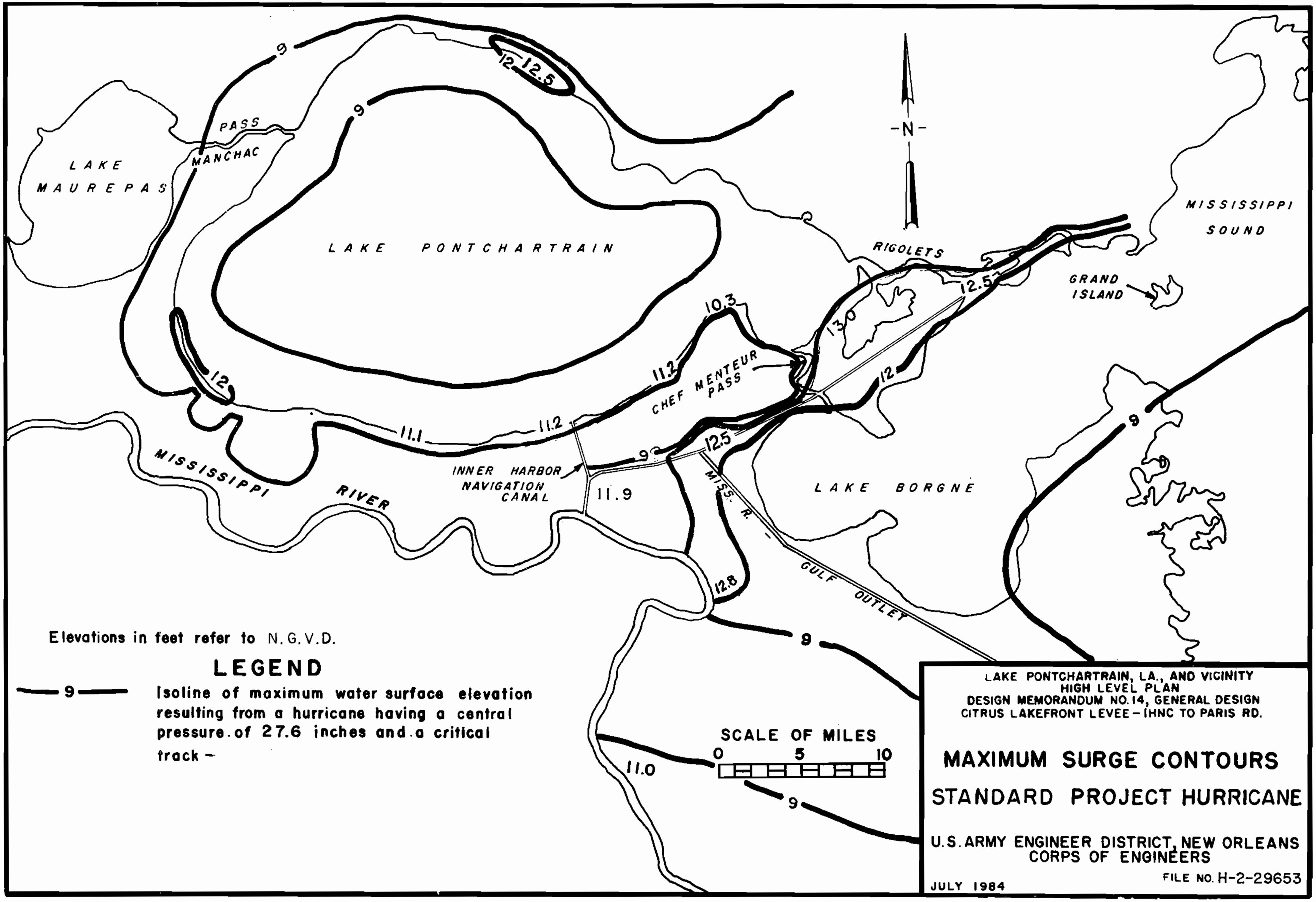
Interpolate with data for MWL=+6.0'
to obtain WTL's for routed MWL=+7.28'.

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE – IHNC TO PARIS RD.

LAKE PONTCHARTRAIN
TYPICAL
WIND TIDE CONTOURS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984 FILE NO. H-2-29653



Elevations in feet refer to N.G.V.D.

LEGEND

—9— Isoline of maximum water surface elevation resulting from a hurricane having a central pressure of 27.6 inches and a critical track -

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - IHNC TO PARIS RD.

MAXIMUM SURGE CONTOURS
STANDARD PROJECT HURRICANE

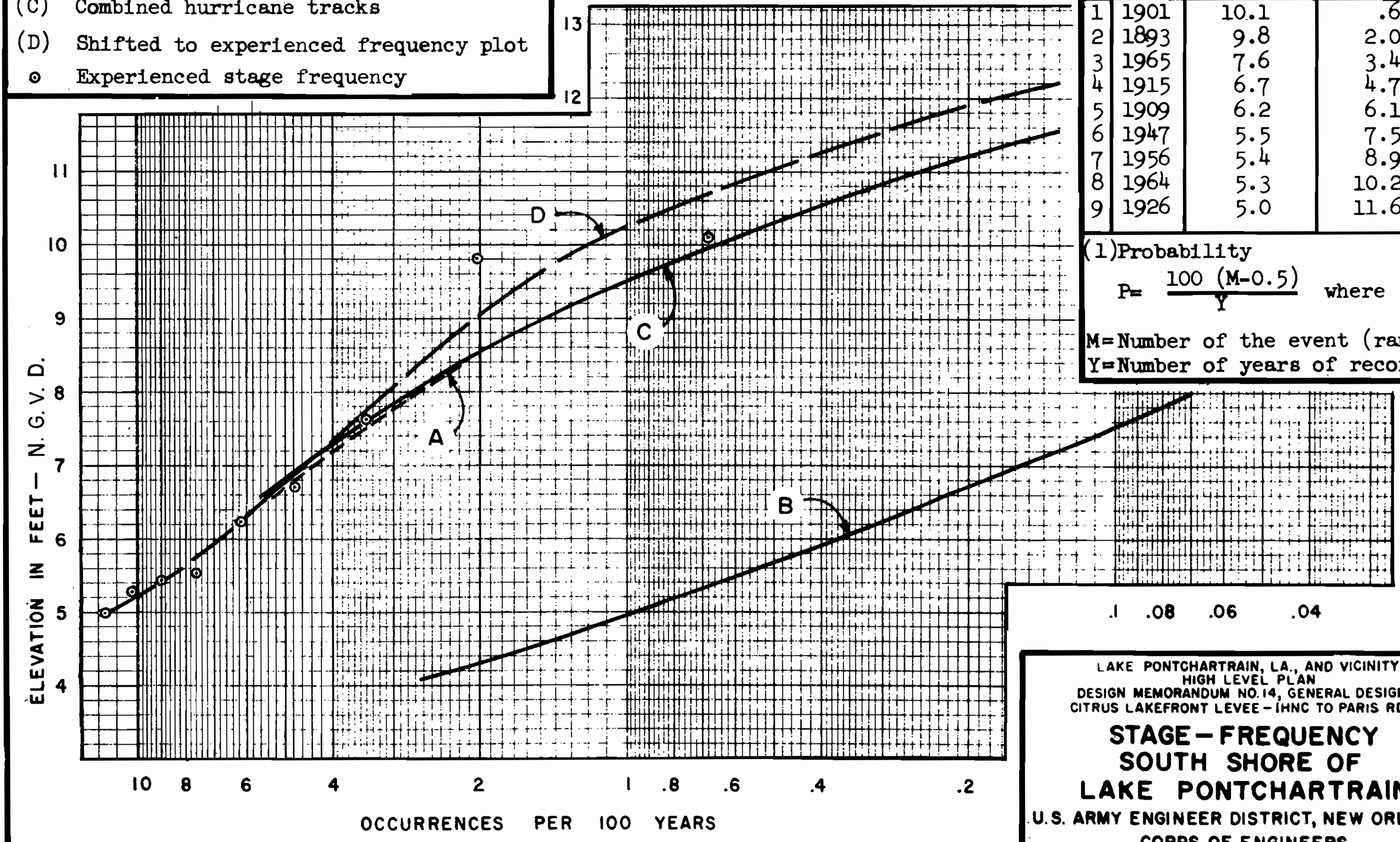
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO. H-2-29653

JULY 1984

L E G E N D

- (A) Hurricane tracks from the south
- (B) Hurricane tracks from the east
- (C) Combined hurricane tracks
- (D) Shifted to experienced frequency plot
- ⊙ Experienced stage frequency



FREQUENCY ANALYSIS

M	Years	Wind tide level (ft.)	(1) Probability
1	1901	10.1	.685
2	1893	9.8	2.05
3	1965	7.6	3.42
4	1915	6.7	4.79
5	1909	6.2	6.16
6	1947	5.5	7.53
7	1956	5.4	8.90
8	1964	5.3	10.27
9	1926	5.0	11.64

(1)Probability

$$P = \frac{100\,(M-0.5)}{Y} \quad \text{where}$$

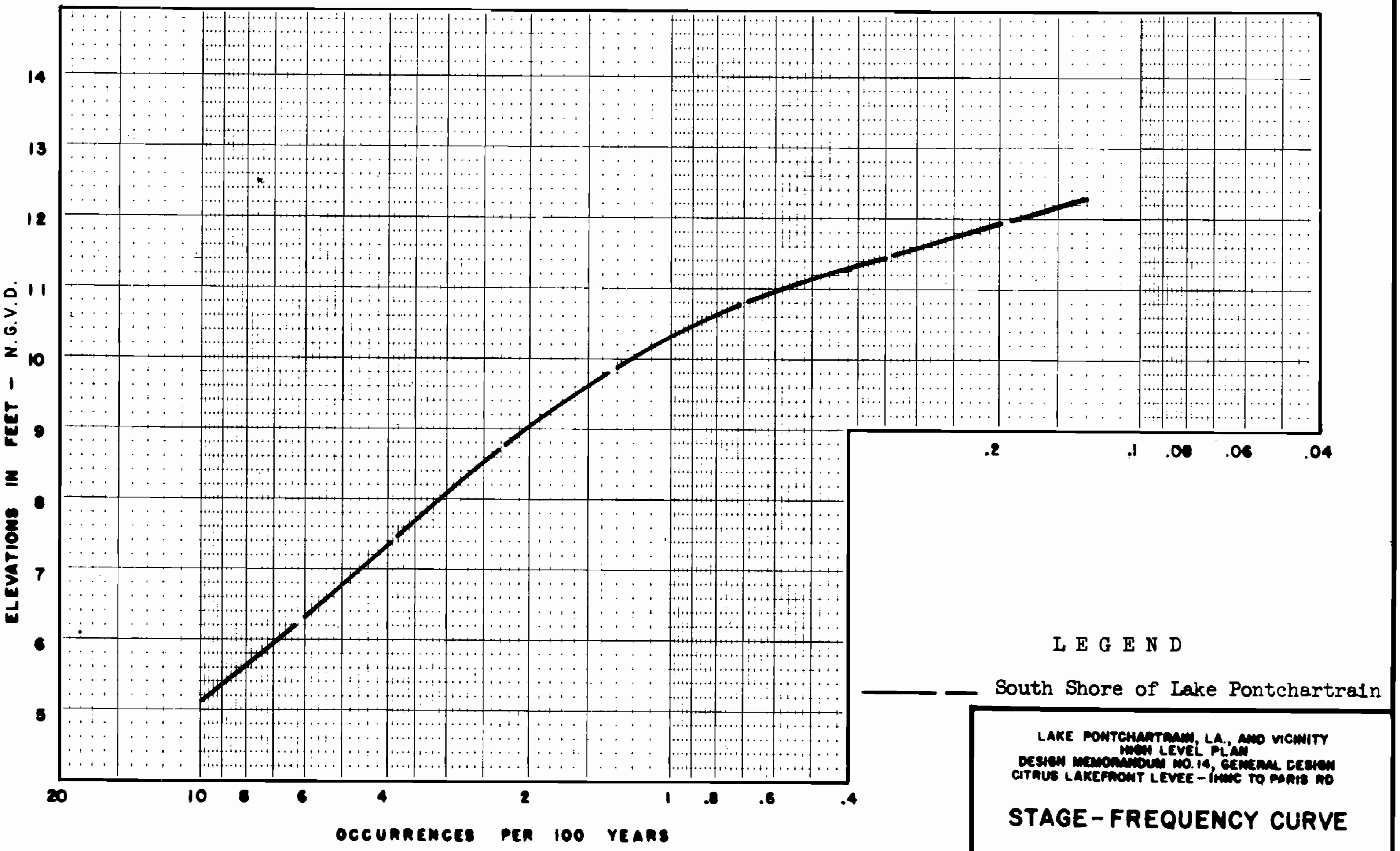
M=Number of the event (rank)
Y=Number of years of record(73)

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE – IHNC TO PARIS RD.

STAGE – FREQUENCY SOUTH SHORE OF LAKE PONTCHARTRAIN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1984 FILE NO. H-2-29653

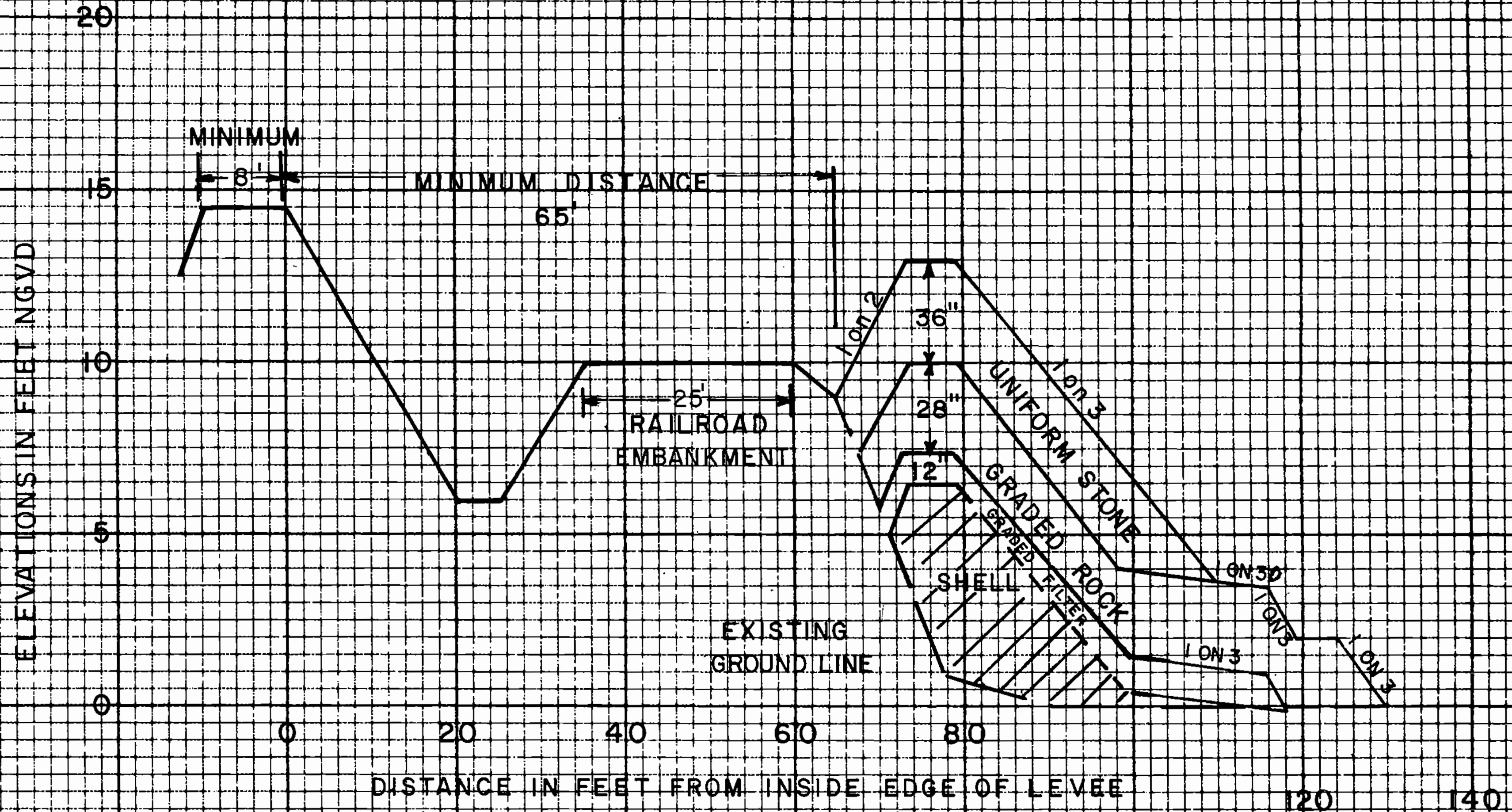


LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - IHNC TO PARIS RD

STAGE-FREQUENCY CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984 FILE NO. H-2-29653

PLATE A-18



HIGH LEVEL PLAN

LAKE PONTCHARTRAIN, L.A., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14, GENERAL DESIGN
CITRUS LAKEFRONT LEVEE - IHNC TO PARIS RD.

TYPICAL CROSS SECTION CITRUS LAKEFRONT LEVEE AND FORESHORE PROTECTION

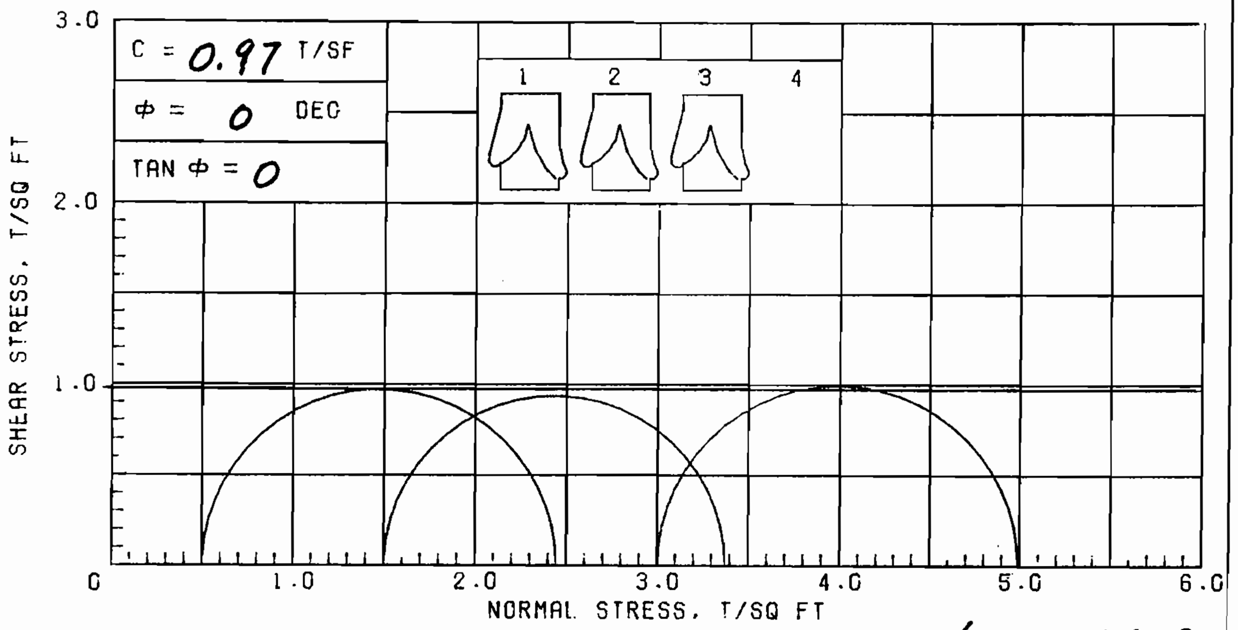
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1984
FILE NO. H-2-29653

PLATE A-19

LAKE PONTCHARTRAIN, LOUISIANA & VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 14 GENERAL DESIGN
CITRUS LAKEFRONT LEVEE
IHNC TO PARIS ROAD

APPENDIX B

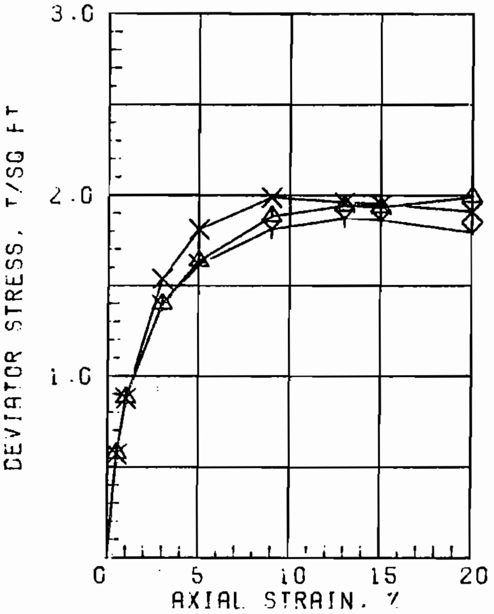
TRIAXIAL COMPRESSION TEST REPORT



C = 0.97 T/SF

Φ = 0 DEG

TAN Φ = 0



γsat. =126.3

	SPECIMEN NO.	Δ1	Y2	X3	Avg
INITIAL	WATER CONTENT, %	21.5	21.5	21.7	21.6
	DRY DENSITY, PCF	100.4	101.9	102.1	
	SATURATION, %	85.6	88.7	90.0	
	VOID RATIO	0.678	0.654	0.651	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	1.94	1.87	1.99	
	TIME TO FAILURE, MIN.	21	21	15	
	RATE OF STRAIN INCR,%				
	INITIAL DIAMETER, IN.	1.41	1.41	1.41	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; ROOTLETS; ORGANIC MATERIAL

LL 49	PL 15	PI 34	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

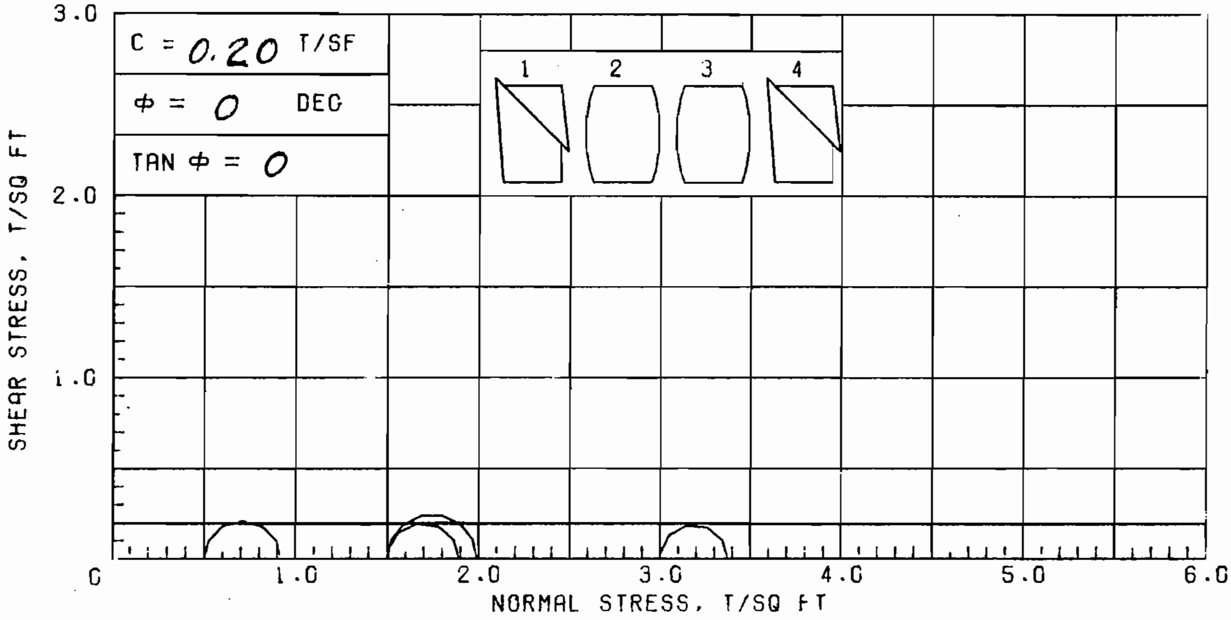
REMARKS:

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 12-ULC	SAMPLE NO. 1-B
DEPTH/ELEV 0.7/+11.7	TECH. PJR
LABORATORY USAE WES	DATE 06 JAN 83

TRIAXIAL COMPRESSION TEST REPORT

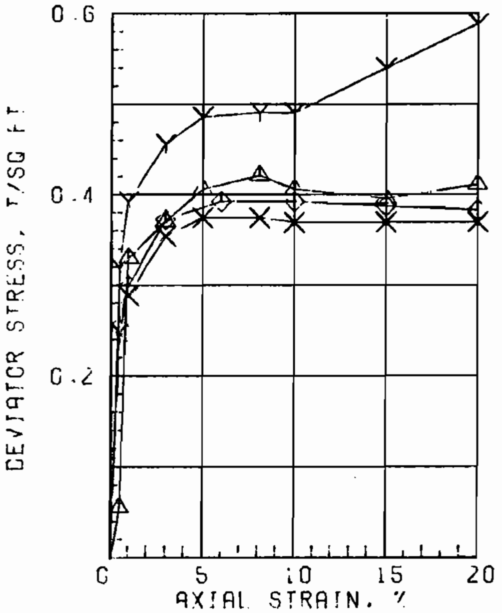


C = 0.20 T/SF

Φ = 0 DEG

TAN Φ = 0

γsat. = 118.6



SPECIMEN NO.		△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	31.3	27.4	33.2	30.8
	DRY DENSITY, PCF	88.7	92.9	87.7	87.4
	SATURATION, %	94.0	90.7	97.1	89.5
	VOID RATIO	0.899	0.815	0.923	0.929
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	1.5
MAX. DEV. STRESS, TSF		0.42	0.49	0.37	0.39
TIME TO FAILURE, MIN.		33	10	6	8
RATE OF STRAIN INCR.,%		15			
INITIAL DIAMETER, IN.		1.39	1.41	1.39	1.41
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00

Avg. 30.7

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; CLAY (CL), GRAY

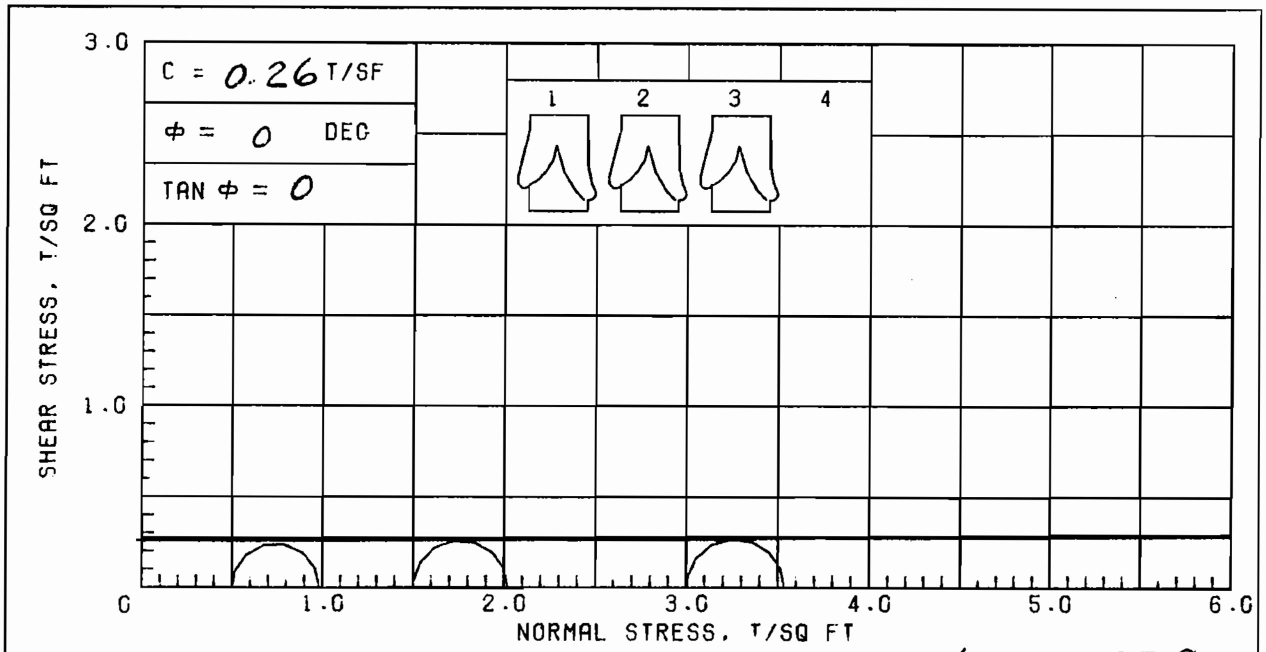
LL 49	PL 14	PI 35	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 12-ULC	SAMPLE NO. 2-C
DEPTH/ELEV 5.2/+7.2	TECH. RC
LABORATORY USAE WES	DATE 06 JAN 83

TRIAXIAL COMPRESSION TEST REPORT

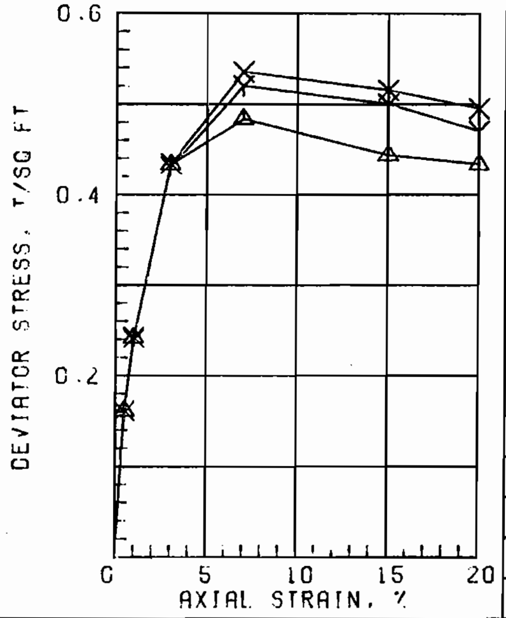


C = 0.26 T/SF

Φ = 0 DEG

TAN Φ = 0

γsat. = 107.9



	SPECIMEN NO.	Δ1	Y2	X3	Ave.
INITIAL	WATER CONTENT, %	47.2	48.7	52.3	49.4
	DRY DENSITY, PCF	73.4	72.4	70.2	
	SATURATION, %	98.2	99.0	100+	
	VOID RATIO	1.298	1.328	1.401	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.48	0.52	0.54	
	TIME TO FAILURE, MIN.	12	12	12	
	RATE OF STRAIN INCR, %				
	INITIAL DIAMETER, IN.	1.39	1.40	1.39	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; FINE SAND POCKETS

LL 52	PL 16	PI 36	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

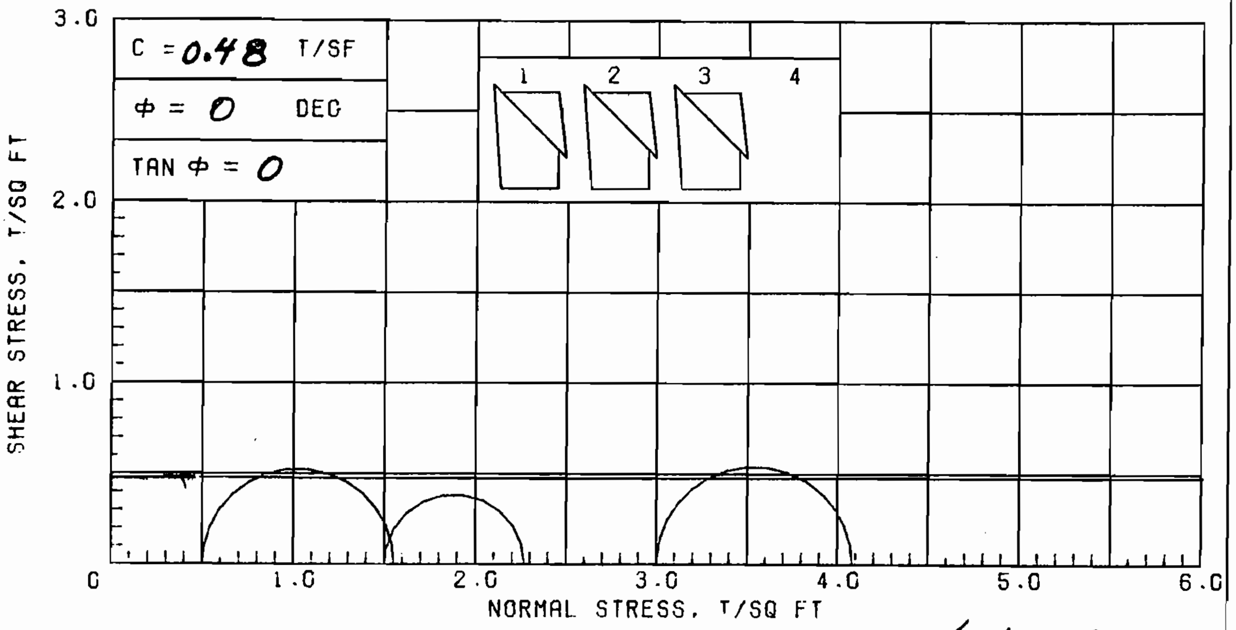
REMARKS:

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

CITRUS LAKEFRONT LEVEE

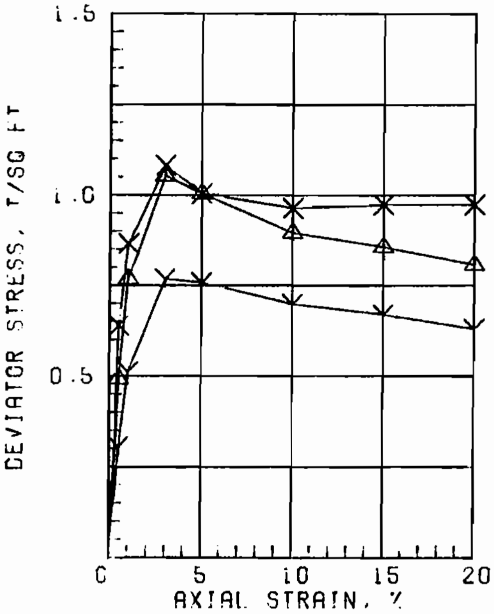
BORING NO. 12-ULC	SAMPLE NO. 5-C
DEPTH/ELEV 21.2/-8.8	TECH. PJR
LABORATORY USAE WES	DATE 06 JAN 83

TRIAXIAL COMPRESSION TEST REPORT


C = 0.48 T/SF

Φ = 0 DEG

TAN Φ = 0



γsat = 119.1

SPECIMEN NO.		△1	Y2	X3	Avg.
INITIAL	WATER CONTENT, %	31.6	34.6	30.7	32.3
	DRY DENSITY, PCF	90.6	86.5	92.6	
	SATURATION, %	99.1	98.6	100+	
	VOID RATIO	0.861	0.948	0.820	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		1.05	0.77	1.08	
TIME TO FAILURE, MIN.		6	6	6	
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.41	1.41	1.41	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: SILTY CLAY (CL), GRAY

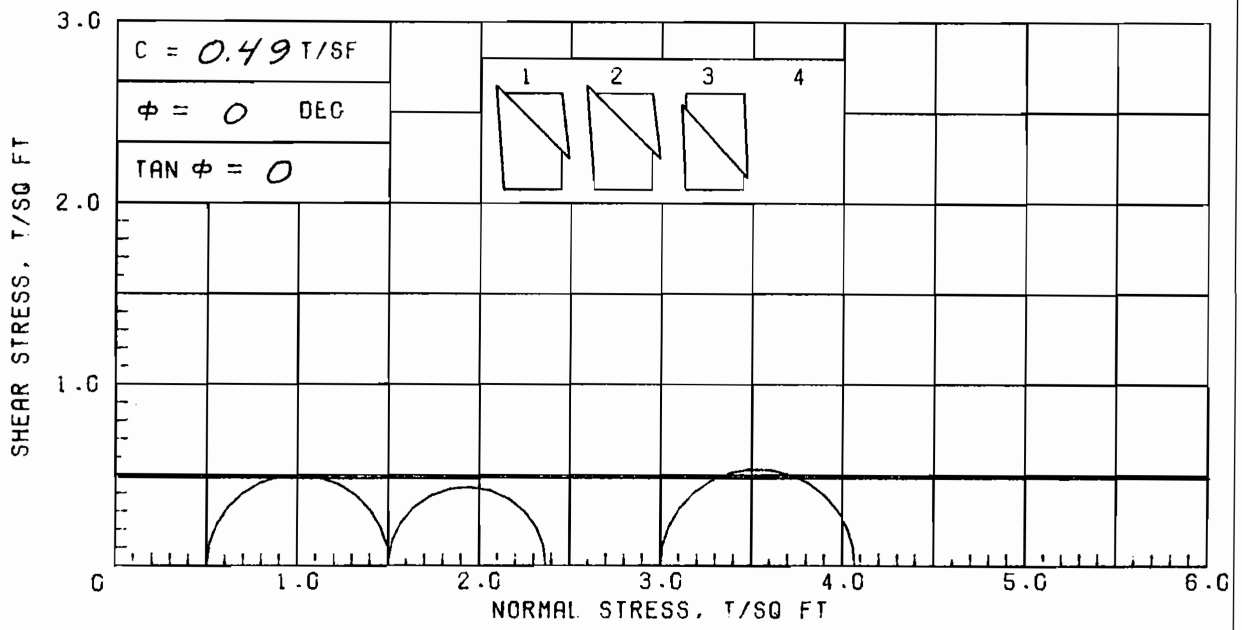
LL 46	PL 18	PI 28	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 12-ULC	SAMPLE NO. 13-C
DEPTH/ELEV 56.9/-44.5	TECH. KOC
LABORATORY USAE WES	DATE 06 JAN 83

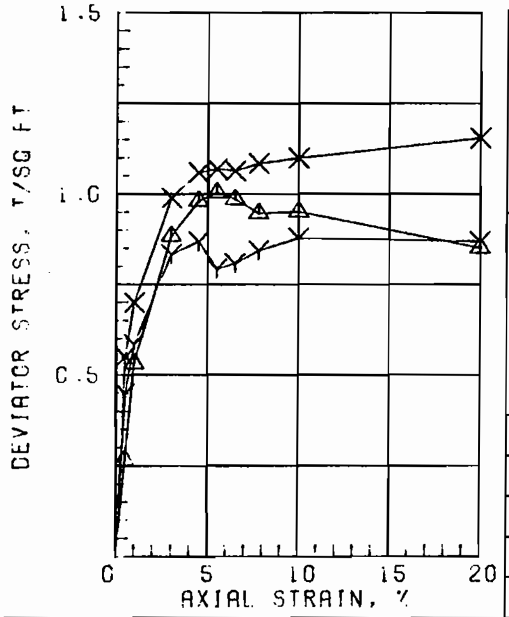
TRIAXIAL COMPRESSION TEST REPORT



C = *0.49* T/SF

Φ = *0* DEG

TAN Φ = *0*



γsat = 118.8

SPECIMEN NO.		Δ1	Y2	X3	*Avg.*
INITIAL	WATER CONTENT, %	32.3	32.3	31.7	*32.1*
	DRY DENSITY, PCF	88.8	89.5	90.1	
	SATURATION, %	97.0	98.8	98.2	
	VOID RATIO	0.899	0.883	0.871	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		1.00	0.87	1.07	
TIME TO FAILURE, MIN.		3	5	5	
RATE OF STRAIN INCR,%		20	20		
INITIAL DIAMETER, IN.		1.42	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY

LL 59	PL 16	PI 43	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 12-ULC

SAMPLE NO. 15-C

DEPTH/ELEV 65.3/-53.9

TECH. RCH

LABORATORY USAE WES

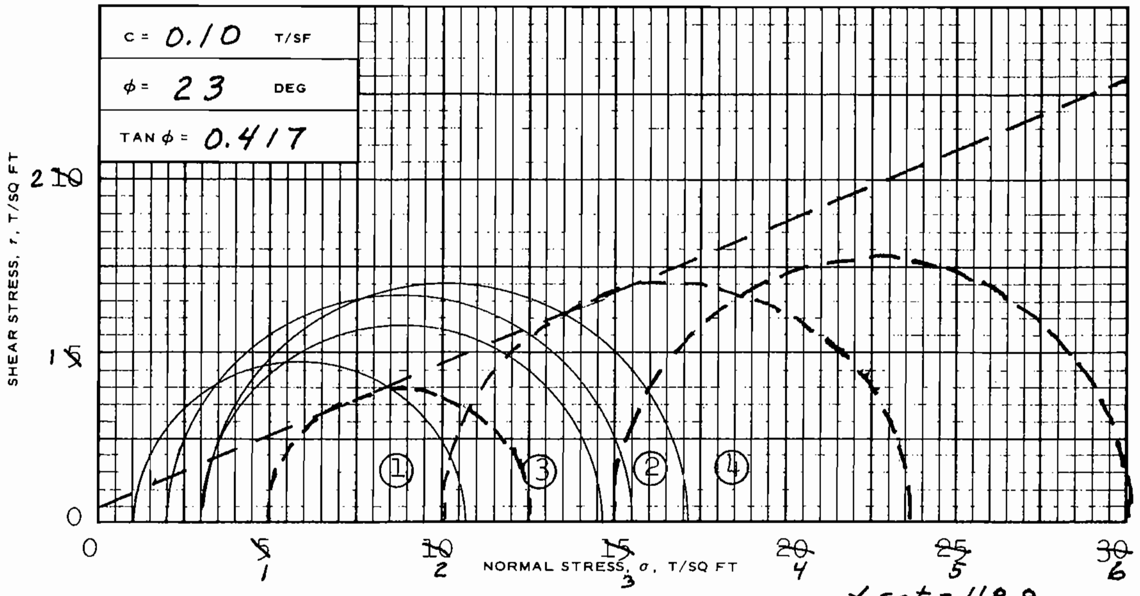
DATE 06 JAN 83

TRIAXIAL COMPRESSION TEST REPORT

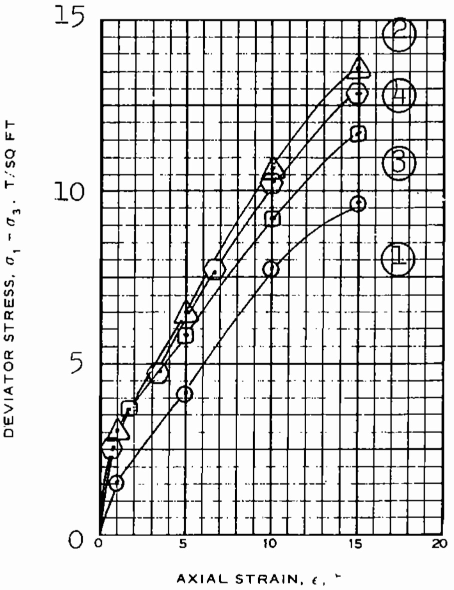
c = 0.10 T/SF

φ = 23 DEG

TAN φ = 0.417



γsat = 118.8



	SPECIMEN NO.		1	2	3	4	AVG.
INITIAL	WATER CONTENT, %	w_o	30.9	30.4	30.9	31.4	30.9
	DRY DENSITY LB/CU FT	γd_o	89.4	90.1	89.1	91.0	
	SATURATION, %	S_o	95.1	95.0	94.3	100+	
	VOID RATIO	e_o	0.871	0.857	0.878	0.838	
BEFORE SHEAR	WATER CONTENT, %	w_c	31.0	30.6	29.8	30.0	
	DRY DENSITY LB/CU FT	γd_c	90.1	92.1	91.4	93.5	
	SATURATION, %	S_c	97.9*	100+	96.1*	100+	
	VOID RATIO	e_c	0.849	0.816	0.831	0.790	
	FINAL BACK PRESSURE, T/SQ FT	u_o	4.32	4.32	4.32	4.32	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0	3.0	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	9.71	13.58	11.62	12.85	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		4	517	517	517	517	
$(\sigma_1 - \sigma_3)$ AT MAX PORE PRESSURE			1.50	2.75	3.00		
INITIAL DIAMETER, IN.		D_o	1.39	1.40	1.40	1.39	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	3.00	

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS SILT (ML), GRAY

LL PL PI Gs 2.68 (EST) TYPE OF SPECIMEN UNDISTURBED TYPE OF TEST R̄

REMARKS: *PORE PRESSURE RESPONSE INDICATED 100% SATURATION

PROJECT LK. PONT. LA. & VIC. - HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 12-ULC SAMPLE NO. 4-C

DEPTH/ELEV 16.7/-4.3

LABORATORY USAEWES DATE 11 JAN 1983

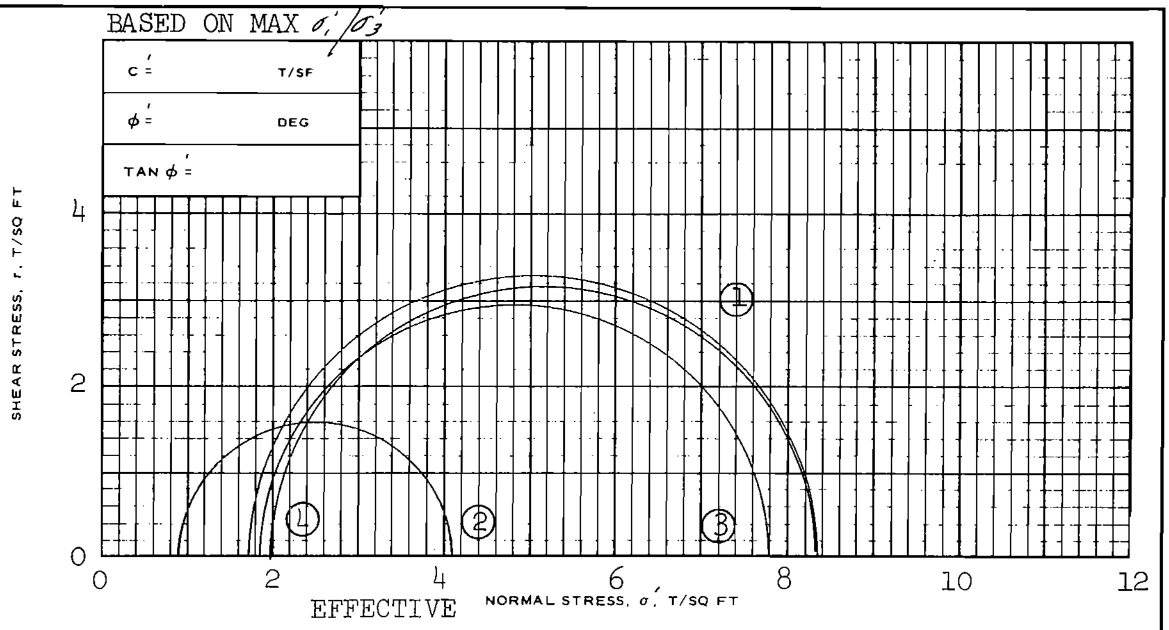
SHEET 1 OF 2

TES **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089
REV JUNE 1970

GPO : 1982 0 - 375-356

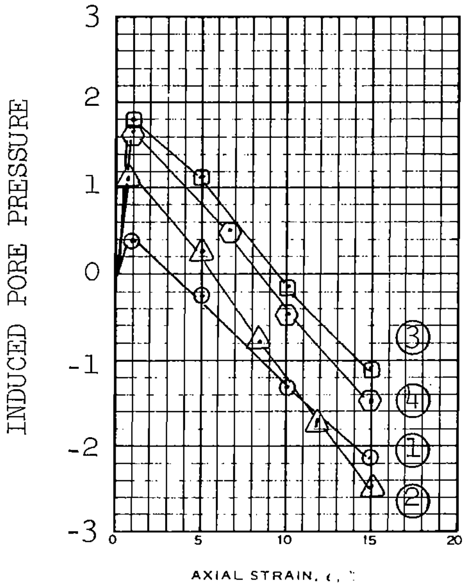
BASED ON MAX σ_1'/σ_3'



c' = T/SF

φ' = DEG

TAN φ' =



SPECIMEN NO.			1	2	3	4
INITIAL	WATER CONTENT, %	w_o				
	DRY DENSITY LB/CU FT	γ_{d_o}				
	SATURATION, %	S_o				
	VOID RATIO	e_o				
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γ_{d_c}				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.72	0.88	1.85	1.99
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	6.63	3.19	5.95	6.35
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f				
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o				
INITIAL HEIGHT, IN.		H_o				

CONTROLLED- TEST

DESCRIPTION OF SPECIMENS

LL	PL	PI	Gs	TYPE OF SPECIMEN	TYPE OF TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC. - HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 12-ULC SAMPLE NO. 4-C

DEPTH/ELEV 16.7/-4.3

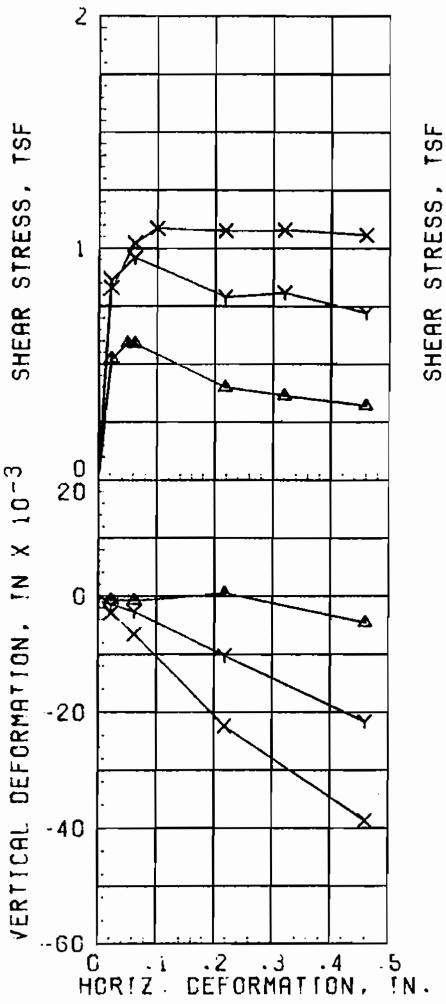
LABORATORY USAEWES DATE 11 JAN 1983

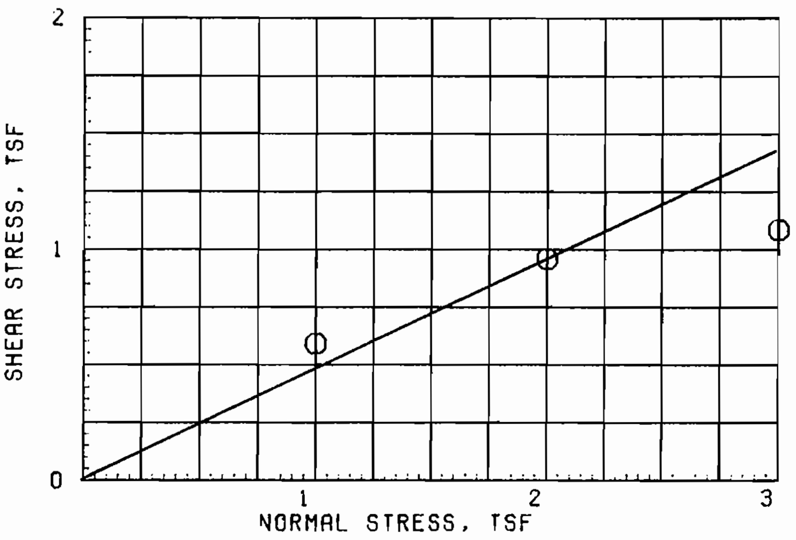
SHEET 2 OF 2

TES **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089
REV JUNE 1970

GPO : 1982 0 - 375-356





$\gamma_{sat.} = 126.8$

		1 ▲	2 Y	3 X	AVG.
	TEST NO.	1 ▲	2 Y	3 X	AVG.
INITAL	WATER CONTENT, %	20.8	21.3	20.5	20.9
	VOID RATIO	0.666	0.646	0.630	
	SATURATION, %	84.2	89.3	88.0	
	DRY DENSITY, PCF	101.1	102.4	103.4	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	2	2	
FINAL	WATER CONTENT, %	28.5	23.8	22.4	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF		0.59	0.96	1.09	
TIME TO FAILURE, MIN		300	374	600	
RATE OF STRAIN, IN/MIN		.00017	.00017	.00017	
ULTIMATE SHEAR STRESS, TSF					

φ = 26°

TAN φ = 0.483

C = 0

TYPE SPECIMEN UNDISTURBED | 3.00 IN. SQUARE | 0.553 IN. THICK

CLASSIFICATION PLASTIC CLAY (CH), GRAY; SHELL PARTICLES

LL 56 | PL 16 | PI 40 | GS 2.70 (EST)

REMARKS:

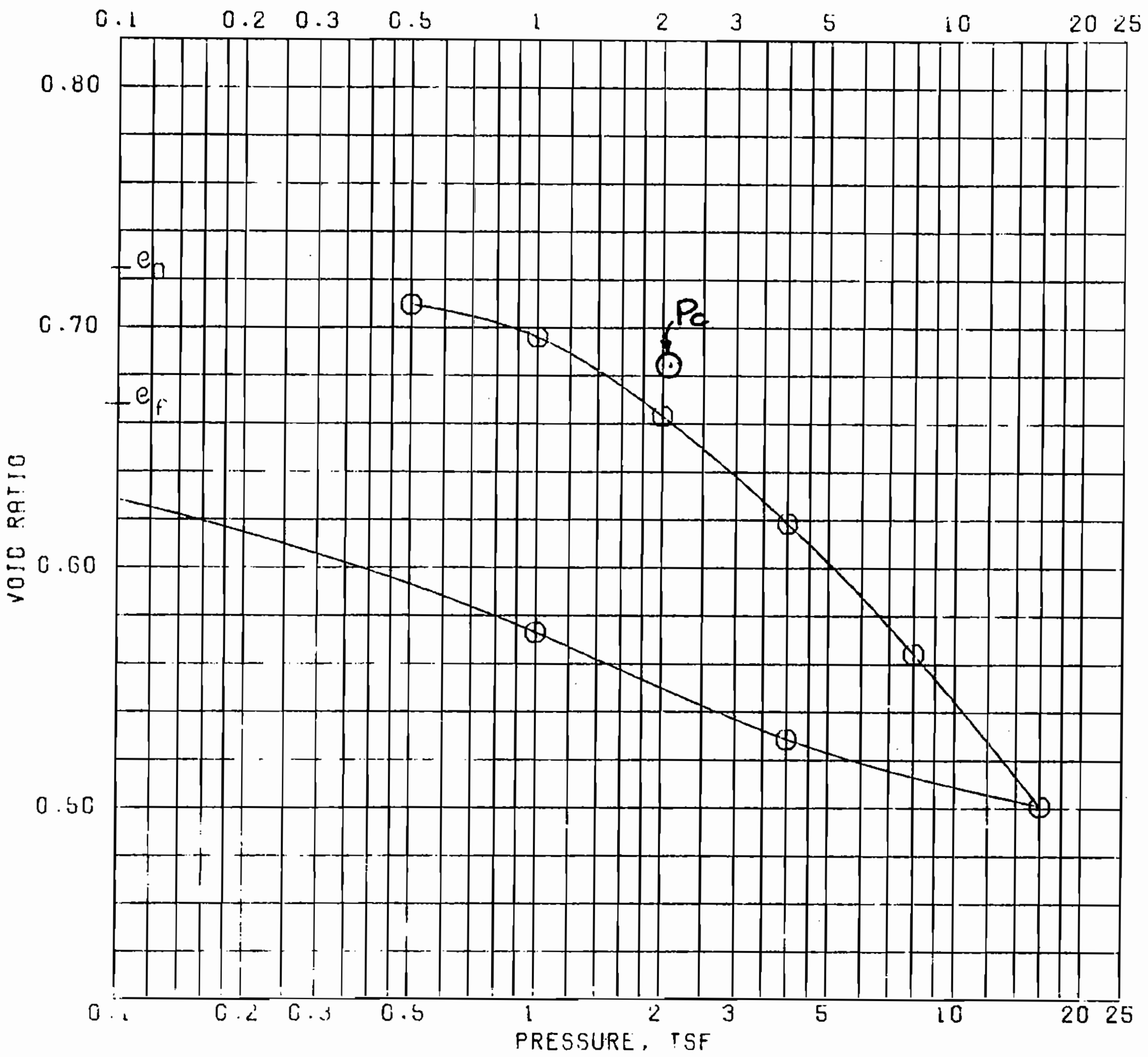
PROJECT LK. PONT. LA. & VIC. - HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 12-ULC | SAMPLE 1-C

DEPTH/ELEV 1.6/+10.8 | DATE 04 JAN 83

DIRECT SHEAR TEST REPORT



$\gamma_{sat.} = 124.0$

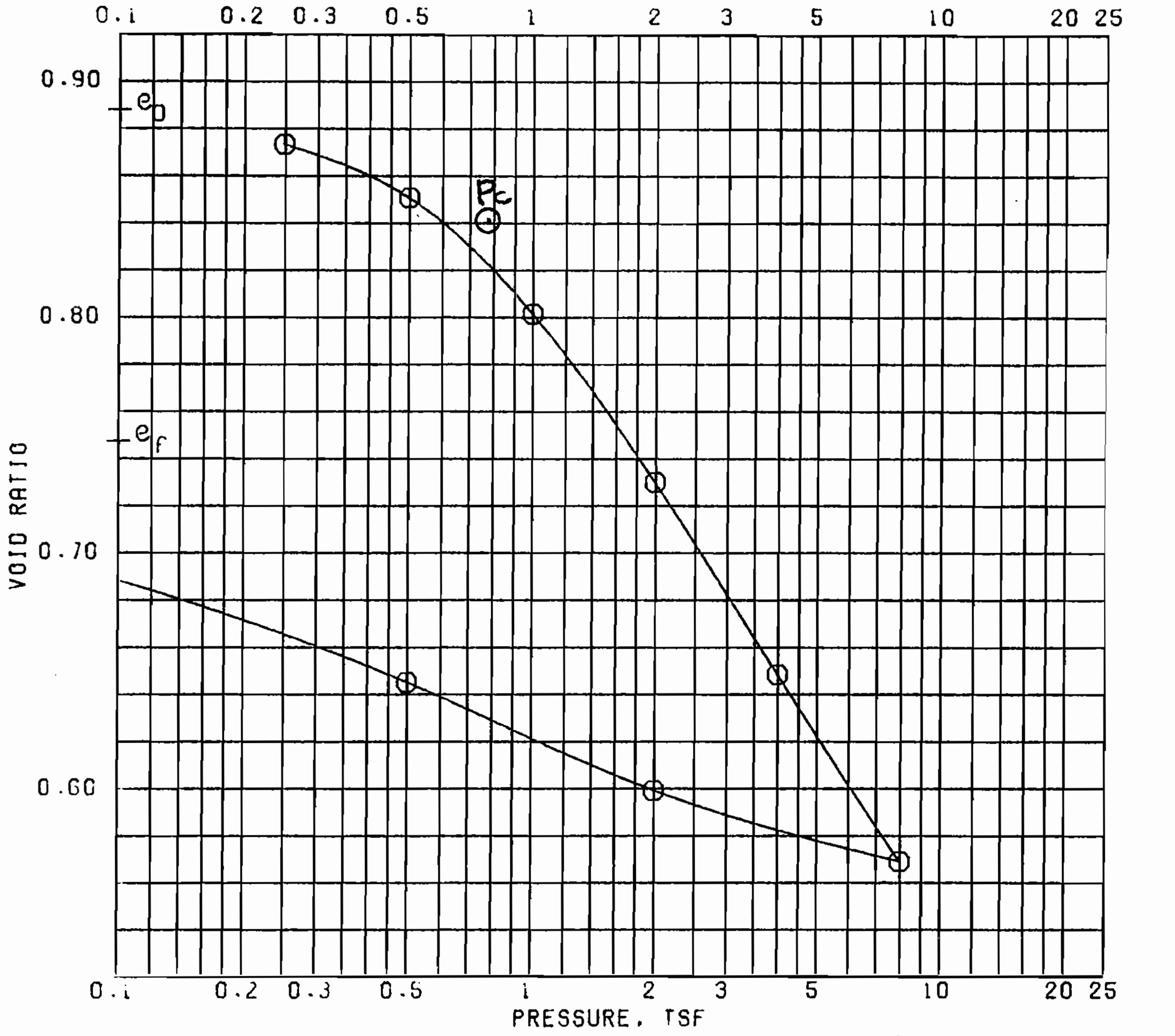
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	22.2	24.1
PRECONSOL. PRESSURE, TSF	2.1	DRY DENSITY, PCF	97.8	101.1
COMPRESSION INDEX	0.205	SATURATION, %	82.8	97.7
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.724	0.667
DIA. IN 4.44	HT. IN 1.115	BACK PRESSURE, TSF		

CLASSIFICATION CLAY (CL), GRAY; SHELL PARTICLES

LL	PL	PI	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
GS 2.70 (EST)	D_{10}		CITUS LAKEFRONT LEVEE
REMARKS		BORING NO. 12-ULC	SAMPLE NO. 1-B
		DEPTH/ELEV 1.1/+11.3	DATE 11 JAN 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 11

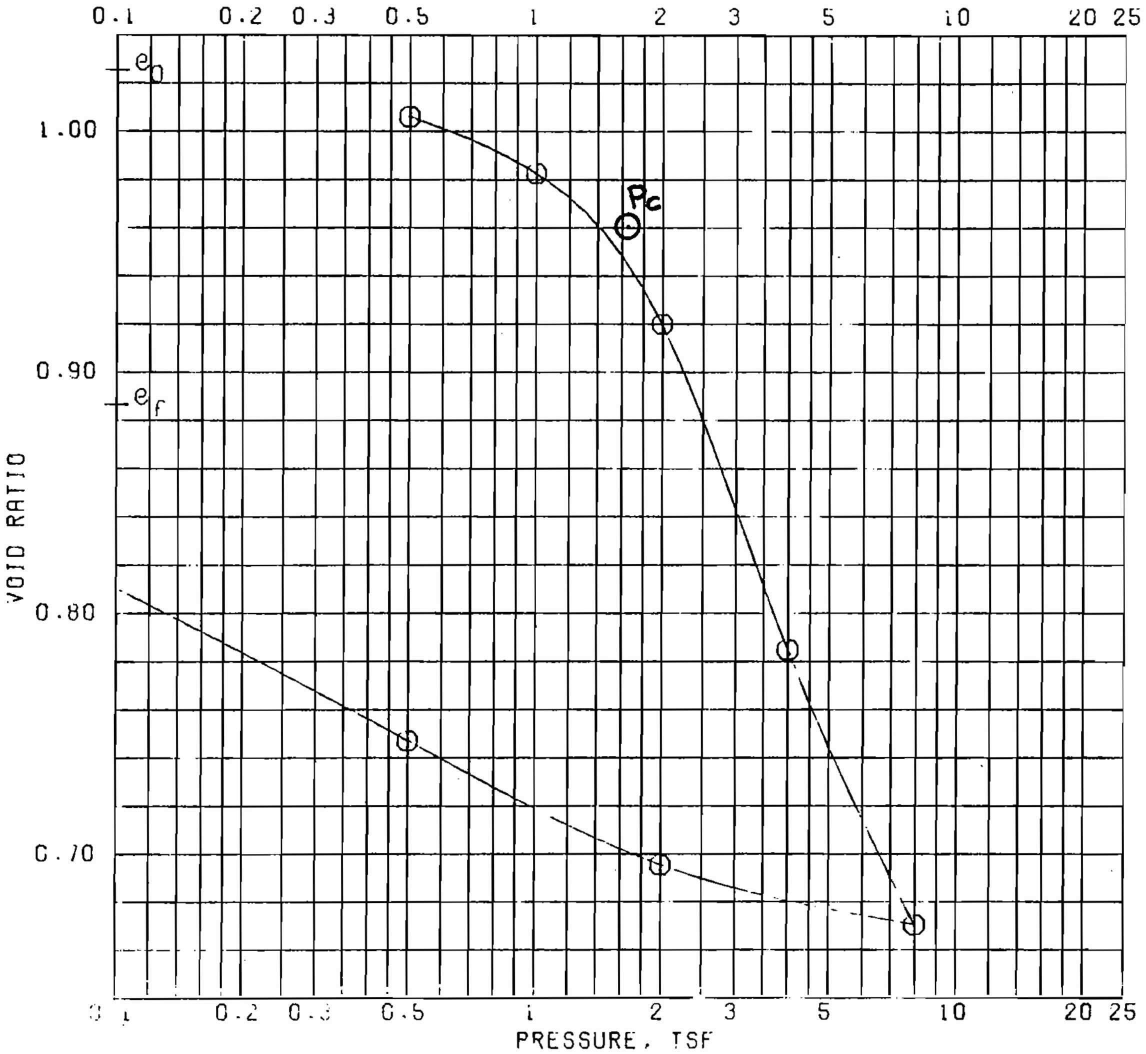


γ sat = 118.7

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	30.0	27.4
PRECONSOL. PRESSURE, TSF	0.78	DRY DENSITY, PCF	89.3	96.5
COMPRESSION INDEX	0.27	SATURATION, %	91.2	99.2
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.887	0.747
DIA. IN 4.44	HT. IN 1.131	BACK PRESSURE, TSF		
CLASSIFICATION CLAY (CL), LT BROWN; SHELL PARTICLES				
LL PL PI		PROJECT LK. PONT. LA. & VIC.-HURR. PROT.		
GS 2.70 (EST)	D_{10}	CITRUS LAKEFRONT LEVEE		
REMARKS		BORING NO. 12-ULC	SAMPLE NO. 2-C	
		DEPTH/ELEV 5.6/+6.8	DATE 12 JAN 83	

CONSOLIDATION TEST REPORT

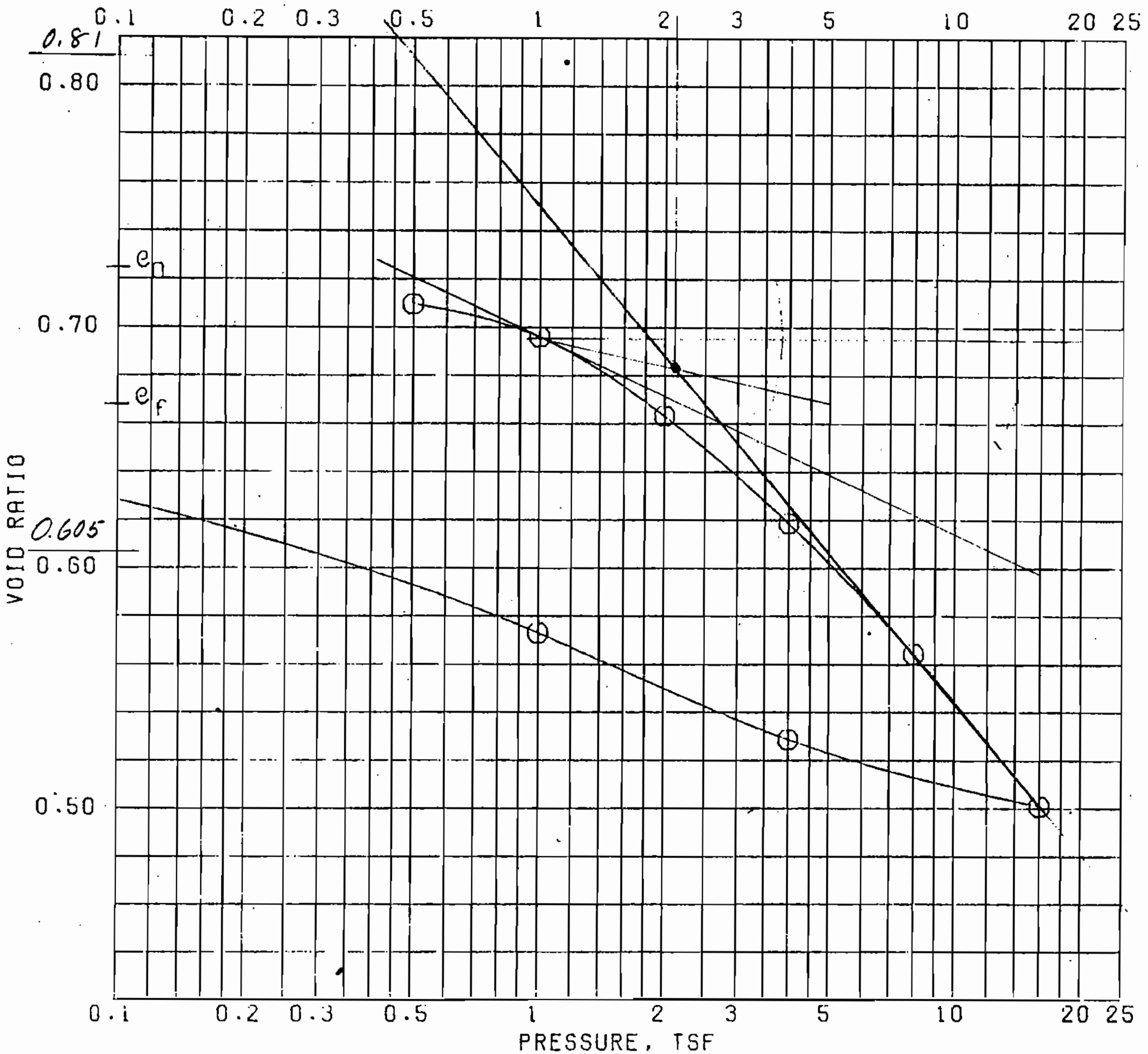
SHEET 1 OF 11



$\gamma_{sat} = 114.9$

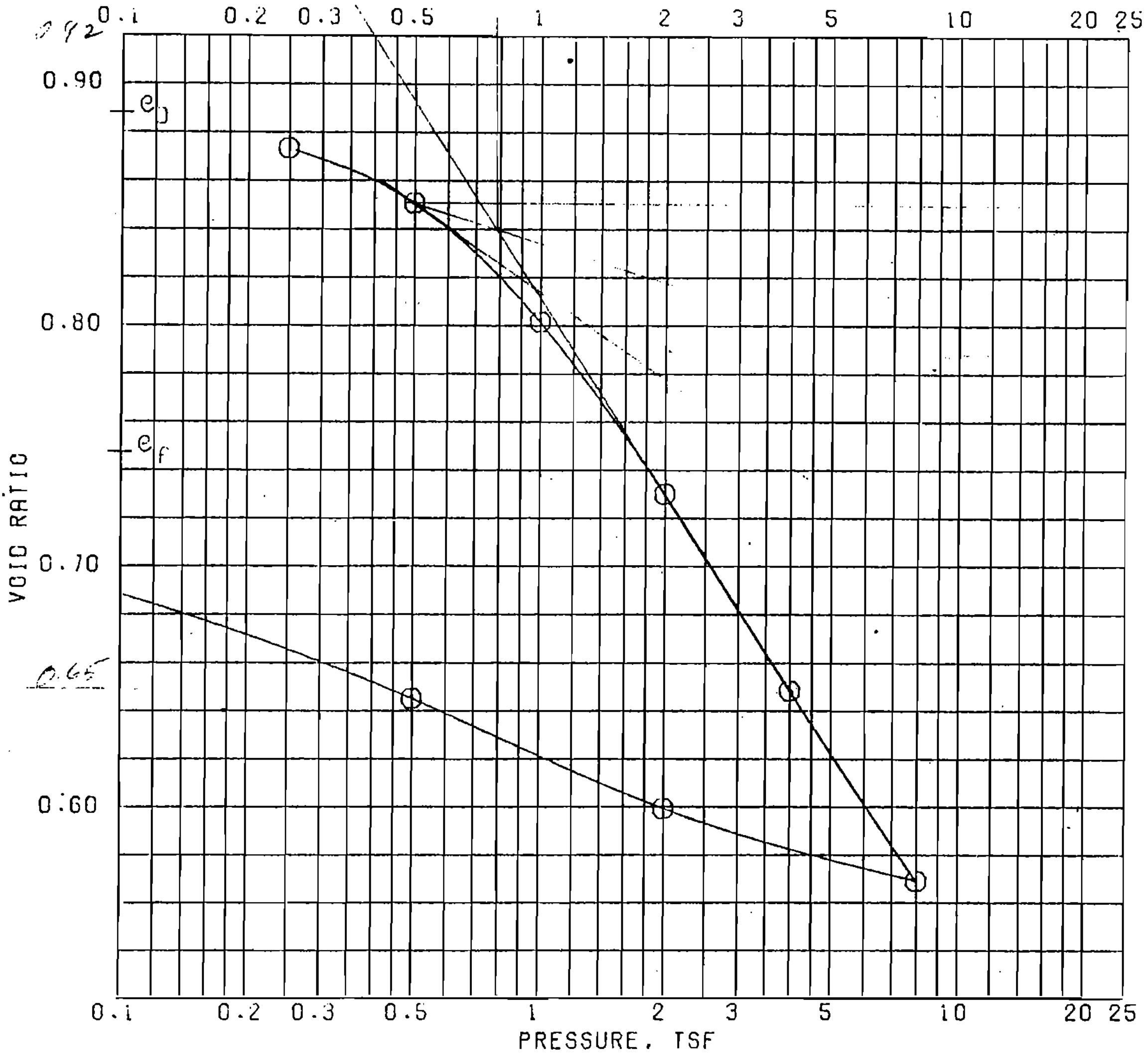
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	36.6	32.3
PRECONSOL. PRESSURE, TSF	1.65	DRY DENSITY, PCF	83.3	89.4
COMPRESSION INDEX	0.455	SATURATION, %	96.5	98.4
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.025	0.886
DIA. IN 4.44	HT. IN 1.144	BACK PRESSURE, TSF		
CLASSIFICATION CLAY (CL), GRAY; SILT LENSES; SHELL PARTICLES				
LL PL PI		PROJECT LK. PONT. LA. & VIC.-HUUR. PROT.		
GS 2.70 (EST)	D_{10}	CITRUS LAKEFRONT LEVEE		
REMARKS		BORING NO. 12-ULC	SAMPLE NO. 13-C	
		DEPTH/ELEV 57.3/-44.9	DATE 12 JAN 83	
		CONSOLIDATION TEST REPORT		

SHEET 1 OF 10



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	22.2	24.1
PRECONSOL. PRESSURE, TSF	2.1	DRY DENSITY, PCF	97.8	101.1
COMPRESSION INDEX	0.205	SATURATION, %	82.8	97.7
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.724	0.667
DIA. IN 4.44	HT. IN 1.115	BACK PRESSURE, TSF		
CLASSIFICATION CLAY (CL), GRAY; SHELL PARTICLES				
LL PL PI		PROJECT LK. PONT. LA. & VIC.-HURR. PROT.		
GS 2.70 (EST)	D_{10}	CITUS LAKEFRONT LEVEE		
REMARKS		BORING NO. 12-ULC		SAMPLE NO. 1-B
		DEPTH/ELEV 1.1/+11.3		DATE 11 JAN 83
		CONSOLIDATION TEST REPORT		

SHEET 1 OF 11



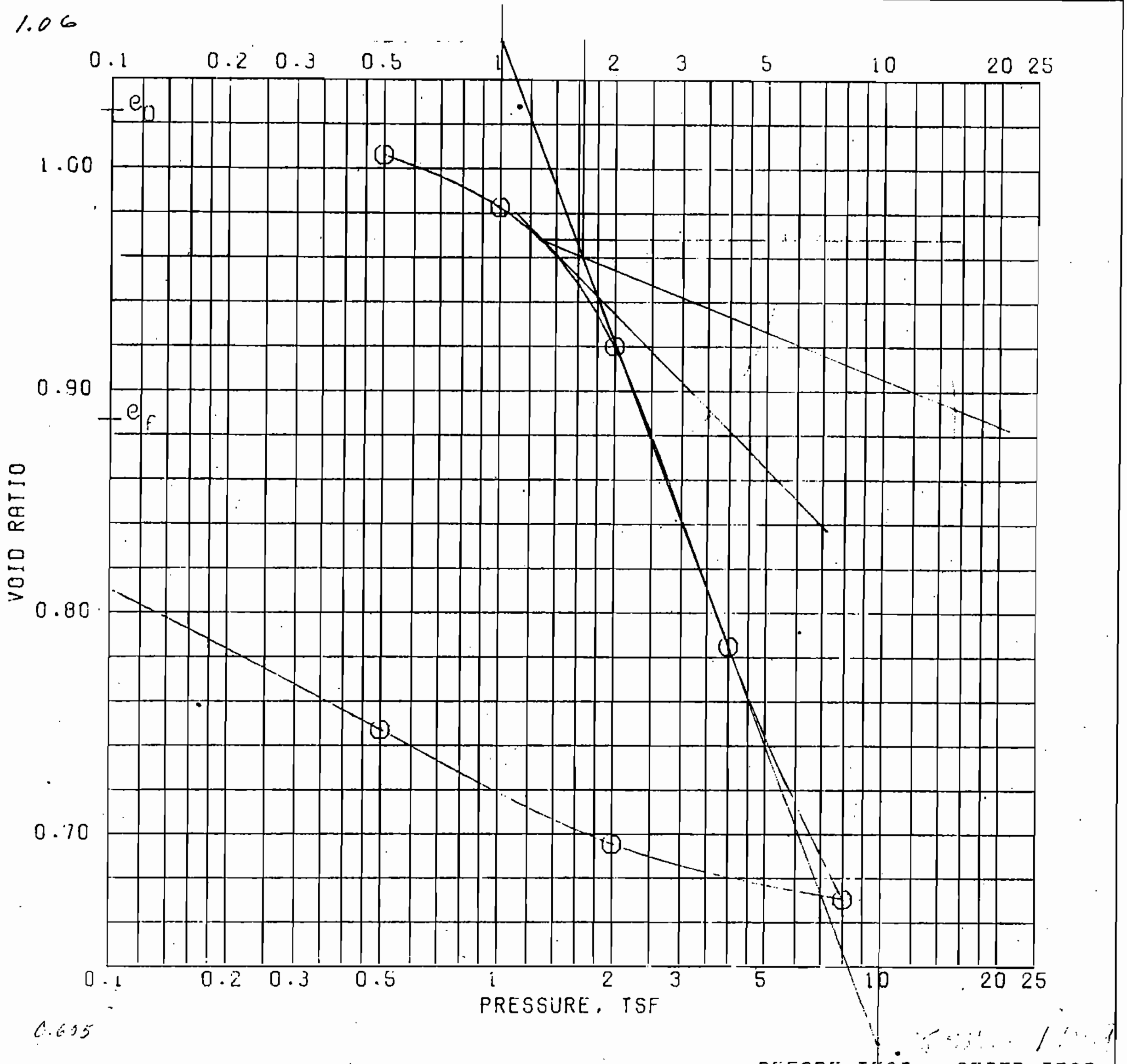
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	30.0	27.4
PRECONSOL. PRESSURE, TSF	0.78	DRY DENSITY, PCF	89.3	96.5
COMPRESSION INDEX	0.27	SATURATION, %	91.2	99.2
TYPE SPECIMEN UNDISTURBED		VOID RATIO	0.887	0.747
DIA. IN 4.44	HT. IN 1.131	BACK PRESSURE, TSF		

CLASSIFICATION CLAY (CL), LT BROWN; SHELL PARTICLES

LL	PL	PI	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.	
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE	
REMARKS			BORING NO. 12-ULC	SAMPLE NO. 2-C
			DEPTH/ELEV 5.6/+6.8	DATE 12 JAN 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 11



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	36.6	32.3
PRECONSOL. PRESSURE, TSF	1.65	DRY DENSITY, PCF	83.3	89.4
COMPRESSION INDEX	0.455	SATURATION, %	96.5	98.4
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.025	0.886
DIA. IN 4.44	HT. IN 1.144	BACK PRESSURE, TSF		

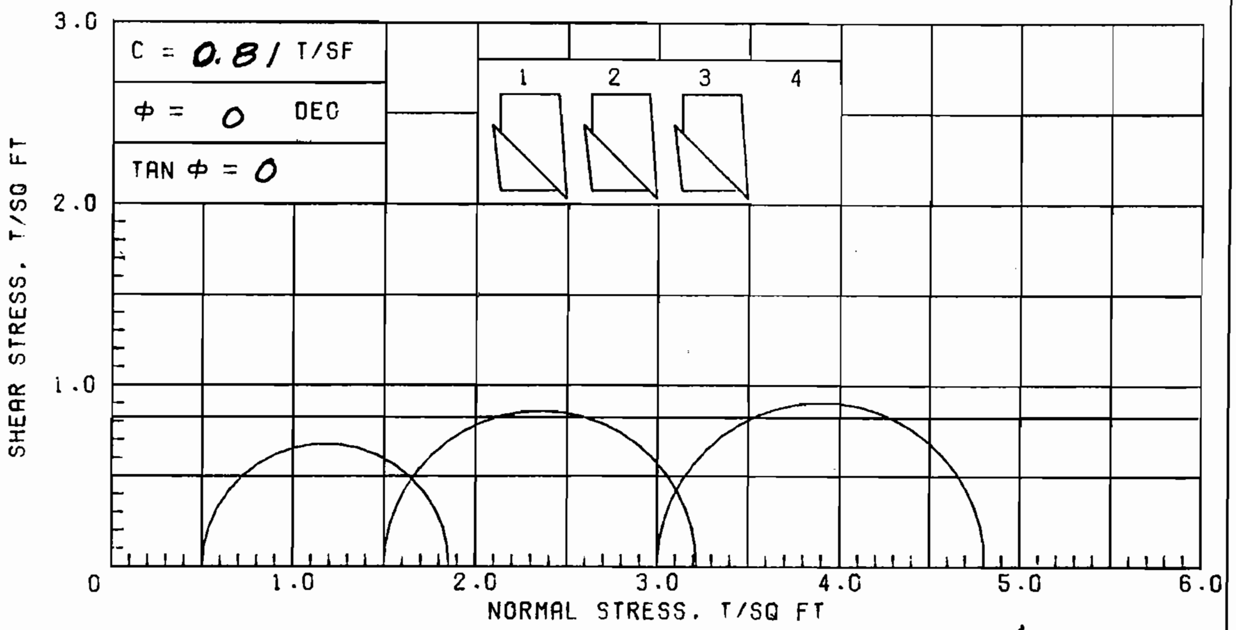
CLASSIFICATION CLAY (CL), GRAY; SILT LENSES; SHELL PARTICLES

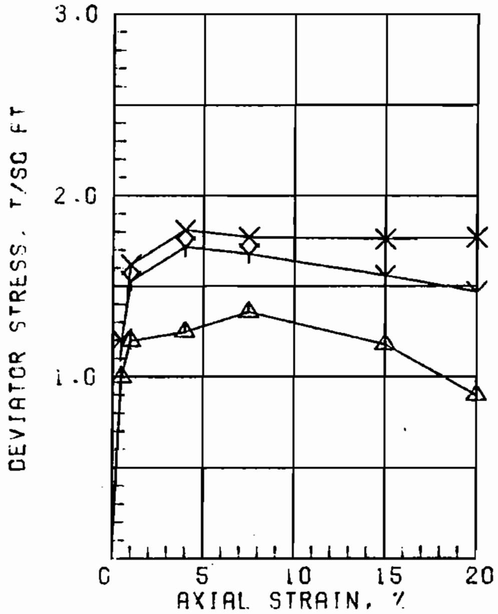
LL	PL	PI	PROJECT LK. PONT. LA. & VIC.-HUUR. PROT.
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE

REMARKS	BORING NO. 12-ULC	SAMPLE NO. 13-C
	DEPTH/ELEV 57.3/-44.9	DATE 12 JAN 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 10





γsat = 121.6

		Δ1	Y2	X3	Avg.
SPECIMEN NO.		Δ1	Y2	X3	Avg.
INITIAL	WATER CONTENT, %	28.8	29.5	28.6	29.0
	DRY DENSITY, PCF	94.4	93.5	94.2	
	SATURATION, %	99.1	99.2	97.9	
	VOID RATIO	0.785	0.803	0.789	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		1.35	1.72	1.81	
TIME TO FAILURE, MIN.		15	8	10	
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.40	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

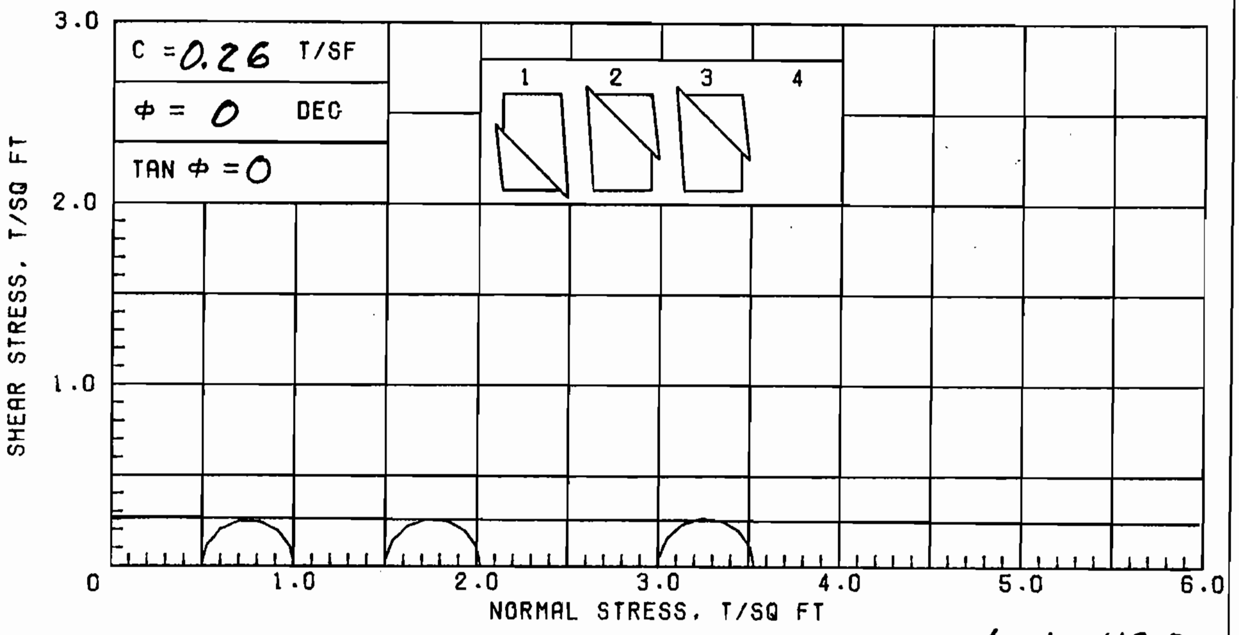
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), LIGHT BROWN; SLICKENSIDED

LL 68	PL 18	PI 50	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

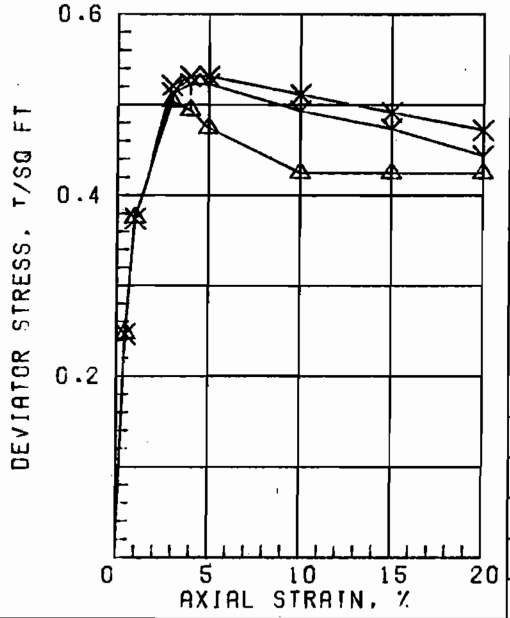
REMARKS:

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE
BORING NO. 13-ULC SAMPLE NO. 1-B
DEPTH/ELEV 1.0/+13.4 TECH. PJR
LABORATORY USAE WES DATE 07 JAN 83

TRIAXIAL COMPRESSION TEST REPORT



γsat = 113.0



SPECIMEN NO.		△1	Y2	X3	Avg
INITIAL	WATER CONTENT, %	41.9	39.2	39.7	40.3
	DRY DENSITY, PCF	78.5	81.5	81.1	
	SATURATION, %	98.6	99.0	99.5	
	VOID RATIO	1.148	1.069	1.078	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.50	0.52	0.53	
TIME TO FAILURE, MIN.		6	8	8	
RATE OF STRAIN INCR.%					
INITIAL DIAMETER, IN.		1.41	1.41	1.41	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SHELL PARTICLES; SILT POCKETS

LL 45	PL 16	PI 29	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

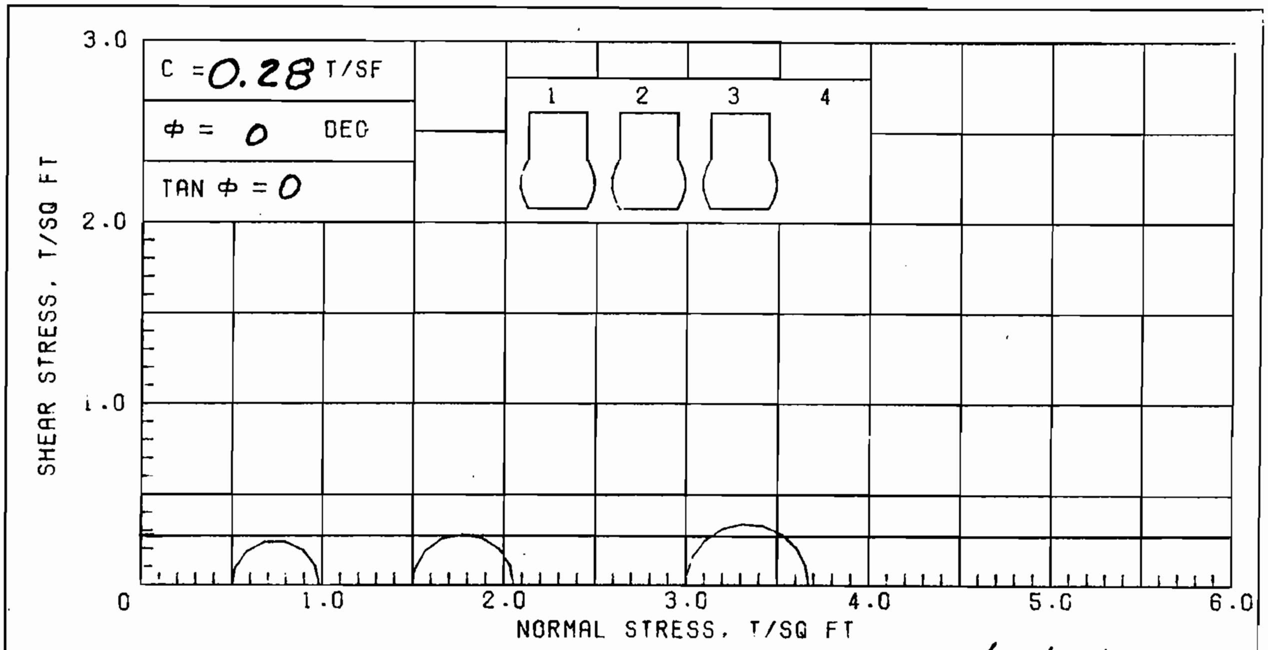
LIMITS ON MIXTURE OF MATERIAL.

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

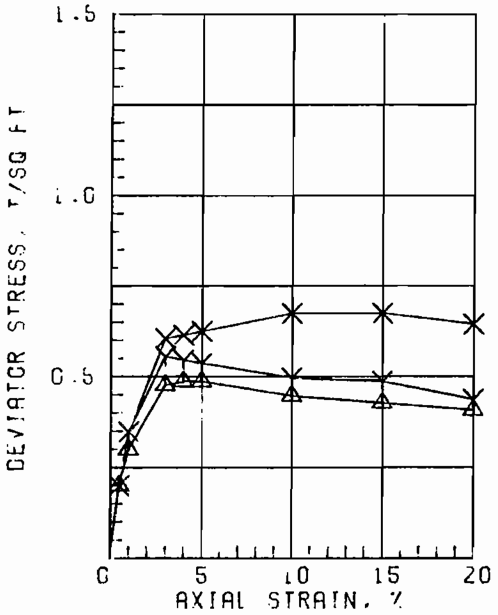
CITRUS LAKEFRONT LEVEE

BORING NO. 13-ULC	SAMPLE NO. 10-C
DEPTH/ELEV 36.9/-22.5	TECH. KOC
LABORATORY USAE WES	DATE 07 JAN 83

TRIAXIAL COMPRESSION TEST REPORT



γsat. = 107.4



		∆1	Y2	X3	4 Avg.
SPECIMEN NO.		∆1	Y2	X3	4 Avg.
INITIAL	WATER CONTENT, %	41.3	52.0	53.1	48.8
	DRY DENSITY, PCF	74.1	70.1	69.5	
	SATURATION, %	87.5	99.9	100+	
	VOID RATIO	1.274	1.405	1.424	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.48	0.55	0.67	
TIME TO FAILURE, MIN.		8	6	20	
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.41	1.41	1.41	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

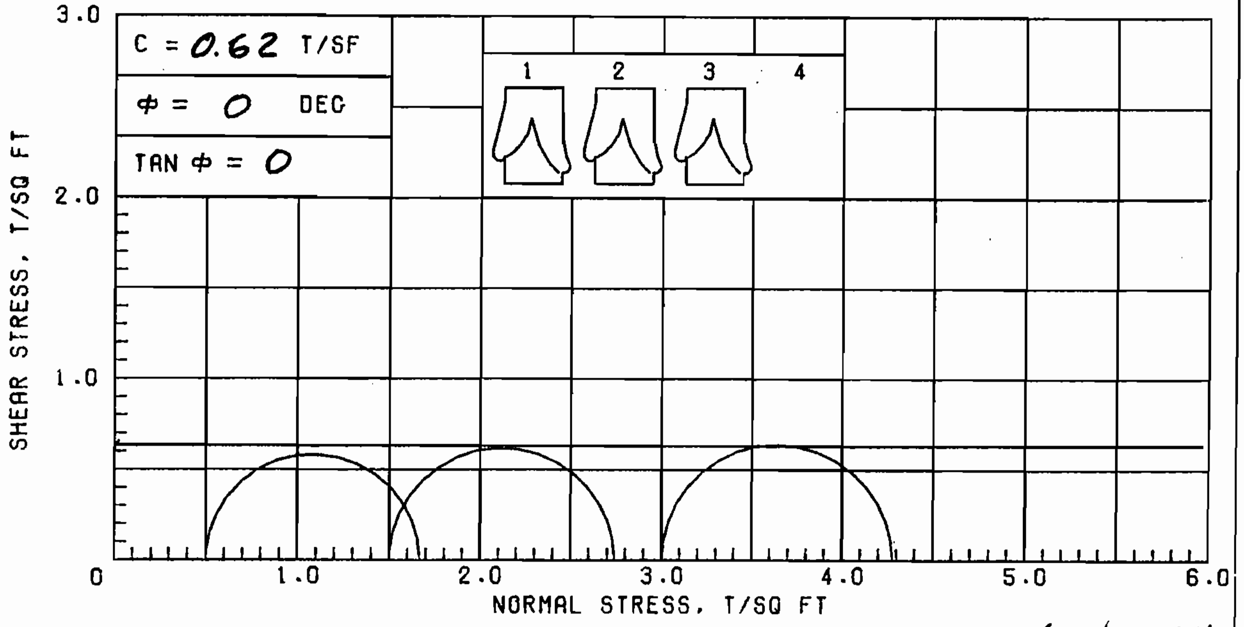
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT LENSES & POCKETS

LL 67	PL 19	PI 48	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
LIMITS ON MIXTURE OF MATERIAL.	CITRUS LAKEFRONT LEVEE

BORING NO. 13-ULC	SAMPLE NO. 11-C
DEPTH/ELEV 40.9/-26.5	TECH. KOC
LABORATORY USAE WES	DATE 07 JAN 83

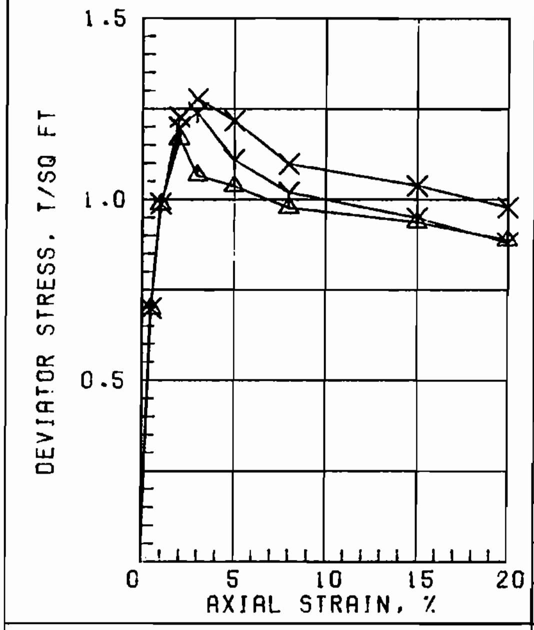
TRIAXIAL COMPRESSION TEST REPORT



C = 0.62 T/SF

Φ = 0 DEG

TAN Φ = 0



γsat=111.4

	SPECIMEN NO.	Δ1	Y2	X3	Avg.
INITIAL	WATER CONTENT, %	44.2	43.7	41.3	43.1
	DRY DENSITY, PCF	76.8	77.2	79.2	
	SATURATION, %	100.0	99.7	98.7	
	VOID RATIO	1.194	1.184	1.129	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		1.17	1.24	1.28	
TIME TO FAILURE, MIN.		5	11	13	
RATE OF STRAIN INCR,%		3			
INITIAL DIAMETER, IN.		1.40	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 61	PL 15	PI 46	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

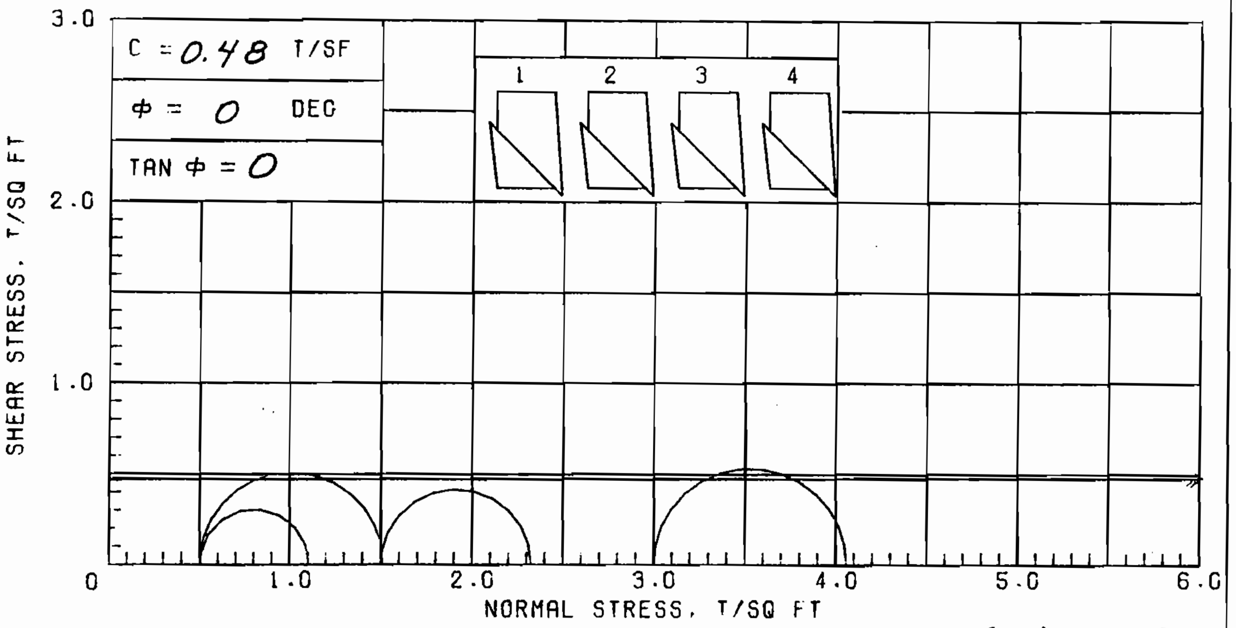
REMARKS:

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

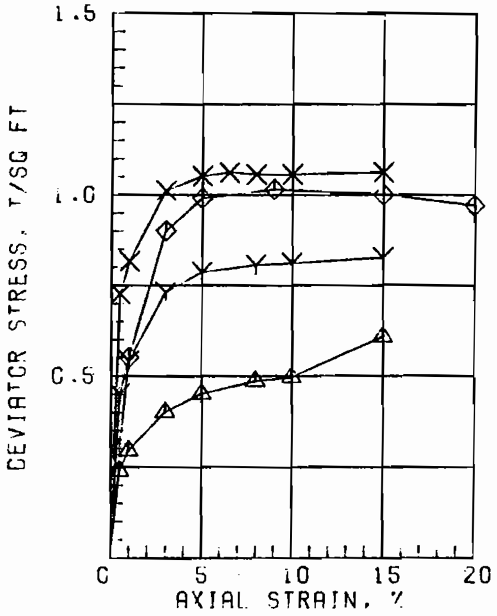
CITRUS LAKEFRONT LEVEE

BORING NO. 13-ULC
SAMPLE NO. 16-C
DEPTH/ELEV 60.9/-46.5
TECH. PJR
LABORATORY USAE WES
DATE 07 JAN 83

TRIAXIAL COMPRESSION TEST REPORT



γsat.=121.9



	SPECIMEN NO.	△1	Y2	X3	◇4	Avg.
INITIAL	WATER CONTENT, %	28.3	28.0	28.6	29.3	28.6
	DRY DENSITY, PCF	95.0	95.6	94.4	93.4	
	SATURATION, %	98.6	98.9	98.2	98.3	
	VOID RATIO	0.775	0.764	0.786	0.804	
BEFORE SHEAR	WATER CONTENT, %					
	DRY DENSITY, PCF					
	SATURATION, %					
	VOID RATIO					
	BACK PRESS., TSF					
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	0.5	
	MAX. DEV. STRESS, TSF	0.61	0.82	1.06	1.01	
	TIME TO FAILURE, MIN.	45	22	16	15	
	RATE OF STRAIN INCR,%					
	INITIAL DIAMETER, IN.	1.39	1.40	1.40	1.40	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY

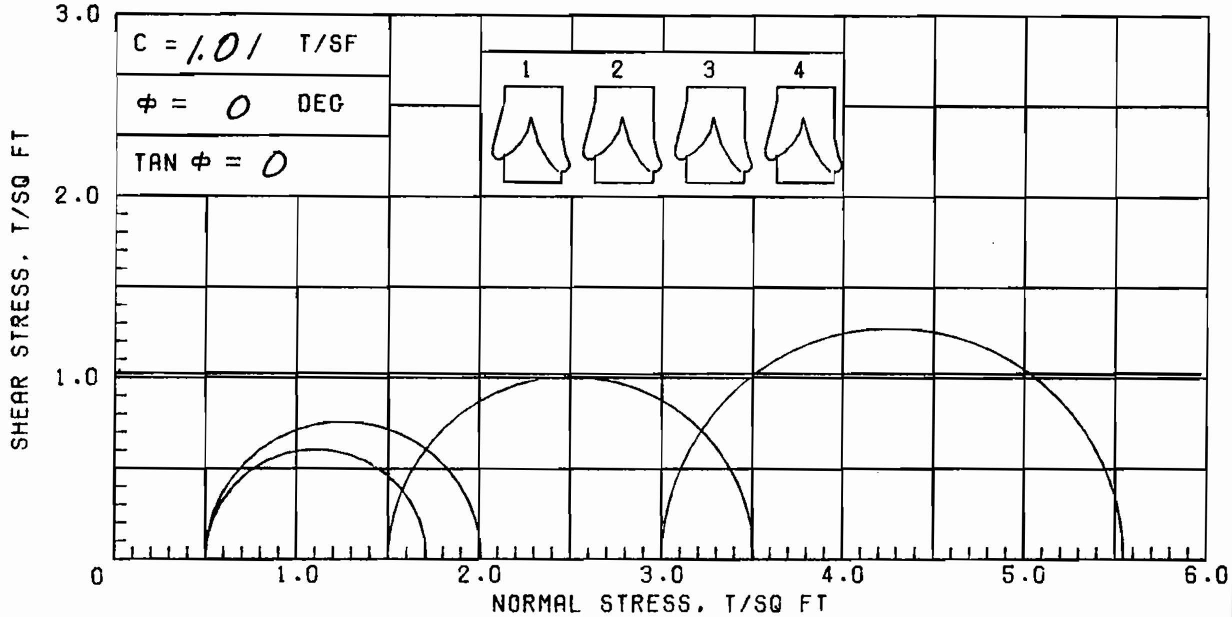
LL 48	PL 13	PI 35	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 13-ULC	SAMPLE NO. 17-B
DEPTH/ELEV 64.0/-49.6	TECH. RCH
LABORATORY USAE WES	DATE 07 JAN 83

TRIAXIAL COMPRESSION TEST REPORT

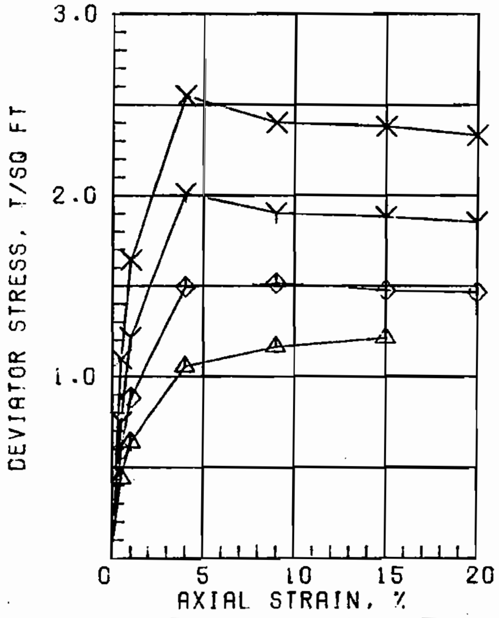


C = 1.01 T/SF

Φ = 0 DEG

TAN Φ = 0

γsat = 122.2



	SPECIMEN NO.	△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	30.3	28.0	27.1	26.9
	DRY DENSITY, PCF	92.6	94.2	95.0	95.3
	SATURATION, %	99.7	95.7	94.5	94.4
	VOID RATIO	0.821	0.790	0.774	0.769
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	0.5
	MAX. DEV. STRESS, TSF	1.21	2.01	2.55	1.51
	TIME TO FAILURE, MIN.	46	12	12	18
	RATE OF STRAIN INCR,%			9	
	INITIAL DIAMETER, IN.	1.41	1.40	1.40	1.41
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	3.00

Avg. 27.3

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY; SILT LENSES

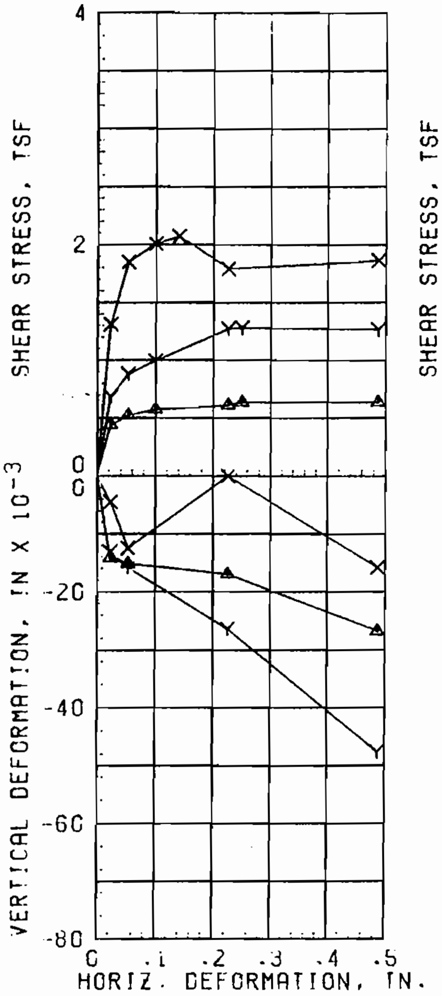
LL 53	PL 14	PI 39	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

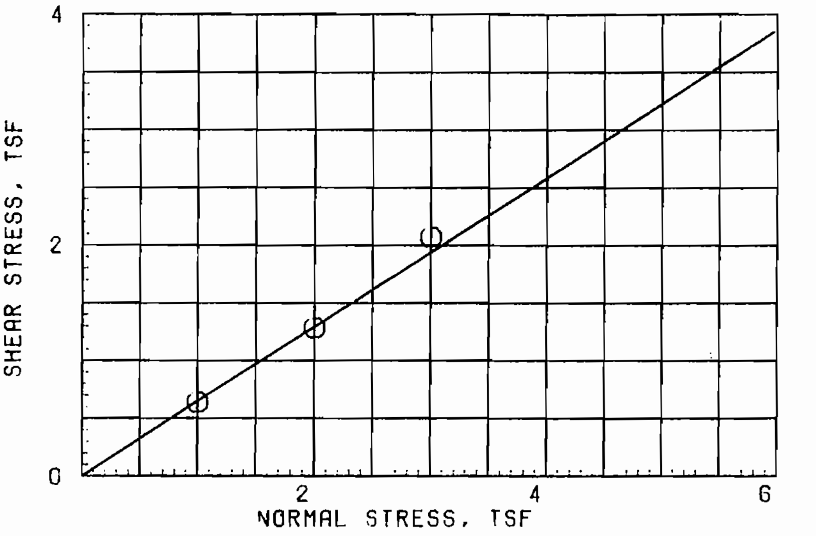
REMARKS;

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 13-ULC	SAMPLE NO. 20-C
DEPTH/ELEV 76.9/-62.5	TECH. PJR
LABORATORY USAE WES	DATE 07 JAN 83

TRIAXIAL COMPRESSION TEST REPORT





$\gamma sat. = 122.9$

	TEST NO.	1 △	2 Y	3 X	Avg.
INITAL	WATER CONTENT, %	20.7	20.8	20.6	20.7
	VOID RATIO	0.708	0.731	0.721	
	SATURATION, %	77.9	76.1	76.4	
	DRY DENSITY, PCF	97.5	96.2	96.8	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	23.7	23.5	23.5	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF		0.64	1.28	2.07	
TIME TO FAILURE, MIN		1416	1416	793	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF					

$\phi = 32°$

TAN $\phi = 0.633$

C = 0

TYPE SPECIMEN UNDISTURBED | 3.00 IN. SQUARE | 0.584 IN. THICK

CLASSIFICATION SILTY SAND (SM), GRAY

LL | PL | PI | | GS 2.67 (EST)

REMARKS:

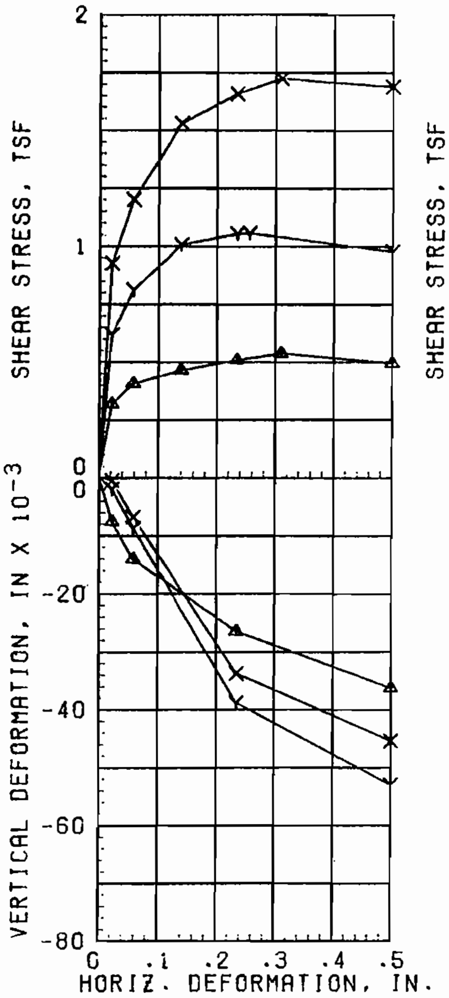
PROJECT LK. PONT. LA. & VIC. - HURR. PROT.

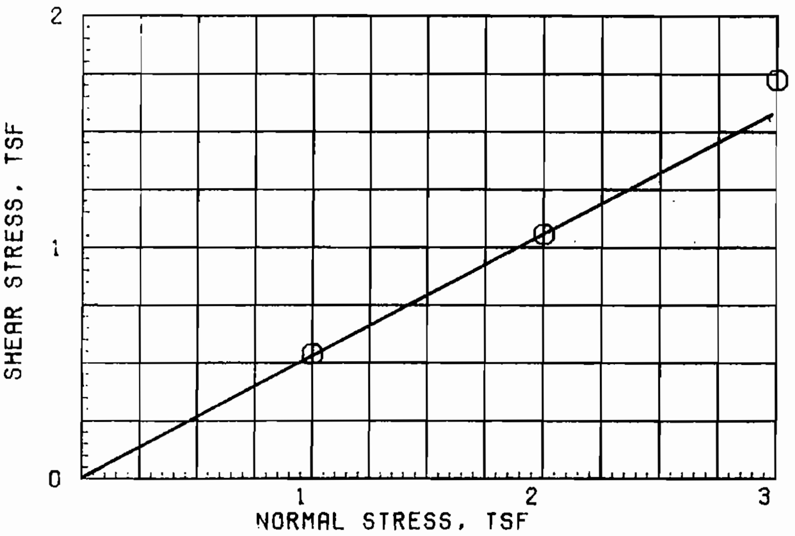
CITRUS LAKEFRONT LEVEE

BORING NO. 13-ULC | SAMPLE 5-B

DEPTH/ELEV 16.5/-2.1 | DATE 04 JAN 83

DIRECT SHEAR TEST REPORT





φ = 28°

TAN φ = 0.533

C = 0

$\gamma_{sat.} = 114.0$

	TEST NO.	1 ▲	2 Y	3 X	Avg.
INITAL	WATER CONTENT, %	42.2	38.5	37.4	39.4
	VOID RATIO	1.108	1.072	1.023	
	SATURATION, %	100 +	96.9	98.7	
	DRY DENSITY, PCF	79.9	81.3	83.3	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		2	4	2	
FINAL	WATER CONTENT, %	31.1	26.8	22.4	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF		0.54	1.06	1.72	
TIME TO FAILURE, MIN		1704	1407	1704	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF					

TYPE SPECIMEN UNDISTURBED | 3.00 IN. SQUARE | 0.553 IN. THICK

CLASSIFICATION CLAY (CL), GRAY; SHELL PARTICLES

LL 40 | PL 13 | PI 27 | GS 2.70 (EST)

REMARKS;

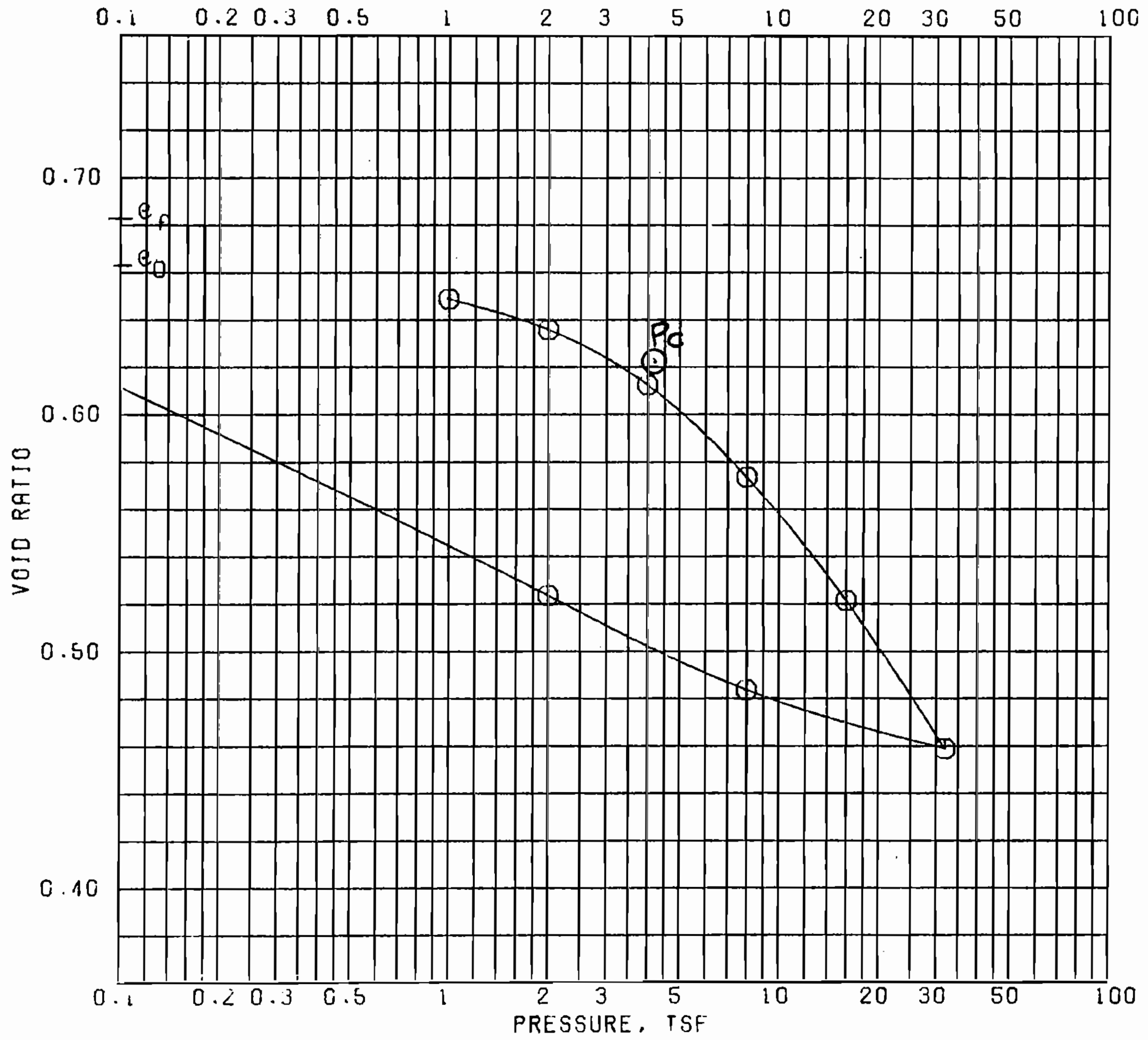
PROJECT LK. PONT. LA. & VIC. - HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 13-ULC | SAMPLE 10-B

DEPTH/ELEV 36.5/-22.1 | DATE 05 JAN 83

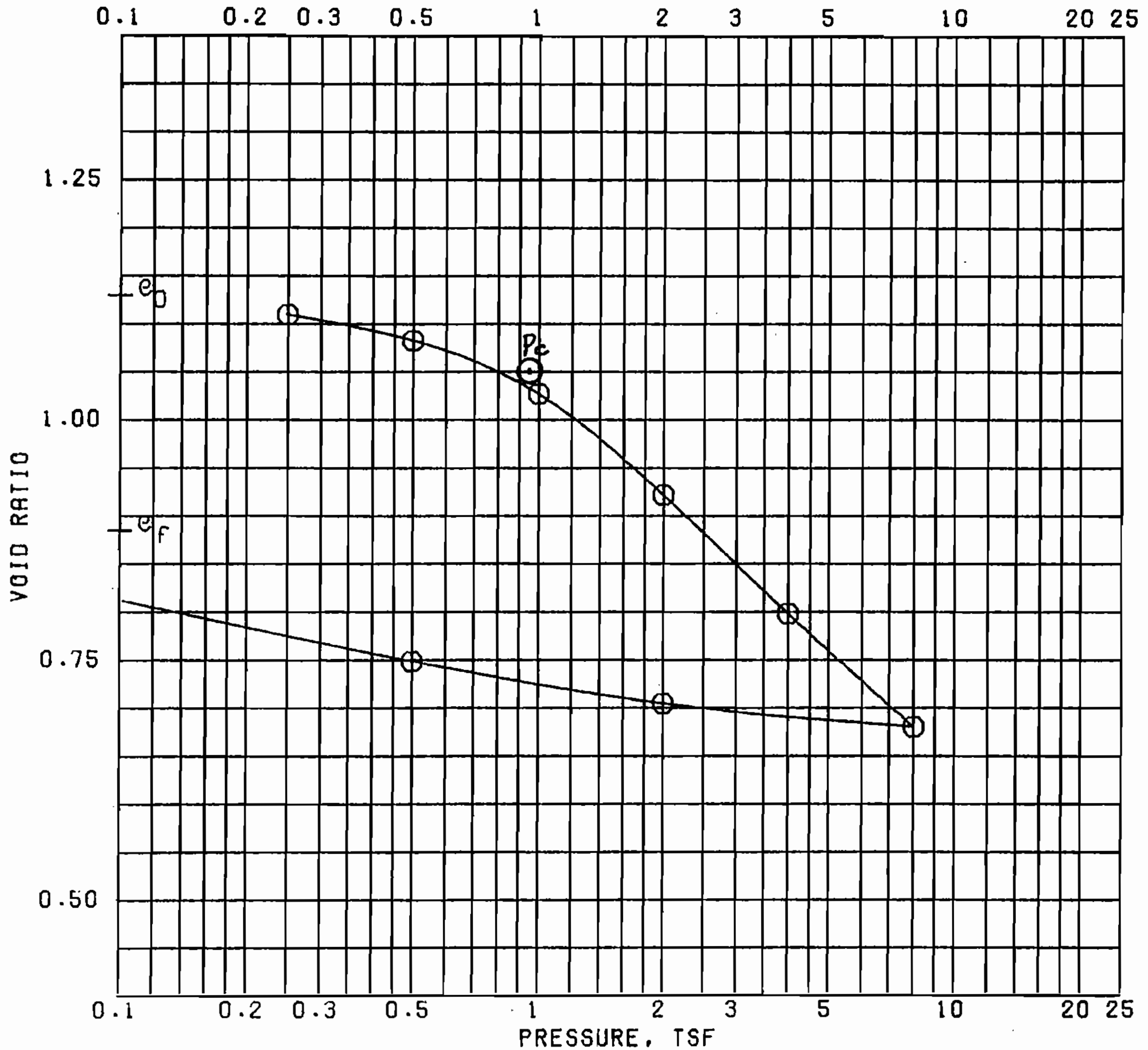
DIRECT SHEAR TEST REPORT



γ sat = 126.3

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	22.2	25.0
PRECONSOL. PRESSURE, TSF	4.2	DRY DENSITY, PCF	101.4	100.2
COMPRESSION INDEX	0.173	SATURATION, %	90.5	98.8
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.663	0.682
DIA. IN 4.44	HT. IN 1.115	BACK PRESSURE, TSF		
CLASSIFICATION SILTY CLAY (CL), GRAY & BROWN MOTTLED				
LL	PL	PI	PROJECT LK. PONT. LA. & VIC. - HURR. PROT.	
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE	
REMARKS		BORING NO. 13-ULC	SAMPLE NO. 1-B	
		DEPTH/ELEV 1.5/+12.9	DATE 13 JAN 83	

CONSOLIDATION TEST REPORT



γ sat. = 112.3

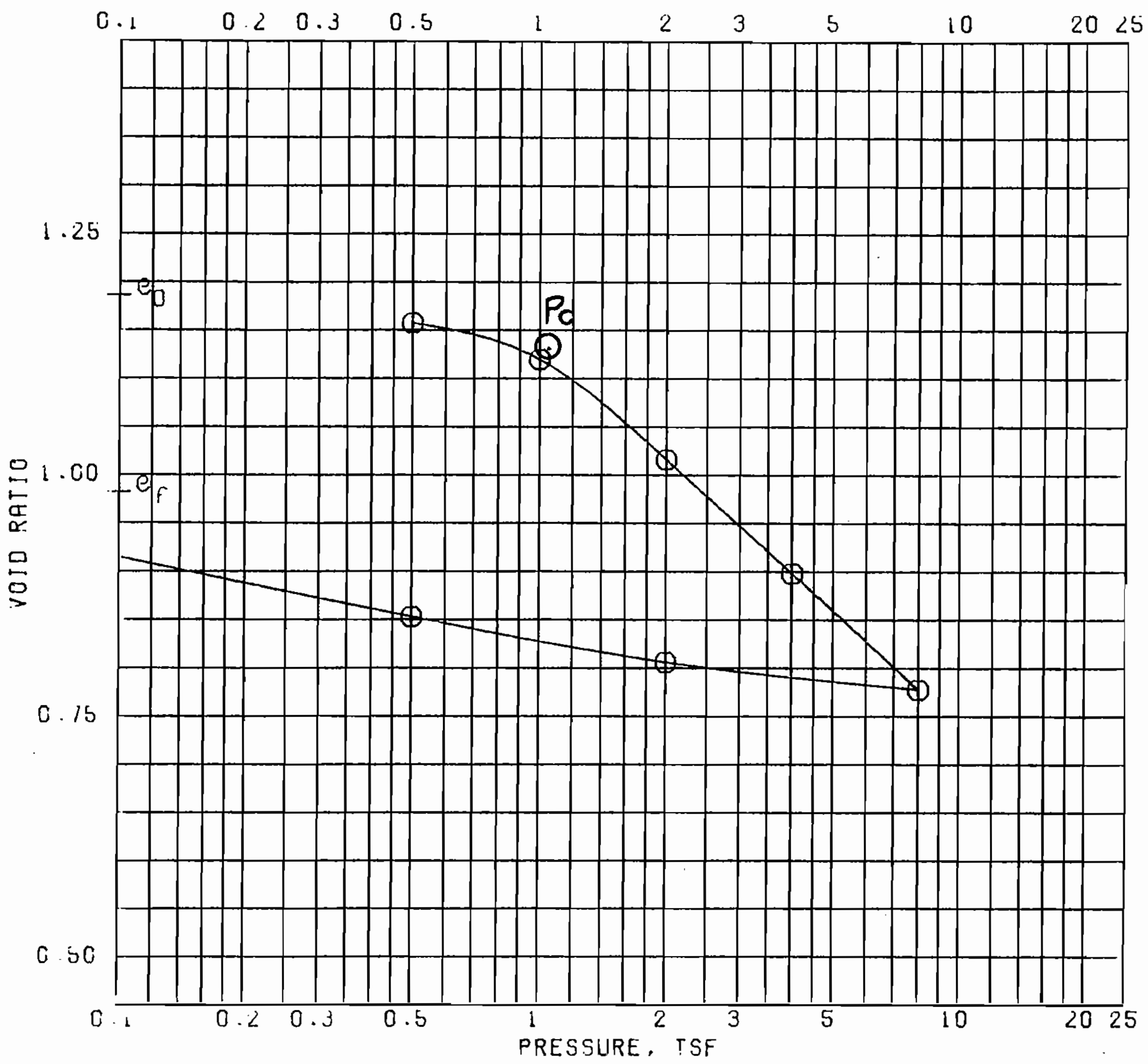
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	39.9	33.6
PRECONSOL. PRESSURE, TSF	0.93	DRY DENSITY, PCF	79.2	89.5
COMPRESSION INDEX	0.79	SATURATION, %	95.4	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.128	0.883
DIA. IN 4.44	HT. IN 1.127	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY; SILT LENSES; SHELL PARTICLES

LL	PL	PI	PROJECT LK. PONT. LA & VIC. - HURR. PROT.	
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE	
REMARKS			BORING NO. 13-ULC	SAMPLE NO. 10-C
			DEPTH/ELEV 37.4/-23.0	DATE 14 JAN 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 10



$\gamma_{sat.} = 111.1$

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	42.1	35.7
PRECONSOL. PRESSURE, TSF	1.03	DRY DENSITY, PCF	77.2	85.1
COMPRESSION INDEX	0.80	SATURATION, %	96.0	98.4
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.185	0.980
DIA. IN 4.44	HT. IN 1.138	BACK PRESSURE, TSF		

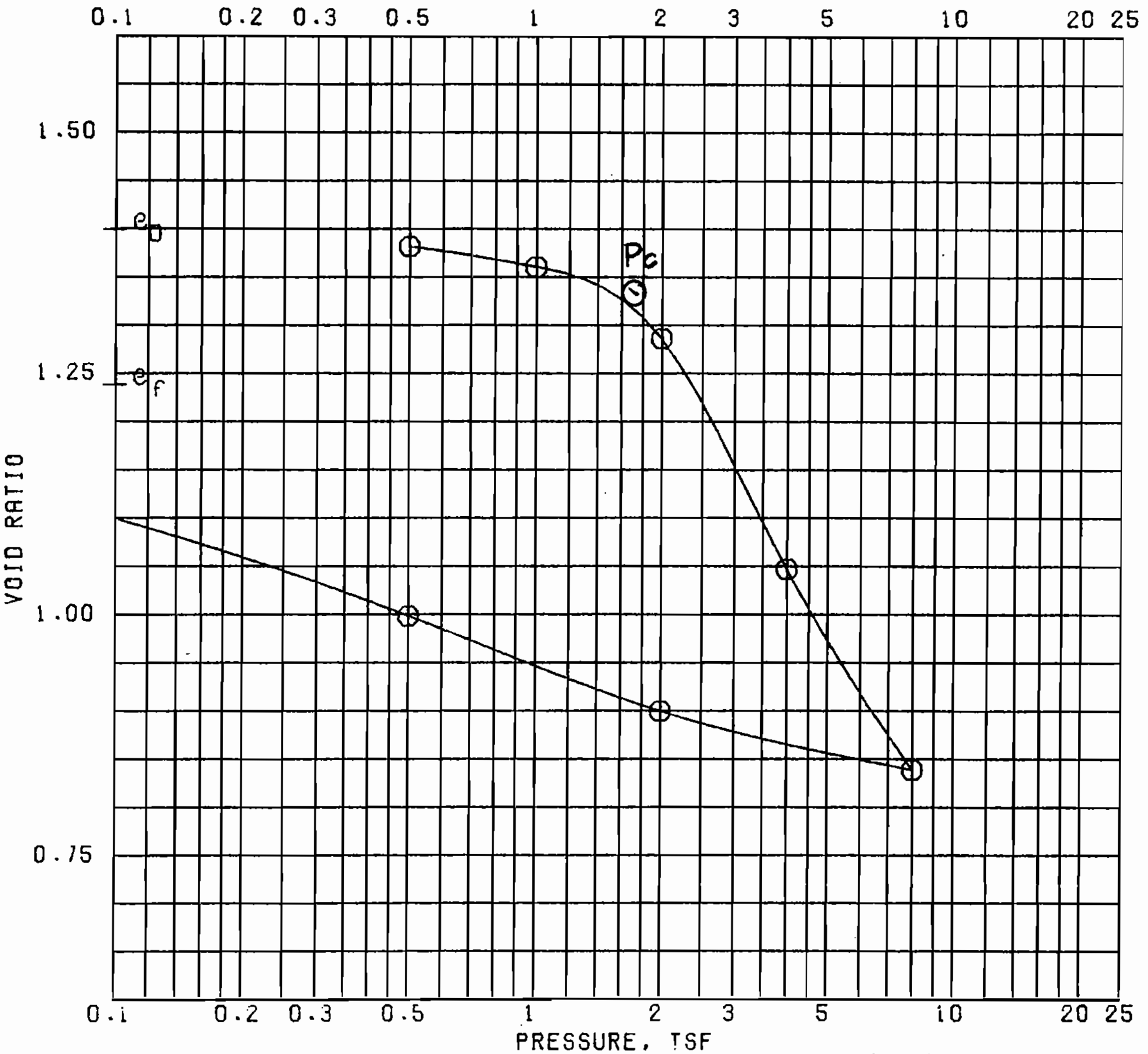
CLASSIFICATION PLASTIC CLAY (CH), GRAY; FINE SAND POCKETS

LL	PL	PI	PROJECT LK. PONT. LA. & VIC. - HURR. PROT.
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE

REMARKS	BORING NO. 13-ULC	SAMPLE NO. 11-C
	DEPTH/ELEV 41.4/-27.0	DATE 14 JAN 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 10

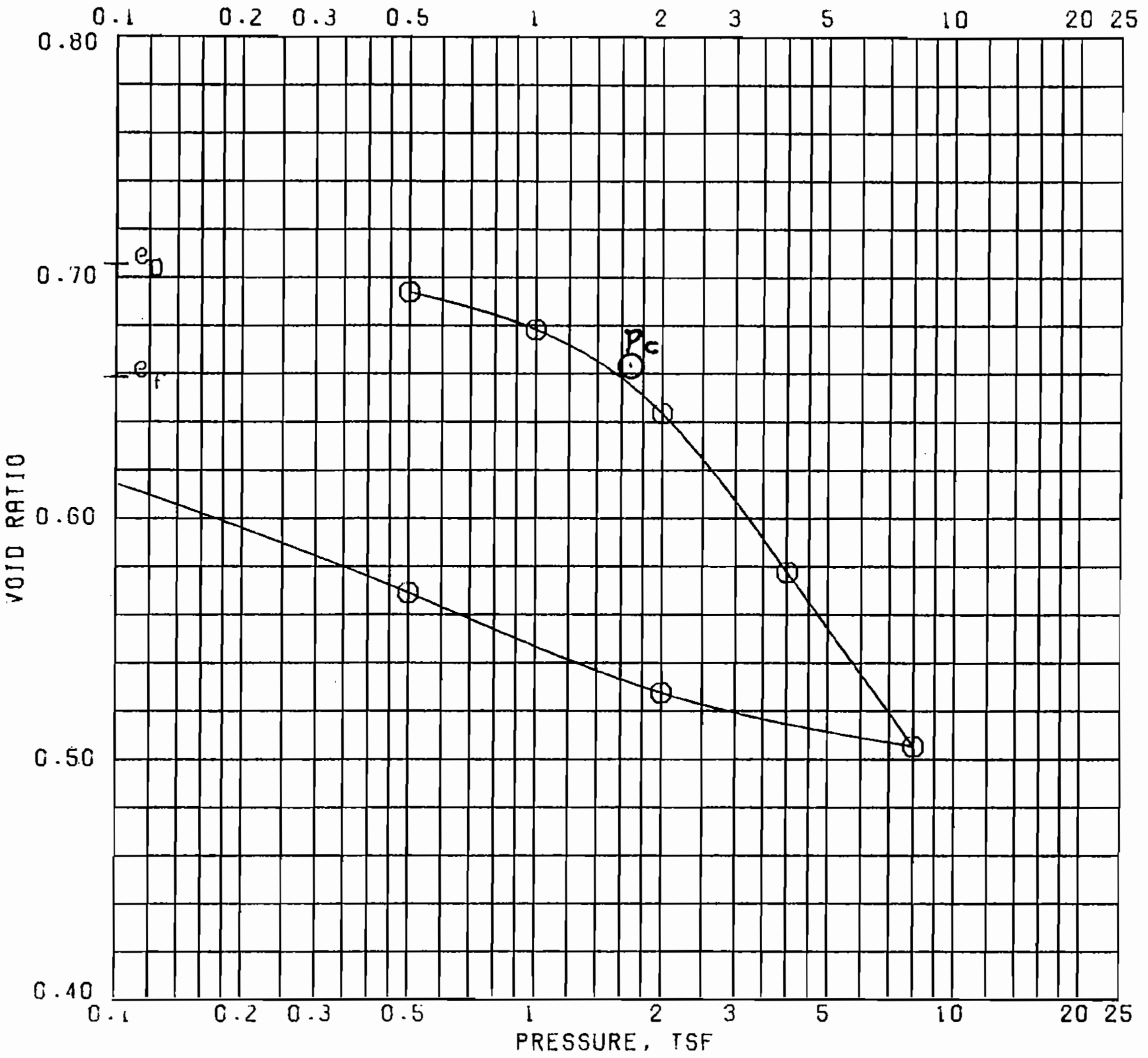


$\gamma_{sat} = 106.7$

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	51.1	45.9
PRECONSOL. PRESSURE, TSF	1.75	DRY DENSITY, PCF	70.3	75.4
COMPRESSION INDEX	0.76	SATURATION, %	98.7	100 +
TYPE SPECIMEN UNDISTURBED		VOID RATIO	1.398	1.236
DIA. IN 4.44	HT. IN 1.132	BACK PRESSURE, TSF		
CLASSIFICATION PLASTIC CLAY (CH), GRAY				
LL	PL	PI	PROJECT LK. PONT. LA. & VIC. - HURR. PROT.	
GS 2.70 (EST)	D_{10}	CITRUS LAKEFRONT LEVEE		
REMARKS		BORING NO. 13-ULC	SAMPLE NO. 16-B	
		DEPTH/ELEV 60.0/-45.6	DATE 14 JAN 83	

CONSOLIDATION TEST REPORT

SHEET 1 OF 10

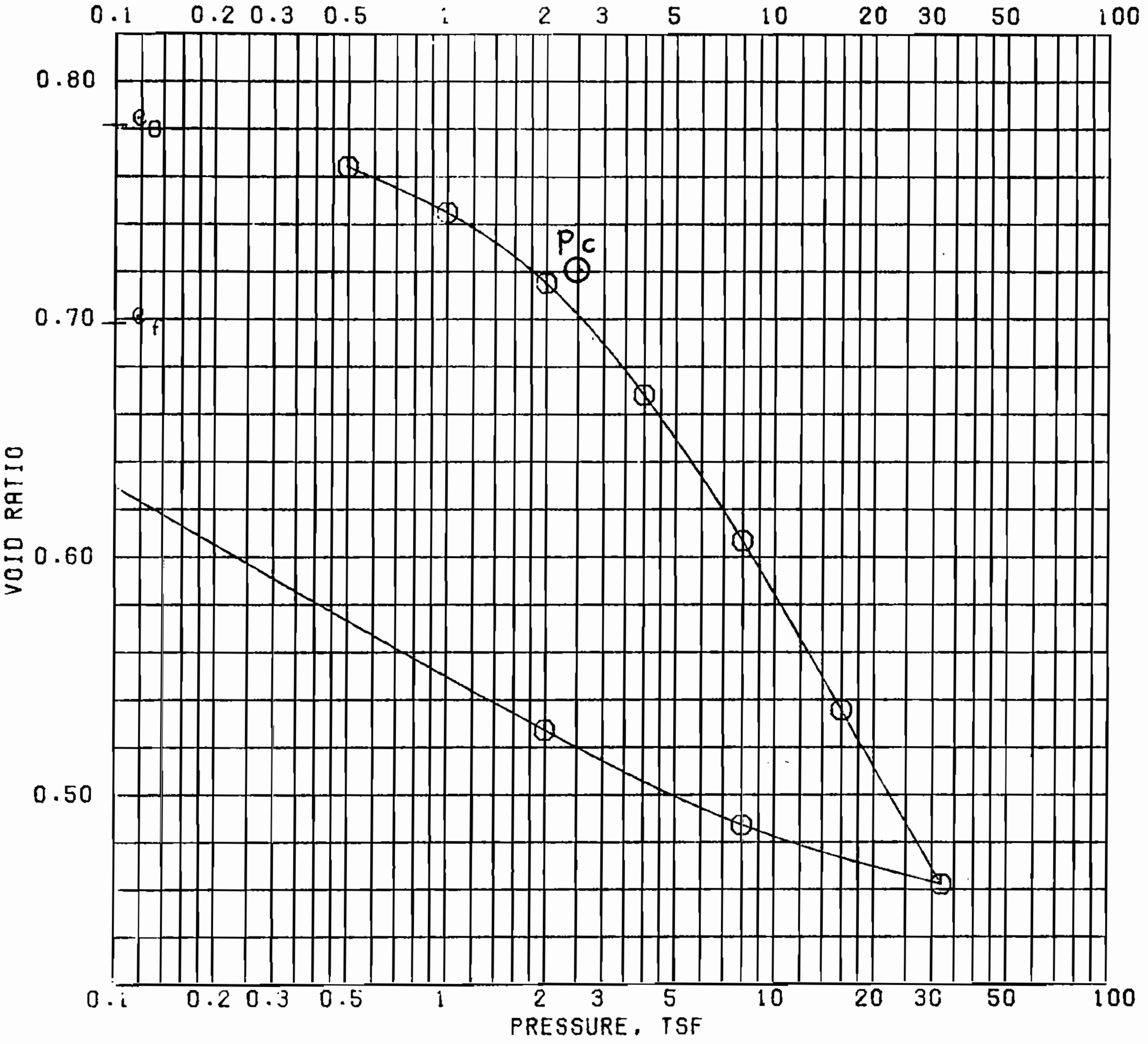


$\gamma_{sat} = 124.7$

				BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF			WATER CONTENT, %	24.6	24.6
PRECONSOL. PRESSURE, TSF		1.68	DRY DENSITY, PCF	98.9	101.7
COMPRESSION INDEX		0.22	SATURATION, %	94.3	100 +
TYPE SPECIMEN	UNDISTURBED		VOID RATIO	0.705	0.658
DIA. IN 4.44	HT. IN 1.125		BACK PRESSURE, TSF		
CLASSIFICATION PLASTIC CLAY (CH), GRAY; FINE SAND POCKETS					
LL	PL	PI	PROJECT LK. PONT. LA. & VIC - HURR. PROT.		
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE		
REMARKS			BORING NO. 13-ULC		SAMPLE NO. 17-B
			DEPTH/ELEV 64.5/-50.0		DATE 18 JAN 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 10



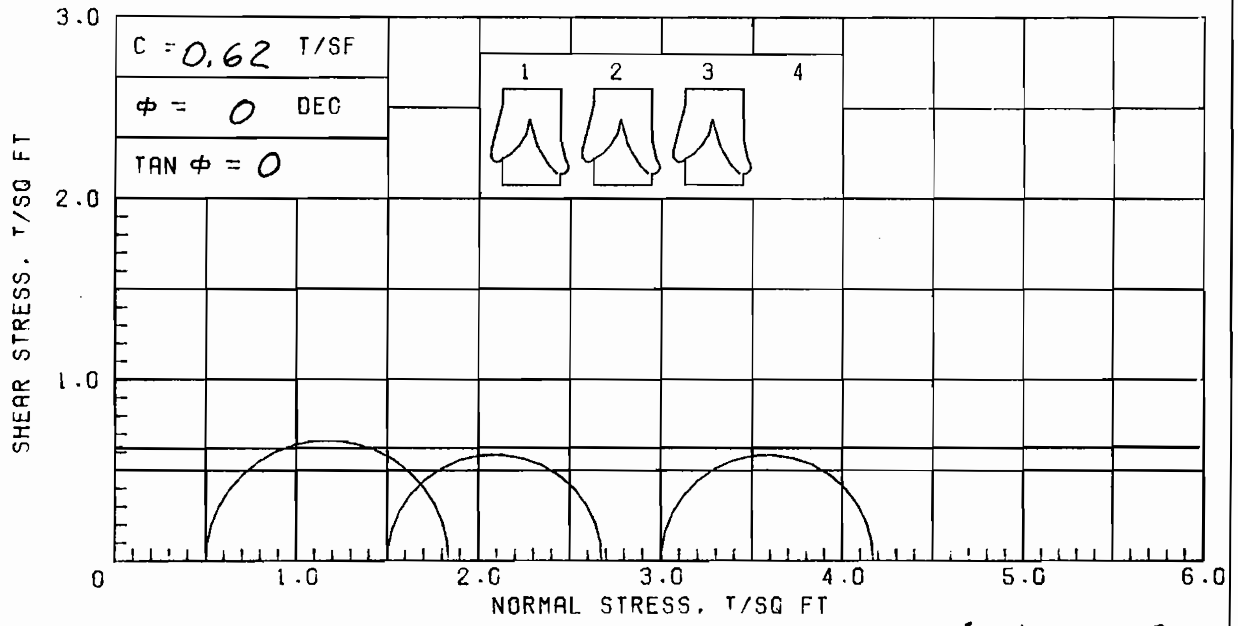
$\gamma sat. = 122.1$

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	24.2	24.7
PRECONSOL. PRESSURE, TSF	2.5	DRY DENSITY, PCF	94.7	99.3
COMPRESSION INDEX	0.23	SATURATION, %	83.5	95.7
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.781	0.697
DIA. IN 4.44	HT. IN 1.140	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), LIGHT GRAY; SILT POCKETS

LL	PL	PI	PROJECT LK. PONT. LA. & VIC - HURR. PROT.
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE
REMARKS			BORING NO. 13-ULC SAMPLE NO. 20-C
			DEPTH/ELEV 77.4/-63.0 DATE 18 JAN 83

CONSOLIDATION TEST REPORT

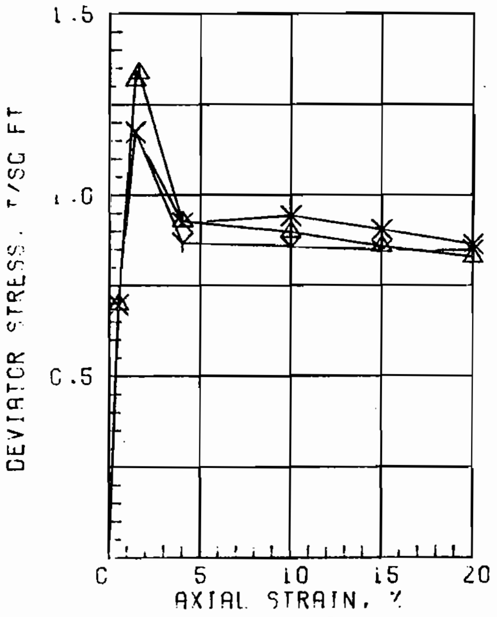


C = 0.62 T/SF

ϕ = 0 DEG

TAN ϕ = 0

γsat. = 103.8



	SPECIMEN NO.	Δ1	Y2	X3	4 AVG.
INITIAL	WATER CONTENT, %	59.3	58.8	55.3	67.8
	DRY DENSITY, PCF	64.8	65.0	67.3	
	SATURATION, %	99.9	99.7	99.3	
	VOID RATIO	1.603	1.592	1.503	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	1.34	1.18	1.17	
	TIME TO FAILURE, MIN.	5	13	14	
	RATE OF STRAIN INCR.,%		5	4	
	INITIAL DIAMETER, IN.	1.40	1.40	1.40	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY

LL 65 | PL 20 | PI 45 | GS 2.70 (ESTIMATED) | UNDISTURBED SPECIMEN | Q TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 14-ULC

SAMPLE NO. 12-B

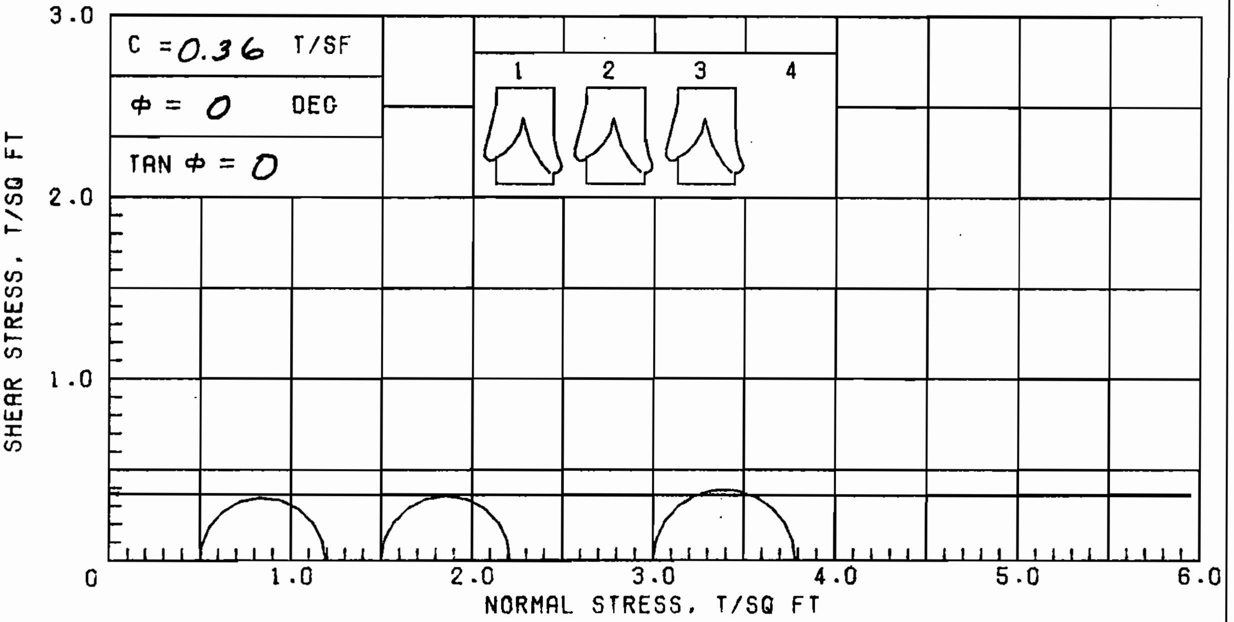
DEPTH/ELEV 44.1/-40.5

TECH. PJR

LABORATORY USAE WES

DATE 17 JAN 83

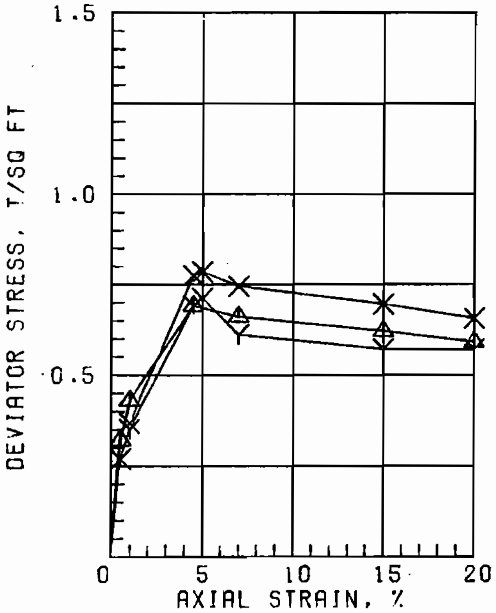
TRIAXIAL COMPRESSION TEST REPORT



C = 0.36 T/SF

Φ = 0 DEG

TAN Φ = 0



γ sat. = 107.4

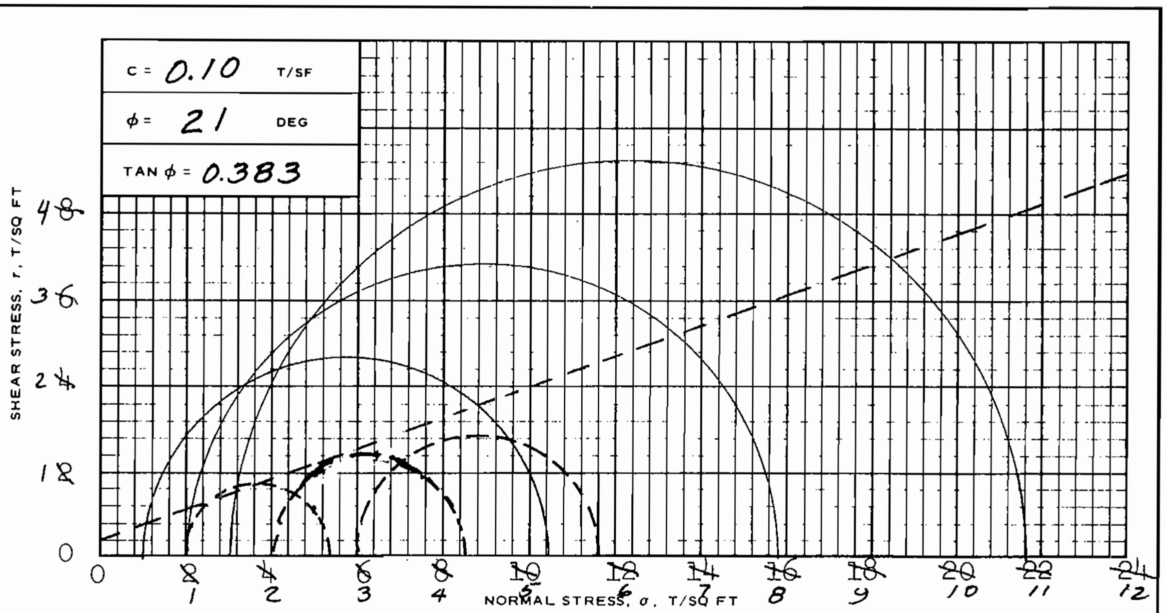
SPECIMEN NO.		△1	Y2	X3	4 Avg.
INITIAL	WATER CONTENT, %	53.9	52.2	45.6	50.6
	DRY DENSITY, PCF	68.9	69.9	75.3	
	SATURATION, %	100+	99.9	99.5	
	VOID RATIO	1.447	1.410	1.238	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.69	0.71	0.78	
TIME TO FAILURE, MIN.		14	15	15	
RATE OF STRAIN INCR.,%					
INITIAL DIAMETER, IN.		1.40	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY

LL 66	PL 17	PI 49	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

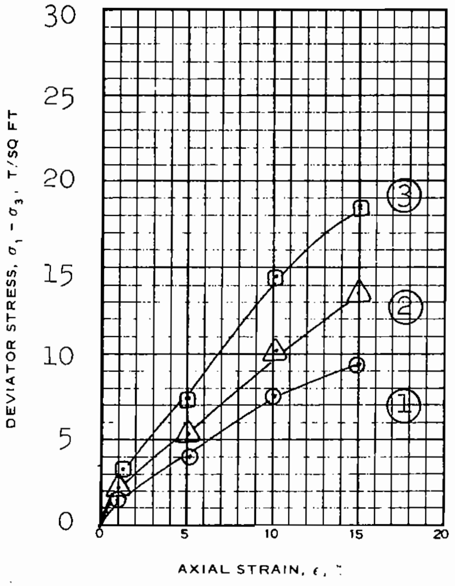
REMARKS:	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.	
	CITRUS LAKEFRONT LEVEE	
	BORING NO. 14-ULC	SAMPLE NO. 13-B
	DEPTH/ELEV 47.9/-44.3	TECH. PJR
	LABORATORY USAE WES	DATE 18 JAN 83
	TRIAXIAL COMPRESSION TEST REPORT	


c = 0.10 T/SF

φ = 21 DEG

TAN φ = 0.383

γsat = 116.6



SPECIMEN NO.			1	2	3	Avg.
INITIAL	WATER CONTENT, %	w_0	32.7	32.1	32.2	32.3
	DRY DENSITY LB/CU FT	γ_{d_0}	86.4	86.0	86.8	
	SATURATION, %	S_0	93.6	91.1	93.0	
	VOID RATIO	e_0	0.936	0.945	0.928	
BEFORE SHEAR	WATER CONTENT, %	w_c	34.5	33.0	32.2	
	DRY DENSITY LB/CU FT	γ_{d_c}	91.1	90.7	88.8	
	SATURATION, %	S_c	100+	100+	97.7*	
	VOID RATIO	e_c	0.837	0.844	0.883	
	FINAL BACK PRESSURE, T/SQ FT	u_0	4.32	4.32	4.32	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	9.49	13.74	18.68	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	536	536	536	
$(\sigma_1 - \sigma_3)$ AT MAX PORE PRESSURE			1.7	2.3	2.8	
INITIAL DIAMETER, IN.		D_0	1.39	1.39	1.39	
INITIAL HEIGHT, IN.		H_0	3.00	3.00	3.00	

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS SILT (ML), GRAY

LL NP | PL NP | PI NP | Gs 2.68(EST) | TYPE OF SPECIMEN UNDISTURBED | TYPE OF TEST $\overline{R}$

REMARKS: *PORE PRESSURE RESPONSE INDICATED 100% SATURATION

PROJECT LK. PONT. LA. & VIC. - HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 14-ULC

SAMPLE NO. 2-B

DEPTH/ELEV 4.9/-1.3

LABORATORY USAEWES

DATE 31 JAN 1983

SHEET 1 OF 2

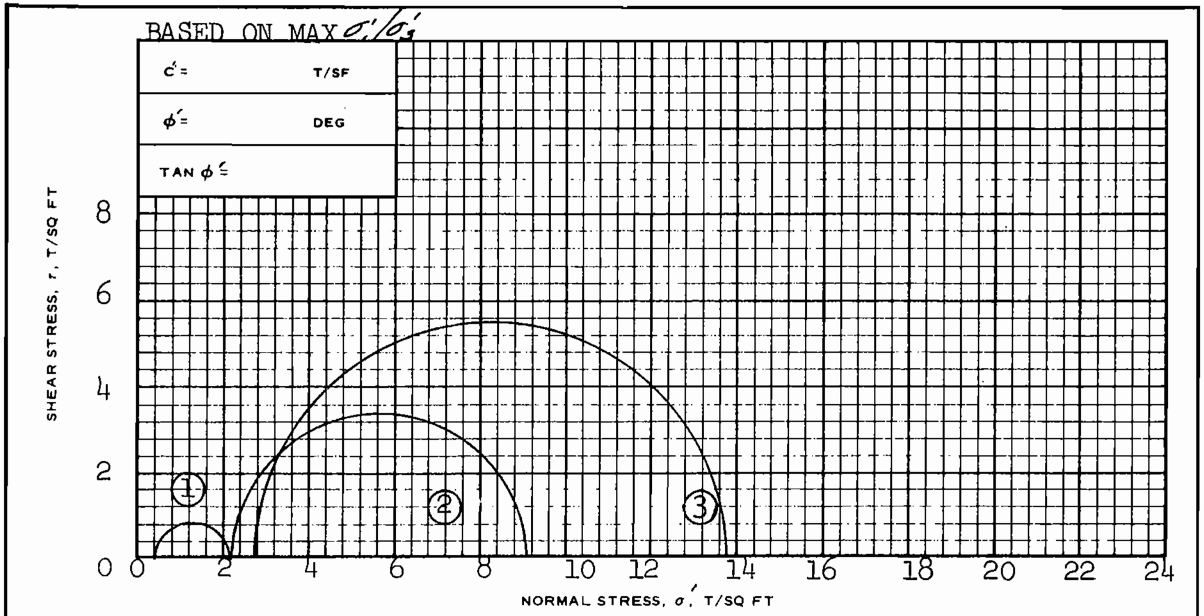
TES **TRIAXIAL COMPRESSION TEST REPORT**

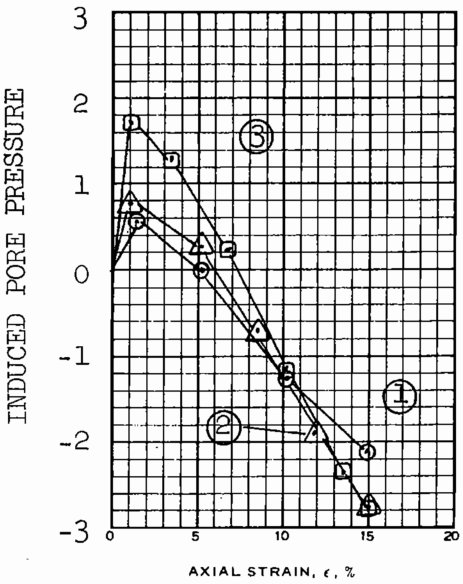
ENG FORM NO. 2089
REV JUNE 1970

GPO : 1982 0 - 375-356

BASED ON MAX σ_1'/σ_3'

c' =	T/SF
ϕ' =	DEG
TAN ϕ' =	





			1	2	3	
SPECIMEN NO.			1	2	3	
INITIAL	WATER CONTENT, %	w_o				
	DRY DENSITY LB/ CU FT	γd_o				
	SATURATION, %	S_o				
	VOID RATIO	e_o				
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.42	2.22	2.78	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	1.74	6.85	10.97	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f				
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o				
INITIAL HEIGHT, IN.		H_o				

CONTROLLED- TEST

DESCRIPTION OF SPECIMENS

LL
PL
PI
Gs

TYPE OF SPECIMEN

TYPE OF TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC. - HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 14-ULC

SAMPLE NO. 2-B

DEPTH/ELEV 4.9/-1.3

LABORATORY USAEWES

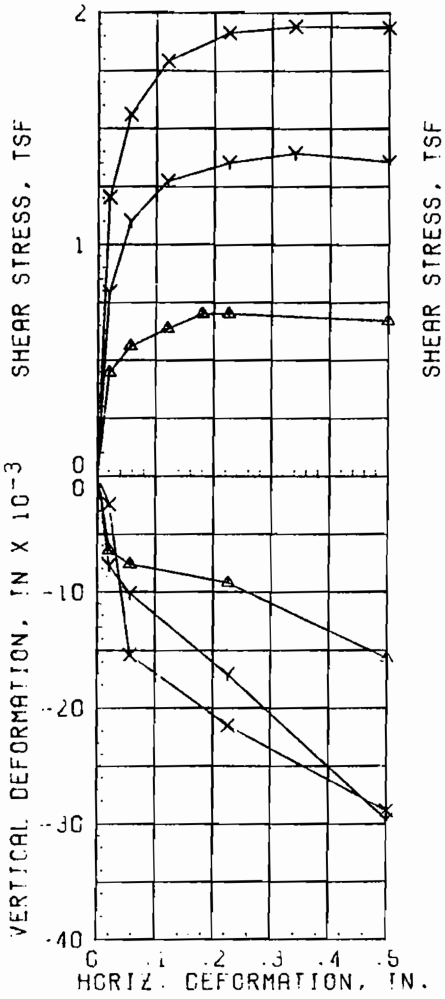
DATE 31 JAN 1983

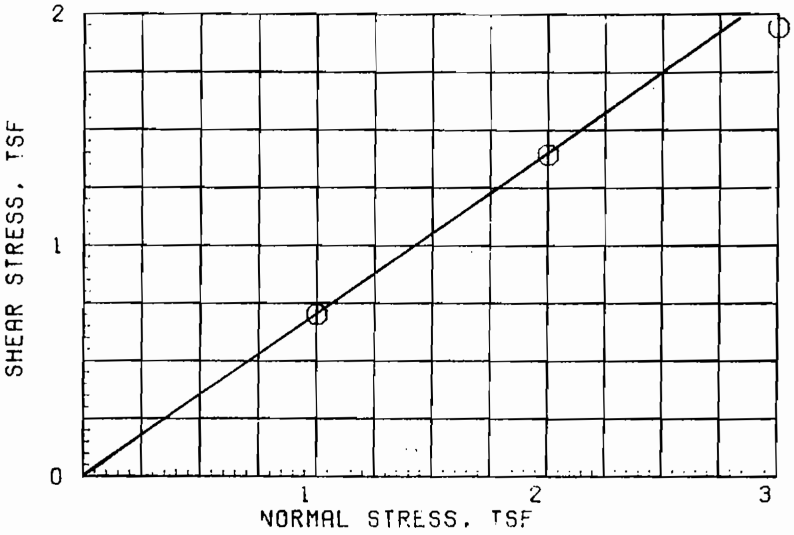
SHEET 2 OF 2

TES **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089
REV JUNE 1970

GPO : 1982 O - 375-356





ɸ = 35°

TAN ɸ = 0.702

C = 0

γsat.= 121.0

	TEST NO.	1 △	2 Y	3 ×	Avg.
INITAL	WATER CONTENT, %	28.7	30.8	35.2	31.6
	VOID RATIO	0.769	0.812	0.855	
	SATURATION, %	99.7	100 +	100 +	
	DRY DENSITY, PCF	94.2	92.0	89.8	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	24.3	23.4	22.8	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF		0.70	1.39	1.94	
TIME TO FAILURE, MIN		968	1829	1829	
RATE OF STRAIN, IN/MIN		.00019	.00019	.00019	
ULTIMATE SHEAR STRESS, TSF					

TYPE SPECIMEN UNDISTURBED	3.00 IN. SQUARE	0.584 IN. THICK

CLASSIFICATION SILTY SAND (SM), GRAY

LL	PL	PI		GS 2.67 (EST)

REMARKS:

PROJECT LK. PONT. LA. & VIC. - HURR. PROT.

CITRUS LAKEFRONT LEVEE

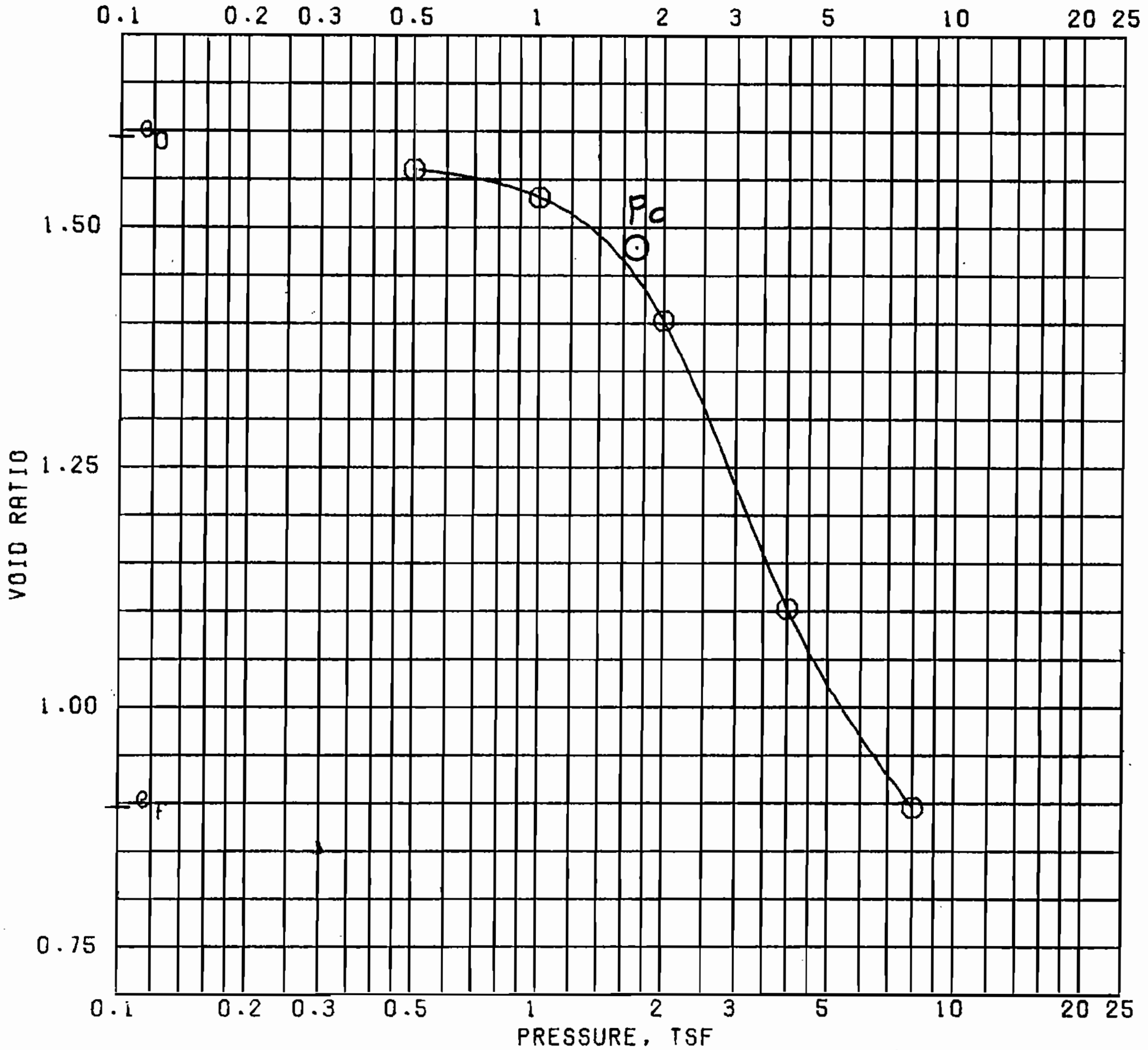
BORING NO. 14-ULC

SAMPLE 5-B

DEPTH/ELEV 16.7/-13.1

DATE 20 JAN 83

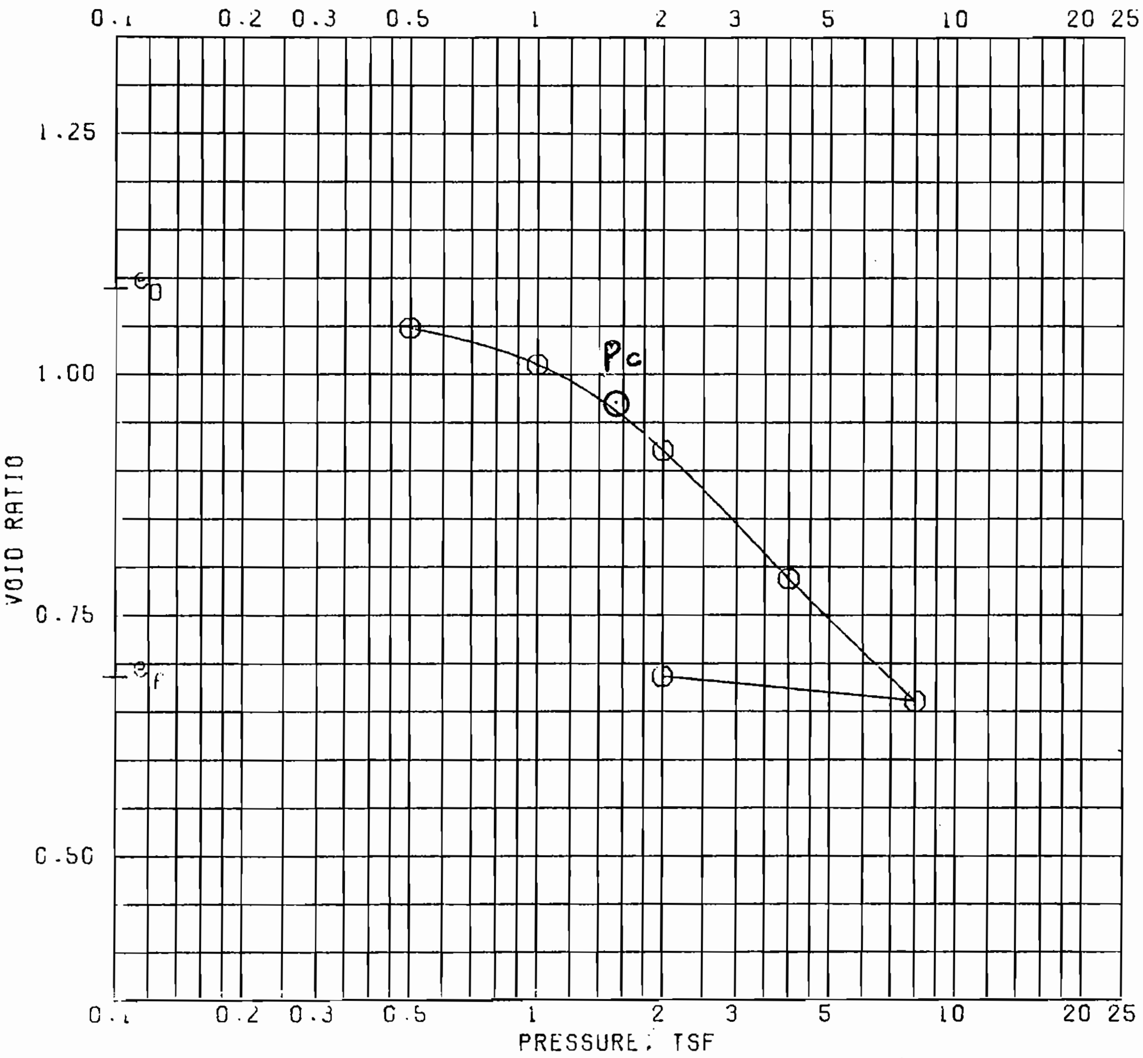
DIRECT SHEAR TEST REPORT



γsat. = 103.3

				BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF			WATER CONTENT, %	57.1	33.7
PRECONSOL. PRESSURE, TSF	1.7		DRY DENSITY, PCF	65.0	89.0
COMPRESSION INDEX	1.0		SATURATION, %	96.8	100 +
TYPE SPECIMEN	UNDISTURBED		VOID RATIO	1.591	0.894
DIA. IN 4.44	HT. IN 1.130		BACK PRESSURE, TSF		
CLASSIFICATION PLASTIC CLAY (CH), GRAY					
LL 80	PL 19	PI 61	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.		
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE		
REMARKS			BORING NO. 14-ULC	SAMPLE NO. 12-C	
			DEPTH/ELEV 45.1/-41.5	DATE 25 JAN 83	
			CONSOLIDATION TEST REPORT		

SHEET 1 OF 7



$\gamma sat. = 113.2$

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	38.1	25.9
PRECONSOL. PRESSURE, TSF	1.55	DRY DENSITY, PCF	80.7	100.1
COMPRESSION INDEX	0.89	SATURATION, %	94.5	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.088	0.685
DIA. IN 4.44	HT. IN 1.123	BACK PRESSURE, TSF		

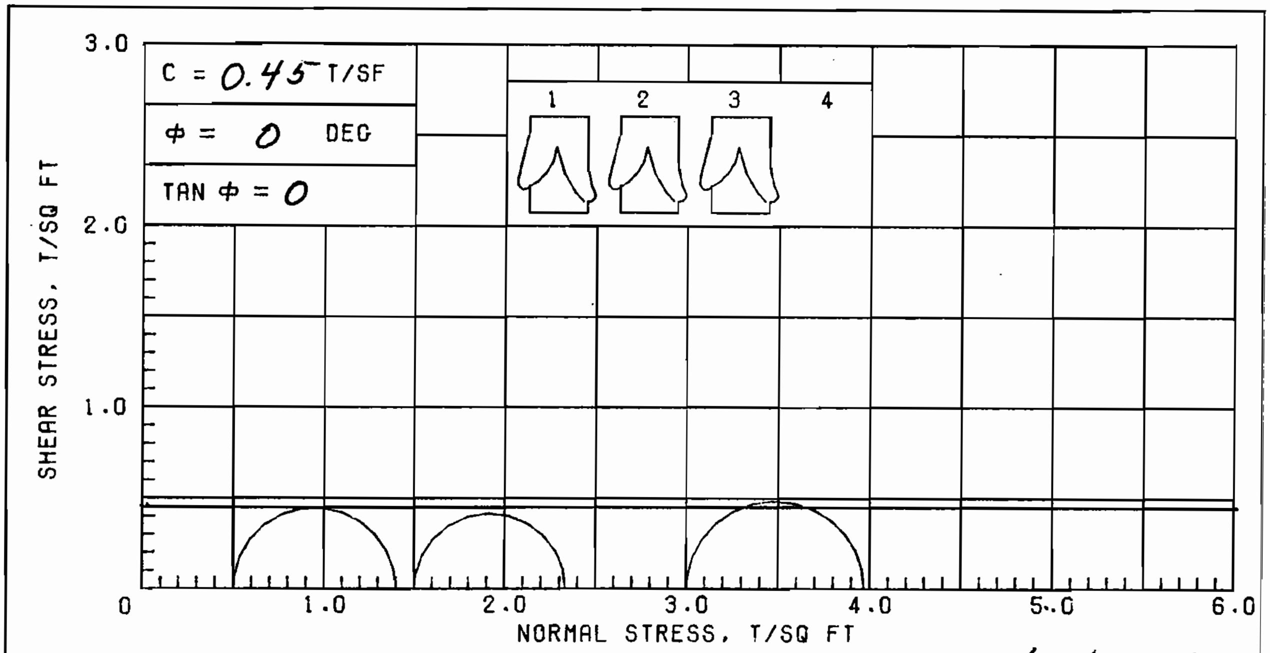
CLASSIFICATION PLASTIC CLAY (CH), GRAY; FINE SAND POCKETS

LL 48	PL 13	PI 35	PROJECT LK. PONT. LA. & VIC.--HURR. PROT.
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE

REMARKS LIMITS ON MIXTURE OF	BORING NO. 14-ULC	SAMPLE NO. 13-C
MATERIAL	DEPTH/ELEV 49.0/-45.4	DATE 26 JAN 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 8

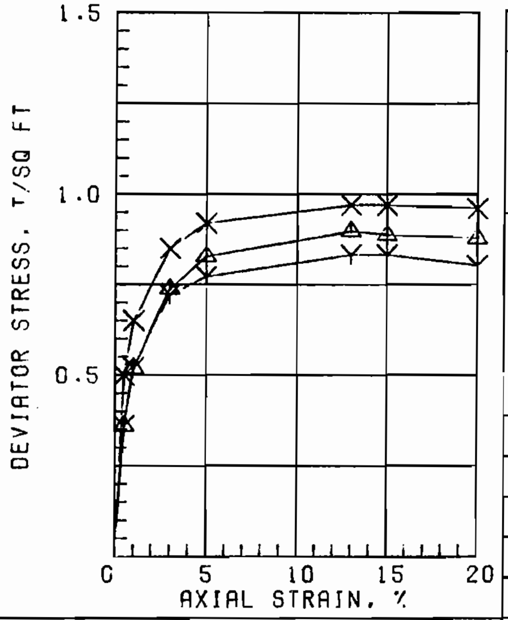


C = 0.45 T/SF

Φ = 0 DEG

TAN Φ = 0

γsat = 117.3



	SPECIMEN NO.	Δ1	Y2	X3	AVG.
INITIAL	WATER CONTENT, %	31.6	34.5	33.9	33.3
	DRY DENSITY, PCF	89.0	86.1	86.5	
	SATURATION, %	95.3	97.3	96.6	
	VOID RATIO	0.895	0.957	0.948	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.90	0.83	0.97	
	TIME TO FAILURE, MIN.	32	32	32	
	RATE OF STRAIN INCR,%				
	INITIAL DIAMETER, IN.	1.40	1.40	1.40	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), LIGHT GRAY

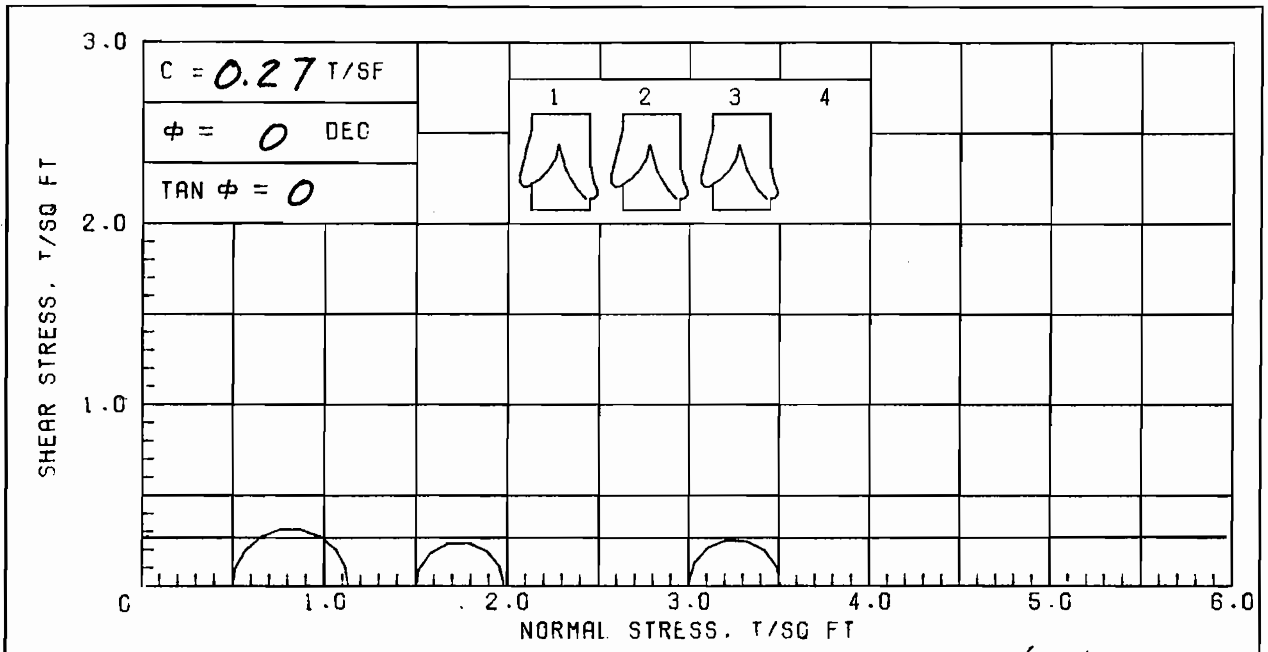
LL 57	PL 17	PI 40	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 15-ULC	SAMPLE NO. 1-B
DEPTH/ELEV 0.8/+13.8	TECH. PJR
LABORATORY USAE WES	DATE 08 JAN 83

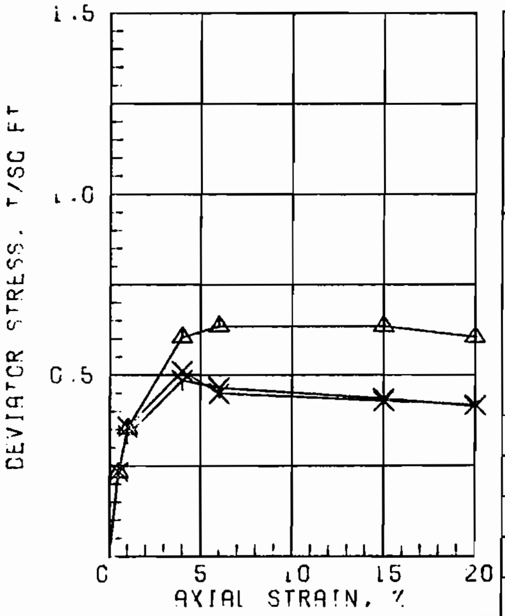
TRIAXIAL COMPRESSION TEST REPORT



C = 0.27 T/SF

φ = 0 DEG

TAN φ = 0



γsat. = 105.7

SPECIMEN NO.		△1	Y2	X3	4 Avg.
INITIAL	WATER CONTENT, %	50.0	57.6	61.6	56.4
	DRY DENSITY, PCF	71.7	66.9	64.4	
	SATURATION, %	99.9	100+	100+	
	VOID RATIO	1.351	1.519	1.619	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.63	0.48	0.51	
TIME TO FAILURE, MIN.		12	8	12	
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.40	1.39	1.39	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY; FINE SAND LENSES

LL 63 | PL 17 | PI 46 | GS 2.70 (ESTIMATED) | UNDISTURBED SPECIMEN | Q TEST

REMARKS;

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

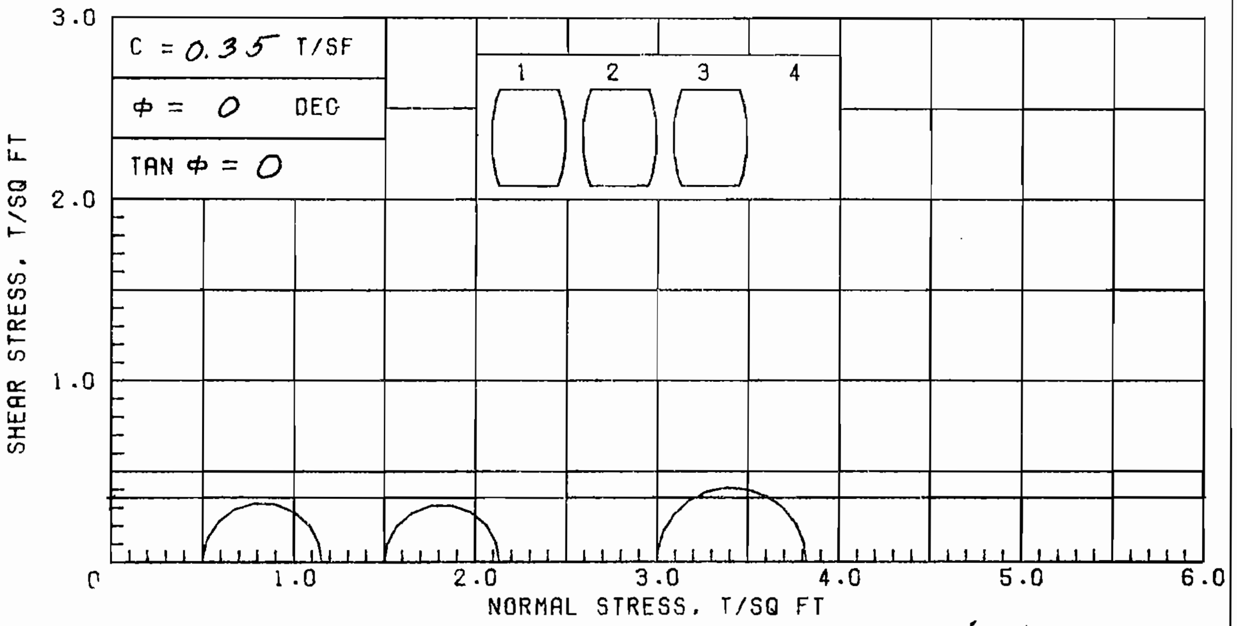
CITRUS LAKEFRONT LEVEE

BORING NO. 15-ULC | SAMPLE NO. 8-C

DEPTH/ELEV 33.0/-18.4 | TECH. PJR

LABORATORY USAE WES | DATE 08 JAN 83

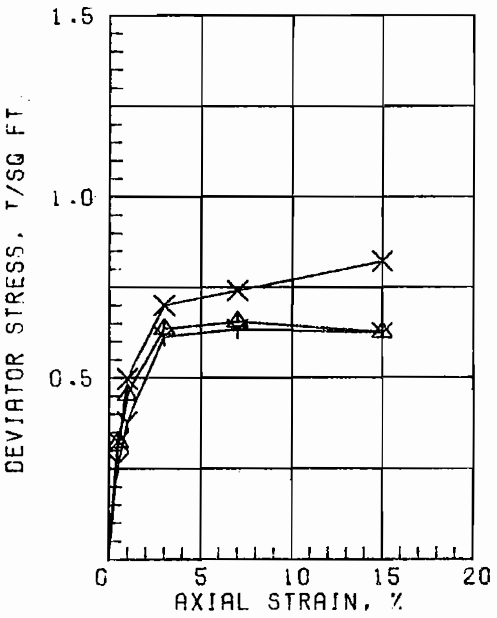
TRIAXIAL COMPRESSION TEST REPORT



C = 0.35 T/SF

Φ = 0 DEG

TAN Φ = 0



γsat. = 111.1

	SPECIMEN NO.	Δ1	Y2	X3	Avg.
INITIAL	WATER CONTENT, %	45.9	44.0	37.0	42.3
	DRY DENSITY, PCF	75.5	76.2	80.0	
	SATURATION, %	100+	98.0	90.3	
	VOID RATIO	1.232	1.212	1.107	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.65	0.63	0.82	
TIME TO FAILURE, MIN.		21	17	37	
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.39	1.39	1.39	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; FINE SAND LENSES

LL 52	PL 16	PI 36	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 15-ULC

SAMPLE NO. 9-B

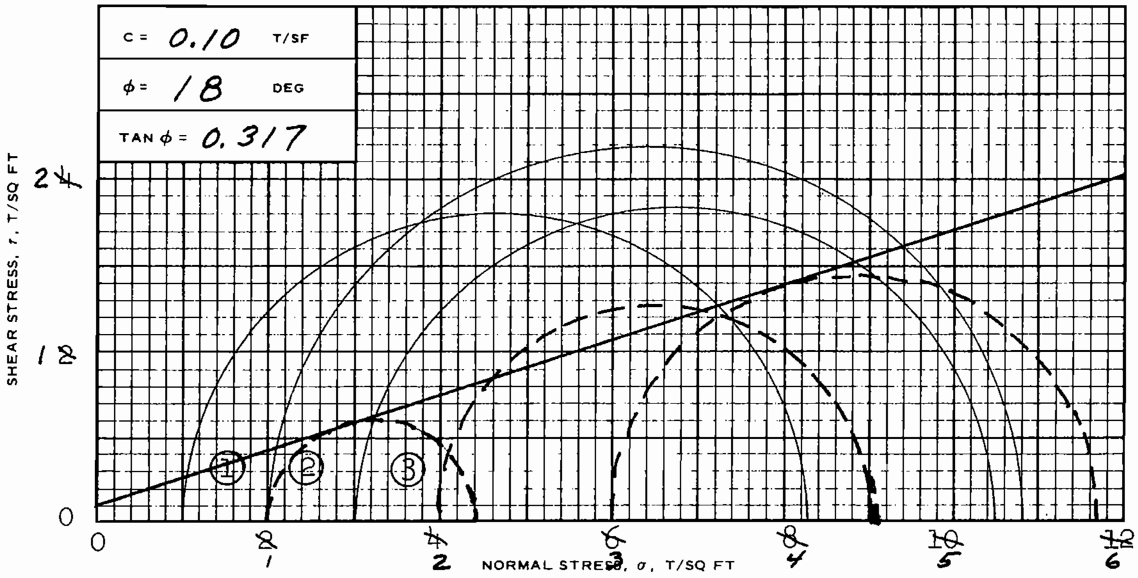
DEPTH/ELEV 36.3/-21.7

TECH. PJR

LABORATORY USAE WES

DATE 08 JAN 83

TRIAXIAL COMPRESSION TEST REPORT

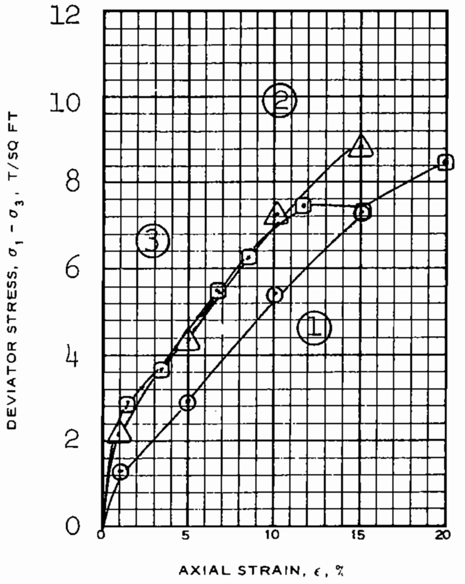


c = 0.10 T/SF

φ = 18 DEG

TAN φ = 0.317

γsat. = 119.5



SPECIMEN NO.			1	2	3	AVG.
INITIAL	WATER CONTENT, %	w_o	29.3	30.5	30.9	30.2
	DRY DENSITY LB/ CU FT	γ_{d_o}	92.2	90.7	89.7	
	SATURATION, %	S_o	95.9	96.4	95.2	
	VOID RATIO	e_o	0.822	0.851	0.873	
BEFORE SHEAR	WATER CONTENT, %	w_c	29.5	30.1	29.4	
	DRY DENSITY LB/CU FT	γ_{d_c}	94.0	93.5	93.5	
	SATURATION, %	S_c	100+	100+	99.2	
	VOID RATIO	e_c	0.787	0.796	0.797	
	FINAL BACK PRESSURE, T/SQ FT	u_o	4.32	4.32	4.32	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	7.26	8.83	7.48	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	536	536	421	
$(\sigma_1 - \sigma_3)$ AT MAX PORE PRESSURE			1.2	2.6	2.8	
INITIAL DIAMETER, IN.		D_o	1.41	1.41	1.41	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS SILT (ML), GRAY: 1/16" LAYER CLAY (CL)

LL
PL
PI
Gs 2.69(EST)
TYPE OF SPECIMEN UNDISTURBED
TYPE OF TEST $\bar{R}$

REMARKS:

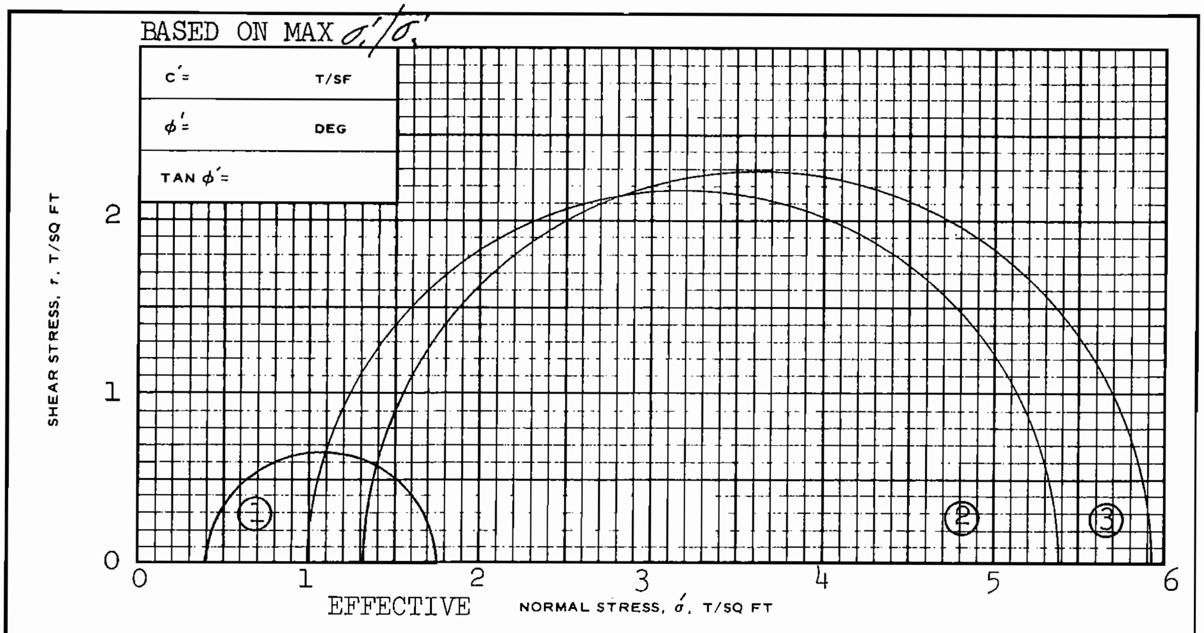
PROJECT LK. PONT. LA. & VIC. - HURR. PROT.
CITRUS LAKEFRONT LEVEE
BORING NO. 15-ULC
SAMPLE NO. 5-B
DEPTH/ELEV 15.9/-1.3
LABORATORY USAEWES
DATE 12 JAN 1983

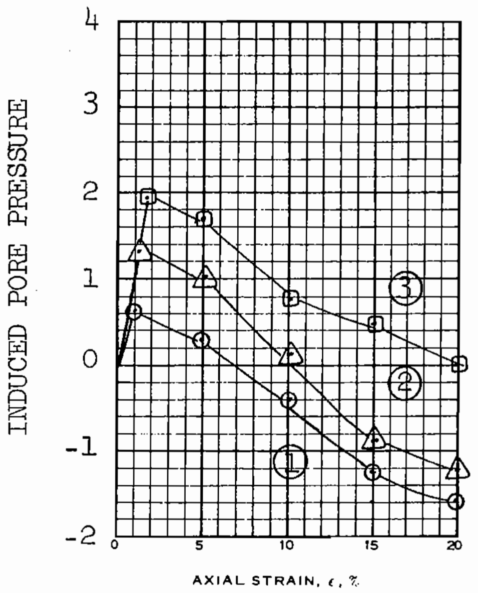
SHEET 1 OF 2

TES **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089
REV JUNE 1970

GPO : 1982 0 - 375-356





SPECIMEN NO.			1	2	3	
INITIAL	WATER CONTENT, %	w_o				
	DRY DENSITY LB/ CU FT	γd_o				
	SATURATION, %	S_o				
	VOID RATIO	e_o				
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.39	0.99	1.31	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	1.37	4.39	4.61	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f				
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o				
INITIAL HEIGHT, IN.		H_o				

CONTROLLED- TEST

DESCRIPTION OF SPECIMENS

LL	PL	PI	Gs	TYPE OF SPECIMEN	TYPE OF TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC. - HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 15-ULC SAMPLE NO. 5-B

DEPTH/ELEV 15.9/-1.3

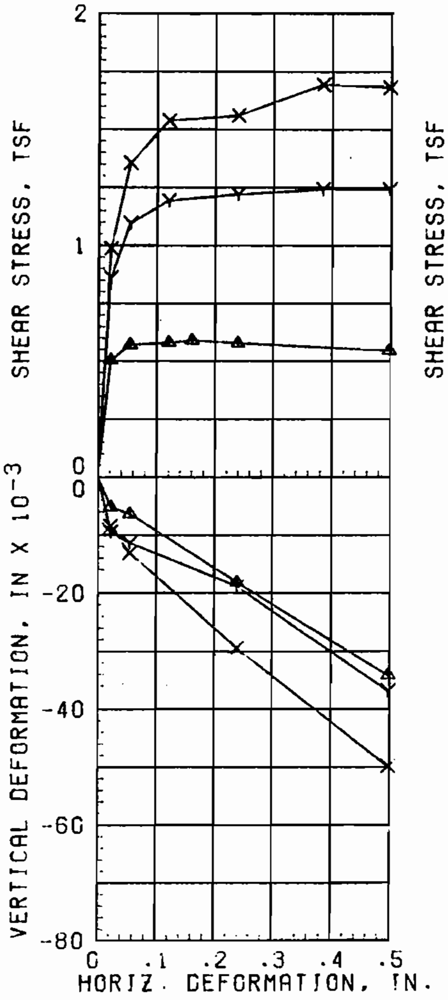
LABORATORY USAEWES DATE 12 JAN 1983

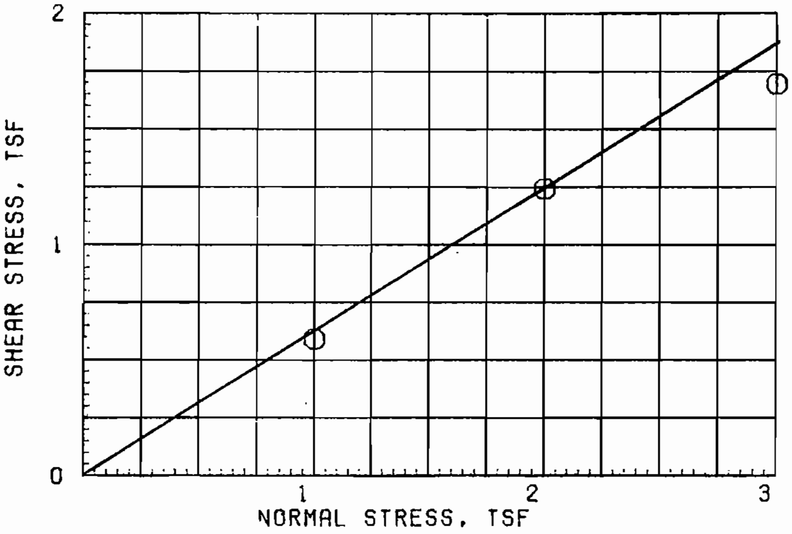
SHEET 2 OF 2

TES **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089
REV JUNE 1970

GPO : 1982 0 - 375-356





$\gamma_{sat.} = 121.7$

	TEST NO.	1 ▲	2 Y	3 ×	AVG.
INITAL	WATER CONTENT, %	20.8	20.3	19.5	20.2
	VOID RATIO	0.755	0.759	0.751	
	SATURATION, %	73.5	71.3	69.4	
	DRY DENSITY, PCF	94.9	94.7	95.1	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	23.4	21.7	21.5	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF		0.59	1.24	1.69	
TIME TO FAILURE, MIN		887	2129	2129	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF					

ϕ = 32°

TAN ϕ = 0.617

C = 0

TYPE SPECIMEN UNDISTURBED | 3.00 IN. SQUARE | 0.584 IN. THICK

CLASSIFICATION SILTY SAND (SM), LIGHT BROWN

LL | PL | PI | | GS 2.67 (EST)

REMARKS:

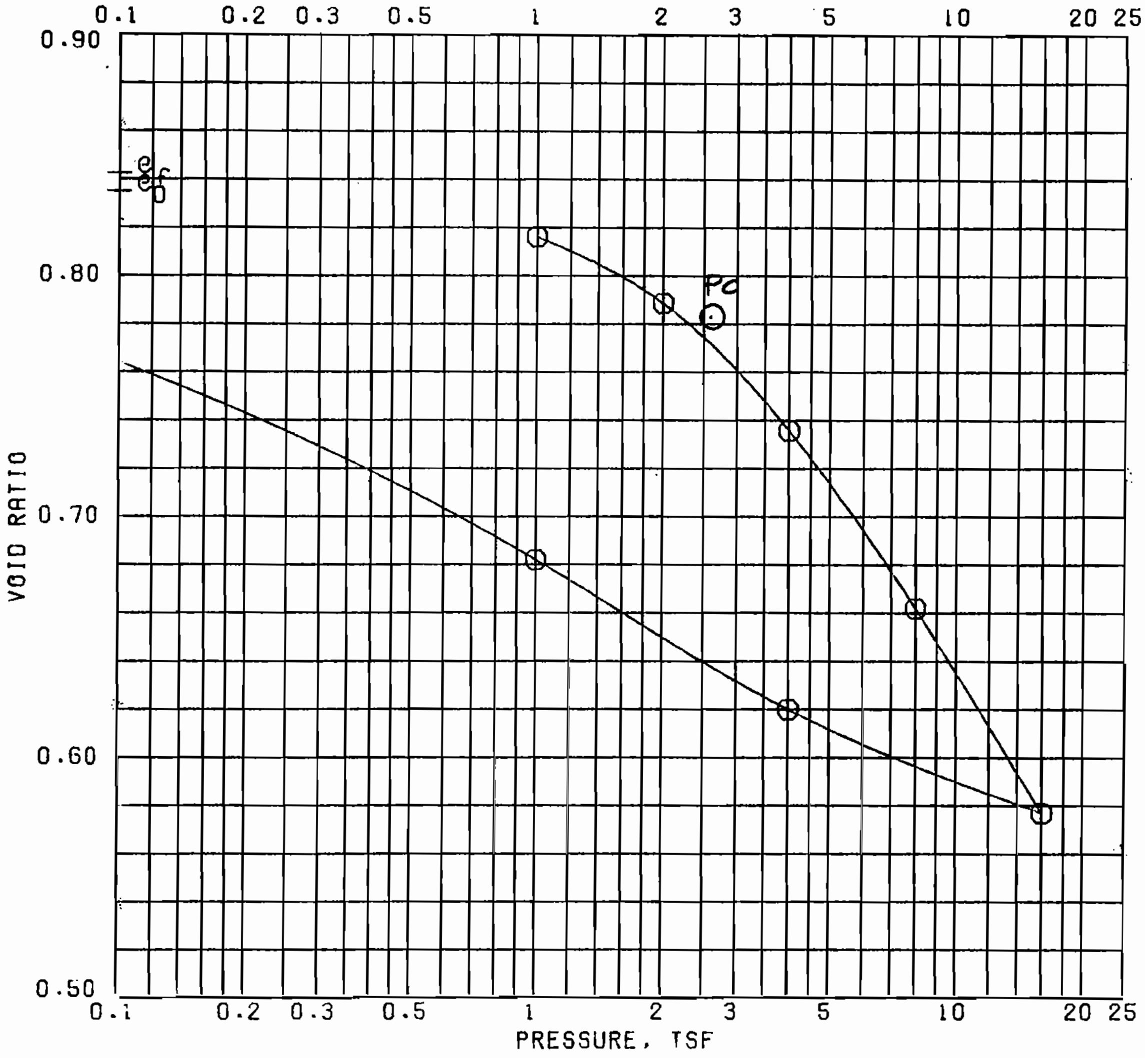
PROJECT LK. PONT. LA. & VIC. - HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 15-ULC | SAMPLE 15-C

DEPTH/ELEV 61.1/-46.5 | DATE 19 JAN 83

DIRECT SHEAR TEST REPORT



$\gamma_{sat.} = 120.2$

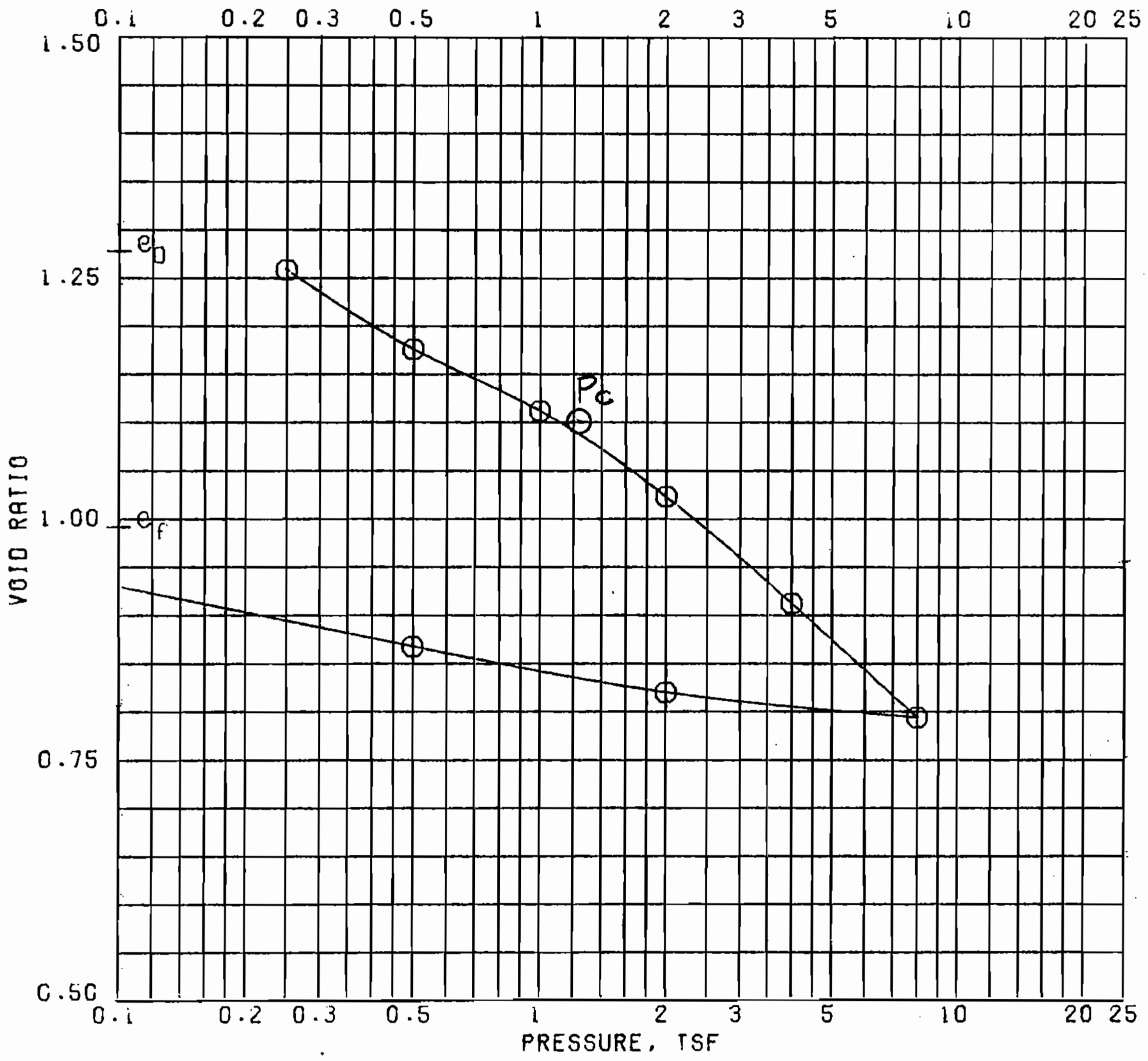
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	30.1	31.1
PRECONSOL. PRESSURE, TSF	2.6	DRY DENSITY, PCF	91.9	91.5
COMPRESSION INDEX	0.24	SATURATION, %	97.6	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.834	0.842
DIA. IN 4.44	HT. IN 1.127	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), LT BROWN; IRON OXIDE STAINS

LL	PL	PI	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.	
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE	
REMARKS			BORING NO. 15-ULC	SAMPLE NO. 1-C
			DEPTH/ELEV 1.9/+12.7	DATE 20 JAN 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 10

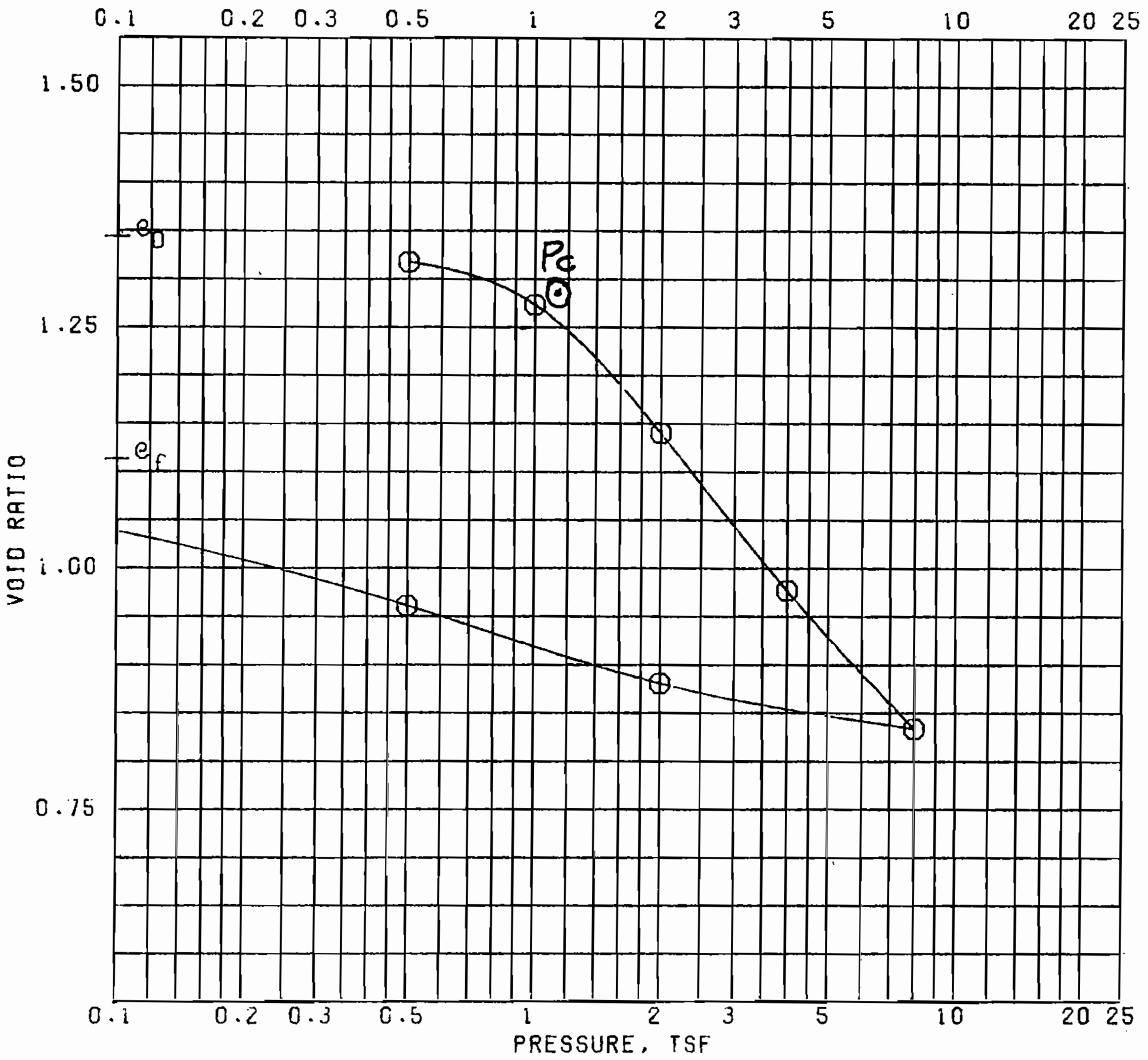


$\gamma_{sat.} = 108.9$

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	43.3	38.2
PRECONSOL. PRESSURE, TSF	1.25	DRY DENSITY, PCF	74.0	84.7
COMPRESSION INDEX	0.73	SATURATION, %	91.7	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.276	0.990
DIA. IN 4.44	HT. IN 1.129	BACK PRESSURE, TSF		
CLASSIFICATION PLASTIC CLAY (CH), GRAY; FINE SAND POCKETS				
LL PL PI		PROJECT LK. PONT. LA. & VIC.-HURR. PROT.		
GS 2.70 (EST)	D_{10}	CITRUS LAKEFRONT LEVEE		
REMARKS		BORING NO. 15-ULC	SAMPLE NO. 8-C	
		DEPTH/ELEV 33.4/-18.8	DATE 21 JAN 83	

CONSOLIDATION TEST REPORT

SHEET 1 OF 11



$\gamma sat. = 107.8$

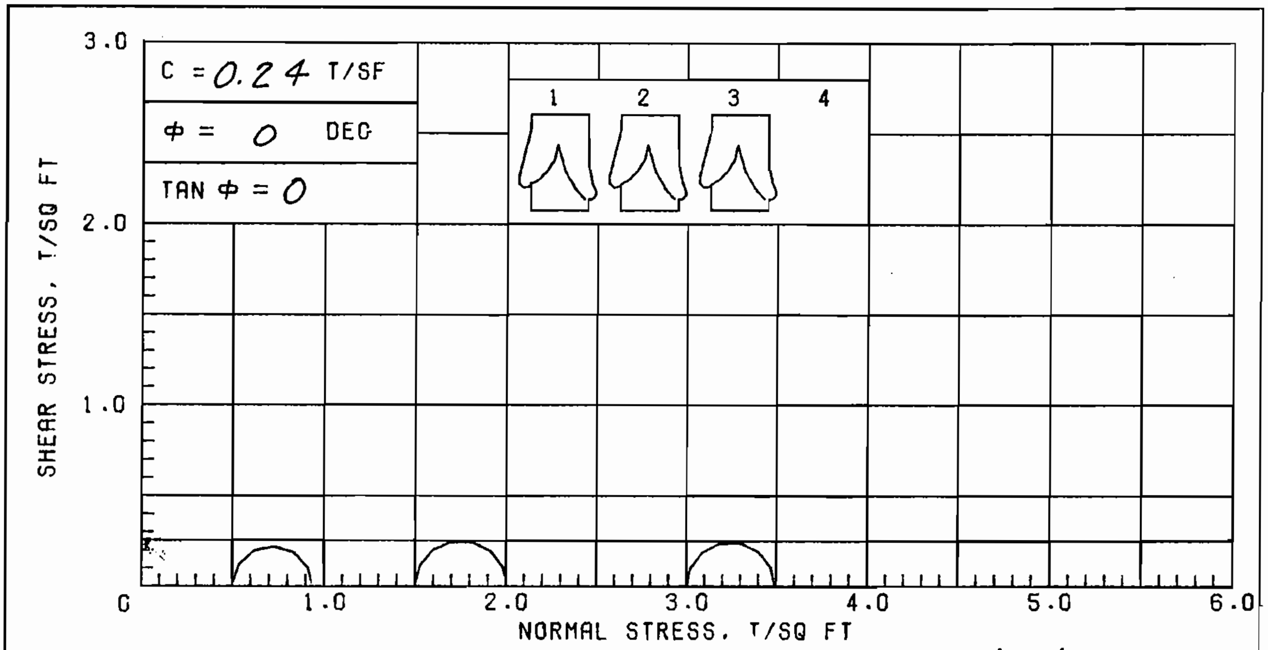
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	49.0	41.1
PRECONSOL. PRESSURE, TSF	1.10	DRY DENSITY, PCF	72.0	79.8
COMPRESSION INDEX	0.55	SATURATION, %	98.6	99.8
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.342	1.111
DIA. IN 4.44	HT. IN 1.41	BACK PRESSURE, TSF		
CLASSIFICATION PLASTIC CLAY (CH), GRAY; FINE SAND POCKETS				
LL 56	PL 17	PI 39	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.	
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE	
REMARKS		BORING NO. 15-ULC	SAMPLE NO. 9-C	
		DEPTH/ELEV 37.2/-22.6	DATE 22 JAN 83	
		CONSOLIDATION TEST REPORT		

SHEET 1 OF 10

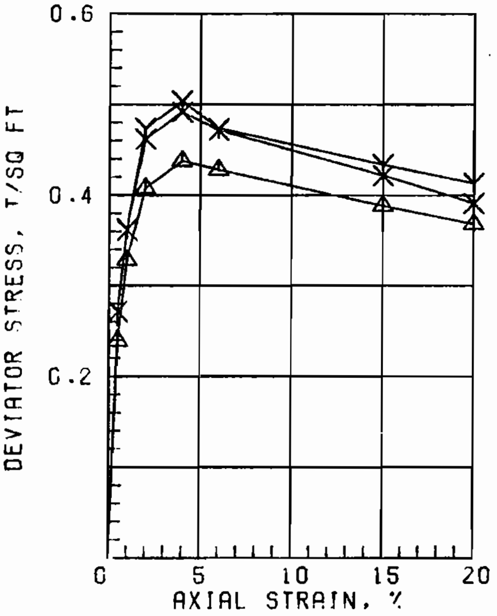
C = 0.24 T/SF

ϕ = 0 DEG

TAN ϕ = 0



γ_{sat} =100.0



SPECIMEN NO.		Δ1	Y2	X3	4 Avg.
INITIAL	WATER CONTENT, %	65.4	73.1	69.6	69.4
	DRY DENSITY, PCF	61.1	57.2	59.0	
	SATURATION, %	100+	100+	100+	
	VOID RATIO	1.759	1.945	1.857	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.44	0.50	0.49	
TIME TO FAILURE, MIN.		12	12	15	
RATE OF STRAIN INCR,%				7	
INITIAL DIAMETER, IN.		1.40	1.39	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

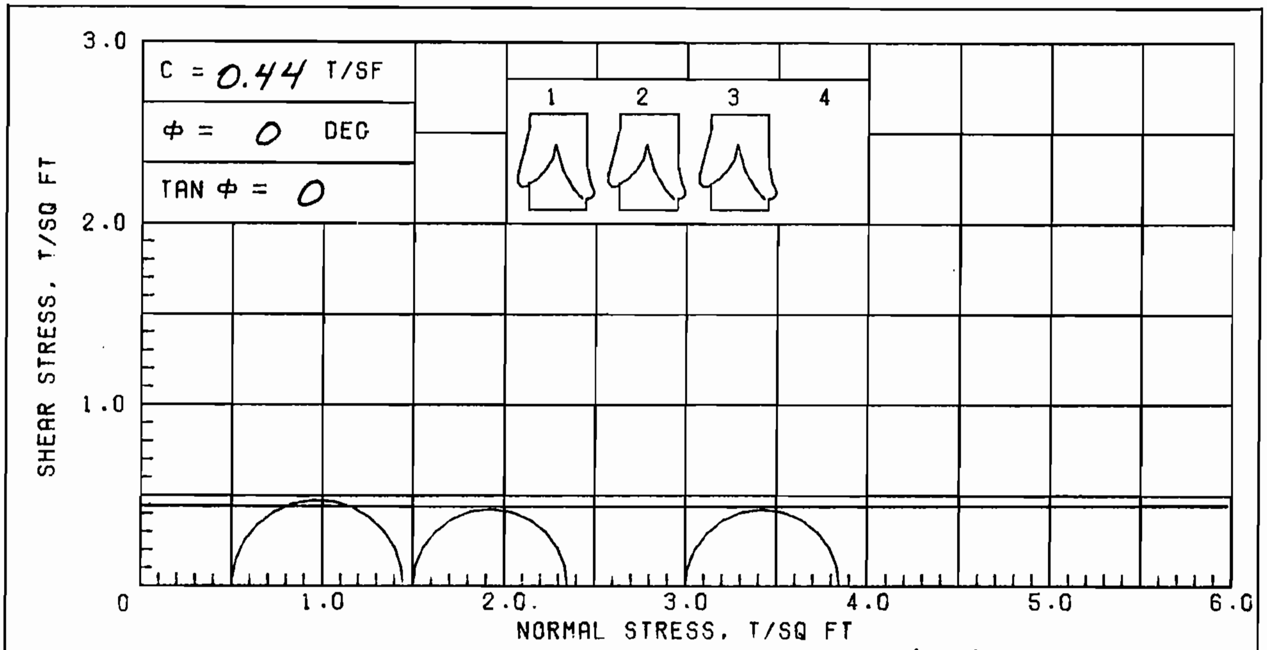
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY

LL 78	PL 21	PI 57	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.	
CITRUS LAKEFRONT LEVEE	
BORING NO. 16-ULC	SAMPLE NO. 7-B
DEPTH/ELEV 24.0/-20.9	TECH. PJR
LABORATORY USAE WES	DATE 18 JAN 83

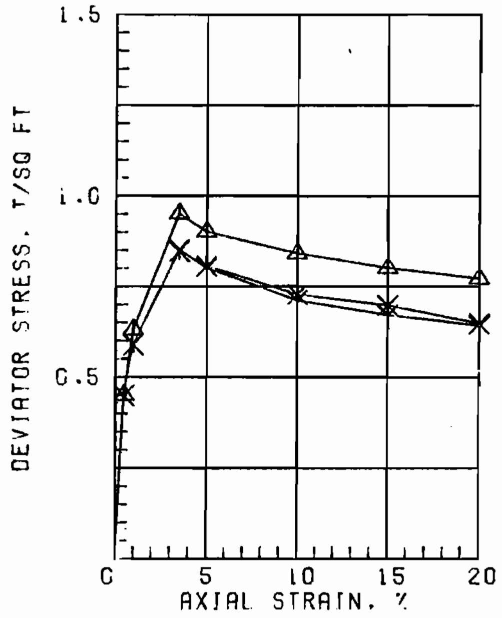
TRIAXIAL COMPRESSION TEST REPORT



C = 0.44 T/SF

ϕ = 0 DEG

TAN ϕ = 0



γ sat. = 108.0

	SPECIMEN NO.	△1	Y2	X3	AVG.
INITIAL	WATER CONTENT, %	49.2	49.7	48.5	49.1
	DRY DENSITY, PCF	72.3	72.0	72.5	
	SATURATION, %	99.8	100+	98.7	
	VOID RATIO	1.331	1.340	1.326	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.95	0.85	0.85	
	TIME TO FAILURE, MIN.	11	13	21	
	RATE OF STRAIN INCR,%	14	5	11	
	INITIAL DIAMETER, IN.	1.40	1.40	1.40	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 55	PL 17	PI 38	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

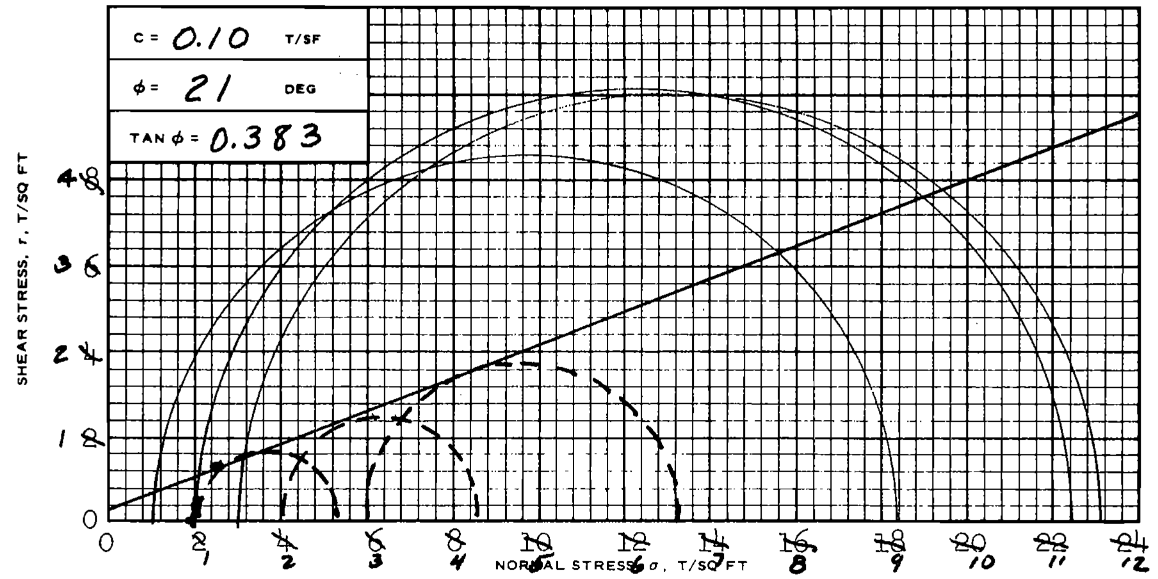
BORING NO. 16-ULC
SAMPLE NO. 11-B
DEPTH/ELEV 40.6/-37.5
TECH. PJR
LABORATORY USAE WES
DATE 18 JAN 83

TRIAXIAL COMPRESSION TEST REPORT

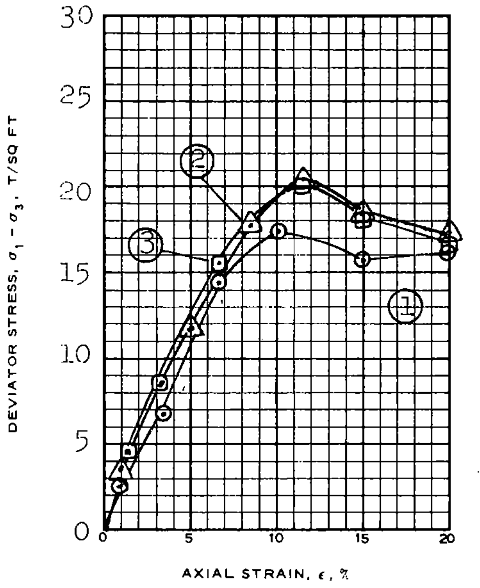
c = 0.10 T/SF

φ = 21 DEG

TAN φ = 0.383



γsat. = 120.3



			1	2	3	AVG.
SPECIMEN NO.			1	2	3	AVG.
INITIAL	WATER CONTENT, %	w_o	29.5	30.0	29.7	29.7
	DRY DENSITY LB/CU FT	γ_{d_o}	92.6	92.0	92.2	
	SATURATION, %	S_o	98.1	98.3	97.7	
	VOID RATIO	e_o	0.806	0.818	0.815	
BEFORE SHEAR	WATER CONTENT, %	w_c	30.9	31.7	31.1	
	DRY DENSITY LB/CU FT	γ_{d_c}	94.8	93.6	92.6	
	SATURATION, %	S_c	100+	100+	100+	
	VOID RATIO	e_c	0.766	0.787	0.806	
	FINAL BACK PRESSURE, T/SQ FT	u_o	4.32	4.32	4.32	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	17.39	20.42	20.14	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	777	900	900	
$(\sigma_1 - \sigma_3)$ AT MAX. PORE PRESSURE			1.7	2.3	3.6	
INITIAL DIAMETER, IN.		D_o	1.39	1.39	1.39	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS SILTY SAND (SM), GRAY

LL NP | PL NP | PI NP | Gs 2.67(EST) | TYPE OF SPECIMEN UNDISTURBED | TYPE OF TEST $\bar{R}$

REMARKS:

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 16-ULC | SAMPLE NO. 3-B

DEPTH/ELEV 8.5/-5.4

LABORATORY USAEWES | DATE 20 JAN 1983

SHEET 1 OF 2

JMS **TRIAXIAL COMPRESSION TEST REPORT**

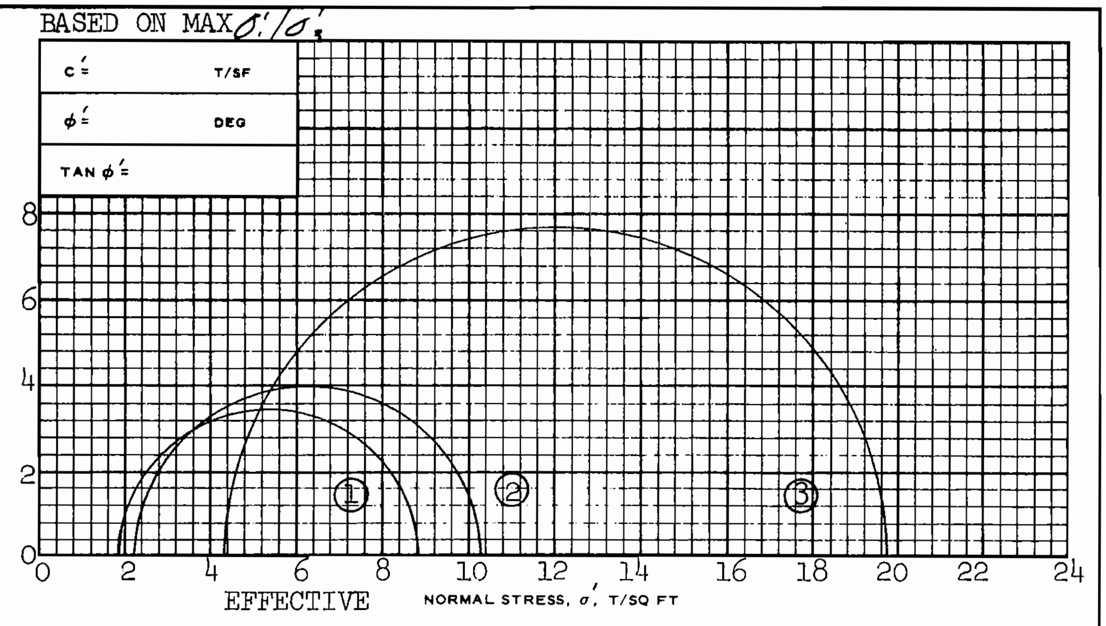
ENG FORM NO. 2089
REV JUNE 1970

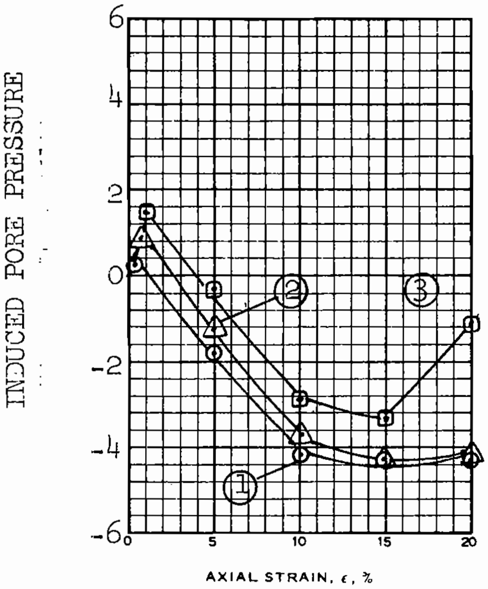
BASED ON MAX σ_1'/σ_3'

c' = T/SF

φ' = DEG

TAN φ' =





SPECIMEN NO.		1	2	3	
INITIAL WATER CONTENT, %	w_o				
INITIAL DRY DENSITY LB/ CU FT	γd_o				
INITIAL SATURATION, %	S_o				
INITIAL VOID RATIO	e_o				
BEFORE SHEAR WATER CONTENT, %	w_c				
BEFORE SHEAR DRY DENSITY LB/CU FT	γd_c				
BEFORE SHEAR SATURATION, %	S_c				
BEFORE SHEAR VOID RATIO	e_c				
BEFORE SHEAR FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT	σ_3	1.84	2.20	4.31	
MAXIMUM DEVIATOR STRESS, T/SQ FT	$(\sigma_1 - \sigma_3)_{MAX}$	6.97	8.12	15.40	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN	t_f				
ULTIMATE DEVIATOR STRESS, T/SQ FT	$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.	D_o				
INITIAL HEIGHT, IN.	H_o				

CONTROLLED- TEST

DESCRIPTION OF SPECIMENS

LL	PL	PI	Gs	TYPE OF SPECIMEN	TYPE OF TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 16-ULC SAMPLE NO. 3-B

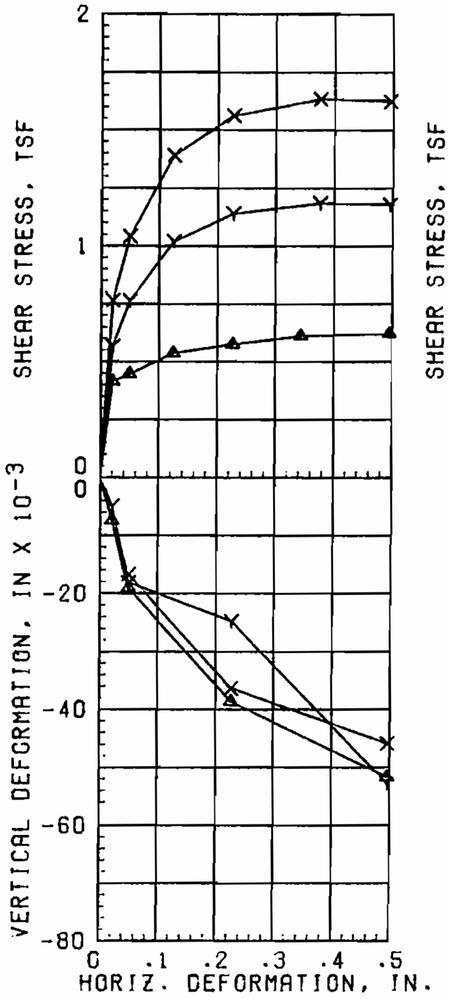
DEPTH/ELEV 8.5/-5.4

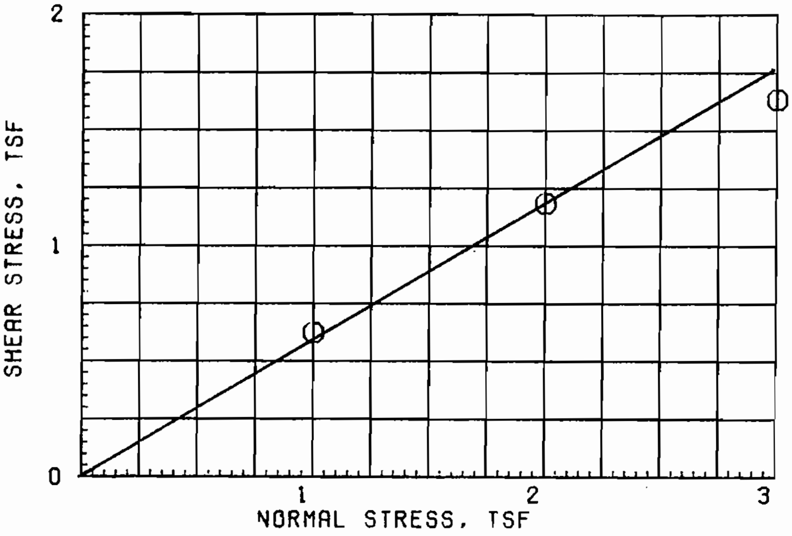
LABORATORY USAEWES DATE 20 JAN 1983

SHEET 2 OF 2

JMS **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089
REV JUNE 1970





$\gamma_{sat} = 117.7$

		1 ▲	2 Y	3 X	Avg.
	TEST NO.	1 ▲	2 Y	3 X	Avg.
INITAL	WATER CONTENT, %	38.6	43.3	40.9	50.9
	VOID RATIO	1.225	1.261	1.243	
	SATURATION, %	85.1	92.7	88.8	
	DRY DENSITY, PCF	75.7	74.5	75.1	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		3	7	3	
FINAL	WATER CONTENT, %	33.8	28.6	29.2	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF		0.62	1.18	1.63	
TIME TO FAILURE, MIN		2760	2094	2094	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF					

ϕ = 31°

TAN ϕ = 0.60

C = 0

TYPE SPECIMEN UNDISTURBED | 3.00 IN. SQUARE | 0.584 IN. THICK

CLASSIFICATION PLASTIC CLAY (CH), GRAY; SILT LENSES

LL | PL | PI | | GS 2.70 (EST)

REMARKS;

PROJECT LK. PONT. LA. & VIC. - HURR. PROT.

CITRUS LAKEFRONT LEVEE

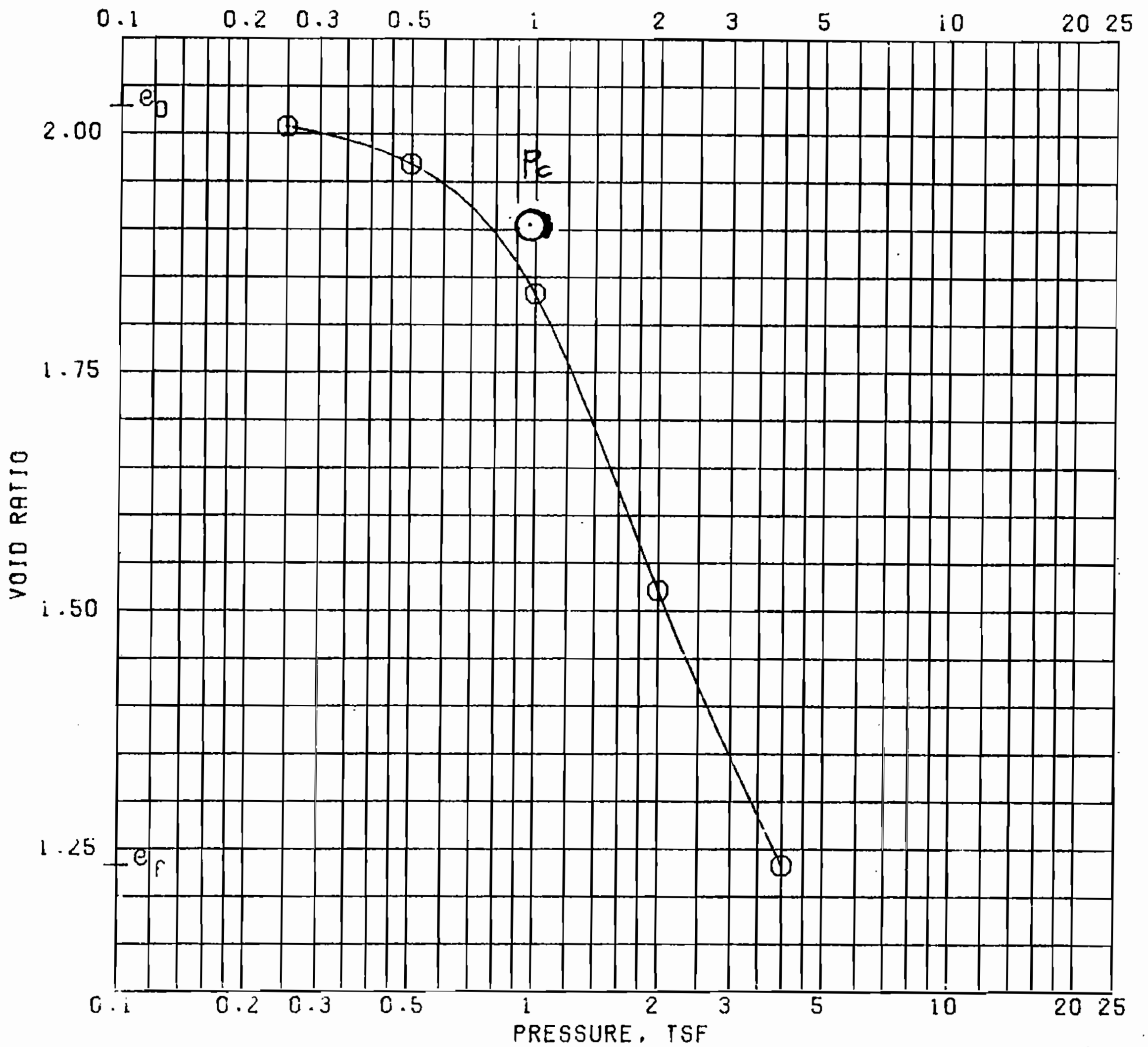
BORING NO. 16-ULC

SAMPLE 8-C

DEPTH/ELEV 28.7/-25.6

DATE 21 JAN 83

DIRECT SHEAR TEST REPORT

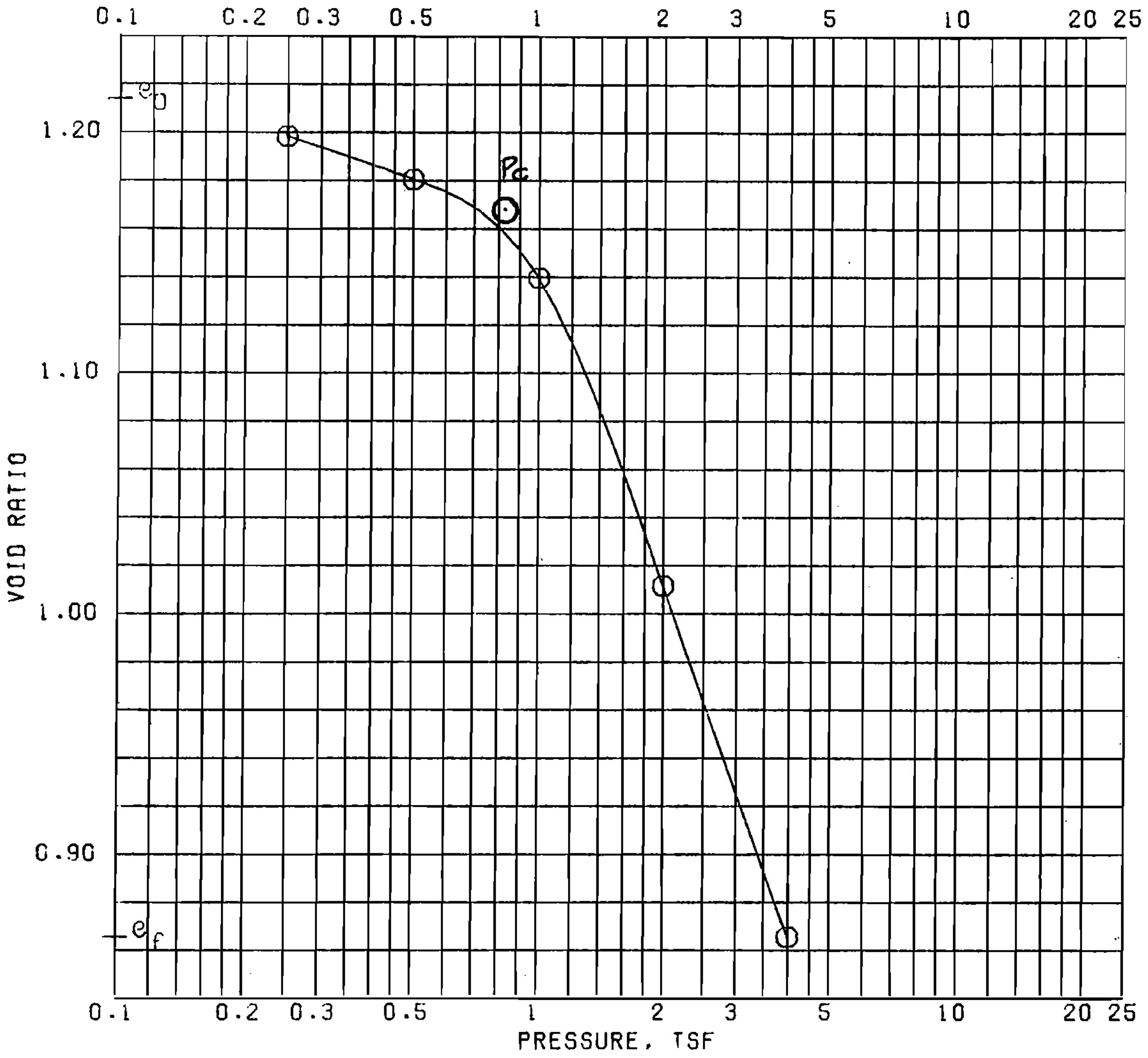


$\gamma_{sat.} = 110.4$

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	74.7	47.8
PRECONSOL. PRESSURE, TSF	0.95	DRY DENSITY, PCF	55.7	75.5
COMPRESSION INDEX	0.72	SATURATION, %	99.6	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	2.027	1.231
DIA. IN 4.44	HT. IN 1.125	BACK PRESSURE, TSF		
CLASSIFICATION PLASTIC CLAY (CH), GRAY; FINE SAND POCKETS				
LL 87	PL 24	PI 63	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.	
GS 2.70 (EST)	D_{10}	CITRUS LAKEFRONT LEVEE		
REMARKS		BORING NO. 16-ULC	SAMPLE NO. 7-B	
		DEPTH/ELEV 24.6/-21.5	DATE 28 JAN 83	

CONSOLIDATION TEST REPORT

SHEET 1 OF 7



$\gamma_{sat.} = 97.5$

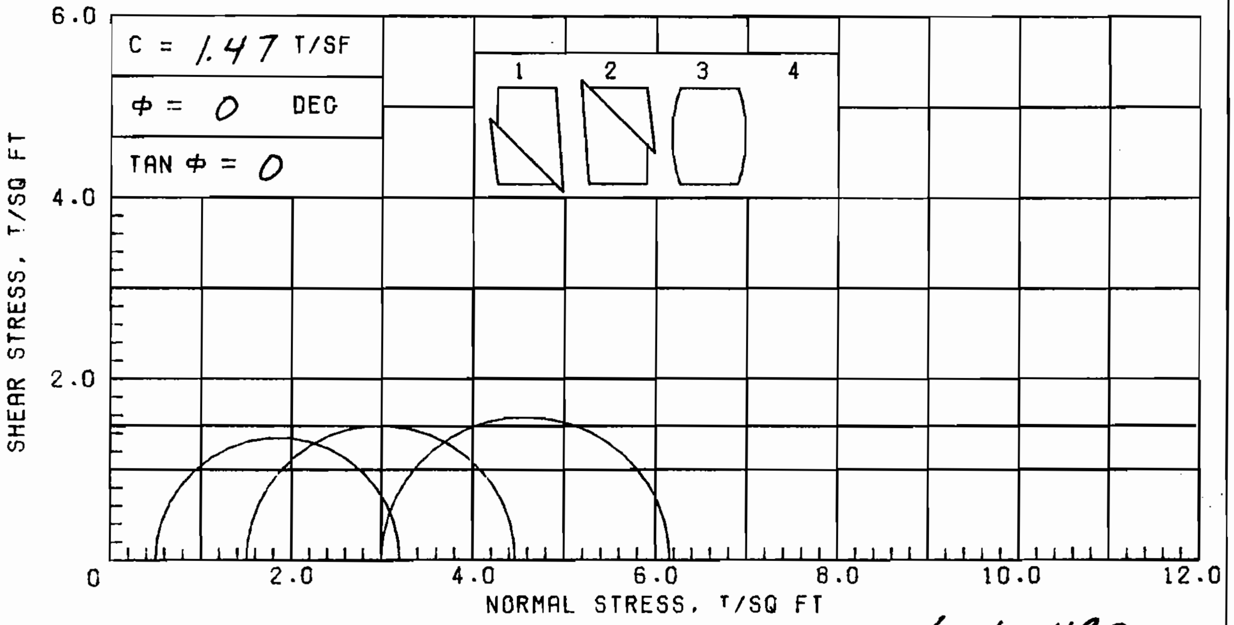
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	42.8	31.7
PRECONSOL. PRESSURE, TSF	0.82	DRY DENSITY, PCF	76.2	90.4
COMPRESSION INDEX	1.03	SATURATION, %	95.3	98.8
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.213	0.865
DIA. IN 4.44	HT. IN 1.129	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY; SILT POCKETS

LL 47	PL 14	PI 33	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE
REMARKS		BORING NO. 16-ULC	SAMPLE NO. 11-C
		DEPTH/ELEV 41.5/-38.4	DATE 29 JAN 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 7

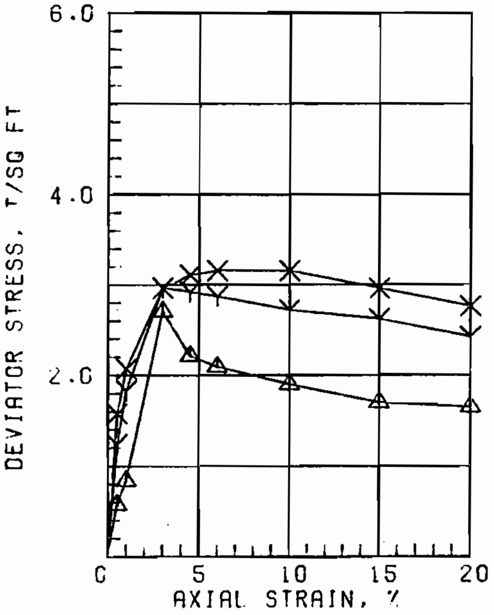


C = *1.47* T/SF

Φ = *0* DEG

TAN Φ = *0*

γ sat. = 119.3



SPECIMEN NO.		△1	Y2	X3	*Avg.*
INITIAL	WATER CONTENT, %	25.7	32.2	25.8	*27.9*
	DRY DENSITY, PCF	92.1	84.9	94.1	
	SATURATION, %	83.7	88.2	88.0	
	VOID RATIO	0.829	0.986	0.792	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		2.70	2.97	3.15	
TIME TO FAILURE, MIN.		23	13	12	
RATE OF STRAIN INCR,%		4	6		
INITIAL DIAMETER, IN.		1.40	1.41	1.41	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY

LL 55	PL 17	PI 38	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 17-ULC

SAMPLE NO. 1-B

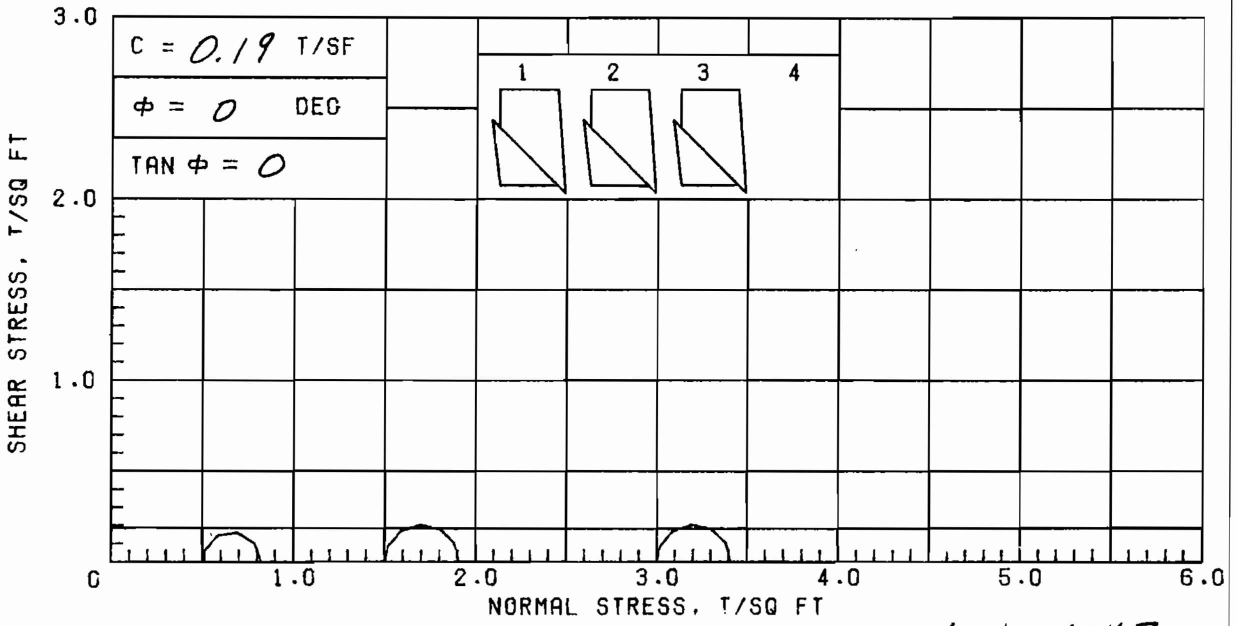
DEPTH/ELEV 0.8/+13.4

TECH. RCH

LABORATORY USAE WES

DATE 17 JAN 83

TRIAXIAL COMPRESSION TEST REPORT

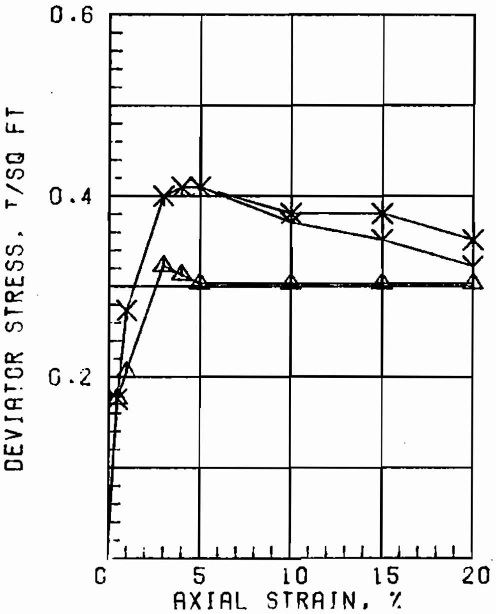


C = 0.19 T/SF

Φ = 0 DEG

TAN Φ = 0

γsat = 104.7



	SPECIMEN NO.	Δ1	Y2	X3	Avg.
INITIAL	WATER CONTENT, %	58.2	54.2	52.5	55.0
	DRY DENSITY, PCF	65.1	67.8	68.5	
	SATURATION, %	99.0	98.4	97.1	
	VOID RATIO	1.588	1.487	1.460	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.32	0.41	0.41	
	TIME TO FAILURE, MIN.	6	8	8	
	RATE OF STRAIN INCR.,%				
	INITIAL DIAMETER, IN.	1.42	1.42	1.42	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY; FINE SAND POCKETS

LL 47	PL 15	PI 32	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;

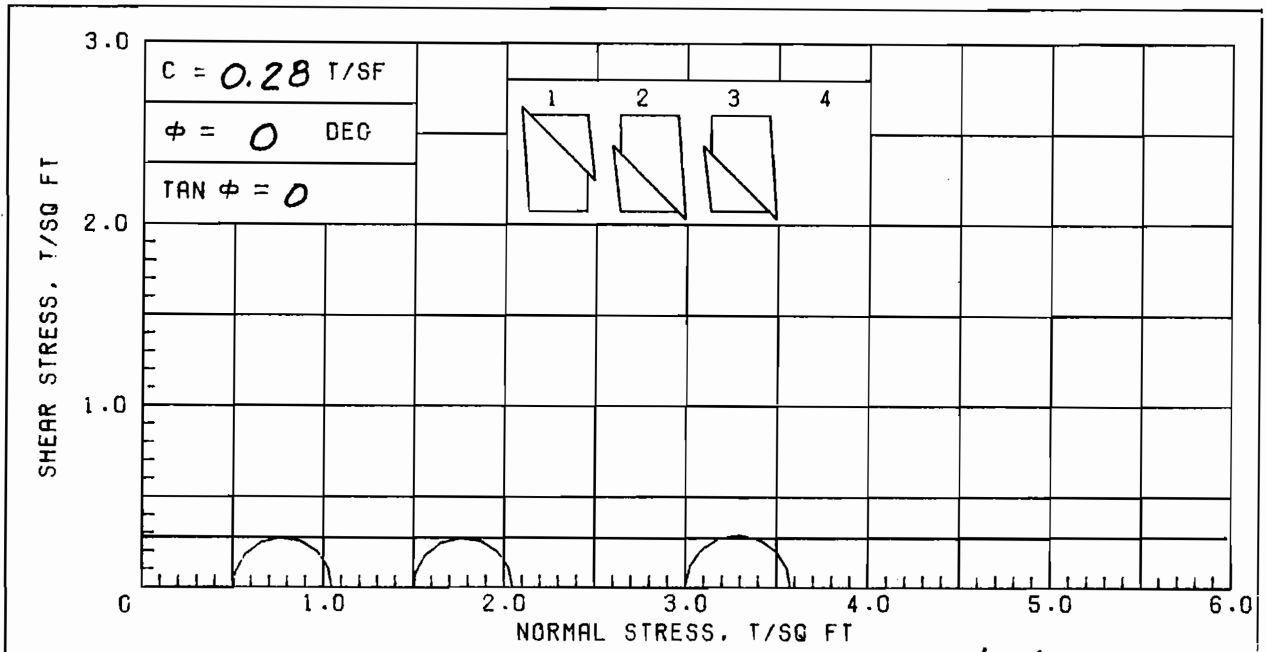
LIMITS ON MIXTURE OF MATERIAL.

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 17-ULC	SAMPLE NO. 9-B
DEPTH/ELEV 31.7/-17.5	TECH. KOC
LABORATORY USAE WES	DATE 18 JAN 83

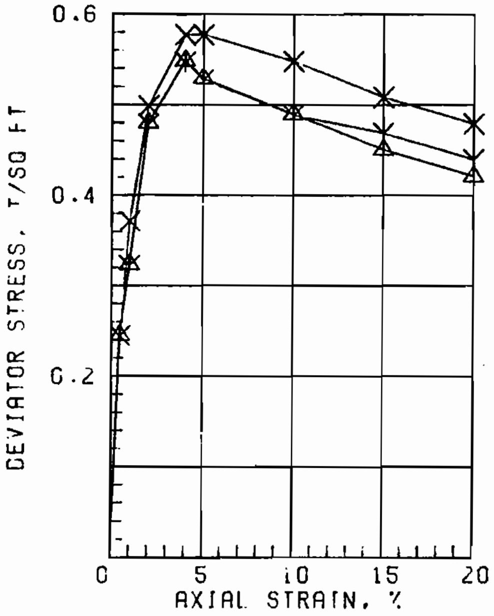
TRIAXIAL COMPRESSION TEST REPORT



C = 0.28 T/SF

Φ = 0 DEG

TAN Φ = 0



γsat. = 106.5

	SPECIMEN NO.	▵1	Y2	X3	Avg.
INITIAL	WATER CONTENT, %	54.0	50.0	51.3	51.8
	DRY DENSITY, PCF	68.7	71.3	69.9	
	SATURATION, %	100+	99.0	98.2	
	VOID RATIO	1.455	1.364	1.410	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.55	0.55	0.58	
	TIME TO FAILURE, MIN.	8	8	8	
	RATE OF STRAIN INCR,%				
	INITIAL DIAMETER, IN.	1.42	1.42	1.42	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY; FINE SAND POCKETS

LL 65	PL 18	PI 47	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

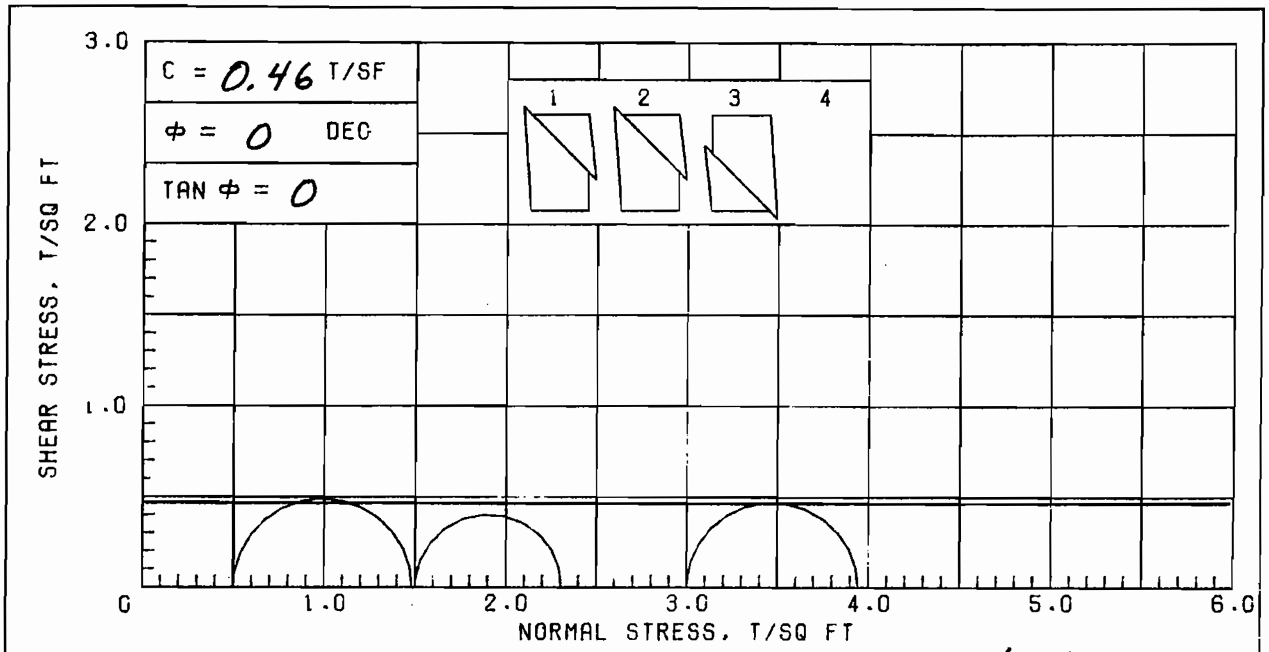
LIMITS ON MIXTURE OF MATERIAL.

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 17-ULC	SAMPLE NO. 10-B
DEPTH/ELEV 36.0/-21.8	TECH. KOC
LABORATORY USAE WES	DATE 18 JAN 83

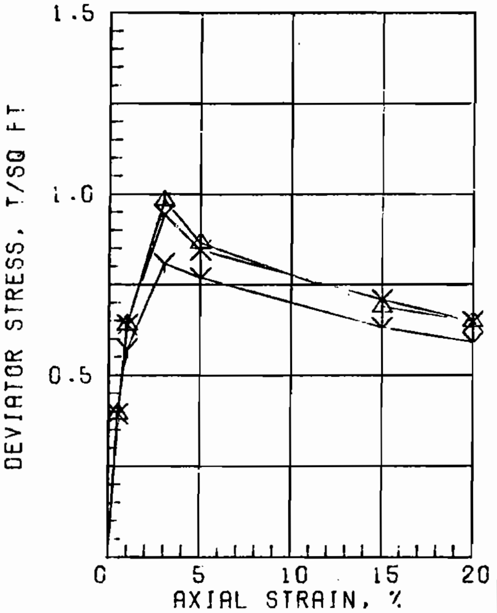
TRIAXIAL COMPRESSION TEST REPORT



C = 0.46 T/SF

Φ = 0 DEG

TAN Φ = 0



γsat. = 104.2

	SPECIMEN NO.	▲1	Y2	X3	Avg.
INITIAL	WATER CONTENT, %	55.2	59.1	57.2	57.2
	DRY DENSITY, PCF	67.2	65.0	66.4	
	SATURATION, %	98.9	100+	100+	
	VOID RATIO	1.507	1.594	1.540	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.98	0.81	0.94	
	TIME TO FAILURE, MIN.	6	18	19	
	RATE OF STRAIN INCR,%		6	6	
	INITIAL DIAMETER, IN.	1.41	1.41	1.41	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY; SILT POCKETS; SHELL PARTICLES

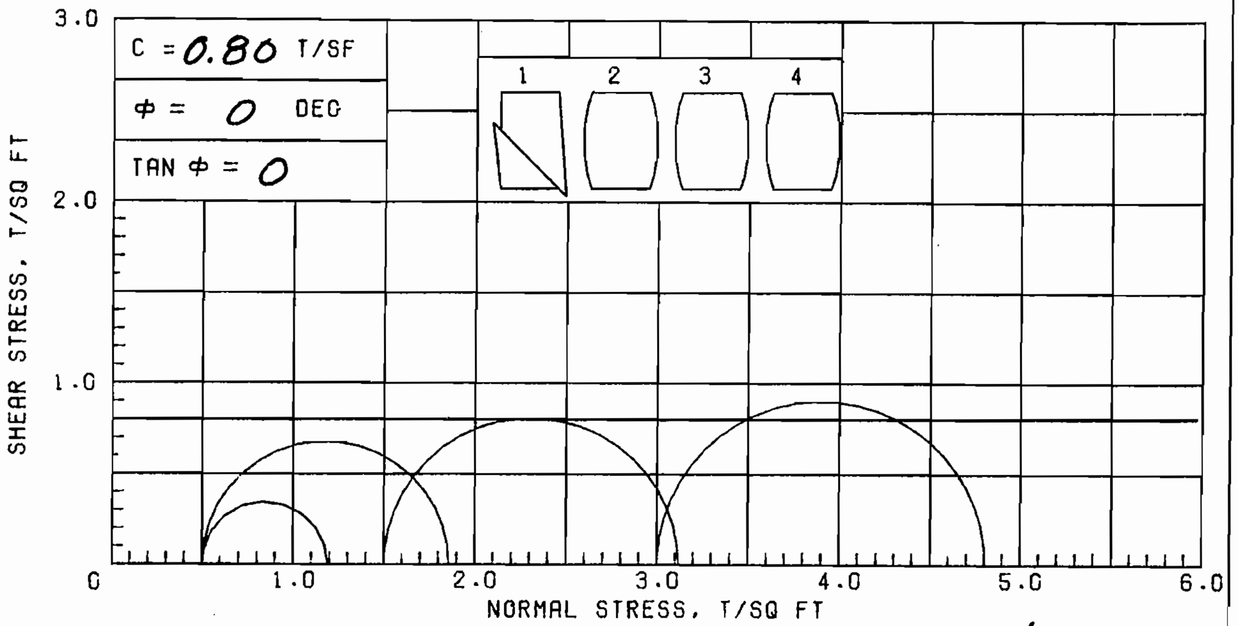
LL 70	PL 20	PI 50	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 17-ULC	SAMPLE NO. 12-B
DEPTH/ELEV 43.6/-29.4	TECH. KOC
LABORATORY USAE WES	DATE 18 JAN 83

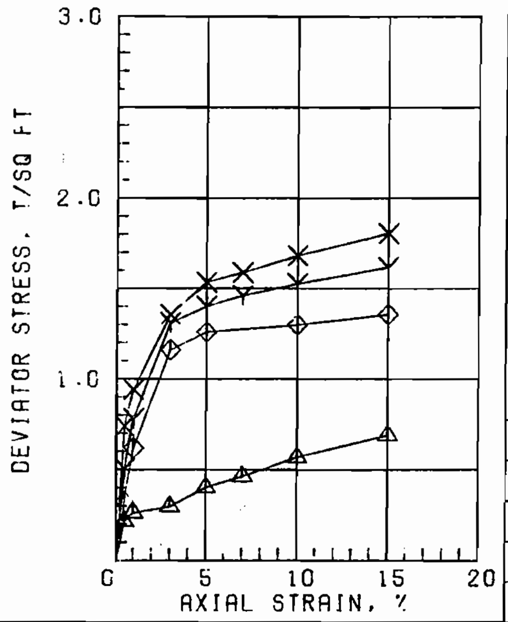
TRIAXIAL COMPRESSION TEST REPORT



C = 0.80 T/SF

Φ = 0 DEG

TAN Φ = 0



γsat. = 128.6

Avg. 20.2

SPECIMEN NO.		△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	20.3	20.6	20.0	19.7
	DRY DENSITY, PCF	105.6	104.0	103.9	106.8
	SATURATION, %	91.8	89.7	86.7	92.1
	VOID RATIO	0.597	0.620	0.623	0.578
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	0.5
MAX. DEV. STRESS, TSF		0.69	1.62	1.80	1.36
TIME TO FAILURE, MIN.		61	61	43	30
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.40	1.39	1.41	1.41
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; CLAY (CL), GRAY

LL 39	PL 12	PI 27	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

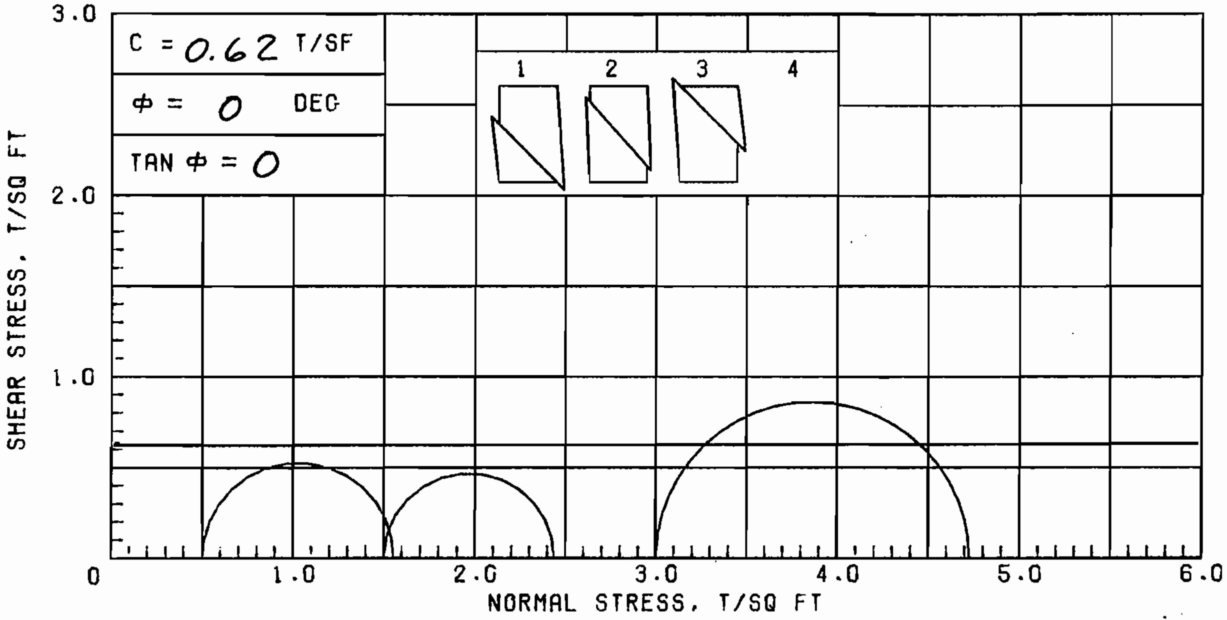
REMARKS;

PROJECT LK. PONT. LA. & VIC. - HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 17-ULC	SAMPLE NO. 14-B
DEPTH/ELEV 50.8/-38.1	TECH. RCH
LABORATORY USAE WES	DATE 18 JAN 83

TRIAXIAL COMPRESSION TEST REPORT

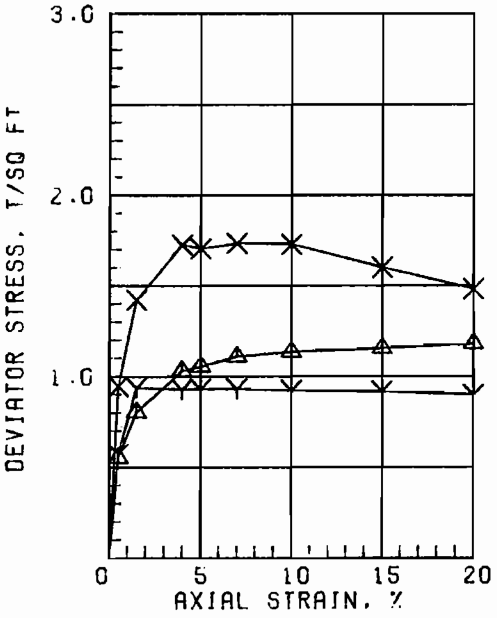


C = 0.62 T/SF

Φ = 0 DEG

TAN Φ = 0

γsat.=110.7



	SPECIMEN NO.	△1	Y2	X3	Avg.
INITIAL	WATER CONTENT, %	42.6	43.7	43.6	43.3
	DRY DENSITY, PCF	77.5	76.1	76.3	
	SATURATION, %	97.9	97.1	97.4	
	VOID RATIO	1.174	1.215	1.208	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	1.05	0.94	1.73	
	TIME TO FAILURE, MIN.	32	8	31	
	RATE OF STRAIN INCR,%	5	7	6	
	INITIAL DIAMETER, IN.	1.40	1.40	1.40	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY; IRON OXIDE STAINS CONCRETIONS

LL 77	PL 25	PI 52	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS; SPECIMEN THREE TAKEN FROM DIFFERENT LIFT.

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

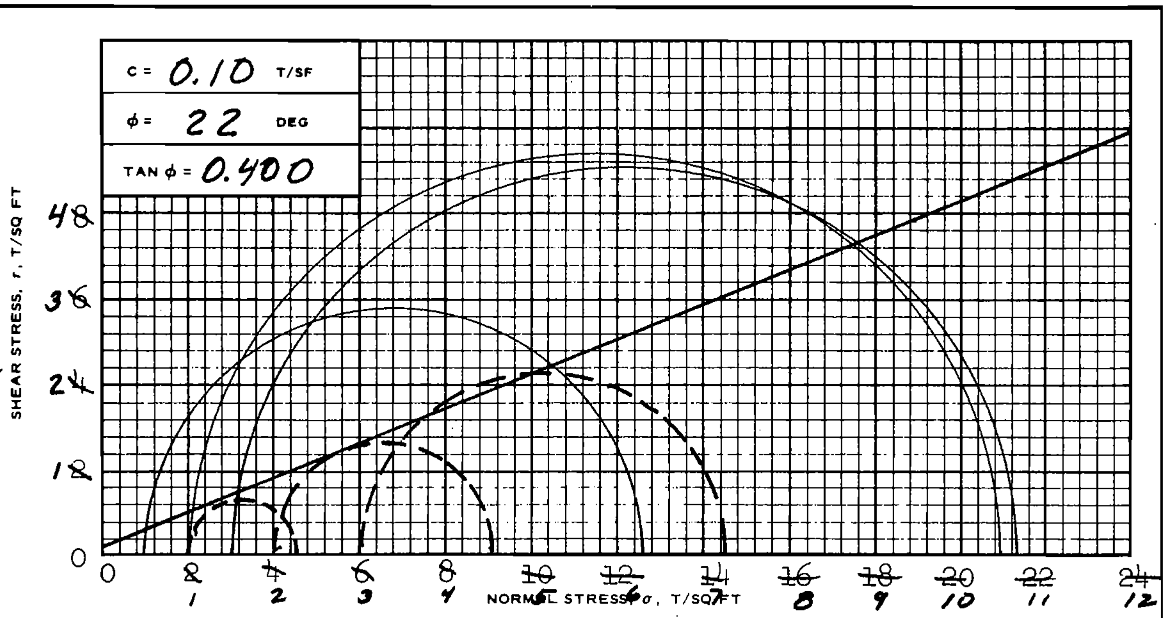
BORING NO. 17-ULC	SAMPLE NO. 16-B
DEPTH/ELEV 60.1/-45.9	TECH. RCH
LABORATORY USAE WES	DATE 18 JAN 83

TRIAXIAL COMPRESSION TEST REPORT

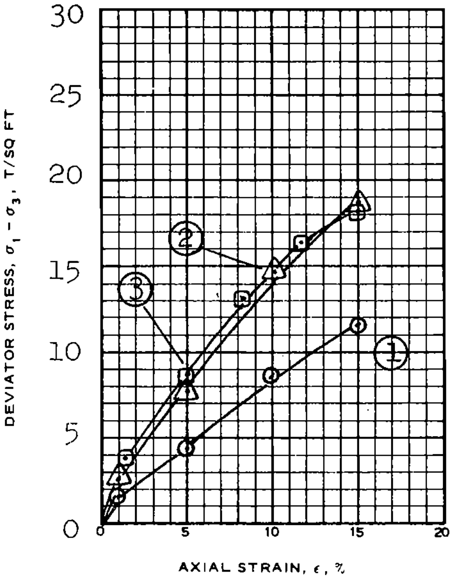
c = 0.10 T/SF

φ = 22 DEG

TAN φ = 0.400



γsat = 118.9



SPECIMEN NO.			1	2	3	Avg.
INITIAL	WATER CONTENT, %	w_o	30.9	30.7	31.0	30.9
	DRY DENSITY LB/CU FT	γ_{d_o}	89.6	90.2	90.5	
	SATURATION, %	S_o	95.5	96.2	97.8	
	VOID RATIO	e_o	0.868	0.855	0.850	
BEFORE SHEAR	WATER CONTENT, %	w_c	31.6	32.2	31.3	
	DRY DENSITY LB/CU FT	γ_{d_c}	91.3	92.7	91.9	
	SATURATION, %	S_c	100+	100+	100+	
	VOID RATIO	e_c	0.833	0.806	0.821	
	FINAL BACK PRESSURE, T/SQ FT	u_o	4.32	4.32	4.32	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	11.60	18.94	18.29	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	1071	1071	1071	
$(\sigma_1 - \sigma_3)$ MAX. PORE PRESSURE			1.3	2.6	4.3	
INITIAL DIAMETER, IN.		D_o	1.42	1.39	1.39	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS SILT (ML), GRAY; 1/4" TO 1/2" SHELLS

LL PL PI Gs 2.68(EST) TYPE OF SPECIMEN UNDISTURBED TYPE OF TEST $\bar{R}$

REMARKS:

PROJECT LK. PONTL LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 17-ULC SAMPLE NO. 7-B

DEPTH/ELEV 24.5/-10.3

LABORATORY USAEWES DATE 19 JAN 1983

SHEET 1 OF 2

JMS **TRIAXIAL COMPRESSION TEST REPORT**

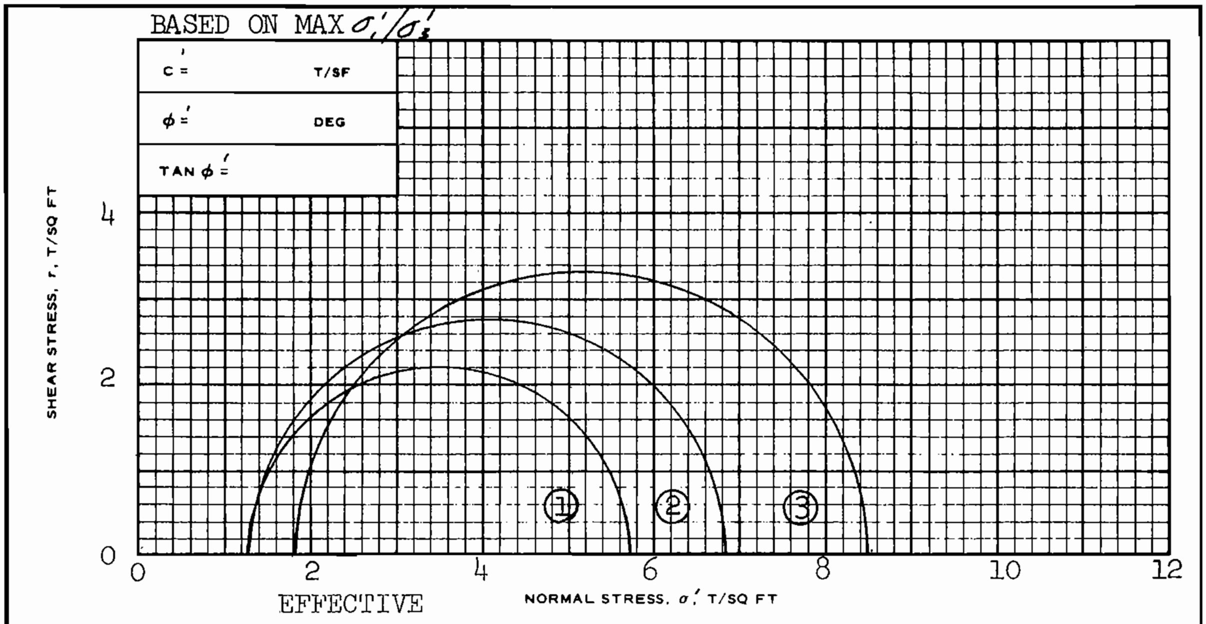
ENG FORM NO. 2089
REV JUNE 1970

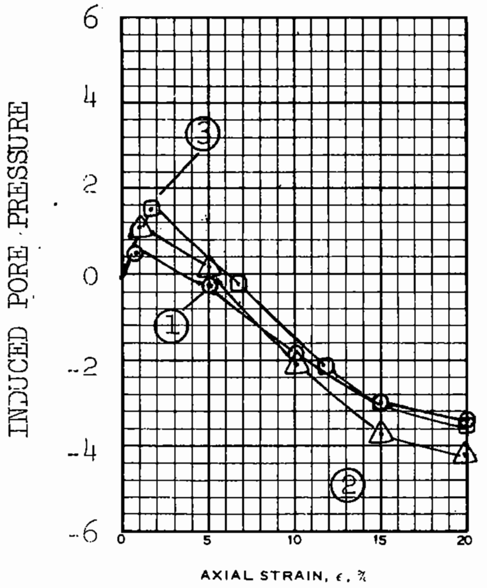
BASED ON MAX σ_1'/σ_3'

c' = T/SF

φ' = DEG

TAN φ' =





SPECIMEN NO.			1	2	3	
INITIAL	WATER CONTENT, %	w_o				
	DRY DENSITY LB/ CU FT	γd_o				
	SATURATION, %	S_o				
	VOID RATIO	e_o				
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.27	1.28	1.81	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	4.45	5.57	6.67	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f				
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o				
INITIAL HEIGHT, IN.		H_o				

CONTROLLED- TEST

DESCRIPTION OF SPECIMENS

LL	PL	PI	Gs

TYPE OF SPECIMEN

TYPE OF TEST

REMARKS:

PROJECT LK. PONT. LA & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 17-ULC

SAMPLE NO. 7-B

DEPTH/ELEV 24.5/-10.3

LABORATORY USAEWES

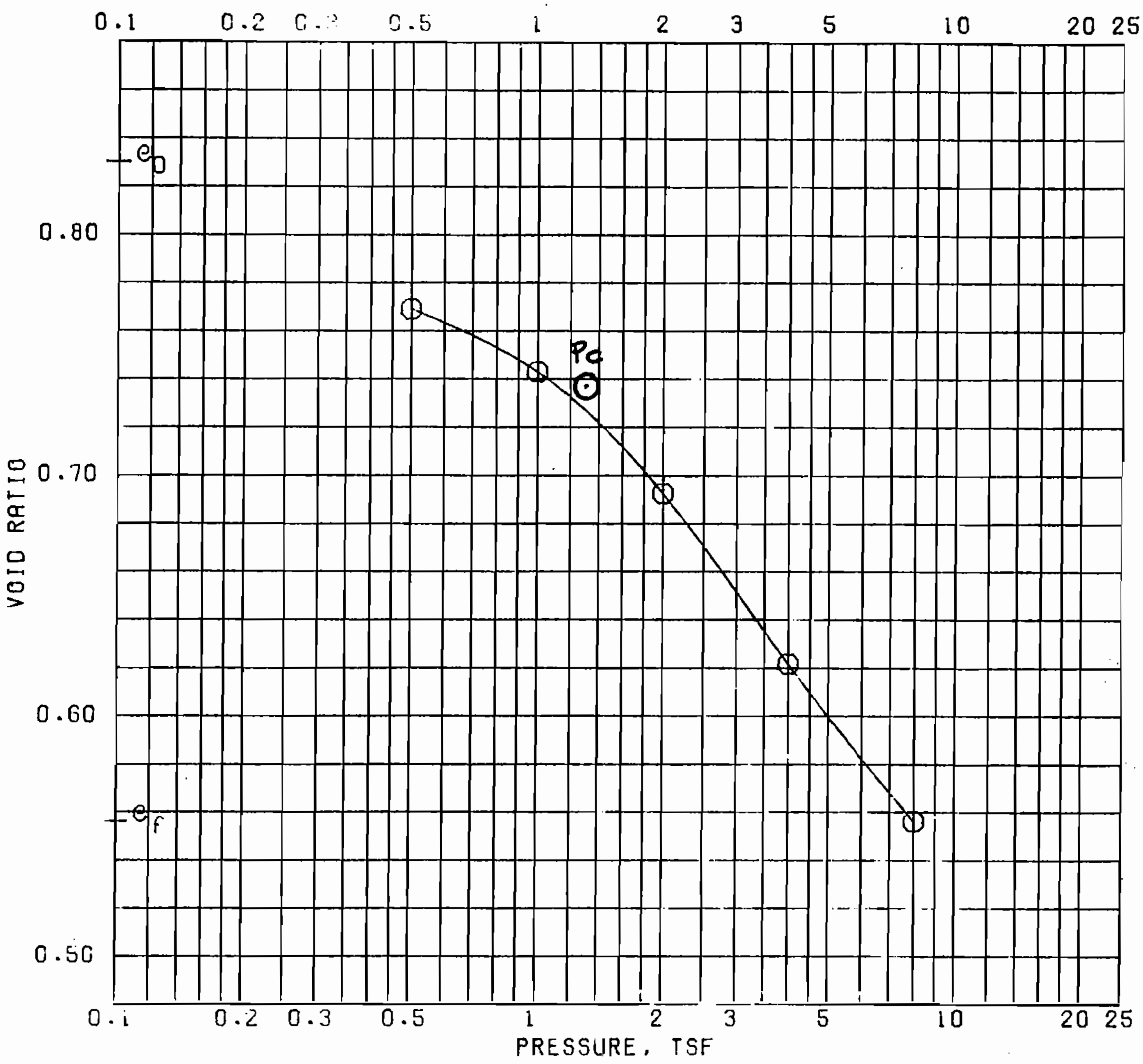
DATE 19 JAN 1983

SHEET 2 OF 2

JMS

TRIAXIAL COMPRESSION TEST REPORT

ENG FORM NO. 2089
REV JUNE 1970



$\gamma sat. = 120.4$

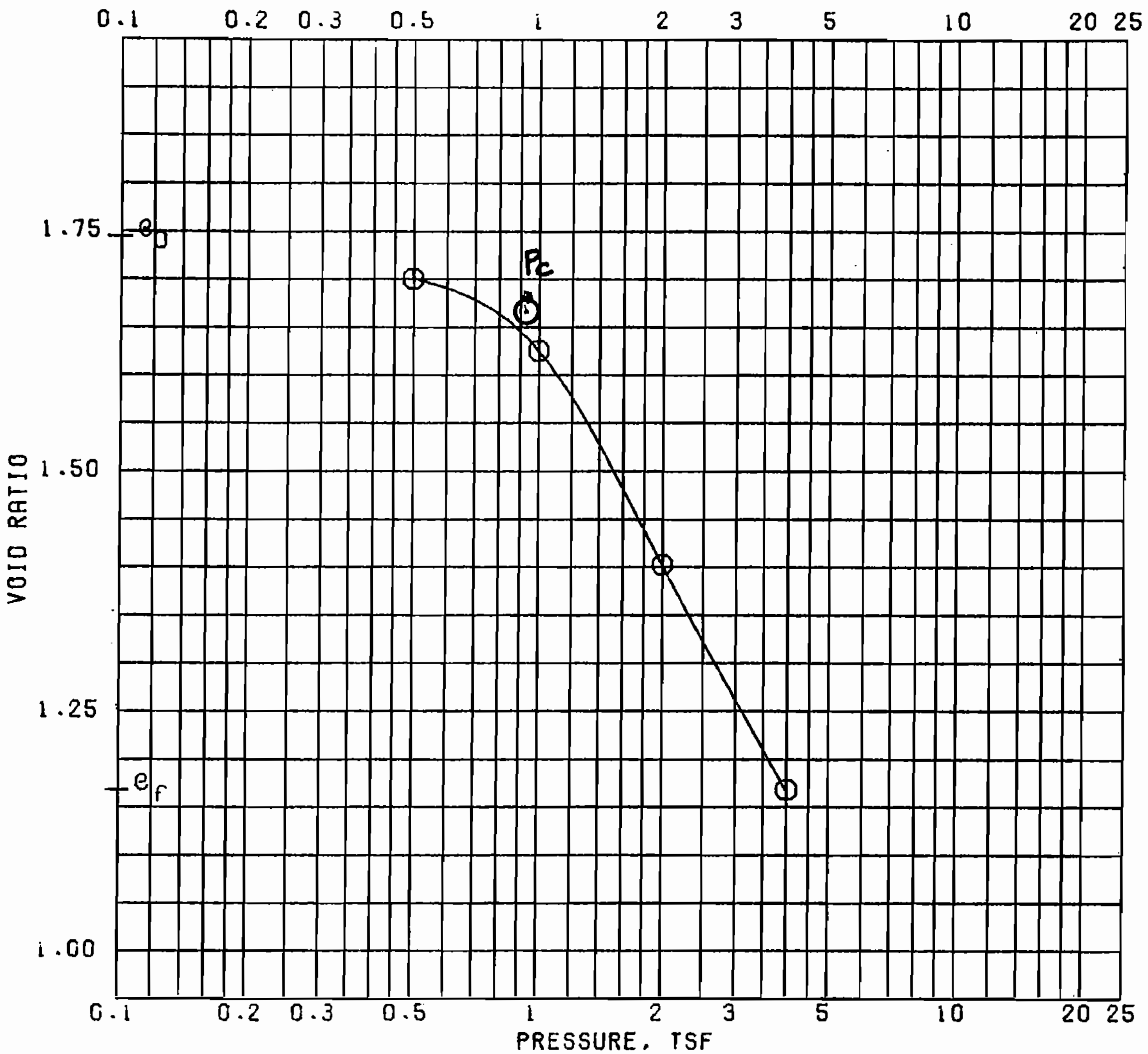
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	25.0	22.7
PRECONSOL. PRESSURE, TSF	1.3	DRY DENSITY, PCF	92.1	108.4
COMPRESSION INDEX	0.237	SATURATION, %	81.5	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.829	0.555
DIA. IN 4.44	HT. IN 1.116	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), LT. BROWN; FISSURED; SILT LENSES

LL 53	PL 14	PI 39	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE
REMARKS		BORING NO. 17-ULC	SAMPLE NO. 1-C
		DEPTH/ELEV 1.7/+12.5	DATE 31 JAN 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 7



γ sat. = 101.2

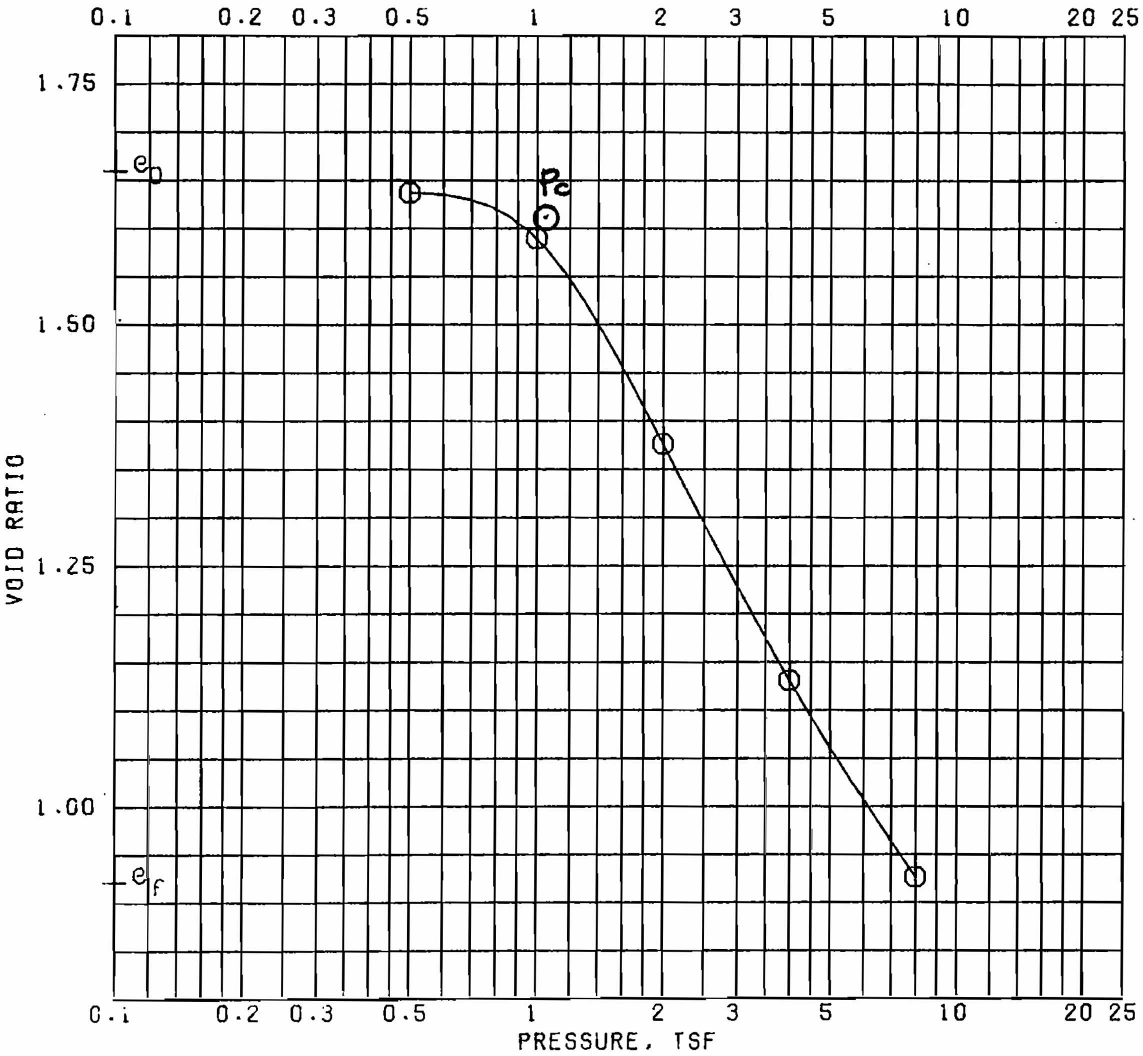
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	63.4	44.4
PRECONSOL. PRESSURE, TSF	0.93	DRY DENSITY, PCF	61.5	77.8
COMPRESSION INDEX	0.79	SATURATION, %	98.3	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.742	1.166
DIA. IN 4.44	HT. IN 1.124	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY

LL 66	PL 19	PI 47	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE
REMARKS		BORING NO. 17-ULC	SAMPLE NO. 9-C
		DEPTH/ELEV 32.5/-18.3	DATE 31 JAN 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 6



γ sat. =102.3

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	60.9	36.5
PRECONSOL. PRESSURE, TSF	1.05	DRY DENSITY, PCF	63.4	87.8
COMPRESSION INDEX	0.82	SATURATION, %	99.2	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.658	0.919
DIA. IN 4.44	HT. IN 1.116	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY

LL 75 | PL 20 | PI 55

GS 2.70 (EST) | D_{10}

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

CITRUS LAKEFRONT LEVEE

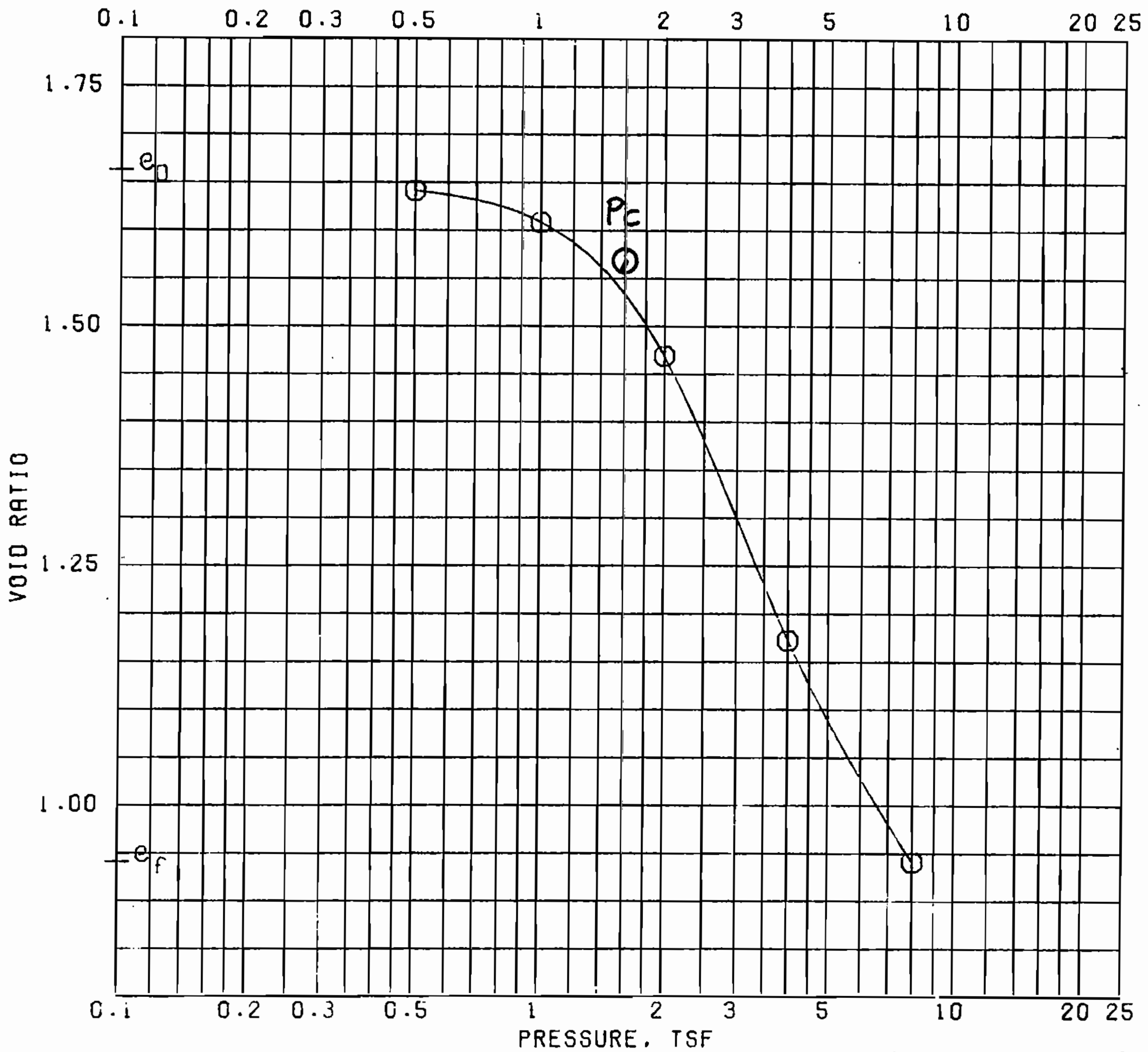
REMARKS

BORING NO. 17-ULC | SAMPLE NO. 10-C

DEPTH/ELEV 36.8/-22.6 | DATE 01 FEB 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 7



γsat. = 102.4

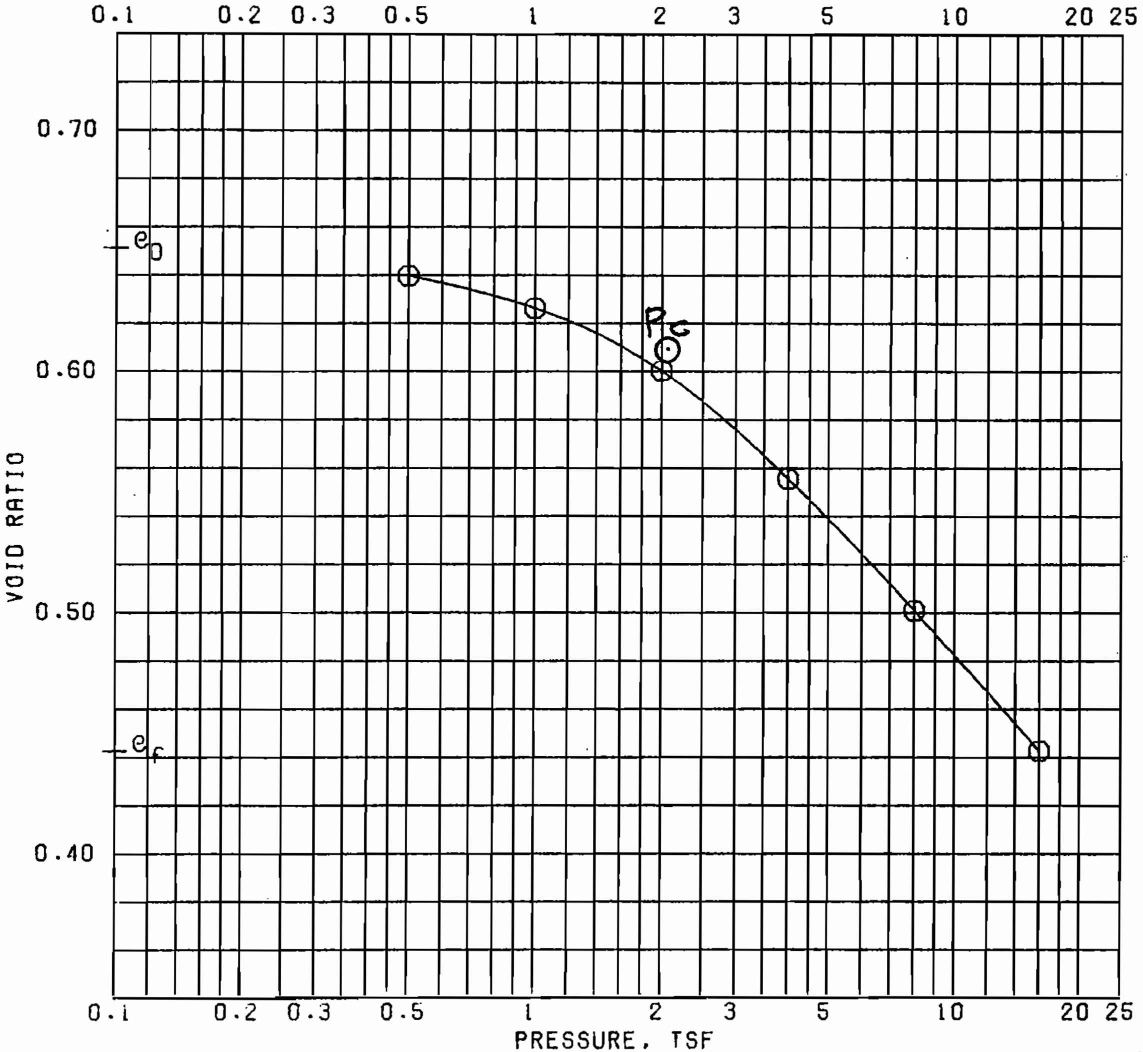
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	60.7	36.7
PRECONSOL. PRESSURE, TSF	1.6	DRY DENSITY, PCF	63.4	86.9
COMPRESSION INDEX	0.99	SATURATION, %	98.7	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.661	0.939
DIA. IN 4.44	HT. IN 1.128	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY; SILT LENSES; SHELL PARTICLES

LL 81	PL 18	PI 63	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.	
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE	
REMARKS			BORING NO. 17-ULC	SAMPLE NO. 12C
			DEPTH/ELEV 47.5/-30.6	DATE 01 FEB 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 7



γsat. = 126.7

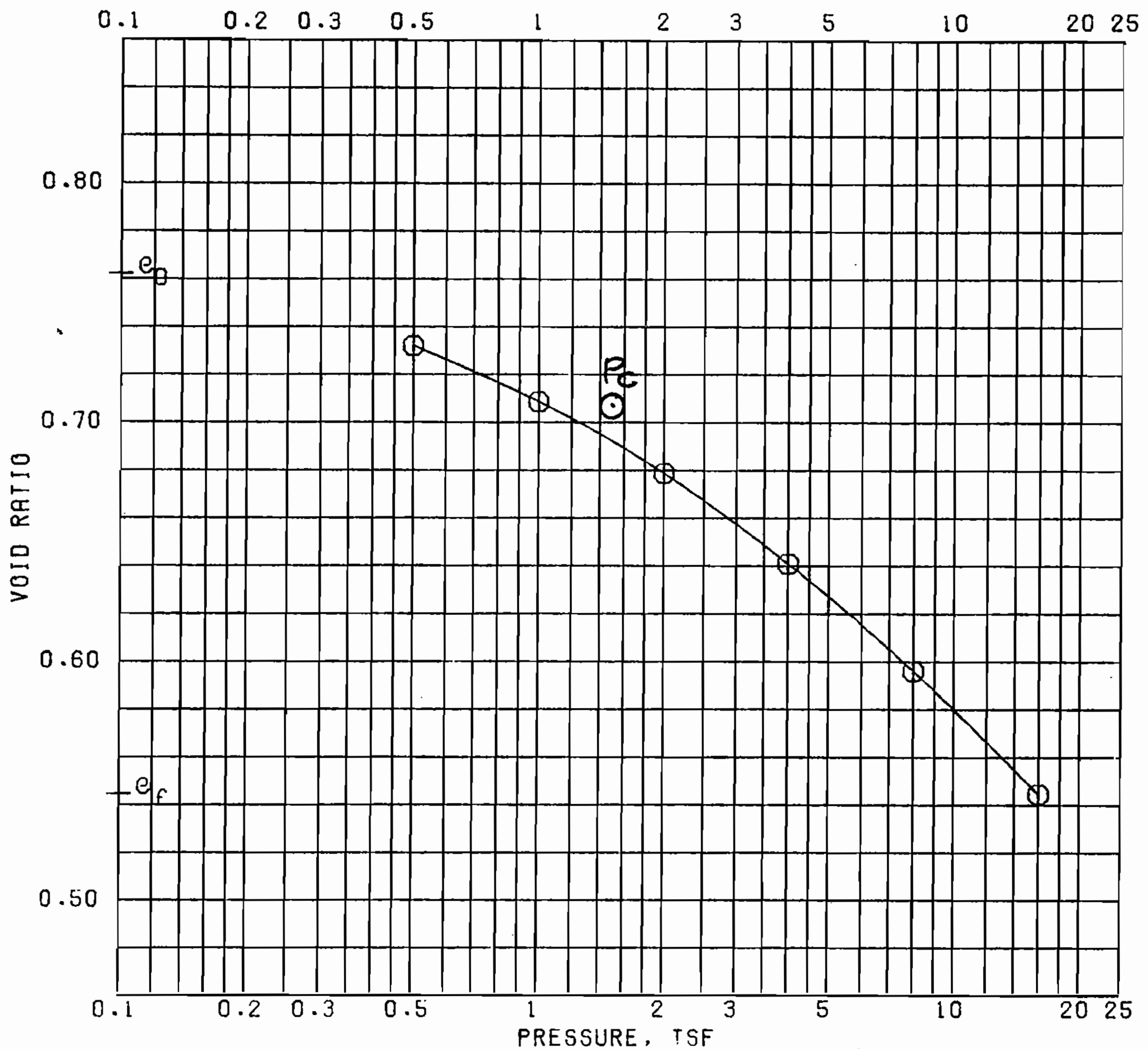
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	22.8	17.3
PRECONSOL. PRESSURE, TSF	2.1	DRY DENSITY, PCF	102.1	116.9
COMPRESSION INDEX	0.183	SATURATION, %	94.5	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.651	0.442
DIA. IN 4.44	HT. IN 1.131	BACK PRESSURE, TSF		

CLASSIFICATION CLAY (CL), LIGHT BROWN

LL 43	PL 13	PI 30	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.	
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE	
REMARKS			BORING NO. 17-ULC	SAMPLE NO. 14-C
			DEPTH/ELEV 53.0/-38.8	DATE 02 FEB 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 8

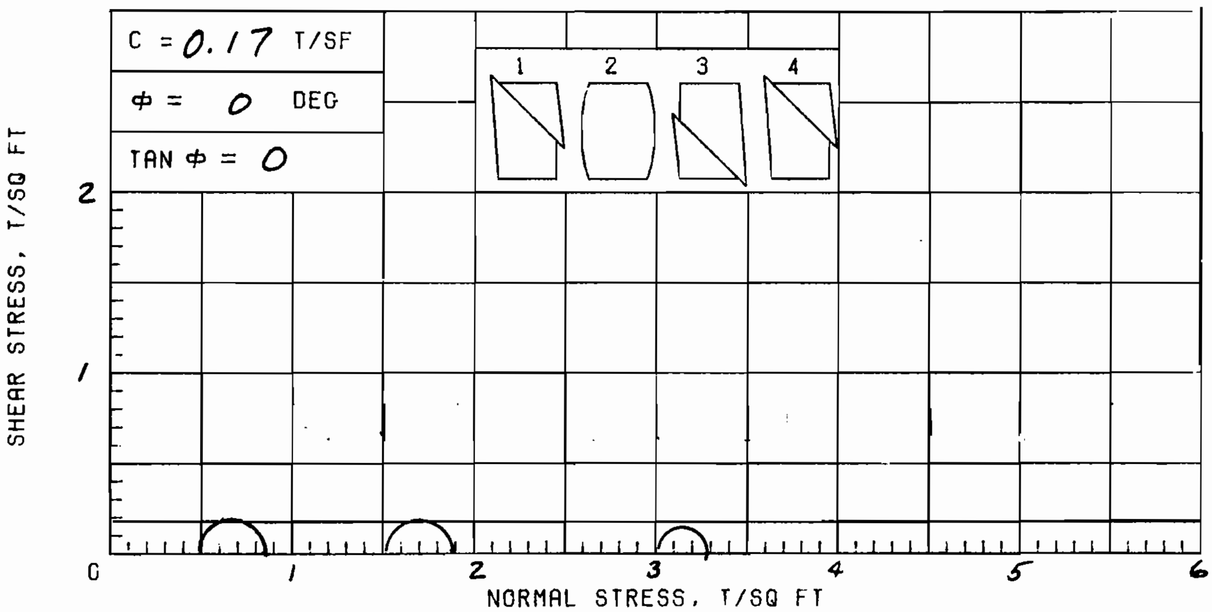


$\gamma_{sat.} = 122.7$

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	26.7	20.0
PRECONSOL. PRESSURE, TSF	1.5	DRY DENSITY, PCF	95.7	109.2
COMPRESSION INDEX	0.305	SATURATION, %	94.6	99.5
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.762	0.544
DIA. IN 4.44	HT. IN 1.130	BACK PRESSURE, TSF		
CLASSIFICATION CLAY (CL), GRAY				
LL 35 PL 11 PI 24		PROJECT LK. PONT. LA. & VIC.-HURR. PTOR		
GS 2.70 (EST)	D_{10}	CITRUS LAKEFRONT LEVEE		
REMARKS		BORING NO. 17-ULC	SAMPLE NO. 16-C	
		DEPTH/ELEV 61.0/-46.8	DATE 02 FEB 83	

CONSOLIDATION TEST REPORT

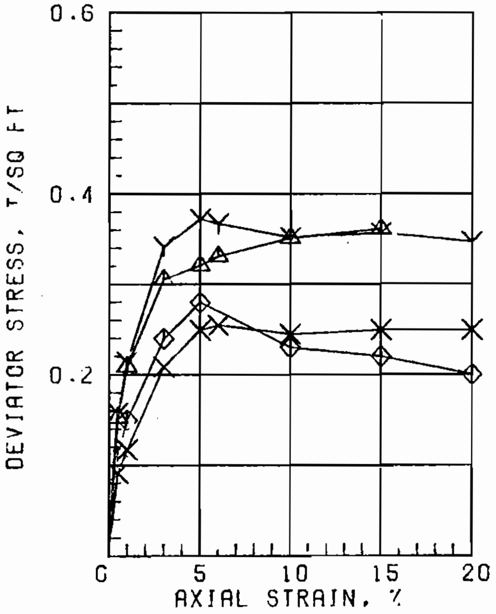
SHEET 1 OF 8



C = 0.17 T/SF

Φ = 0 DEG

TAN Φ = 0



γsat = 105.2

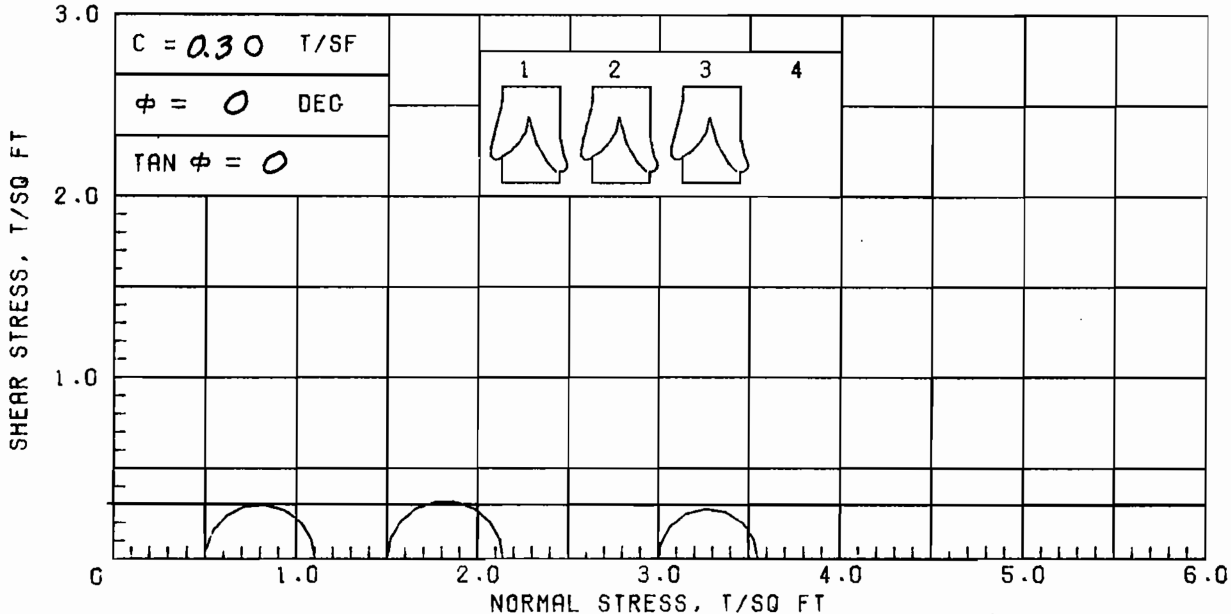
		△1	Y2	X3	◇4	
SPECIMEN NO.		△1	Y2	X3	◇4	Avg.
INITIAL	WATER CONTENT, %	53.9	54.6	53.3	60.5	55.6
	DRY DENSITY, PCF	68.9	68.0	68.8	64.7	
	SATURATION, %	100+	99.7	99.4	100+	
	VOID RATIO	1.445	1.478	1.449	1.606	
BEFORE SHEAR	WATER CONTENT, %					
	DRY DENSITY, PCF					
	SATURATION, %					
	VOID RATIO					
	BACK PRESS., TSF					
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	3.0	
MAX. DEV. STRESS, TSF		0.36	0.37	0.25	0.28	
TIME TO FAILURE, MIN.		39	9	13	10	
RATE OF STRAIN INCR.,%			6			
INITIAL DIAMETER, IN.		1.39	1.39	1.39	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY

LL 57	PL 18	PI 39	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

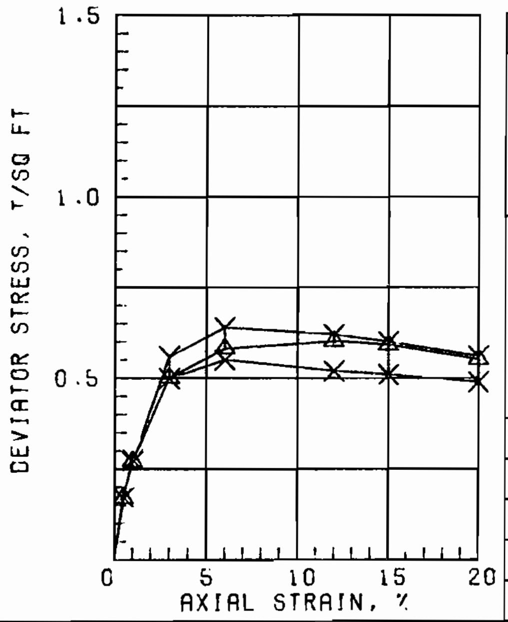
REMARKS;	PROJECT LK. PONT. LA. & VIC. - HURR. PROT.	
	CITRUS LAKEFRONT LEVEE	
	BORING NO. 18-ULC	SAMPLE NO. 7-C
	DEPTH/ELEV 25.2/-21.3	TECH. RC
	LABORATORY USAE WES	DATE 25 JAN 83
	TRIAXIAL COMPRESSION TEST REPORT	



C = 0.30 T/SF

Φ = 0 DEG

TAN Φ = 0



γsat. = 110.9

SPECIMEN NO.		Δ1	Y2	X3	Avg.
INITIAL	WATER CONTENT, %	43.7	41.7	46.0	43.8
	DRY DENSITY, PCF	77.2	78.3	75.4	
	SATURATION, %	99.7	97.7	100+	
	VOID RATIO	1.183	1.152	1.234	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.60	0.64	0.55	
TIME TO FAILURE, MIN.		23	12	15	
RATE OF STRAIN INCR.,%					
INITIAL DIAMETER, IN.		1.40	1.40	1.39	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY

LL 36	PL 19	PI 17	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

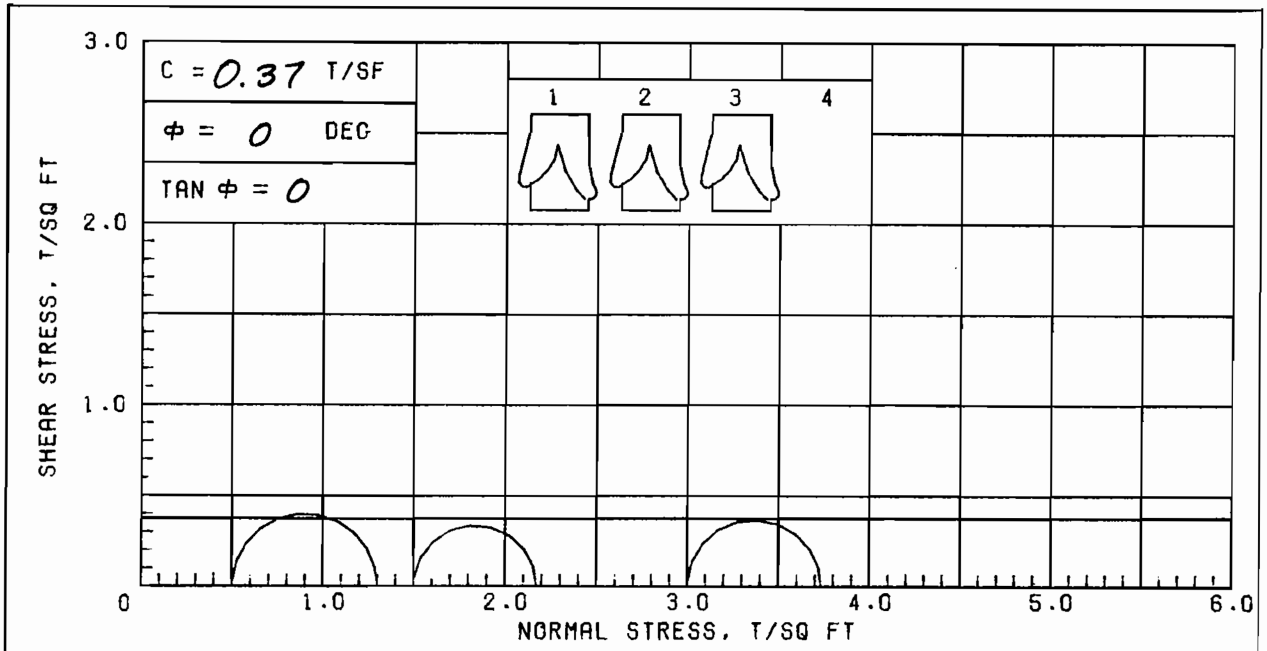
REMARKS;

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 18-ULC	SAMPLE NO. 9-B
DEPTH/ELEV 31.9/-28.0	TECH. PJR
LABORATORY USAE WES	DATE 19 JAN 83

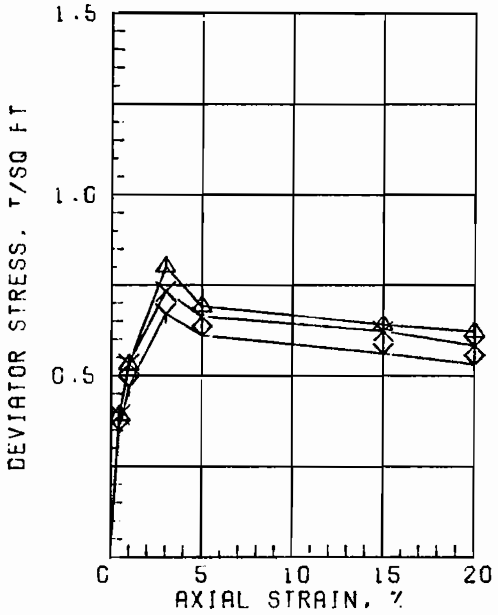
TRIAXIAL COMPRESSION TEST REPORT



C = 0.37 T/SF

φ = 0 DEG

TAN φ = 0



	SPECIMEN NO.	Δ1	Y2	X3	4
INITIAL	WATER CONTENT, %	54.0	56.3	52.0	
	DRY DENSITY, PCF	68.3	67.0	69.6	
	SATURATION, %	99.3	100+	98.9	
	VOID RATIO	1.469	1.515	1.420	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.80	0.67	0.73	
	TIME TO FAILURE, MIN.	6	18	18	
	RATE OF STRAIN INCR.,%		6	6	
	INITIAL DIAMETER, IN.	1.40	1.40	1.40	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY; FINE SAND LENSES

LL 62	PL 16	PI 46	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

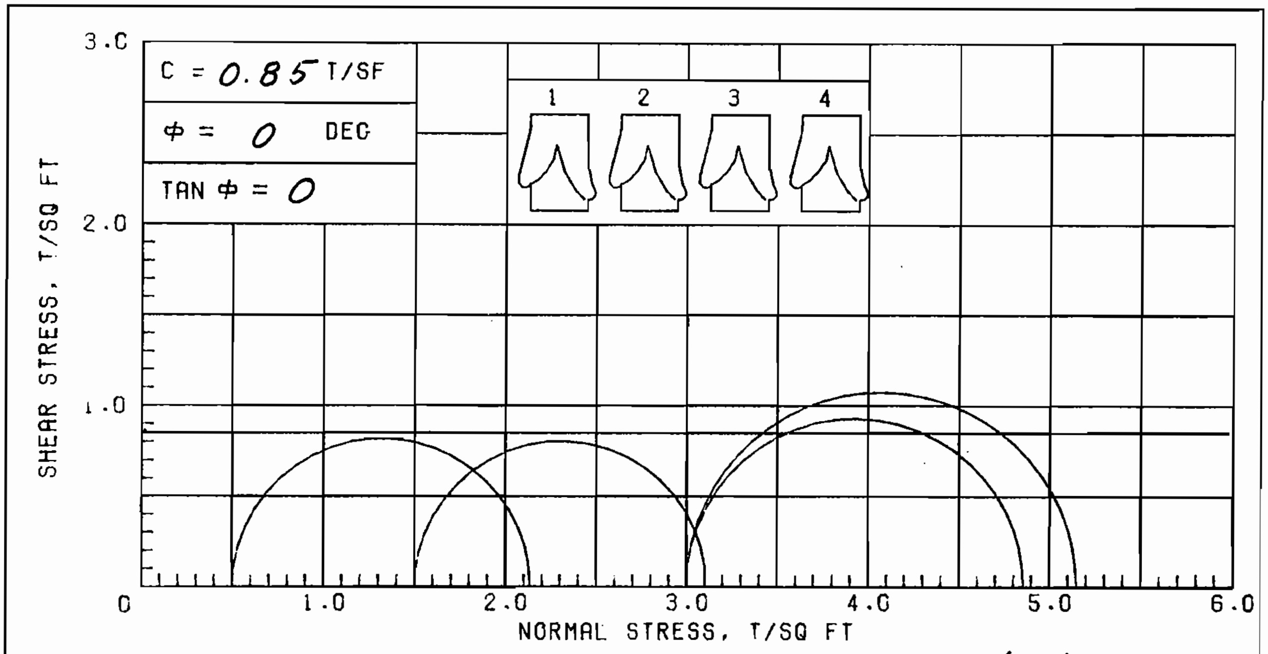
REMARKS;

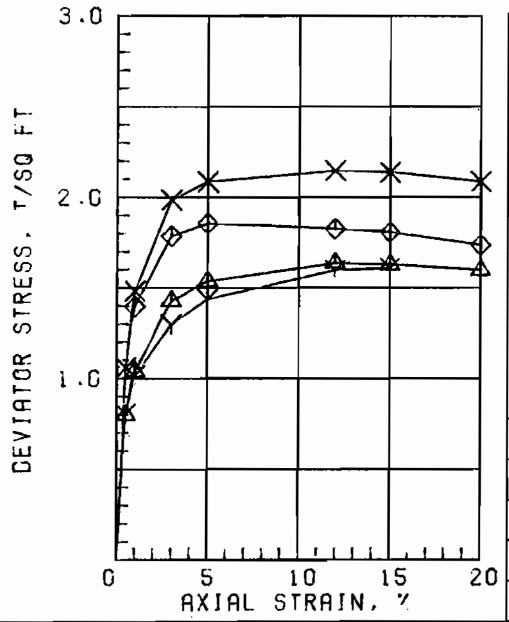
PROJECT LK. PONT. LA. & VIC.-HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 18-ULC	SAMPLE NO. 10-C
DEPTH/ELEV 37.4/-33.5	TECH. PJR
LABORATORY USAE WES	DATE 19 JAN 83

TRIAXIAL COMPRESSION TEST REPORT





γsat. = 116.2

SPECIMEN NO.		Δ1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	25.9	31.8	29.9	31.3
	DRY DENSITY, PCF	98.6	91.4	93.3	91.7
	SATURATION, %	98.6	100+	100.0	100+
	VOID RATIO	0.709	0.845	0.808	0.838
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	3.0
MAX. DEV. STRESS, TSF		1.64	1.61	2.15	1.85
TIME TO FAILURE, MIN.		37	46	37	10
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.40	1.40	1.39	1.40
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00

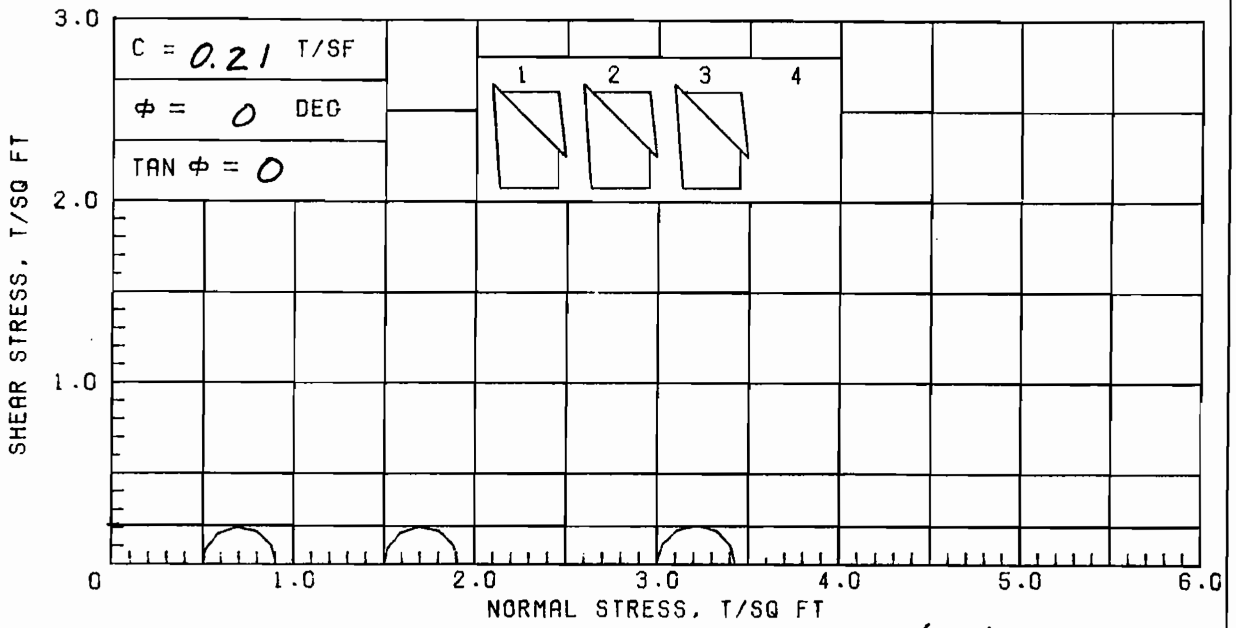
AVG.
29.7

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), LIGHT GRAY; 1/8" SEAMS OF SANDY CLAY (CL)

LL 62	PL 18	PI 44	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

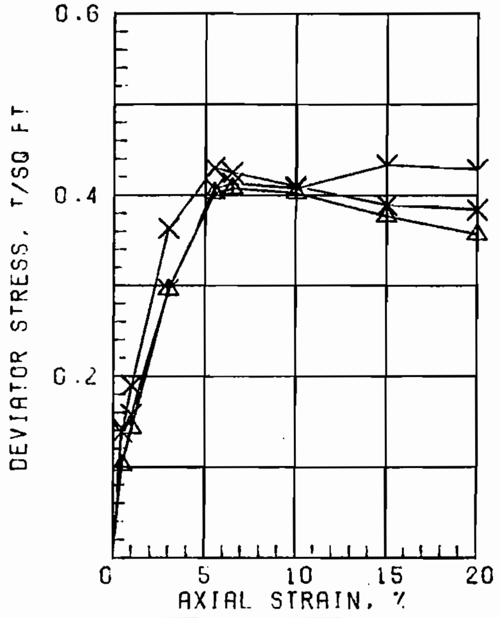
REMARKS;	PROJECT LK. PONT. LA. & VIC.-HURR. PROT.	
LIMITS ON MIXTURE OF MATERIAL.	CITRUS LAKEFRONT LEVEE	
	BORING NO. 18-ULC	SAMPLE NO. 12-C
	DEPTH/ELEV 44.8/-40.9	TECH. PJR
	LABORATORY USAE WES	DATE 19 JAN 83
	TRIAXIAL COMPRESSION TEST REPORT	



C = 0.21 T/SF

Φ = 0 DEG

TAN Φ = 0



γsat = 108.1

SPECIMEN NO.		Δ1	Y2	X3	AvG.
INITIAL	WATER CONTENT, %	50.3	46.7	51.8	49.6
	DRY DENSITY, PCF	71.9	74.7	70.1	
	SATURATION, %	100+	100+	99.5	
	VOID RATIO	1.343	1.258	1.405	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.41	0.41	0.43	
TIME TO FAILURE, MIN.		11	15	10	
RATE OF STRAIN INCR.,%					
INITIAL DIAMETER, IN.		1.39	1.39	1.38	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY

LL 55	PL 17	PI 38	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;

PROJECT LK. PONT. LA. & VIC.-HURR. PROT.
CITRUS LAKEFRONT LEVEE

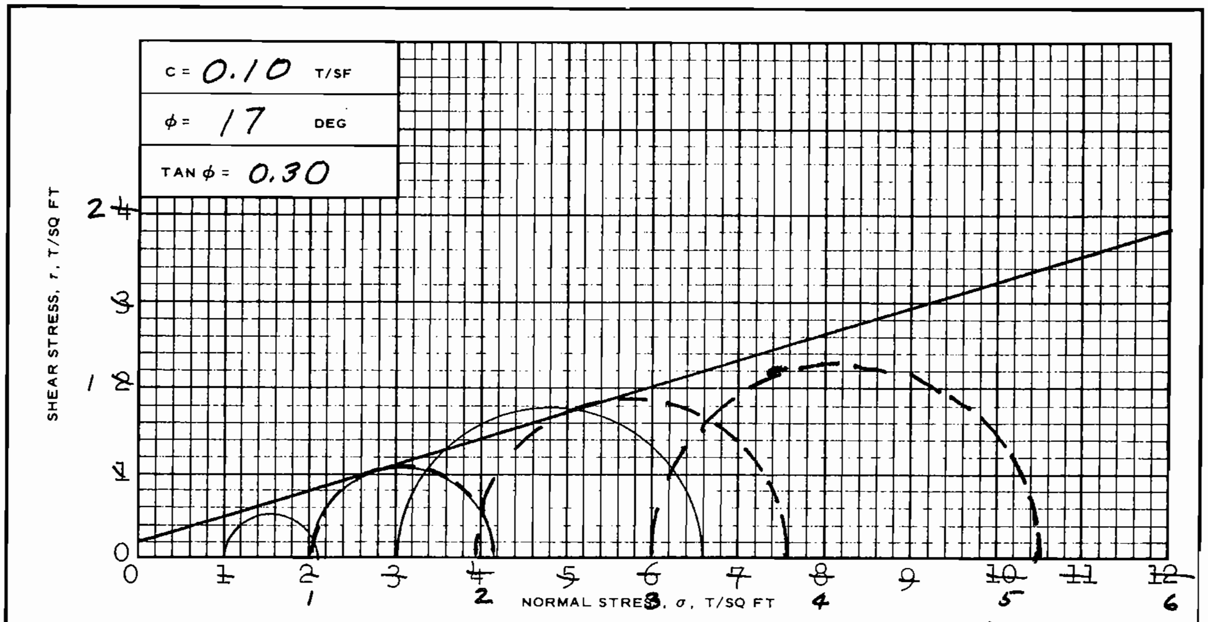
BORING NO. 18-ULC	SAMPLE NO. 16-C
DEPTH/ELEV 61.0/-57.1	TECH. RCH
LABORATORY USAE WES	DATE 18 JAN 83

TRIAXIAL COMPRESSION TEST REPORT

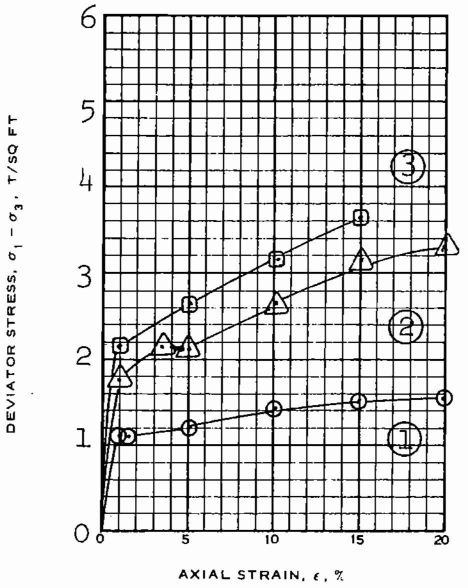
c = 0.10 T/SF

ϕ = 17 DEG

TAN ϕ = 0.30



γsat. = 121.4



SPECIMEN NO.			1	2	3	AVG.
INITIAL	WATER CONTENT, %	w_o	28.0	28.3	28.4	28.2
	DRY DENSITY LB/ CU FT	γ_{d_o}	94.5	93.3	93.6	
	SATURATION, %	S_o	96.9	95.2	96.2	
	VOID RATIO	e_o	0.778	0.800	0.794	
BEFORE SHEAR	WATER CONTENT, %	w_c	25.7	26.9	25.8	
	DRY DENSITY LB/CU FT	γ_{d_c}	98.1	97.7	99.2	
	SATURATION, %	S_c	97.0*	100+	100+	
	VOID RATIO	e_c	0.713	0.719	0.693	
	FINAL BACK PRESSURE, T/SQ FT	u_o	4.32	4.32	4.32	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	1.09	2.17	3.61	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	32	109	484	
$(\sigma_1 - \sigma_3)$ AT MAX PORE PRESSURE			1.10	1.75	2.25	
INITIAL DIAMETER, IN.		D_o	1.38	1.38	1.39	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS SANDY CLAY (CL), GRAY; SILT POCKETS TO 1/2"

LL 22 | PL 20 | PI 2 | Gs 2.69(EST) | TYPE OF SPECIMEN UNDISTURBED | TYPE OF TEST $\bar{R}$

REMARKS: *PORE PRESSURE RESPONSE INDICATED 100% SATURATION

PROJECT LK. PONT. LA. & VIC. - HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 18-ULC | SAMPLE NO. 5-B

DEPTH/ELEV 16.5/-12.6

LABORATORY USAEWES | DATE 5 FEB 1983

SHEET 1 OF 2

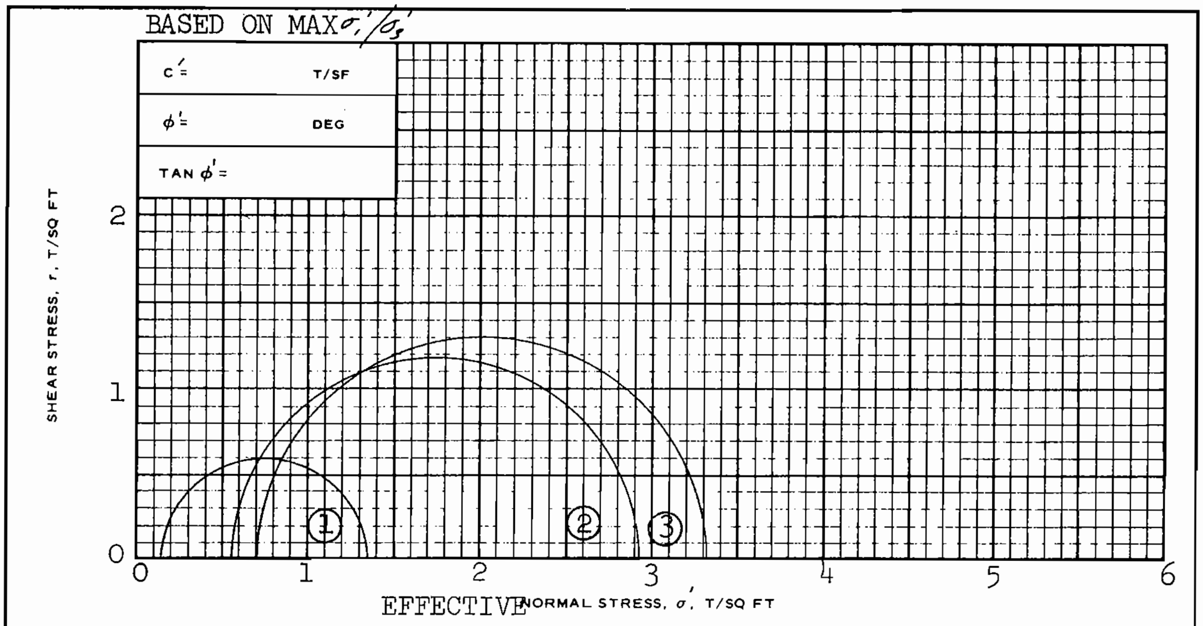
TES **TRIAXIAL COMPRESSION TEST REPORT**

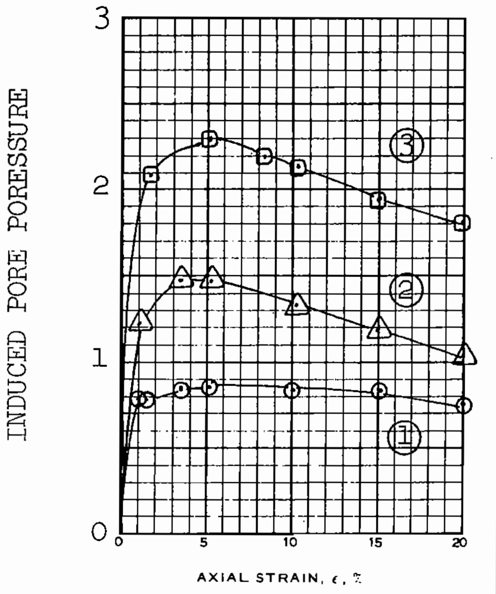
ENG FORM NO. 2089
REV JUNE 1970

GPO : 1982 0 - 375-356

BASED ON MAX σ_1'/σ_3'

c' =	T/SF
ϕ' =	DEG
TAN ϕ' =	





			1	2	3	
SPECIMEN NO.			1	2	3	
INITIAL	WATER CONTENT, %	w_o				
	DRY DENSITY LB/ CU FT	γd_o				
	SATURATION, %	S_o				
	VOID RATIO	e_o				
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.14	0.56	0.70	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	1.21	2.37	2.62	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f				
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o				
INITIAL HEIGHT, IN.		H_o				

CONTROLLED- TEST

DESCRIPTION OF SPECIMENS

LL	PL	PI	Gs	TYPE OF SPECIMEN	TYPE OF TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC. - HURR. PROT.
CITRUS LAKEFRONT LEVEE

BORING NO. 18-ULC SAMPLE NO. 5-B

DEPTH/ELEV 16.5/-12.6

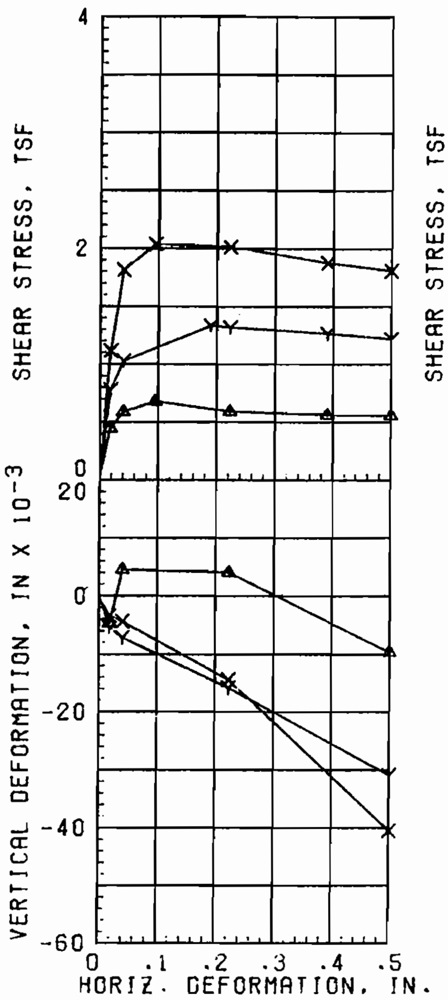
LABORATORY USAEWES DATE 5 FEB 1983

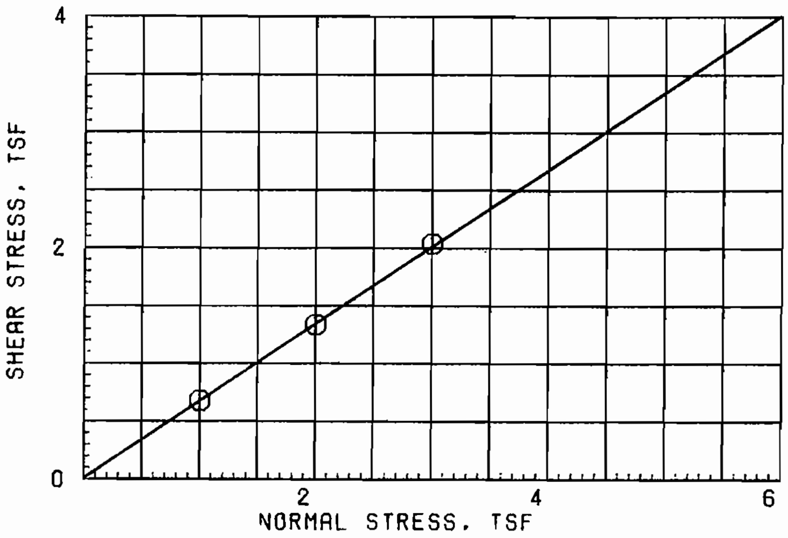
SHEET 2 OF 2

TES **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089
REV JUNE 1970

GPO : 1982 0 - 375-356





γsat. = 122.7

		TEST NO.	1 △	2 Y	3 X	AVG.
INITAL	WATER CONTENT, %		22.8	22.4	19.8	21.7
	VOID RATIO		0.757	0.749	0.710	
	SATURATION, %		80.7	80.1	74.6	
	DRY DENSITY, PCF		95.2	95.6	97.8	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			< 1	< 1	< 1	
FINAL	WATER CONTENT, %		23.5	25.7	27.5	
	VOID RATIO					
	SATURATION, %					
NORMAL STRESS, TSF			1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF			0.68	1.34	2.04	
TIME TO FAILURE, MIN			524	1049	524	
RATE OF STRAIN, IN/MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF						

Φ = 34°

TAN Φ = 0.666

C = 0

TYPE SPECIMEN UNDISTURBED | 3.00 IN. SQUARE | 0.584 IN. THICK

CLASSIFICATION SILT (ML), GRAY

LL | PL | PI | | GS 2.68 (EST)

REMARKS;

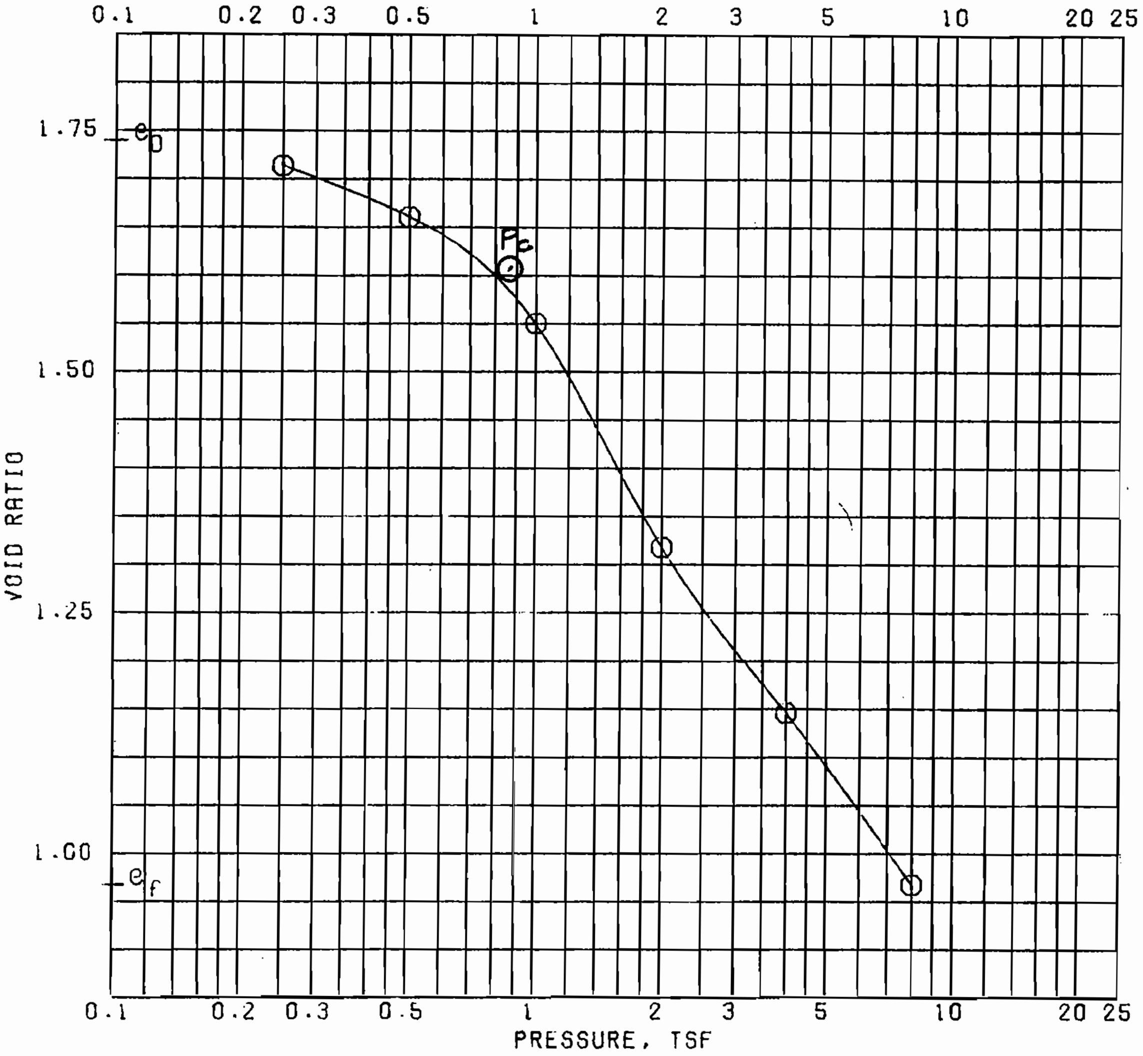
PROJECT LK. PONT. LA. & VIC. - HURR. PROT.

CITRUS LAKEFRONT LEVEE

BORING NO. 18-ULC | SAMPLE 4-B

DEPTH/ELEV 11.5/-7.6 | DATE 28 JAN 83

DIRECT SHEAR TEST REPORT

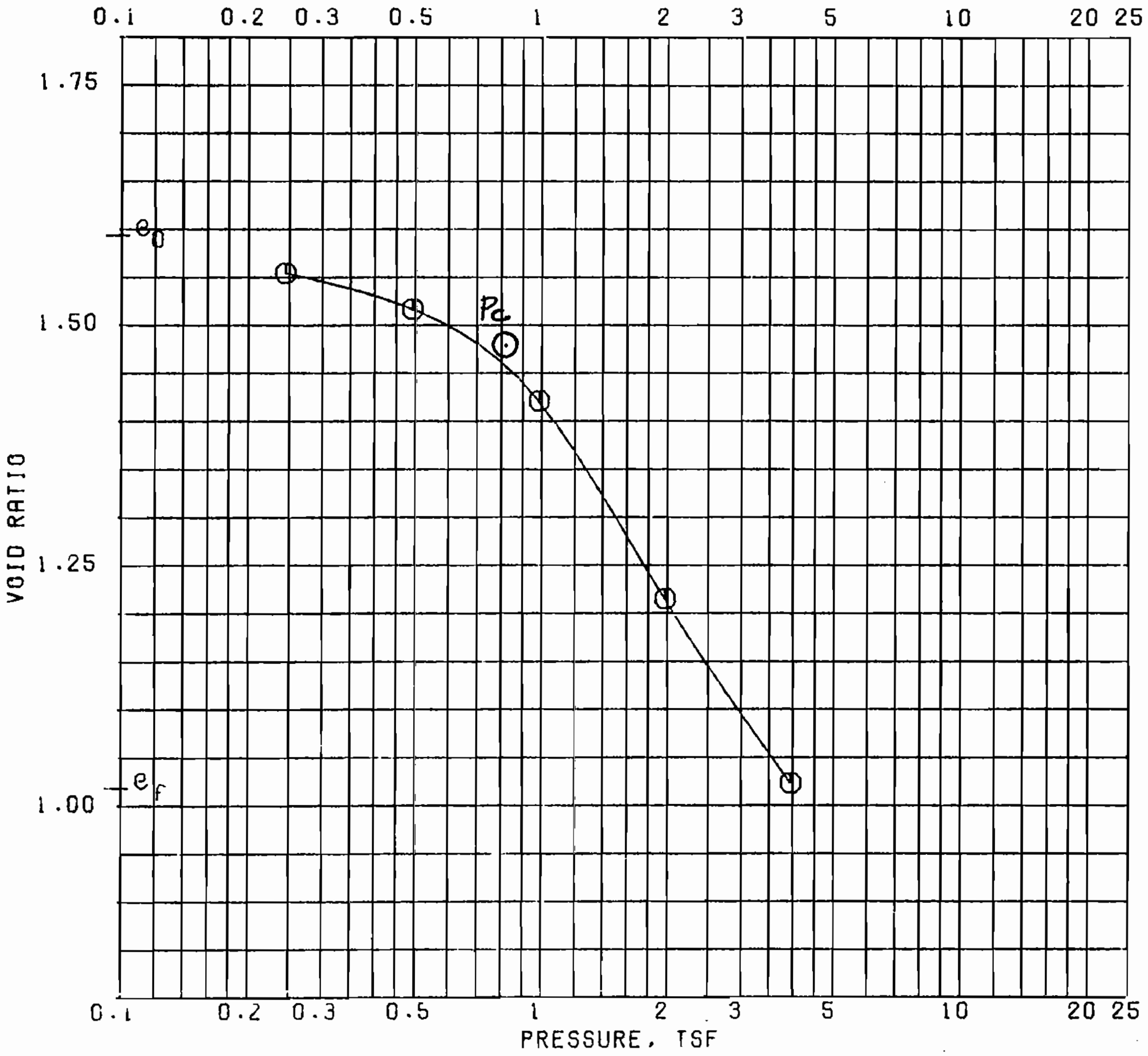


$\gamma_{sat.} = 101.3$

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	64.1	36.9
PRECONSOL. PRESSURE, TSF	0.85	DRY DENSITY, PCF	61.6	85.8
COMPRESSION INDEX	0.78	SATURATION, %	99.5	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.738	0.966
DIA. IN 4.44	HT. IN 1.131	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY; SILT POCKETS				
LL 72	PL 21	PI 51	PROJECT LK. PONT. LA. & VIC. - HURR. PROT.	
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE	
REMARKS			BORING NO. 18-ULC	SAMPLE NO. 7-B
			DEPTH/ELEV 24.0/-20.1	DATE 04 FEB 83
			CONSOLIDATION TEST REPORT	

SHEET 1 OF 8



γsat = 103.4

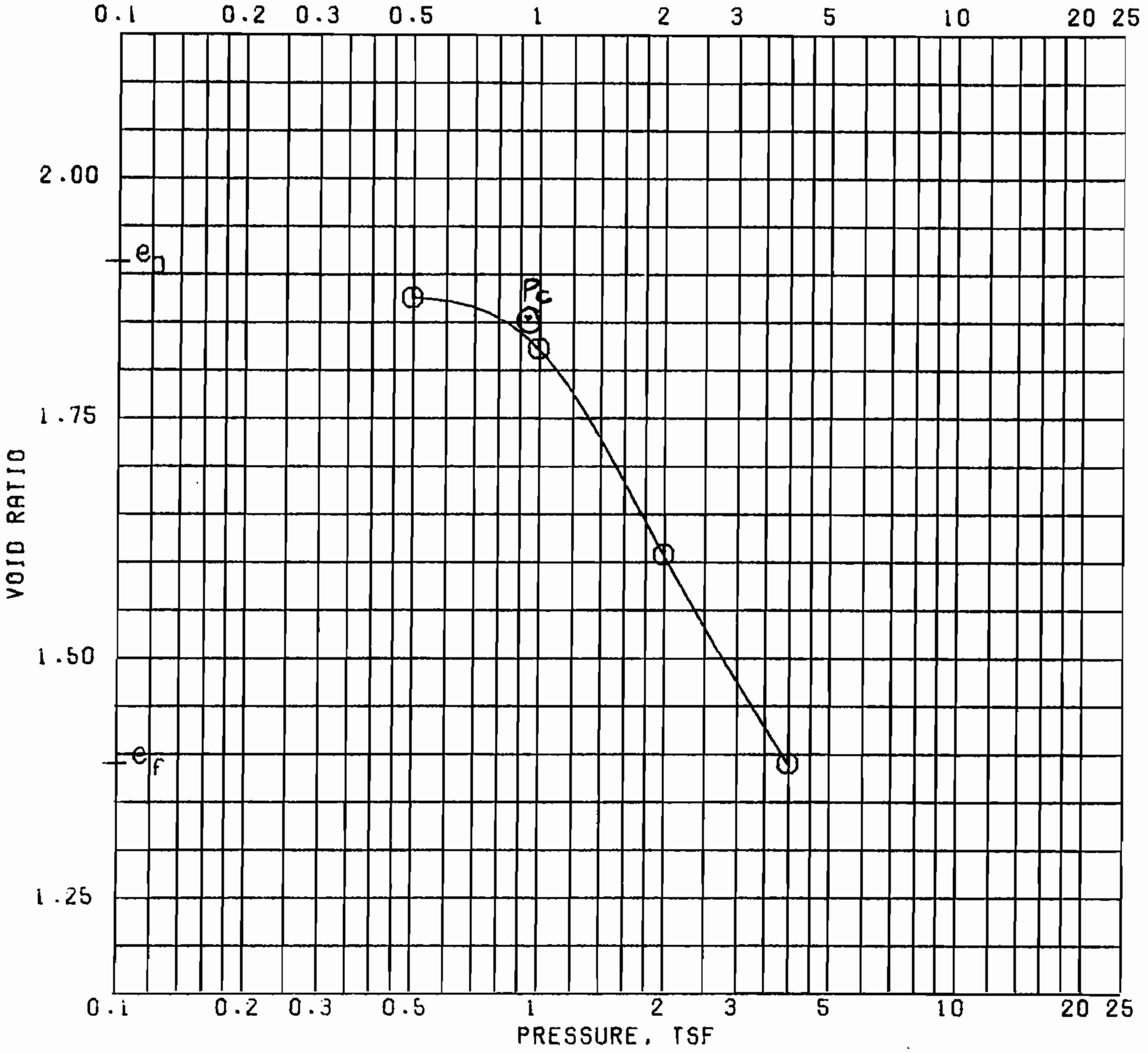
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	57.5	37.5
PRECONSOL. PRESSURE, TSF	0.81	DRY DENSITY, PCF	65.1	83.6
COMPRESSION INDEX	0.67	SATURATION, %	97.7	99.6
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.590	1.016
DIA. IN 4.44	HT. IN 1.119	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY

LL	PL	PI	PROJECT LK. PONT. LA. & VIC. - HURR. PROT.	
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE	
REMARKS			BORING NO. 18-ULC	SAMPLE NO. 9-B
			DEPTH/ELEV 32.6/-28.1	DATE 03 FEB 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 7



γ_{sat} = 98.9

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	53.6	36.3
PRECONSOL. PRESSURE, TSF	0.91	DRY DENSITY, PCF	57.9	70.6
COMPRESSION INDEX	0.73	SATURATION, %	75.7	70.5
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.910	1.388
DIA. IN 4.44	HT. IN 1.328	BACK PRESSURE, TSF		

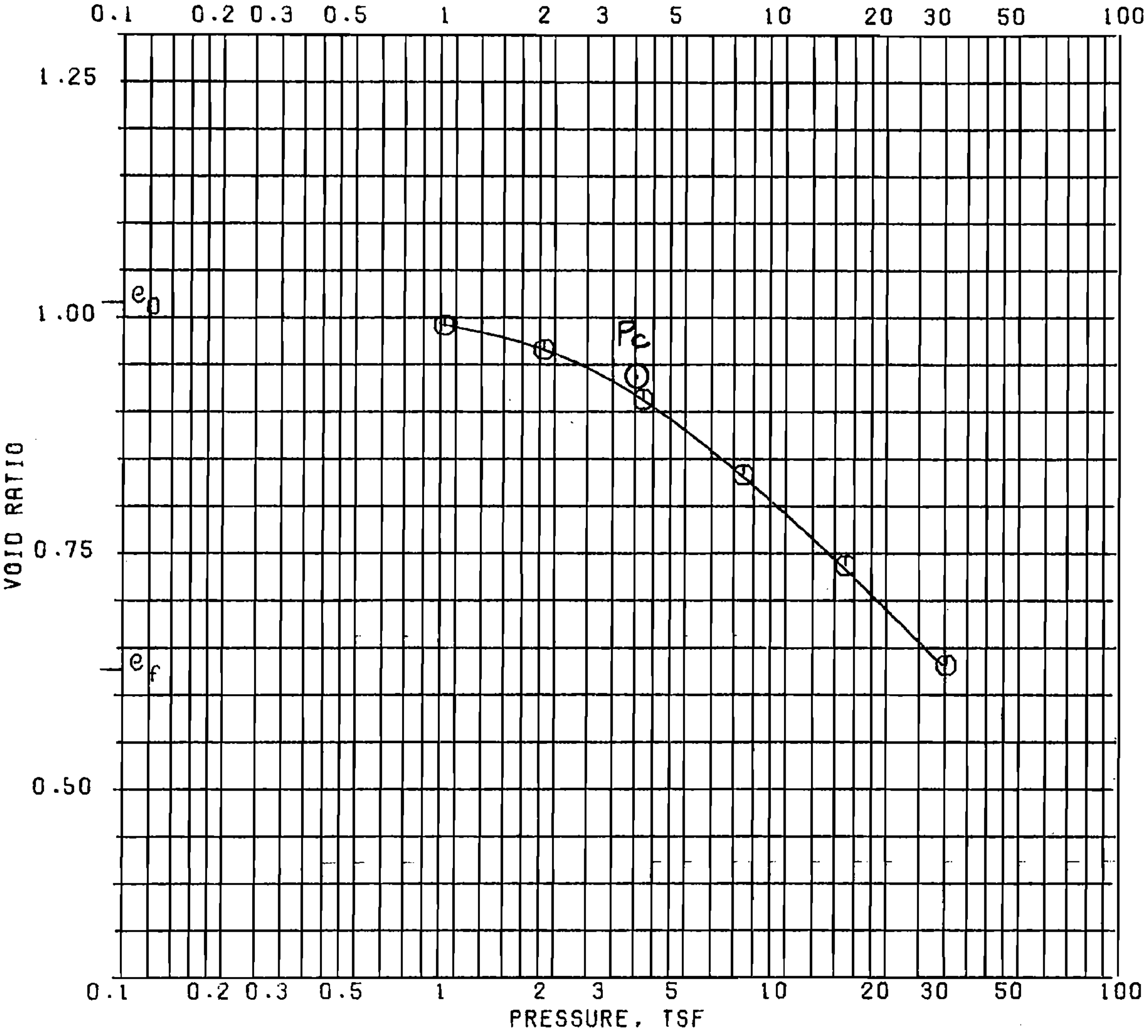
CLASSIFICATION PLASTIC CLAY (CH), GRAY

LL 57	PL 17	PI 40	PROJECT LK. PONT. LA. & VIC. - HURR. PROT.
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE

REMARKS	BORING NO. 18-ULC	SAMPLE NO. 10-B
	DEPTH/ELEV 36.5/-32.6	DATE 05 FEB 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 6



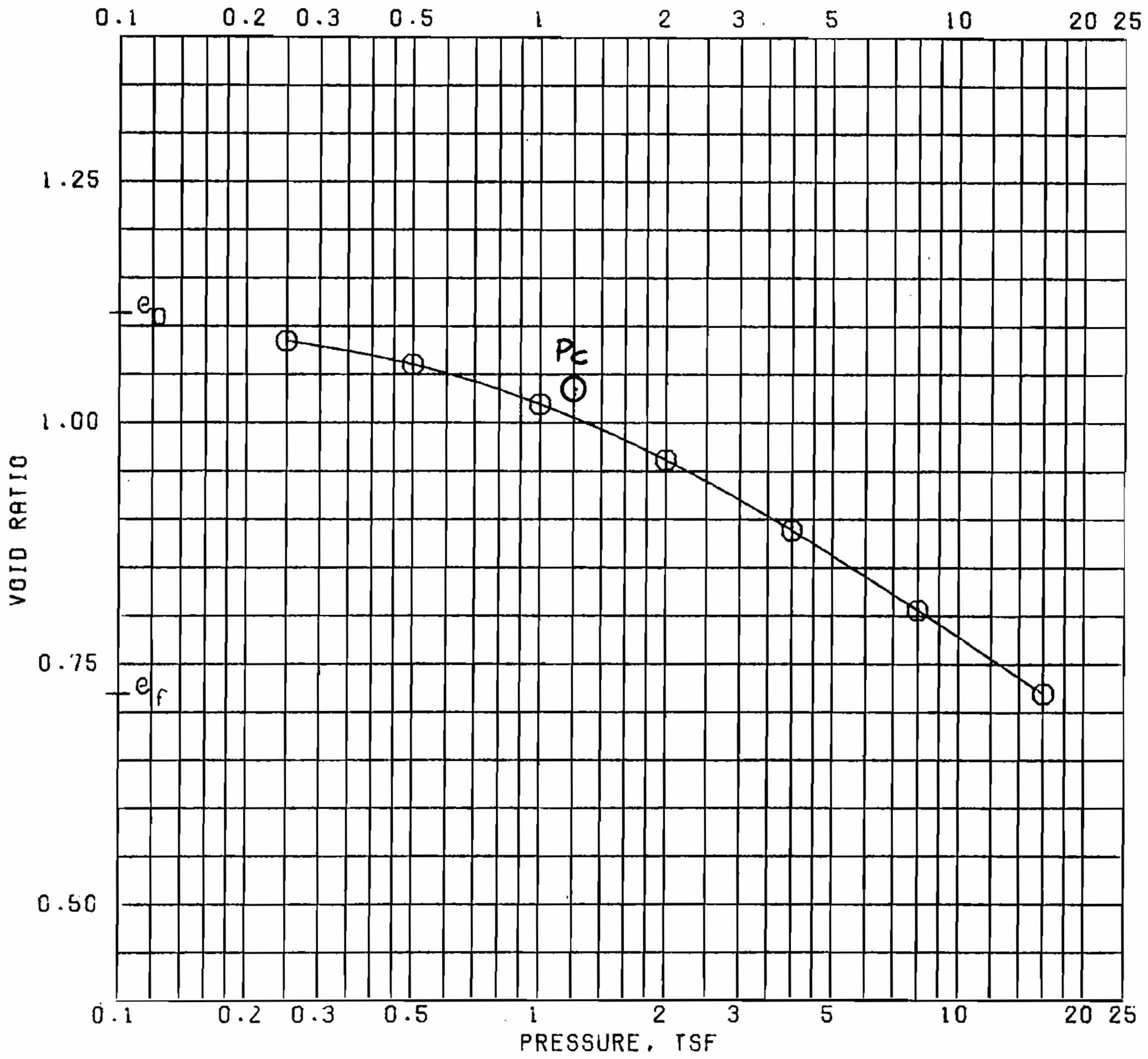
$\gamma_{sat.} = 115.2$

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	37.3	25.7
PRECONSOL. PRESSURE, TSF	3.5	DRY DENSITY, PCF	83.8	103.9
COMPRESSION INDEX	0.32	SATURATION, %	99.5	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.012	0.623
DIA. IN 4.44	HT. IN 1.124	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), LIGHT GRAY				
LL	PL	PI	PROJECT LK. PONT. LA. & VIC. - HURR. PROT.	
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE	
REMARKS			BORING NO. 18-ULC	SAMPLE NO. 12-C
			DEPTH/ELEV 45.6/-41.7	DATE 05 FEB 83

CONSOLIDATION TEST REPORT

SHEET 1 OF 8



$\gamma sat. = 112.7$

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	39.5	27.4
PRECONSOL. PRESSURE, TSF	1.2	DRY DENSITY, PCF	79.8	98.1
COMPRESSION INDEX	0.54	SATURATION, %	95.9	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.112	0.718
DIA. IN 4.44	HT. IN 1.121	BACK PRESSURE, TSF		

CLASSIFICATION 1/2 PLASTIC CLAY (CH), GRAY; 1/2 SILT (ML), GRAY

LL	PL	PI	PROJECT LK. PONT. LA. & VIC. - HURR. PROT.	
GS 2.70 (EST)	D_{10}		CITRUS LAKEFRONT LEVEE	
REMARKS			BORING NO. 18-ULC	SAMPLE NO. 16-C
			DEPTH/ELEV 61.6/-57.7	DATE 07 FEB 83

CONSOLIDATION TEST REPORT

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