U. S. ARMY, CORPS OF ENGINEERS

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN

DESIGN MEMORANDUM NO. 10,
CORROSION PROTECTION

Prepared in the Office of the District Engineer
New Orleans District, Corps of Engineers
New Orleans, Louisiana

March 1969

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

LMNED-PP

26 March 1969

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Design Memorandum No. 10, Corrosion Protection

Division Engineer, Lower Mississippi Valley
ATTN: LMVED-TD

1. The subject design memorandum is submitted herewith for review and approval in accordance with the provisions of ER 1110-2-1150 dated 1 July 1966.

2. Approval of Design Memorandum No. 10 is recommended.

Herbert R. Haar, Jr.

1 Incl (16 cys)
DM No. 10

HERBERT R. HAAR, JR.
Colonel, CE
District Engineer

Rm 1310

LMVED-TD (NOD 26 Mar 69) 1st Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Design Memorandum No. 10, Corrosion Protection

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 25 Apr 69

TO: Chief of Engineers, ATTN: ~~ENGCW-T~~ ENGCW-E

1. Pursuant to para 17a, ER 1110-2-1150, the subject design memorandum is forwarded for review and approval. Approval is recommended, subject to the following comments.

2. Para 13, page 6. a. Change the first sentence to read as follows: "The major portion of the steel piling being driven for the Lake Pontchartrain Barrier Plan is located in existing levees 10 or more years old and in undisturbed soil.

b. In the last sentence after the third "and" change to "this exposed portion of the piling not in undisturbed soil will be coated to obtain maximum protection."

3. Para 15, page 7. A paragraph should be added to indicate that piling on the east side of the IHNC between Lake Pontchartrain and the Citrus back levee will not be coated. Also, since the soil from Sta. 34+05 to Sta. 45+00 and Sta. 65+50 to Sta. 72+50 is high resistivity sand or silt, there is no possibility of serious corrosion, and the bonding should be deleted.

4. Para 15a(3), page 7. Add at the beginning of the paragraph "Except for bonding,."

5. Plate 4. The Station 25+00 on the east side of the canal apparently should be station 35+00.

FOR THE DIVISION ENGINEER:

for Robert J. Kaufman

A. J. DAVIS
Chief, Engineering Division

1 Incl
wd 11 cy

CF:
NOD-LMNED-PP

ENGCW-EZ (LNNED-PP, 26 Mar 69) 2nd Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Design Memorandum No. 10, Corrosion Protection

DA, Office of the Chief of Engineers, Washington, D.C. 20315 21 May 1969

TO: Division Engineer, Lower Mississippi Valley

1. Design Memorandum No. 10 is approved, subject to the comments of the Division Engineer in the 1st indorsement and to the following comments.

2. Paragraph 15a. In the contract specifications, consideration should be given to omitting the paint coats within the interlocks. Not only are these difficult to clean and prepare for painting, but the paint coat will require close attention to obtain adequate coverage and will be subject to damage during driving. The corrosion protection will be adequate without painting these areas since they will be a small percentage of the total surface.

3. Plate 11. Consideration should be given to using flexible cable for CP-3 connection along the top of sheet piling to avoid problems due to piling irregularity.

FOR THE CHIEF OF ENGINEERS:

C. E. Slayton
for WENDELL E. JOHNSON
Chief, Engineering Division
Civil Works

1 Incl
wd

LMVED-TD (NOD 26 Mar 69) 3d Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Design Memorandum No. 10, Corrosion Protection

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 26 May 69

TO: District Engineer, New Orleans, ATTN: LMNED-PP

Referred to note approval, subject to the comments in the 1st and 2d Indorsements.

FOR THE ACTING DIVISION ENGINEER:

A. J. DAVIS
Chief, Engineering Division

LMNED-PP (NOD 26 Mar 69) 4th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Design Memorandum No. 10, Corrosion Protection

DA, New Orleans District, Corps of Engineers, PO Box 60267, New Orleans, La. 70160 25 Jun 69

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

1. The proposed disposition of comments in the 1st & 2d indorsements of this chain of correspondence is as follows:

a. 1st Ind.

(1) Paragraphs 2a and 2b. These comments are concurred in.

(2) Paragraph 3. The first sentence of paragraph 3 is concurred in. The sheet pile between stations 34+05 and 45+00 and stations 65+50 and 72+50 has been bonded and a concrete cap installed by previous construction contracts.

(3) Paragraphs 4 and 5. These comments are concurred in.

b. 2d Ind.

(1) Paragraph 2. These comments are concurred in.

(2) Paragraph 3. To date, no difficulties have been encountered due to piling irregularity while using the No. 6 reinforcing bar for bonding purposes. In addition, substitution of flexible cable would result in more costly corrosion protection systems. Therefore, it is recommended that No. 6 reinforcing bars be used for the CP-3 connection along the top of the sheet piling as presented in the subject design memorandum.

2. Approval of the disposition of comments presented herein is recommended.

FOR THE DISTRICT ENGINEER:

JEROME C. BAEHR
Chief, Engineering Division

LMVED-TD (NOD 26 Mar 69) 5th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Design Memorandum No. 10, Corrosion Protection

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 31 Jul 69

TO: District Engineer, New Orleans, ATTN: LMNED-PP

1. Disposition of comments in the 1st and 2d Indorsements is approved subject to the following comment.

2. Para 1b(2) of 4th Ind. In the contract specifications, consideration should be given to permitting the Contractor, at his option, to locate the No. 6 bonding bar against the vertical face of the steel sheet piling if any irregularity in top of piling is encountered.

FOR THE ACTING DIVISION ENGINEER:

A. J. DAVIS
Chief, Engineering Division

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 10
CORROSION PROTECTION

STATUS OF DESIGN MEMORANDA

Design Memo No.	Title	Status
1	Hydrology and Hydraulic Analysis Part I - Chalmette Part II - Barrier Part III - Lakeshore Part IV - Chalmette Extension	 Approved 27 Oct 66 Approved 18 Oct 67 Submitted 30 Sep 68 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, Supplement No. 1, Lake Pontchartrain Barrier, Rigolets Control Structure, Closure Dam, and Adjoining Levees	To be rescheduled subsequent to A-E contract modification
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 2, Lake Pontchartrain Barrier, Rigolets Lock and Adjoining Levees	Scheduled Apr 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 3, Lake Pontchartrain Barrier, Chef Menteur Complex	Scheduled May 69
2	Lake Pontchartrain Barrier Plan GDM, Supplement No. 4,New Orleans East Back Levees	Scheduled Aug 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5, Orleans Parish Lakefront Levees	Scheduled Apr 70

STATUS OF DESIGN MEMORANDA (cont'd)

Design Memo No.	Title	Status
2	Lake Pontchartrain Barrier Plan. GDM, Supplement No. 6, St. Charles Parish Lakefront Levees	Scheduled Aug 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 7, St. Tammany Parish, Mandeville Seawall	Scheduled Feb 71
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 8, IHNC Remaining Levees	Approved 6 Jun 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 9, New Orleans East Levee from South Point to GIW	Scheduled Mar 69
3	Chalmette Area Plan, GDM	Approved 31 Jan 67
3	Chalmette Area Plan, GDM, Supplement No. 1, Chalmette Extension	Submitted 21 Oct 68
4	Lake Pontchartrain Barrier Plan and Chalmette Area Plan, GDM, Florida Avenue Complex, IHNC	Not scheduled
5	Chalmette Area Plan, DDM, Bayous Bienvenue and Dupre	Submitted 25 Jun 68
6	Lake Pontchartrain Barrier Plan, DDM, Rigolets Control Structure and Closure	Will be rescheduled subsequent to A-E contract modification
7	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Control Structure and Closure	Scheduled 30 Jan 70
8	Lake Pontchartrain Barrier Plan, DDM, Rigolets Lock	Scheduled 31 Mar 70
9	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Navigation Structure	Scheduled 30 Jan 70

STATUS OF DESIGN MEMORANDA (cont'd)

Design Memo No.	Title	Status
10	Lake Pontchartrain Barrier Plan Corrosion Protection	Submitted 26 Mar 69
11	Beautification	Not scheduled
12	Source of Construction Materials	Approved 30 Aug 66
1	Lake Pontchartrain, La., and Vicinity, and Mississippi River-Gulf Outlet, La., GDM, Seabrook Lock	Submitted 6 Feb 69
2	Lake Pontchartrain, La., and Vicinity, and Mississippi River-Gulf Outlet, La., DDM, Seabrook Lock	Scheduled Jul 69

LEGEND

EXISTING IMPROVEMENTS

- Levee
- Seawall
- Location of work covered in this document.

AUTHORIZED IMPROVEMENTS

- New Levee
- Levee Enlargement
- Control Structure
- Drainage Structure
- Lock
- Floodgate
- Navigation Channel
- Floodwall
- Seawall Strengthening
- Rock Fill

LAKE PONTCHARTRAIN

LAKE BORGNE

LAKE MAUREPAS

PASS MANCHAC

LAKE PONTCHARTRAIN CAUSEWAY

Mandeville

Seawall

190

ST. JOHN THE BAPTIST PARISH / ST. CHARLES PARISH

ST. CHARLES PARISH / JEFFERSON PARISH

JEFFERSON PARISH / ORLEANS PARISH

ST. TAMMANY PARISH / ORLEANS PARISH

Apple Pie Ridge

THE RIGOLETS

South Point

New Orleans Lakefront Airport

Seabrook Lock

Seawall

NEW ORLEANS EAST

CITRUS

CHEF MENTEUR PASS

ORLEANS PARISH / ST BERNARD PARISH

GULF INTRACOASTAL WATERWAY

MISSISSIPPI RIVER - GULF OUTLET

ST CHARLES PARISH

JEFFERSON PARISH

NEW ORLEANS

INNER HARBOR NAVIGATION CANAL

FLORIDA AVE. BRIDGE

EXISTING LOCK

CHALMETTE

Chalmette

Violet

Boyou Dupre

Verret

Caernarvon

BONNET CARRE SPILLWAY

MISSISSIPPI RIVER

10 · 61 · 90 · 11 · 47 · 46

N

SCALE OF MILES

1 0 1 2 3 4 5

LAKE PONTCHARTRAIN
AND VICINITY, LA.
(HURRICANE PROTECTION)

AUTHORIZED PLAN OF PROTECTION

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

NOVEMBER 1965 FILE NO. H-2-23693

REV. OCT. 1968

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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CORROSION PROTECTION

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LAKE PONTCHARTRAIN BARRIER PLAN
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CORROSION PROTECTION

GENERAL

1. Authority. 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.

2. Purpose. This design memorandum presents complete basic information concerning the corrosive nature of the soils for that portion of the Lake Pontchartrain Barrier Plan covered in paragraphs 3a. through 3c. following. It was prepared for the purpose of developing a corrosion protection system and for facilitating review of the recommendations regarding the protection of ferrous components of minor structures subject to corrosive action. Corrosion protection of major structures are to be covered in the individual feature memorandums.

3. Previous reports. For general information and basic data concerning the project, reference is made to the following design memoranda:

a. Lake Pontchartrain Barrier Plan, Design Memorandum No. 2 - General, Advance Supplement, Inner Harbor Navigation Canal West Levee, Florida Avenue to IHNC Lock, approved 31 May 1967.

b. Lake Pontchartrain Barrier Plan, Design Memorandum No. 2 - General, Supplement No. 8, IHNC Remaining Levees, approved 6 June 1968.

c. Lake Pontchartrain Barrier Plan, Design Memorandum No. 2 - General Design, Citrus Back Levee, approved 29 December 1967.

4. Location. The corrosion protection analysis presented in this memorandum covers the project areas described in paragraphs 3a. through 3c. above. These project areas are also outlined on flyleaf map, file No. H-2-23693. Corrosion studies for the project features of the Barrier Plan not included in this report will be contained in respective project design memoranda.

5. Description of protective works. The portion of the Lake Pontchartrain Barrier Plan covered in this memorandum is a series of levees and floodwalls along the IHNC (Inner Harbor Navigation Canal), Mississippi River-Gulf Outlet, and the Gulf Intracoastal Waterway in the New Orleans area. The protective works consist of levees, "I"-Type floodwalls comprised of steel sheet piling capped with reinforced concrete in those areas where the height of the wall is less than 8 feet above the ground surface, and "T"-Type concrete floodwalls with steel sheet pile cutoffs and prestressed concrete bearing piles in those areas where the height of the wall exceeds 8 feet above the ground surface. Gap closures at points of ingress and egress are steel roller gates or swing gates as storage space permits. The net grade of the protective works for the project varies from elevation 14.0* to elevation 18.0. References presented in paragraphs 3a. through 3 c., above, contain a detailed description of the protective works covered in this memorandum. General locations of the protective works are shown on plates 1 through 5.

SOIL CHARACTERISTICS

6. General. The soils data and results of field investigations for the indicated segments of the Lake Pontchartrain Barrier Plan, as contained in the approved design memoranda, are presented in the following paragraphs.

7. Inner Harbor Navigation Canal West Levee, Florida Avenue to IHNC Lock. Subsurface soil conditions along this project segment consist generally of 6 to 16 feet of artificial fill overlying 60 to 70 feet of Recent deposits of clays, silts, and sands which are underlain by the Pleistocene soils that were encountered at elevations -75 at the north end and -65 at the south end. A generalized soil and geologic profile along the baseline is shown on plate 6. The portion of the subsurface soils above the Pleistocene deposit which directly affects the design of this project feature consists generally of the following: (Stationing referred to is along the floodwall centerline.)

a. Station 34+95 (Florida Avenue end of the project feature) to station 70+00. Predominantly clay fill exists down to elevations varying from -5 to -10 underlain by a 3- to 9-foot layer

*All elevations are in feet and refer to m.s.l. (mean sea level) datum unless otherwise noted.

of organic clay extending down to elevations varying from -15 to -20. Beneath the organic clay is a 22- to 30-foot layer of fat clay with some silt strata near its top. The fat clay is underlain by a fine sand deposit extending from about elevation -40 to elevation -75, where the top of the Pleistocene formation is encountered.

b. Station 70+00 to station 100+00. Clay predominates down to elevations varying from -3 to -10 underlain by a 3- to 8-foot layer of organic clay extending down to elevations varying from -15 to -20. Beneath the organic clay there is a 26- to 40-foot layer of fat clay, with some silt strata near its top, extending down to approximate elevation -45. The fat clay layer is underlain by a deposit containing layers of fat and lean clays and fine sands extending down to approximate elevations -65 to -75, where the top of the Pleistocene formation is encountered.

c. Station 100+00 to station 108+00 (lock end of project feature). Except for a 3- to 4-foot surface layer of silty sand, clay predominates down to approximate elevation -18 where a 3- to 4-foot layer of silt overlies a clay layer extending down to approximate elevation -48. The clay layer is underlain by a clay deposit containing a 2- to 3-foot layer of fine sands at its top and extends down to approximate elevations -68 to -75, where the top of the Pleistocene formation is encountered.

8. Inner Harbor Navigation Canal Remaining Levees. Subsurface soil conditions along the project feature consist generally of 6 to 10 feet of artificial fill overlying 40 to 50 feet of Recent deposits of sands, silts, and clays which are underlain by the Pleistocene soils. The top of the Pleistocene is encountered at approximate elevation -50 at the lake end of the project, and -70 at various locations along the alignment except for ancient entrenchments incised deeper into the Pleistocene. Generalized soil and geologic profiles are shown on plates 7 through 9. The portion of the subsurface soils above the Pleistocene deposit, which directly affects the design of this project feature, consists generally of the following:

a. Station 31+00 (lake end of the project feature) to station 85+00 (on both east and west side of IHNC). This reach is predominately fine sand fill which extends to elevations varying from 0 to -10, underlain by a 5- to 10-foot layer of organic clay which overlies a buried beach sand extending to elevations varying from -35 to -50 where a 5- to 20-foot layer of fat clay overlies the Pleistocene formation.

b. Station 85+00 to station 140+00 (on both sides of IHNC). This reach is predominately fat clay fill which extends to elevations varying from 4 to 0 overlying a 5- to 10-foot layer of

natural levee clay, which, in turn, is underlain by fat clays with lenses and layers of lean clay and silt extending down to approximate elevation -40 where a stratified layer of silt, sand, and clay overlies the Pleistocene formation.

c. Station 140+00 to station 180+00 (on both sides of IHNC) and from station 180+00 along the west side of IHNC to Florida Avenue. This reach is predominately fat clay fill which extends to elevations varying from 10 to 4 overlying a 2- to 20-foot layer of natural levee clay, underlain by organic clays extending to elevations varying from -15 to -20. Beneath the organic clay is a 20- to 30-foot layer of fat clay with lenses and areas of silt and lean clay overlying a 4- to 30-foot stratified layer of sands, silts, and clays overlying the Pleistocene formation.

9. Citrus Back Levee. Subsurface soil conditions along this project segment consist generally of 10 to 15 feet of artificial levee fill overlying 45 to 60 feet of Recent deposits of clays, silts, and sands which are underlain by a Pleistocene deposit encountered at elevations -50 at the west end of the project and -60 at the east end of the project. A generalized soil and geologic profile is shown on plate 10. The portion of the subsurface soils above the Pleistocene deposit, which directly affects the design of this project, consists generally of the following:

a. Station 176+75.87 (west end of the project) to station 415+00 (vicinity of Paris Road). This reach is predominately soft to stiff clay fill down to elevations varying from -5 to -8 underlain by a 5- to 10-foot layer of soft organic clay which overlies soft to medium clays extending down to elevations varying from -40 to -45 where a 5- to 15-foot layer of fine sand overlies the Pleistocene deposit.

b. Station 415+00 to station 481+00. This reach is predominately soft to stiff clay fill down to approximate elevation -3 underlain by a 10- to 20-foot layer of soft to medium fat clay which overlies a stratified layer of silts and lean clays extending down to varying elevations of -30 to -40 where a 7- to 20-foot stratified layer of fine sands and medium clays overlies the Pleistocene formation.

c. Station 481+00 to station 495+00. This reach is predominately medium to stiff clay fill down to approximate elevation 0.0 underlain by a 10-foot layer of soft to medium organic clay which overlies an abandoned distributary of silts and sands overlying the Pleistocene formation.

d. Station 495+00 to station 550+00. This reach is predominately soft to medium clay fill down to approximate elevation -3 underlain by a 5- to 10-foot layer of soft to medium organiz clay which overlies a stratified layer of silts and soft to medium clays extending down to the top of the Pleistocene formation.

e. Station 550+00 to station 580+00. This reach is predominately soft to medium clay fill down to approximate elevation -3. Below the clay fill is a 10-foot layer of soft organic clay which overlies a 10-foot layer of soft to medium fat clay. Below the layer of fat clay is a 10-foot layer of fine sand overlying a medium clay layer extending down to the top of the Pleistocene formation.

f. Station 580+00 to station 650+00. This reach is predominately soft to medium clay fill down to approximate elevation -4.0. Below the clay fill is an 8-foot layer of soft to medium organic clay underlain by 10 feet of stratified layers of silts and lean clays. Below the layers of silts and lean clays is a 5- to 10-foot layer of fine sand which overlies a medium fat clay layer extending to the top of the Pleistocene formation.

g. Station 650+00 to station 664+73.3 (east end of project feature). From the surface to elevation 0.0, this reach consists of a medium to stiff clay fill underlain by a 10foot medium fat clay layer. Below the fat clay layer is 10 feet of stratified layers of silts and lean clays which overlies soft to stiff clays extending to the top of the Pleistocene formation.

10. Field investigations. Soil resistivity measurements using the 4-pin method were made every 200 to 500 feet along the floodwall alignment. Electrode spacings of 5 and 10 feet were used at each location to obtain the average resistivity of the soil to 5- and 10-foot depths. At each location where the above measurements were made, a soil sample was obtained near the ground surface (3 to 12 inches in depth) and the following laboratory tests were performed on the sample:

a. Visual classification.

b. Determination of pH.

c. Electrical soil resistivity using the soil box method.

d. The soil temperatures at the times of the tests.

The data obtained in the above survey and tests are shown in appendix A.

Par 11

11. In the project areas, there is only one section along which sheet piling have been previously installed. These piling were installed by the Orleans Levee Board in 1966 along the west side of the IHNC. Since an original testing program was not undertaken for these piling, there is no basis for definitive comparison with tests that might be taken now. Further, none of these piling have been pulled to date for examination, and it is doubtful that the elapsed time has been sufficient so that corrosion effects could be detected.

EVALUATION OF OVERALL CORROSION PROBLEMS

12. General. The major cause of corrosion of iron and steel structures in soil can be attributed to moisture and the nonuniform distribution of oxygen on the surface of these structures. The National Bureau of Standards Monograph No. 58, April 1962, "Corrosion of Steel Pilings in Soils" states that when driven into natural undisturbed soil, steel piling does not corrode at a rate sufficient to significantly affect strength or useful life. The absence of significant corrosion on the piling inspected by the Bureau at eleven different locations is attributable to the probability that there is not enough oxygen available either originally or by replenishment to support corrosion on the underground sections. The conditions at the test sites varied widely and even though the soil properties and characteristics did indicate a corrosive environment at many of the sites, the data obtained indicate that sufficient oxygen is not available a short distance below the ground line, and especially below the water table to promote corrosion by differential aeration or other causes.

13. The major portion of the steel piling being driven for the Lake Pontchartrain Barrier Plan is located in old existing levees and undisturbed fill. While soil samples obtained from these areas do indicate an environment which may be suspect from a corrosion standpoint, it is anticipated that sufficient oxygen will not be available to promote corrosion both below the ground line and below the water table. In those areas where the levee is to be raised or relocated and the piling is exposed to new fill and disturbed soil, corrosion damage is anticipated and coated piling will be utilized to obtain maximum protection.

14. Utility companies in this area have not encountered any corrosion problems on their gas, water, and sewer mains which can be attributed to stray currents. Therefore, stray current corrosion is not anticipated to present a problem at this time. However, since the project area is essentially an industrial area, stray current corrosion must be considered as a possible future problem.

CORROSION PROTECTIVE MEASURES

15. Steel piling.

a. Painting. All steel piling in contact with backfill or new levee fill will be coated with 20 mils of coal tar epoxy. This includes the steel sheet piling of the I-type floodwall, the steel sheet pile cutoff of the T-type floodwall, and the steel pipe piles supporting the T-type floodwall under the North Claiborne Avenue Bridge, and the gates and the kicker pile wall through the Jones and Laughlin warehouse. Piling to be coated are as follows:

(1) Inner Harbor Navigation Canal West Levee, Florida Avenue to IHNC Lock. Sheet pile approximate station 34+95 to 38+58; elevation 2.5 to elevation 7.5. Sheet pile approximate station 39+78.5 to 44+34; elevation 2.5 to elevation 7.5. Pipe pile approximate station 59+45 to 65+42; upper 12 feet coated from 6 inches below the top of the sheet piling. Pipe pile approximate station 94+53 to 95+78; upper 12 feet coated from 6 inches below the top of the sheet piling.

(2) Inner Harbor Navigation Canal Remaining Levees (on west side of IHNC). Sheet pile approximate station 132+10 to 135+46; elevation -2.0 to elevation 10.0.

(3) Citrus Back Levee. No corrosion protection measures are proposed for this reach since any piling that would have to be driven would be installed in old existing levees where protection is not needed.

b. Bonding. All steel sheet piling and all pipe piling coated and uncoated will be bonded together to obtain electrical continuity and provide for installation of cathodic protection if the need arises in the future. These provisions are shown on plate 11 and are as follows:

(1) I-Type Floodwall. The piles will be bonded together with a No. 6 reinforcing bar welded to each of the piles near the top. Flexible jumpers insulated with cross-linked polyethelene will be welded or brazed to adjacent sheet piles at the monolith joints 3 inches below the bottom of the concrete.

(2) T-Type Floodwall. In addition to the electrical bonding described above, No. 6 reinforcing bars welded to the sheet piles at 100-foot intervals will be brought up through the concrete to a ferrule located 18 inches below the ground line. The ferrules will be set at 100 feet, and adjacent ferrules will be located on opposite sides of the wall providing connection points at intervals of 200 feet on either side of the wall.

Par 15b(3)

(3) Steel Pipe Piles. The steel piles supporting the T-type floodwall will be coated with 20 mils of coal tar epoxy and bonded to the sheet pile cutoff with No. 6 reinforcing bars.

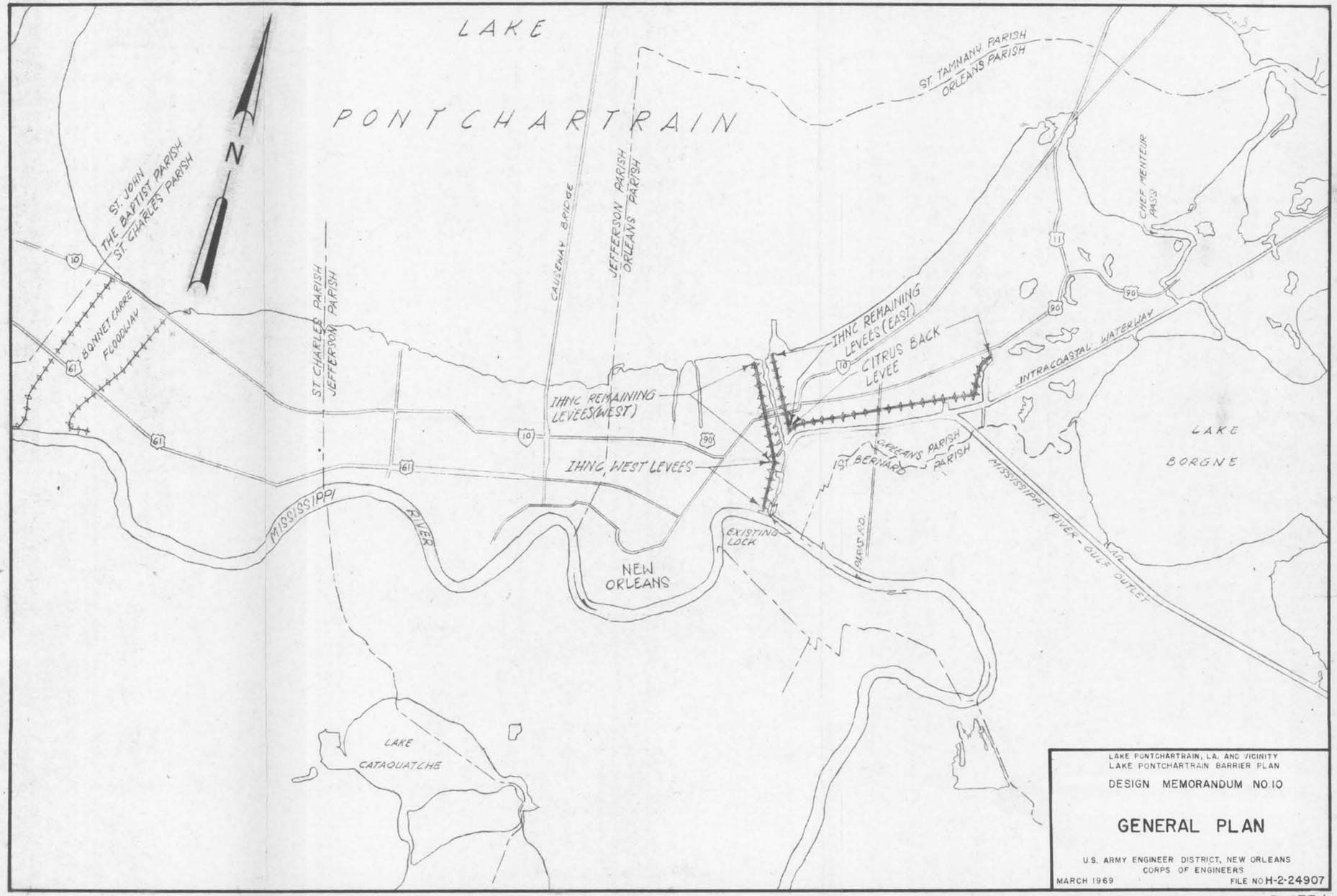
16. Gates. The swing gates, roller gates, flap gates, trolleys, "I" beams, corner plates and all ferrous metal components which are not galvanized or stainless steel will be coated with a 5-coat vinyl paint system.

ESTIMATES OF COST

17. Estimates of cost. Estimated costs for corrosion protection and painting are included in the referenced design memorandums (see paragraph 3). The cost of painting is included in the item painted; bonding rods are covered under Steel Reinforcement and Ferrules; covers and jumpers are covered under Miscellaneous Metal Work.

RECOMMENDATION

18. Recommendation. The plan for corrosion protection included herein, consisting of coating piling and painting miscellaneous ferrous metal components which are not galvanized or stainless steel, is considered to be the most practical plan and is recommended for approval.

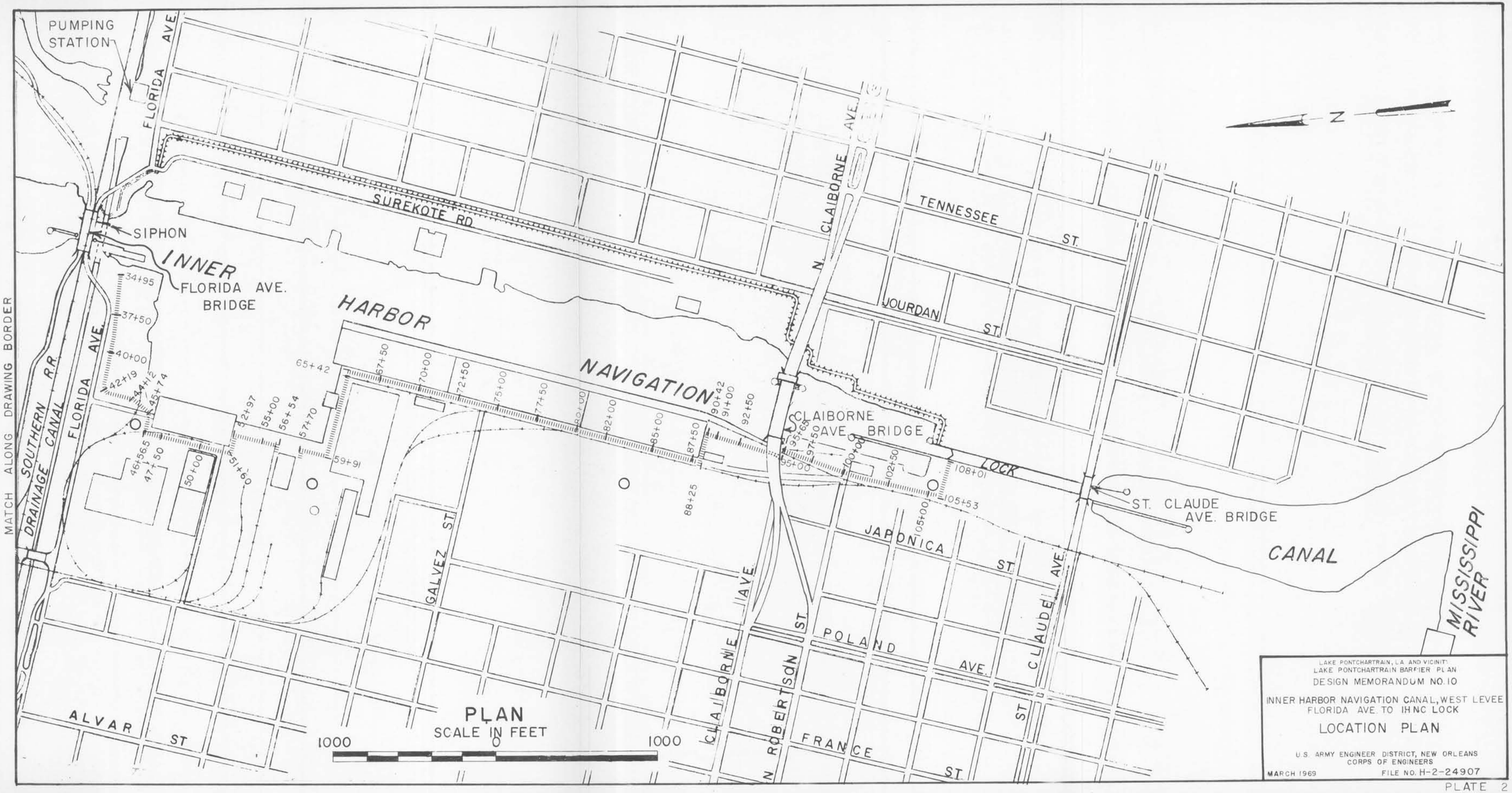


LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 10

GENERAL PLAN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1969 FILE NO. H-2-24907

PLATE I



LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 10

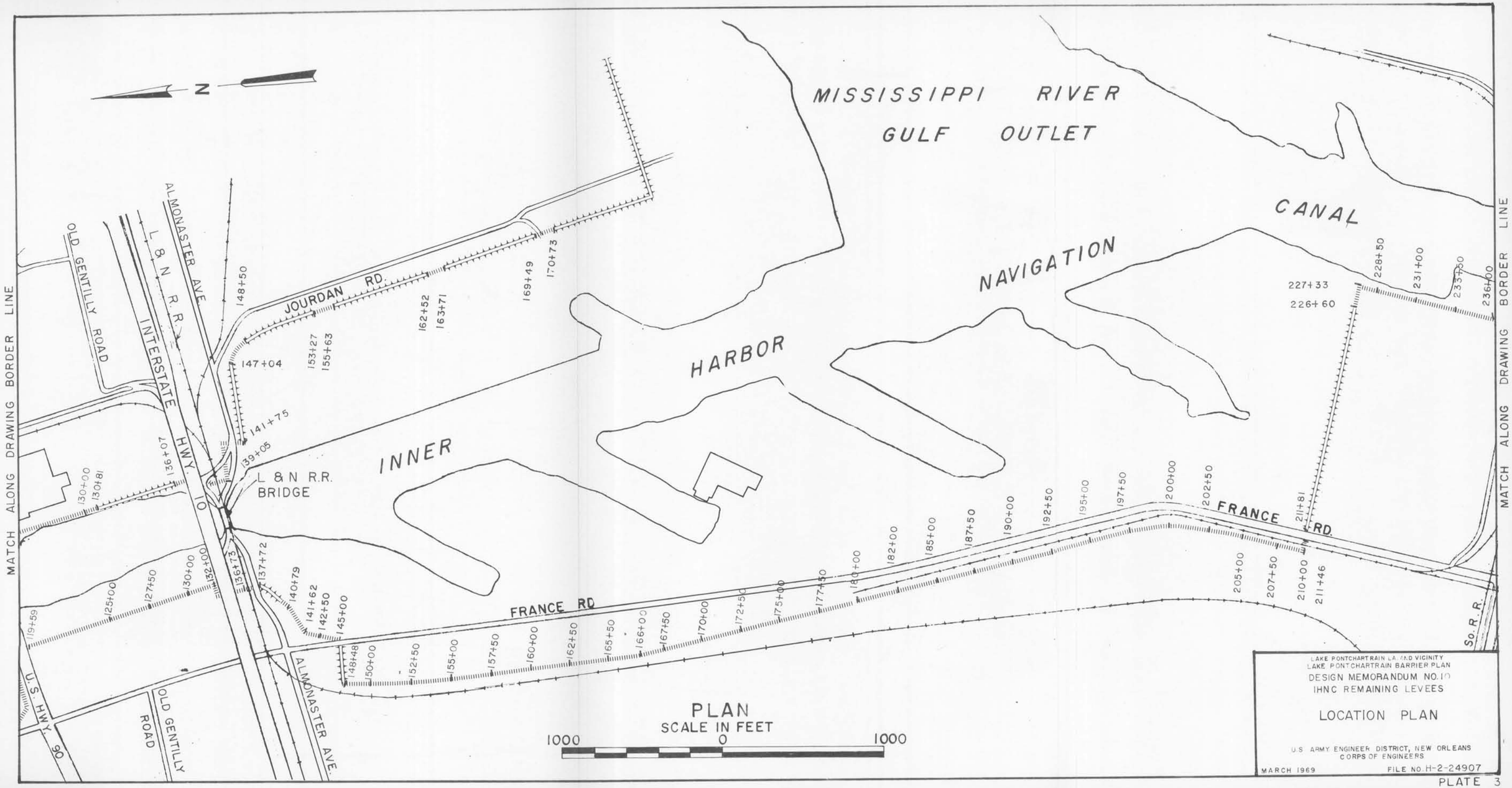
INNER HARBOR NAVIGATION CANAL, WEST LEVEE
FLORIDA AVE. TO IHNC LOCK

LOCATION PLAN

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

MARCH 1969 FILE NO. H-2-24907

PLATE 2



PLAN
SCALE IN FEET
1000 0 1000

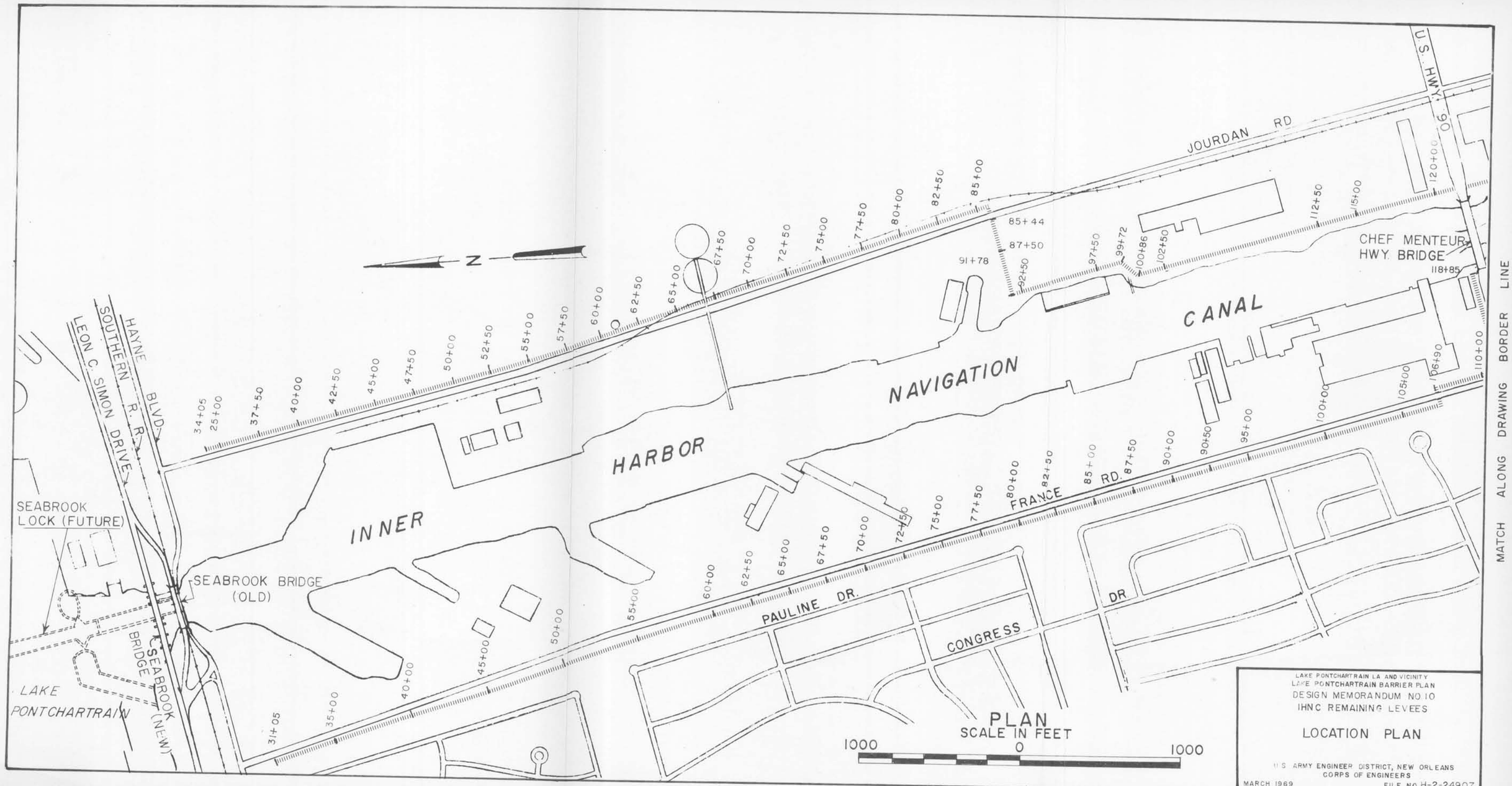
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 10
IHNC REMAINING LEVEES

LOCATION PLAN

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

MARCH 1969 FILE NO. H-2-24907

PLATE 3



LAKE PONTCHARTRAIN LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.10
IHNC REMAINING LEVEES

LOCATION PLAN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1969 FILE NO. H-2-24907

MATCH ALONG DRAWING BORDER LINE

PLATE 4

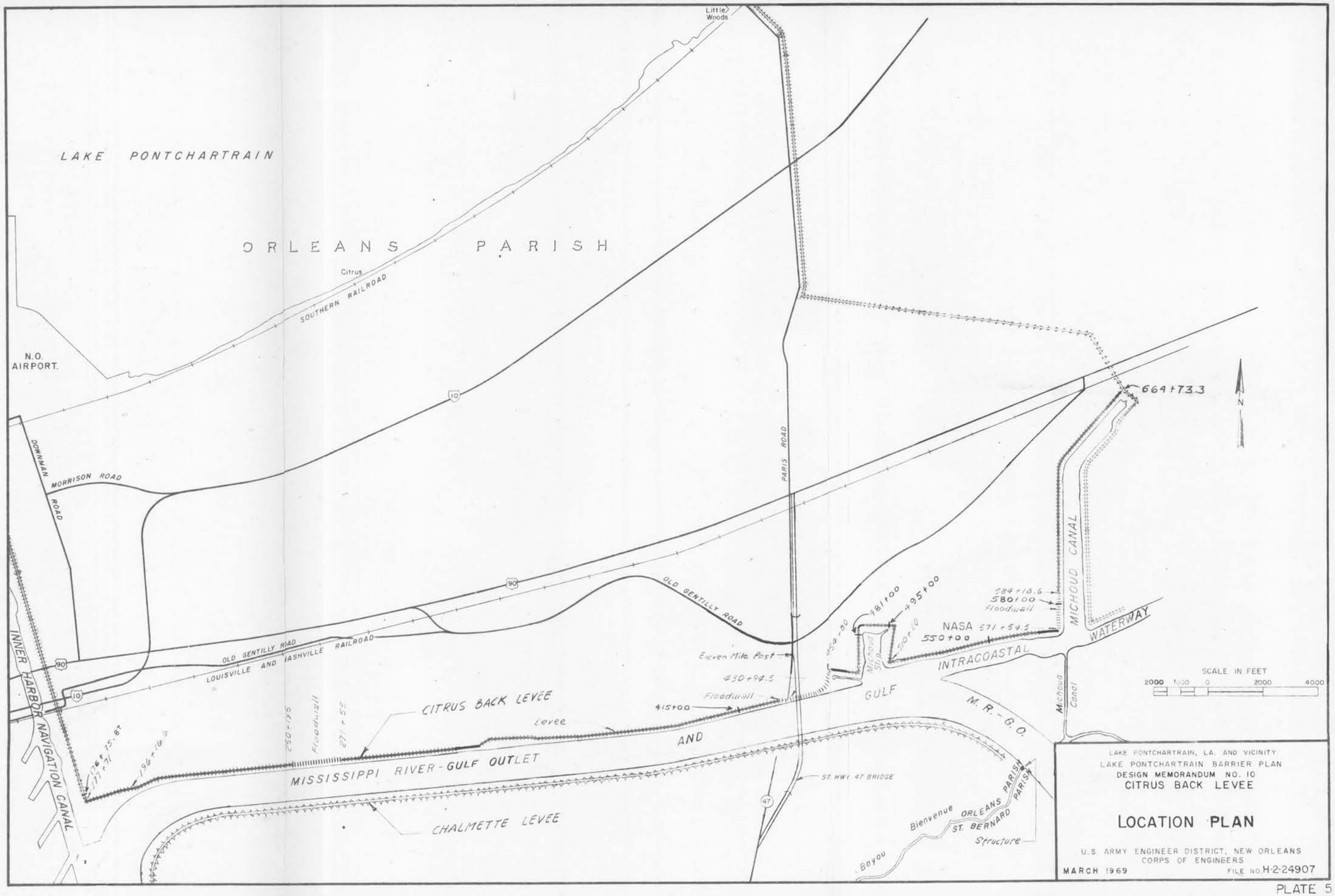
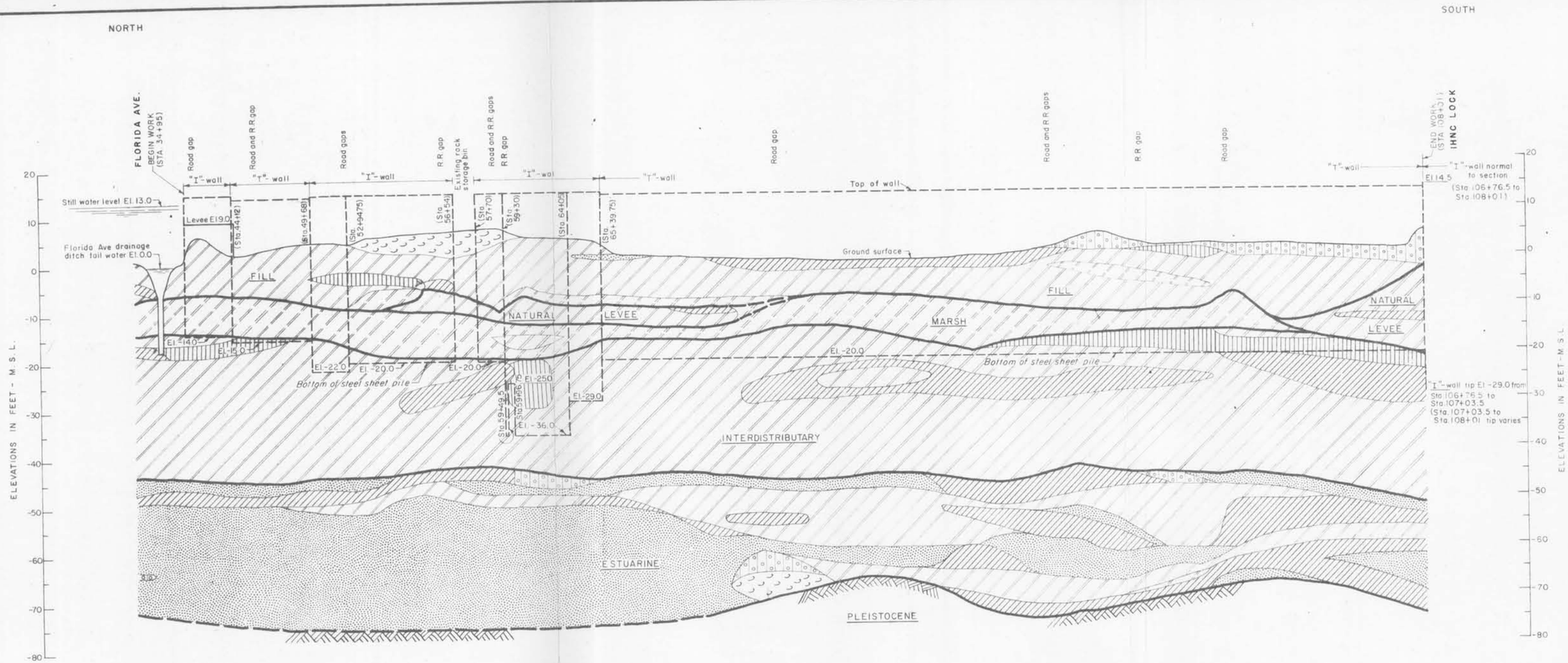

LAKE PONTCHARTRAIN
ORLEANS PARISH
Little Woods
Citrus
SOUTHERN RAILROAD
N.O. AIRPORT
DOMINMAN ROAD
MORRISON ROAD
OLD GENTILLY ROAD
LOUISVILLE AND NASHVILLE RAILROAD
PARIS ROAD
INNER HARBOR NAVIGATION CANAL
CITRUS BACK LEVEE
Levee
AND
MISSISSIPPI RIVER-GULF OUTLET
CHALMETTE LEVEE
Floodwall
Eleven Mile Post
430+94.5
415+00
664+73.3
584+18.6
580+00
550+00
495+00
181+00
NASA 571+54.5
MICHOUD CANAL
INTRACOASTAL WATERWAY
GULF
M.R.-G.O.
Michoud Canal
ST. HWY. 47 BRIDGE
Bienvenue
ORLEANS PARISH
ST. BERNARD PARISH
Structure
Bayou
N
SCALE IN FEET
2000 1000 0 2000 4000
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 10
CITRUS BACK LEVEE
LOCATION PLAN
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1969
FILE NO. H-2-24907

PLATE 5



LEGEND

- CH – Fat clay
- CHO– Fat clay with organic matter and peat
- CL – Lean clay
- ML – Silt
- SM – Silty sand
- SP – Fine sand
- SI – Shells
- Pleistocene Horizon

MARSH – very soft clays with organic matter and peat

NATURAL LEVEE – soft to stiff clays with lenses and layers of silt

INTERDISTRIBUTARY – very soft to soft clays with lenses and layers of silt and sand

ESTUARINE – sand, clay and silt with shell fragments

PLEISTOCENE – stiff to very stiff clays

Note!
For soil boring legend see plate A.
For general location see plate 2.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN

DESIGN MEMORANDUM NO. 10

INNER HARBOR NAVIGATION CANAL, WEST LEVEE
FLORIDA AVE. TO IHNC LOCK

GENERALIZED SOIL AND GEOLOGIC PROFILE

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

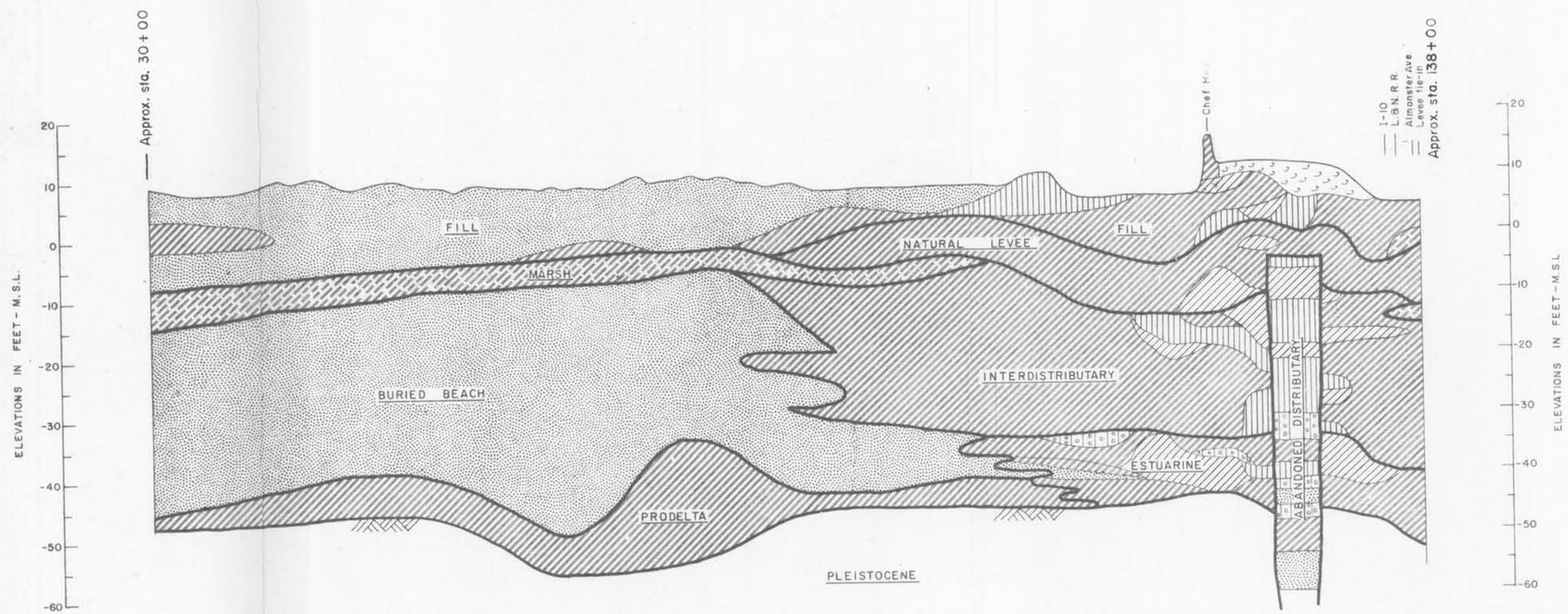
MARCH 1969

FILE NO. H-2-24907

PLATE 6

LAKE PONTCHARTRAIN END
(NORTH)

(SOUTH)



LEGEND

CH – Fat clay	NATURAL LEVEE – soft to stiff clays with lenses and layers of silt
CHO– Fat clay with organic matter and peat	MARSH – very soft clays with organic matter and peat
CL – Lean clay	ABANDONED DISTRIBUTARY – silts, silty sands with clay layers
ML – Silt	INTERDISTRIBUTARY – very soft to soft clays with lenses and layers of silt and sand
SM – Silty sand	BURIED BEACH – sand with shell and shell fragments
SP – Fine sand	PRODELTA – medium to stiff clays
SI – Shells	ESTUARINE – sand, clay and silt with shell and shell fragments
Pleistocene Horizon	

Note:
For soil boring legend see plate A.
For general location see plate 3 & 4

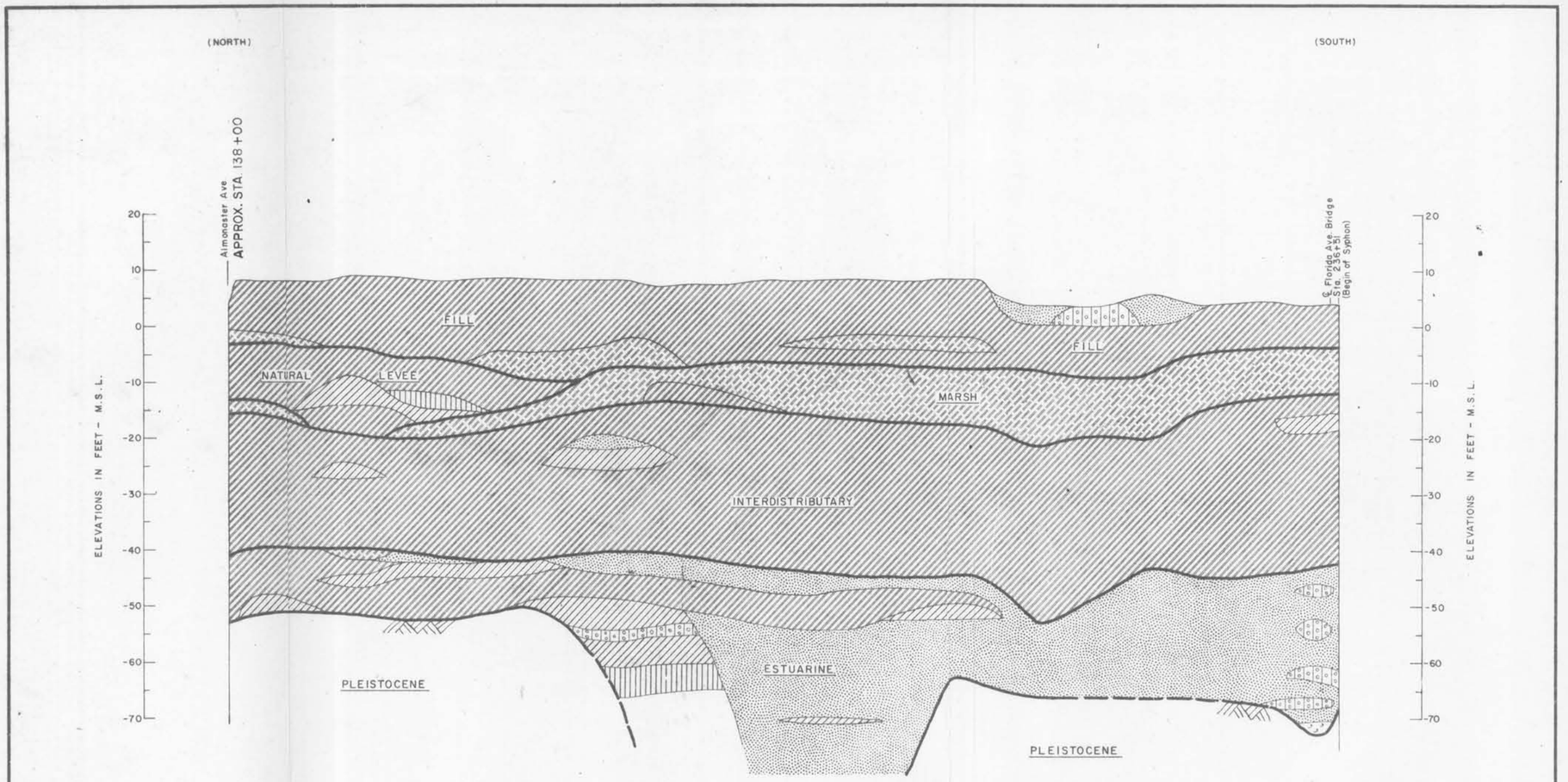
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 10

IHNC REMAINING LEVEES
GENERALIZED SOIL AND GEOLOGIC PROFILE
WEST LEVEE-LAKE PONTCHARTRAIN TO ALMONASTER AVE.

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

MARCH 1969 FILE NO H-2-24907

PLATE 7



LEGEND

- CH – Fat clay
- CHO – Fat clay with organic matter and peat
- CL – Lean clay
- ML – Silt
- SM – Silty sand
- SP – Fine sand
- SI – Shell
- Pleistocene Horizon

NATURAL LEVEE - soft to stiff clays with lenses and layers of silt

MARSH - very soft clays with organic matter and peat

INTERDISTRIBUTARY - very soft to soft clays with lenses and layers of silt and sand

ESTUARINE - sand, clay and silt with shell and shell fragments

Note:
For soil boring legend see plate A.
For general location see plate 3 & 4

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 10

IHNC REMAINING LEVEES

GENERALIZED SOIL AND GEOLOGIC PROFILE

WEST LEVEE - ALMONASTER AVE. TO FLORIDA AVE.

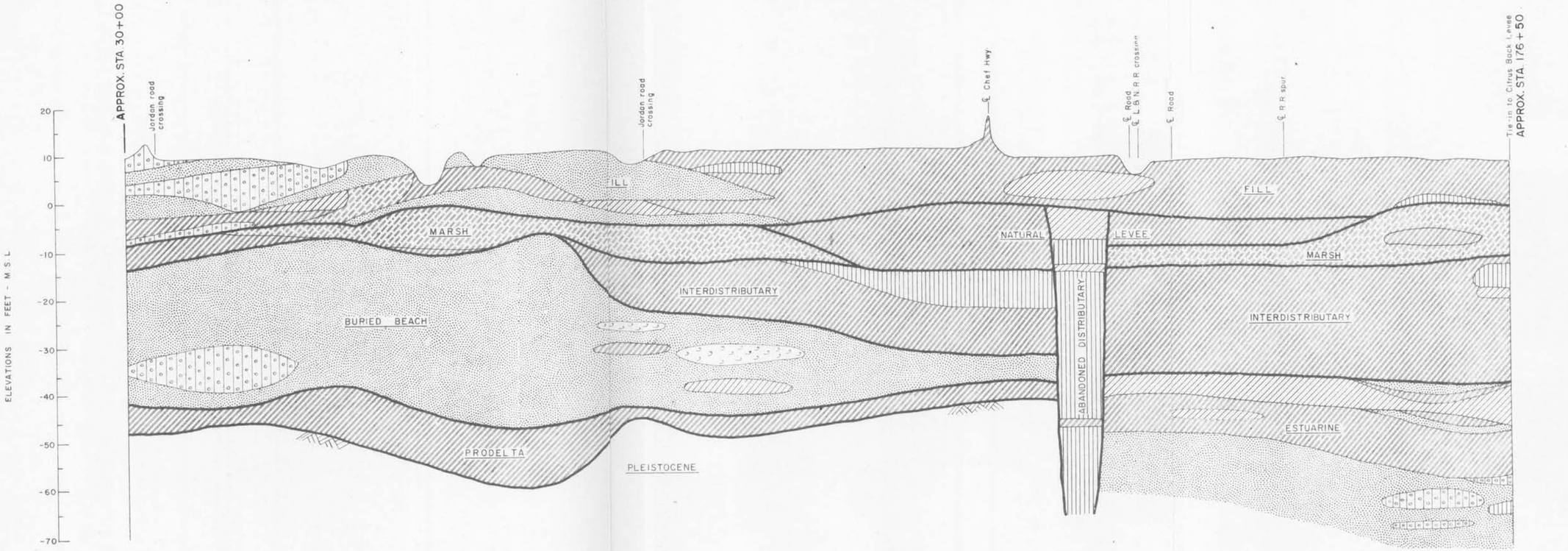
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

MARCH 1969 FILE NO. H-2-24907

PLATE 8

LAKE PONTCHARTRAIN END
(NORTH)

(SOUTH)



LEGEND

CH – Fat clay	NATURAL LEVEE – soft to stiff clays with lenses and layers of silt
CHO – Fat clay with organic matter and peat	MARSH – very soft clays with organic matter and peat
CL – Lean clay	ABANDONED DISTRIBUTARY – silts, silty sands with clay layers
ML – Silt	INTERDISTRIBUTARY – very soft to soft clays with lenses and layers of silt and sand
SM – Silty sand	BURIED BEACH – sand with shell and shell fragments
SP – Fine sand	PRODELTA – medium to stiff clays
SI – Shells	ESTUARINE – sand, clay and silt with shell and shell fragments
Pleistocene Horizon	

Note:
For soil boring legend see plate A.
For general location see plate 3 & 4

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.10

IHNC REMAINING LEVEES
GENERALIZED SOIL AND GEOLOGIC PROFILE
EAST LEVEE-LAKE PONTCHARTRAIN TO CITRUS BACK LEVEE

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

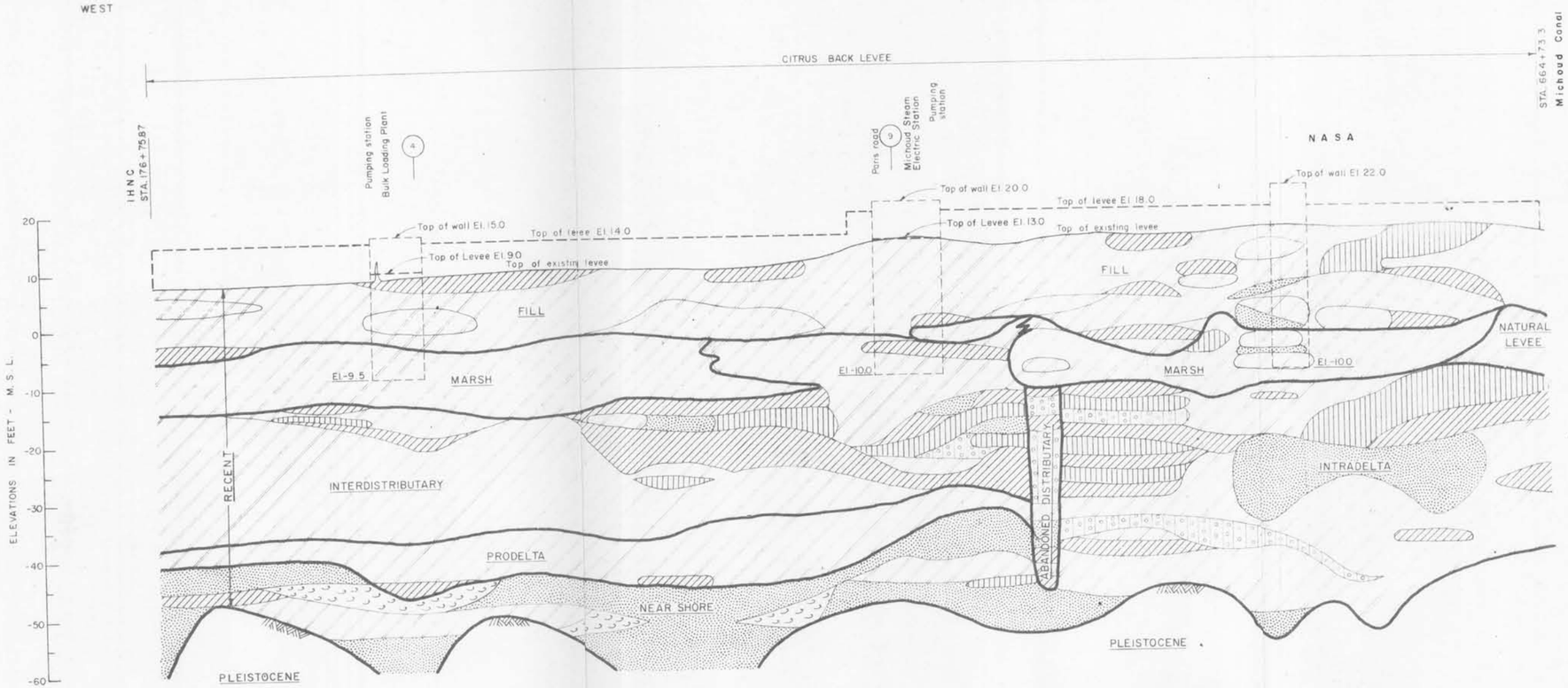
MARCH 1969

FILE NO H-2-24907

PLATE 9

WEST

EAST



LEGEND

- CH - Fat clay
- CHO - Fat clay with organic matter
- CL - Lean clay
- ML - Silt
- SM - Silty sand
- SP - Fine sand
- SI - Shells
- Pleistocene Horizon

MARSH - very soft clays with organic matter and peat

NATURAL LEVEE - soft to stiff clays with lenses and layers of silt

ABANDONED DISTRIBUTARY - silts and silty sands with lenses and layers of clay

INTERDISTRIBUTARY - very soft to soft clays with lenses and layers of silts and sands

INTRADELTA - soft alternating clays and silts with layers silty sands and sands

PRODELTA - medium to stiff clays

NEAR SHORE - sands with shell and shell fragments with lenses and layers of clay

Note:

For soil boring legend see plate A

For general location see plate 5

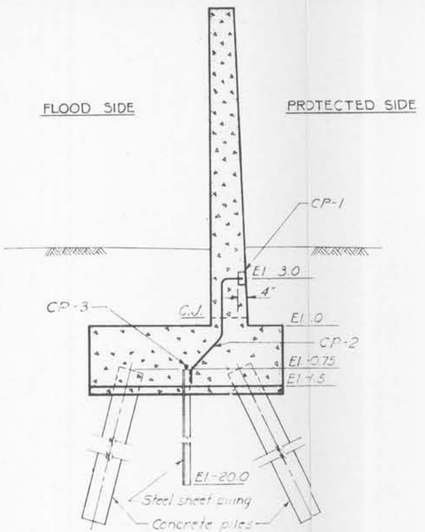
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 10
CITRUS BACK LEVEE
IHNC THRU NASA

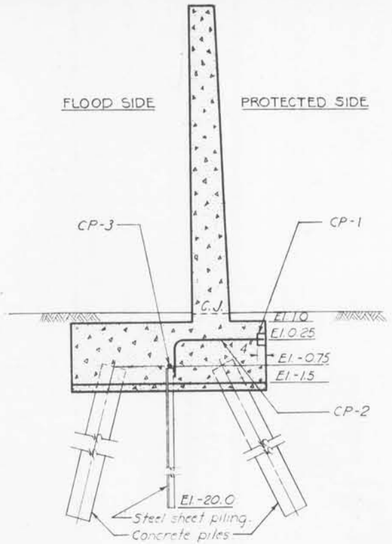
GENERALIZED SOIL AND GEOLOGIC PROFILE

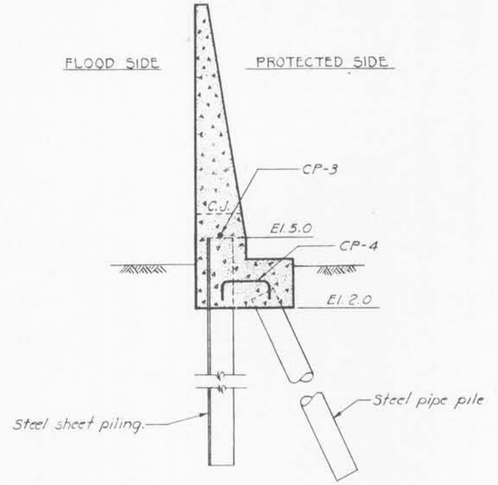
IHNC TO MICHOUD CANAL

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1969
FILE NO. H-2-24907

PLATE 10

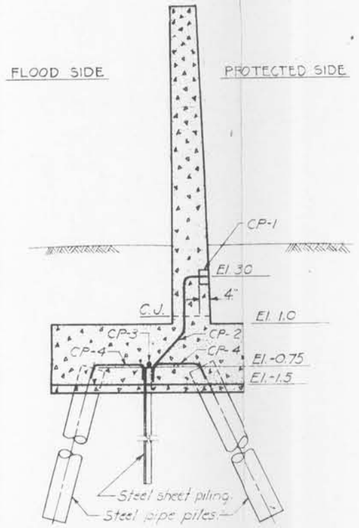


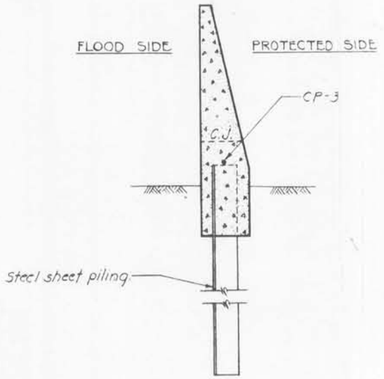




TYPICAL T-TYPE WALLS

Scale: 3/8 = 1'-0"





TYPICAL I-TYPE WALLS

Scale: 3/8" = 1'-0"

LEGEND

CP-1 6" std iron body trap screw ferrule w/ brass plug and countersunk nut. Location and elevation of ferrule as shown in the table.

CP-2 No 6 reinf. bar welded to sheet pile and terminated in the ferrule within 1/2" of the cover.

CP-3 No 6 reinf. bar welded to the top of each sheet pile. Install flexible jumpers at the monoliths joints approximately 30 ft apart. Jumpers shall be bridged or welded to the sheet piles 3" below the concrete cap.

CP-4 No 6 reinf. bar welded to each pipe pile and the sheet pile wall.

NOTE:

Elevations are in feet and refer to mean see level (m.s.l.) datum.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN

DESIGN MEMORANDUM NO. 10

CORROSION PROTECTION

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

MARCH 1969 FILE NO. H-2-24907

PLATE 11

CORPS OF ENGINEERS

U.S. ARMY

UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION		TYPE	LETTER SYMBOL	SYMBOL	TYPICAL NAMES
COARSE – GRAINED SOILS More than half of material is larger than No. 200 sieve size.	GRAVELS More than half of coarse fraction is larger than No.4 sieve size.	CLEAN GRAVEL (Little or No Fines)	GW		GRAVEL, Well Graded, gravel-sand mixtures, little or no fines
			GP		GRAVEL, Poorly Graded, gravel-sand mixtures, little or no fines
		GRAVEL WITH FINES (Appreciable Amount of Fines)	GM		SILTY GRAVEL, gravel-sand-silt mixtures
			GC		CLAYEY GRAVEL, gravel-sand-clay mixtures
	SANDS More than half of coarse fraction is smaller than No.4 sieve size.	CLEAN SAND (Little or No Fines)	SW		SAND, Well-Graded, gravelly sands
			SP		SAND, Poorly-Graded, gravelly sands
		SANDS WITH FINES (Appreciable Amount of Fines	SM		SILTY SAND, sand-silt mixtures
			SC		CLAYEY SAND, sand-clay mixtures
FINE – GRAINED SOILS More than half the material is smaller than No. 200 sieve size.		SILTS AND CLAYS (Liquid Limit <50)	ML		SILT & very fine sand, silty or clayey fine sand or clayey silt with slight plasticity
			CL		LEAN CLAY; Sandy Clay; Silty Clay; of low to medium plasticity
			OL		ORGANIC SILTS and organic silty clays of low plasticity
		SILTS AND CLAYS (Liquid Limit >50)	MH		SILT, fine sandy or silty soil with high plasticity
			CH		FAT CLAY, inorganic clay of high plasticity
			OH		ORGANIC CLAYS of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			Pt		PEAT, and other highly organic soil
WOOD			Wd		WOOD
SHELLS			Sl		SHELLS
NO SAMPLE					

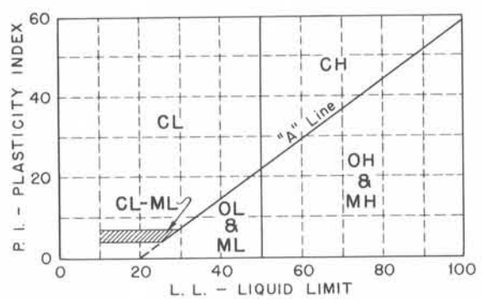
NOTE: Soils possessing characteristics of two groups are designated by combinations of group symbols

DESCRIPTIVE SYMBOLS

COLOR	
COLOR	SYMBOL
TAN	T
YELLOW	Y
RED	R
BLACK	BK
GRAY	Gr
LIGHT GRAY	lGr
DARK GRAY	dGr
BROWN	Br
LIGHT BROWN	lBr
DARK BROWN	dBr
BROWNISH-GRAY	br Gr
GRAYISH-BROWN	gy Br
GREENISH-GRAY	gn Gr
GRAYISH-GREEN	gy Gn
GREEN	Gn
BLUE	Bl
BLUE-GREEN	Bl Gn
WHITE	Wh
MOTTLED	Mot

CONSISTENCY FOR COHESIVE SOILS		
CONSISTENCY	COHESION IN LBS./SQ.FT. FROM UNCONFINED COMPRESSION TEST	SYMBOL
VERY SOFT	< 250	vSo
SOFT	250 - 500	So
MEDIUM	500 - 1000	M
STIFF	1000 - 2000	St
VERY STIFF	2000 - 4000	vSt
HARD	> 4000	H

MODIFICATIONS	
MODIFICATION	SYMBOL
Traces	Tr-
Fine	F
Medium	M
Coarse	C
Concretions	cc
Rootlets	rt
Lignite fragments	lg
Shale fragments	sh
Sandstone fragments	sds
Shell fragments	slf
Organic matter	O
Clay strata or lenses	CS
Silt strata or lenses	SIS
Sand strata or lenses	SS
Sandy	S
Gravelly	G
Boulders	B
Slickensides	SL
Wood	Wd
Oxidized	Ox



PLASTICITY CHART

For classification of fine - grained soils

NOTES:

FIGURES TO LEFT OF BORING UNDER COLUMN "W OR D_{10}"

Are natural water contents in percent dry weight

When underlined denotes D_{10} size in mm *

FIGURES TO LEFT OF BORING UNDER COLUMNS "LL" AND "PL"

Are liquid and plastic limits, respectively

SYMBOLS TO LEFT OF BORING

▽ Ground-water surface and date observed

(C) Denotes location of consolidation test **

(S) Denotes location of consolidated-drained direct shear test **

(R) Denotes location of consolidated-undrained triaxial compression test **

(Q) Denotes location of unconsolidated-undrained triaxial compression test **

(T) Denotes location of sample subjected to consolidation test and each of the above three types of shear tests **

FW Denotes free water encountered in boring or sample

FIGURES TO RIGHT OF BORING

Are values of cohesion in lbs./sq.ft. from unconfined compression tests

In parenthesis are driving resistances in blows per foot determined with a standard split spoon sampler ($1\frac{3}{8}$" I.D., 2" O.D.) and a 140 lb. driving hammer with a 30" drop

Where underlined with a solid line denotes laboratory permeability in centimeters per second of undisturbed sample

Where underlined with a dashed line denotes laboratory permeability in centimeters per second of sample remoulded to the estimated natural void ratio

* The D_{10} size of a soil is the grain diameter in millimeters of which 10% of the soil is finer, and 90% coarser than size D_{10}.

**Results of these tests are available for inspection in the U.S. Army Engineer District Office, if these symbols appear beside the boring logs on the drawings.

GENERAL NOTES:

While the borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local variations characteristic of the subsurface materials of the region are anticipated and, if encountered, such variations will not be considered as differing materially within the purview of clause 4 of the contract.

Ground-water elevations shown on the boring logs represent ground-water surfaces encountered on the dates shown. Absence of water surface data on certain borings implies that no ground-water data is available, but does not necessarily mean that ground water will not be encountered at the locations or within the vertical reaches of these borings.

Consistency of cohesive soils shown on the boring logs is based on driller's log and visual examination and is approximate, except within those vertical reaches of the borings where shear strengths from unconfined compression tests are shown.

REVISION	DATE	DESCRIPTION	BY
2	6-8-64	SYMBOL FW, NOTE REVISED	ORAL FROM L.M.V.G.G. 5 JUNE 1964
1	9-17-63	1ST PAR. OF GENERAL NOTES REVISED	L.M.V.D. MULTIPLE LETTER, DATED 5 SEPT., 1963

SOIL BORING LEGEND

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO. H-2-21800

PLATE A

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 10
CORROSION PROTECTION

APPENDIX A

RESULTS OF SOILS INVESTIGATIONS

APPENDIX A

RESULTS OF SOILS INVESTIGATIONS

Part 1. Inner Harbor Navigation Canal West Levee, Florida Ave. to IHNC Lock

Field Data				Laboratory Data			
Sta. No.	Resistance in ohms	Distance in feet	Resistivity in ohm-cm	Classification	Resistivity in ohm-cm	Temp. in °C	pH	Temp. in °C
35+00	0.66	5.0	632.0	SP	5000+	25.5	7.4	22.0
	0.28	10.0	536.2	-	-	-	-	-
37+50	0.80	5.0	766.0	CH	1058	27.9	6.8	25.0
	0.37	10.0	708.6	-	-	-	-	-
40+00	0.84	5.0	804.3	SP	5000+	25.3	7.5	23.0
	0.34	10.0	651.1	-	-	-	-	-
42+50	0.62	5.0	593.7	CH	417	29.6	6.8	24.0
	0.30	10.0	574.5	-	-	-	-	-
44+00	0.84	5.0	804.3	-	810	26.9	7.0	26.9
	0.44	10.0	842.6	-	-	-	-	-
47+50	0.56	5.0	536.2	CH	1613	27.9	7.4	24.0
	0.28	10.0	536.2	-	-	-	-	-
50+00	0.50	5.0	487.8	SP	5000+	28.0	7.4	23.0
	0.20	10.0	383.0	-	-	-	-	-
52+50	3.00	5.00	2,872.5	SM; slf, & G	5000+	26.9	8.1	22.0
	0.42	10.0	804.3	-	-	-	-	-
55+00	0.84	5.0	804.3	SP	5000+	26.9	7.8	22.0
	0.15	10.0	287.3	-	-	-	-	-
60+00	15.0	5.0	14,362.5	SP	5000+	26.7	7.8	22.0
	7.2	10.0	13,788.0	-	-	-	-	-
66+00	0.53	5.0	507.5	SP & CH; slf	2725	27.0	7.5	23.0
	0.15	10.0	287.3	-	-	-	-	-
67+50	0.42	5.0	402.2	SP	3650	23.7		
	0.15	10.0	287.3	-	-	-	-	-
70+00	1.40	5.0	1,340.5	SP	5000+	26.7	7.7	23.0
	0.35	10.0	670.3	-	-	-	-	-

Part 1. Inner Harbor Navigation Canal West Levee, Florida Ave. to IHNC Lock (cont'd)

Field Data				Laboratory Data				
Sta. No.	Resistance in ohms	Distance in feet	Resistivity in ohm-cm	Classification	Resistivity in ohm-cm	Temp. in °C	pH	Temp. in °C
72+50	0.71	5.0	679.8	CH & sl	1538	28.8	7.7	21.0
	0.16	10.0	306.4	-	-	-	-	-
75+00	0.87	5.0	833.0	SP	5000+	26.8	7.7	22.0
	0.20	10.0	383.0	-	-	-	-	-
77+50	1.10	5.0	1,053.3	SP	2597	25.9	7.6	22.0
	0.16	10.0	306.4	-	-	-	-	-
80+00	0.97	5.0	900.1	SP; ars CH	5000+	26.6	7.7	22.0
	0.14	10.0	268.1	-	-	-	-	-
82+00	1.50	5.0	1,436.3	SP & slf	2591	28.0	7.7	22.0
	0.26	10.0	497.9	-	-	-	-	-
85+00	0.56	5.0	536.2	SP & sl	5000+	26.6	7.9	24.0
	0.07	10.0	134.1	-	-	-	-	-
87+50	0.53	5.0	507.5	Shells only	5000+	26.0	(No soil)	
	0.13	10.0	249.0	-	-	-	-	-
91+00	1.10	5.0	1,053.3	SP & CH	2653	27.8	7.9	24.0
	0.35	10.0	670.3	-	-	-	-	-
92+50	0.54	5.0	517.1	CH; ars SP	1389	28.6	7.8	25.0
	0.31	10.0	593.7	-	-	-	-	-
95+00	1.40	5.0	1,340.5	SP	1290	27.7	7.6	22.0
	0.43	10.0	823.5	-	-	-	-	-
97+50	2.20	5.0	2,106.5	SP & CH; slf	3731	27.7	7.5	23.0
	0.54	10.0	1,034.1	-	-	-	-	-
100+00	1.00	5.0	957.5	SP	5000+	26.9	7.5	24.0
	0.40	10.0	766.0	-	-	-	-	-
102+50	0.43	5.0	411.7	SP	2941	28.5	7.7	25.0
	0.08	10.0	153.2	-	-	-	-	-
105+00	0.68	5.0	651.3	SP	5000+	27.2	7.8	24.0
	0.22	10.0	421.3	-	-	-	-	-

Part 2. Inner Harbor Navigation Canal Remaining Levees (East Levee)

Field Data				Laboratory Data				
Sta. No.	Resistance in ohms	Distance in feet	Resistivity in ohm-cm	Classification	Resistivity in ohm-cm	Temp. in °C	pH	Temp. in °C
35+00	26.0	5.0	24,895.0	SM	5000+	22.8	7.4	24.0
	9.4	10.0	18,001.0	-	-	-	-	-
37+50	22.0	5.0	21,065.0	SM	5000+	22.6	7.2	24.0
	7.2	10.0	13,788.0	-	-	-	-	-
40+00	22.0	5.0	21,065.0	SM	5000+	23.5	7.4	24.0
	7.4	10.0	14,171.0	-	-	-	-	-
42+50	16.0	5.0	15,320.0	SM	3636	24.2	6.8	24.0
	3.8	10.0	7,277.0	-	-	-	-	-
45+00	20.0	5.0	19,150.0	SP	5000+	23.3	6.9	25.0
	4.8	10.0	9,192.0	-	-	-	-	-
47+50	18.0	5.0	17,235.0	SP & CL	5000+	24.7	5.7	24.0
	3.2	10.0	6,128.0	-	-	-	-	-
50+00	7.5	5.0	7,181.3	SP	5000+	24.4	6.2	24.0
	0.70	10.0	1,340.5	-	-	-	-	-
52+50	12.0	5.0	11,490.0	SP	5000+	24.6	7.2	23.0
	1.4	10.0	2,681.0	-	-	-	-	-
55+00	12.0	5.0	11,490.0	SP	5000+	26.0	7.0	23.0
	2.0	10.0	3,830.0	-	-	-	-	-
57+50	18.0	5.0	17,235.0	SP	5000+	25.5	5.9	23.0
	4.6	10.0	8,809.0	-	-	-	-	-
60+00	15.0	5.0	11,490.0	SP	5000+	24.9	6.9	25.0
	2.0	10.0	3,830.0	-	-	-	-	-
62+50	0.76	5.0	727.7	SP & CH	2299	25.4	7.2	25.0
	0.38	10.0	727.7	-	-	-	-	-
65+00	7.8	5.0	7,468.0	SP	5000+	26.5	7.0	23.0
	0.98	10.0	1,876.7	-	-	-	-	-
67+50	22.0	5.0	21,065.0	SP	5000+	26.5	7.2	23.0
	5.3	10.0	10,149.5	-	-	-	-	-
70+00	33.0	5.0	31,597.5	SP	5000+	25.9	7.1	23.0
	9.8	10.0	18,767.0	-	-	-	-	-

Part 2. Inner Harbor Navigation Canal Remaining Levees (East Levee) (cont'd)

Field Data				Laboratory Data				
Sta. No.	Resistance in ohms	Distance in feet	Resistivity in ohm-cm	Classification	Resistivity in ohm-cm	Temp. in °C	pH	Temp. in °C
72+50	50.0	5.0	47,875.0	SP	5000+	25.9	7.2	22.0
	6.6	10.0	12,639.0	-	-	-	-	-
75+00	12.0	5.0	11,490.0	SP & CH	5000+	26.9	7.4	22.0
	4.3	10.0	8,234.5	-	-	-	-	-
77+50	8.8	5.0	8,426.0	SP	5000+	25.8	7.1	22.0
	0.74	10.0	1,417.1	-	-	-	-	-
80+00	6.6	5.0	6,319.5	SP	5000+	24.9	6.7	23.0
	0.90	10.0	1,723.5	-	-	-	-	-
82+50	3.4	5.0	3,255.5	SP	5000+	24.0	7.4	22.0
	0.86	10.0	1,646.9	-	-	-	-	-
87+50	15.0	5.0	14,362.5	ML; ars CH	5000+	24.0	7.4	23.0
	7.6	10.0	14,554.0	-	-	-	-	-
92+50	4.0	5.0	3,830.0	ML	5000+	26.8	7.7	22.0
	0.97	10.0	1,857.6	-	-	-	-	-
97+50	2.9	5.0	2,776.8	ML	5000+	26.0	7.9	22.0
	0.52	10.0	995.8	-	-	-	-	-
102+50	3.6	5.0	3,447.0	ML	5000+	25.7	7.6	22.0
	0.6	10.0	1,149.0	-	-	-	-	-
112+50	1.4	5.0	1,340.5	CL	3546	28.3	7.5	22.0
	0.38	10.0	727.7	-	-	-	-	-
115+00	8.6	5.0	8,234.5	ML; ars CH	3425	26.1	7.8	22.0
	3.6	10.0	6,894.0	-	-	-	-	-
120+00	2.9	5.0	2,776.88	CL	3891	25.6	7.6	22.0
	0.50	10.0	957.5	-	-	-	-	-
125+00	1.9	5.0	1,819.3	CH	2404	25.3	7.4	24.0
	0.74	10.0	1,417.1	-	-	-	-	-
130+00	2.2	5.0	2,106.5	CH	1515	26.3	7.3	23.0
	0.58	10.0	1,110.7	-	-	-	-	-

Part 2. Inner Harbor Navigation Canal Remaining Levees (East Levee) (cont'd)

Field Data				Laboratory Data			
Sta. No.	Resistance in ohms	Distance in feet	Resistivity in ohm-cm	Classification	Resistivity in ohm-cm	Temp. in °C	pH	Temp. in °C
137+00	3.0	5.0	2,872.5	CH	2041	26.6	7.4	24.0
	2.0	10.0	3,830.0	-	-	-	-	-
139+50	3.0	5.0	2,872.5	SP & slf	1761	26.6	8.1	23.0
	0.40	10.0	766.0	-	-	-	-	-
153+50	0.44	5.0	421.3	CH	781	27.0	7.5	24.0
	0.16	10.0	306.4	-	-	-	-	-

Part 2. Inner Harbor Navigation Canal Remaining Levees (West Levee)

35+00	5.9	5.0	5,649.3	-	No Sample			
	1.1	10.0	2,106.5	-	-	-	-	-
40+00	14.0	5.0	13,450.0	-	No Sample			
	4.3	10.0	8,234.5	-	-	-	-	-
45+00	20.0	5.0	19,150.0	SP	4717	26.1	7.1	23.0
	7.9	10.0	15,128.5	-	-	-	-	-
50+00	7.4	5.0	7,085.5	-	No Sample			
	0.68	10.0	1,302.2	-	-	-	-	-
55+00	3.90	5.0	3,734.3	-	No Sample			
	0.82	10.0	1,570.3	-	-	-	-	-
60+00	7.0	5.0	6,702.5	-	No Sample			
	6.5	10.0	12,447.5	-	-	-	-	-
62+50	2.9	5.0	2,776.8	SP ars CH	2353	26.6	7.4	22.0
	0.29	10.0	555.4	-	-	-	-	-
65+00	1.2	5.0	1,149.0	-	-	-	-	-
	0.26	10.0	497.9	-	-	-	-	-
67+50	0.98	5.0	938.4	CH	1481	27.7	7.3	23.0
	0.12	10.0	229.8	-	-	-	-	-
70+00	2.0	5.0	1,915.0	-	-	-	-	-
	0.25	10.0	478.8	-	-	-	-	-

Part 2. Inner Harbor Navigation Canal Remaining Levees (West Levee) (cont'd)

Field Data				Laboratory Data				
Sta. No.	Resistance in ohms	Distance in feet	Resistivity in ohm-cm	Classification	Resistivity in ohm-cm	Temp. in °C	pH	Temp. in °C
72+50	1.5	5.0	1,436.3	CH	5000+	26.8	7.5	22.0
	0.24	10.0	459.6	-	-	-	-	-
75+00	3.4	5.0	3,255.5	-	-	-	-	-
	0.48	10.0	919.2	-	-	-	-	-
77+50	2.1	5.0	2,010.8	CH & sl	5000+	24.5	7.6	22.0
	0.30	10.0	574.5	-	-	-	-	-
80+00	2.6	5.0	2,489.5	-	-	-	-	-
	0.28	10.0	536.2	-	-	-	-	-
82+50	1.7	5.0	1,627.8	SM, sl & G	4878	27.2	7.9	22.0
	0.18	10.0	344.7	-	-	-	-	-
85+00	1.6	5.0	1,532.0	-	-	-	-	--
	0.24	10.0	459.6	-	-	-	-	-
87+50	0.53	5.0	507.5	SP & CH	1351	26.1	7.8	25.0
	0.12	10.0	229.8	-	-	-	-	-
90+00	0.54	5.0	517.1	-	-	-	-	-
	0.14	10.0	268.1	-	-	-	-	-
92+50	0.68	5.0	651.1	CH	952	27.5	7.3	26.0
	0.12	10.0	229.8	-	-	-	-	-
95+00	0.94	5.0	900.1	-	-	-	-	-
	0.14	10.0	268.1	-	-	-	-	-
100+00	2.0	5.0	1,915.0	-	-	No Sample		
	0.36	10.0	689.4	-	-	-	-	-
105+00	6.6	5.0	6,319.5	-	-	-	-	-
	1.1	10.0	2,106.5	-	-	-	-	-
110+00	26.0	5.0	24,895.0	Shells only	5000+	25.1	(No Soil)	
	5.4	10.0	10,341.0	-	-	-	-	-
115+00	6.4	5.0	6,128.0	Shells only	4032	25.5	(No Soil)	
	0.62	10.0	1,187.3	-	-	-	-	-
125+00	2.3	5.0	2,202.3	Gravel & Shells	1176	25.7	(No Soil)	
	0.50	10.0	957.5	-	-	-	-	-

Part 2. Inner Harbor Navigation Canal Remaining Levees (West Levee) (cont'd)

Field Data				Laboratory Data				
Sta. No.	Resistance in ohms	Distance in feet	Resistivity in ohm-cm	Classification	Resistivity in ohm-cm	Temp. in °C	pH	Temp. in °C
127+50	7.8	5.0	7,468.5	Shells only	2105	25.4	(No Soil)	
	2.6	10.0	4,979.0	-	-	-	-	-
130+00	0.86	5.0	823.5	Shells only	645	24.6	(No Soil)	
	0.32	10.0	612.8	-	-	-	-	-
132+00	2.80	5.0	2,681.0	Shells only	1156	24.7	(No Soil)	
	0.57	10.0	1,019.6	-	-	-	-	-
135+00	1.80	5.0	1,723.5	CH & sl	2151	27.6	7.8	24.0
	0.62	10.0	1,187.3	-	-	-	-	-
142+50	3.40	5.0	3,255.5	CH & SM	3650	25.3	7.5	24.0
	2.0	10.0	3,830.0	-	-	-	-	-
145+00	10.4	5.0	9,958.0	Shells only	5000+	25.3	(No Soil)	
	3.0	10.0	5,745.0	-	-	-	-	-
150+00	0.6	5.0	497.9	CH	2857	27.7	7.0	25.0
	0.16	10.0	306.4	-	-	-	-	-
152+50	0.52	5.0	497.9	CH	2525	27.9	7.1	24.0
	0.16	10.0	306.4	-	-	-	-	-
155+00	0.56	5.0	536.2	CH	2151	27.5	7.0	24.0
	0.14	10.0	268.1	-	-	-	-	-
157+50	0.70	5.0	670.3	CH	3378	26.8	7.1	24.0
	0.17	10.0	325.6	-	-	-	-	-
160+00	0.59	5.0	564.9	CH	3030	27.9	7.1	24.0
	0.14	10.0	268.1	-	-	-	-	-
162+50	0.64	5.0	612.8	CH	2611	27.9	7.1	26.0
	0.16	10.0	306.4	-	-	-	-	-
165+00	0.70	5.0	670.3	CH	2849	27.8	7.2	26.0
	0.18	10.0	344.7	-	-	-	-	-
167+50	0.72	5.0	689.4	CH	2273	27.9	7.2	24.0
	0.18	10.0	344.7	-	-	-	-	-
170+00	0.57	5.0	545.8	CH	1980	24.2	7.1	24.0
	0.10	10.0	191.5	-	-	-	-	-

Part 2. Inner Harbor Navigation Canal Remaining Levees (West Levee) (cont'd)

Field Data				Laboratory Data				
Sta. No.	Resistance in ohms	Distance in feet	Resistivity in ohm-cm	Classification	Resistivity in ohm-cm	Temp. in °C.	pH	Temp. in °C
172+50	0.46	5.0	440.5	CH	2500	25.9	7.0	25.0
	0.08	10.0	153.2	-	-	-	-	-
175+00	0.32	5.0	306.4	CH	2410	27.7	7.2	24.0
	0.06	10.0	114.9	-	-	-	-	-
177+50	0.34	5.0	325.6	CH	2571	29.9	7.3	23.0
	0.04	10.0	76.6	-	-	-	-	-
180+00	0.45	5.0	430.9	CH	2740	26.1	7.1	22.0
	0.07	10.0	134.1	-	-	-	-	-
182+50	0.22	5.0	210.7	CH	2710	27.6	6.9	22.0
	0.03	10.0	57.5	-	-	-	-	-
185+00	0.38	5.0	363.9	CH	1698	27.5	7.2	23.0
	0.07	10.0	134.1	-	-	-	-	-
187+50	0.37	5.0	354.3	CH	2500	26.9	7.3	24.0
	0.10	10.0	191.5	-	-	-	-	-
190+00	0.66	5.0	632.0	CH	2326	27.7	6.9	24.0
	0.12	10.0	229.8	=	=	=	=	=
192+50	0.45	5.0	430.9	CH	2128	27.8	7.2	23.0
	0.09	10.0	172.4	-	-	-	-	-
195+00	0.47	5.0	450.0	CH	1695	27.9	7.2	23.0
	0.09	10.0	172.4	-	-	-	-	-
197+50	0.40	5.0	383.0	CH	2030	26.9	7.1	23.0
	0.06	10.0	114.9	-	-	-	-	-
200+00	0.26	5.0	249.0	CH	2222	26.3	7.2	24.0
	0.04	10.0	76.6	-	-	-	-	-
202+50	0.28	5.0	268.1	CH	2558	27.5	7.0	24.0
	0.04	10.0	76.6	-	-	-	-	-
205+00	0.24	5.0	229.8	CH	2618	27.1	7.1	24.0
	0.03	10.0	57.5	-	-	-	-	-

Part 2. Inner Harbor Navigation Canal Remaining Levees (West Levee) (cont'd)

Field Data				Laboratory Data				
Sta. No.	Resistance in ohms	Distance in feet	Resistivity in ohm-cm	Classification	Resistivity in ohm-cm	Temp. in °C	pH	Temp. in °C
207+50	1.05	5.0	201.1	CH	2347	28.8	7.2	23.0
	0.20	10.0	38.3	-	-	-	-	-
210+00	0.25	5.0	239.4	CH	2062	29.1	7.2	21.0
	0.03	10.0	57.5	-	-	-	-	-
228+50	0.28	5.0	268.1	CH	238	26.0	6.9	22.0
	0.08	10.0	153.2	-	-	-	-	0
231+00	0.40	5.0	383.0	CH	286	25.9	6.9	23.0
	0.12	10.0	229.8	-	-	-	-	-
233+50	0.28	5.0	268.1	CH	213	27.8	7.2	23.0
	0.04	10.0	76.6	-	-	-	-	-
236+00	0.25	5.0	239.4	CH	286	25.5	7.1	23.0
	0.04	10.0	76.6	-	-	-	-	-
Part 3. Citrus Back Levee								
255+00	0.25	5.0	239.4	-	515	26.8	7.1	25.2
	0.16	10.0	306.4	-	-	-	-	-
257+50	0.28	5.0	268.1	CH; slf	238	24.1	7.4	25.8
	0.14	10.0	268.1	-	-	-	-	-
260+00	0.26	5.0	249.0	-	295	26.6	7.5	25.1
	0.15	10.0	287.3	-	-	-	-	-
262+50	0.29	5.0	277.7	CH & ML	313	23.1	7.9	25.0
	0.13	10.0	249.0	-	-	-	-	-
265+00	0.38	5.0	263.9	-	240	26.6	7.3	25.0
	0.21	10.0	402.2	-	-	-	-	-
267+50	0.31	5.0	296.8	CH	238	26.3	7.3	26.3
	0.31	10.0	593.7	-	-	-	-	-
270+00	0.29	5.0	277.7	-	285	26.5	7.7	25.4
	0.14	10.0	268.1	-	-	-	-	-

Part 3. Citrus Back Levee (cont'd)

Field Data				Laboratory Data				
Sta. No.	Resistance in ohms	Distance in feet	Resistivity in ohm-cm	Classificiation	Resistivity in ohm-cm	Temp. in °C	pH	Temp. in °C
433+00	0.97	5.0	928.8	-	1141	26.9	7.4	25.5
	0.42	10.0	804.3	-	-	-	-	-
435+50	1.20	5.0	1149.0	CH	1692	25.4	7.4	26.4
	0.45	10.0	861.8	-	-	-	-	-
438+00	0.98	5.0	938.4	-	1327	26.7	7.3	25.3
	0.45	10.0	861.8	-	-	-	-	-
440+40	0.94	5.0	900.1	CH	2070	22.8	7.4	26.0
	0.24	10.0	459.6	-	-	-	-	-
443+00	0.54	5.0	517.1	-	850	26.2	7.5	24.7
	0.28	10.0	536.2	-	-	-	-	-
445+50	0.68	5.0	651.3	CH	952	26.3	7.4	25.3
	0.28	10.0	536.2	-	-	-	-	-
448+00	0.53	5.0	507.5	-	1132	27.4	7.5	24.8
	0.20	10.0	383.0	-	-	-	-	-
450+50	0.50	5.0	478.8	CH	2151	25.3	7.5	25.4
	0.22	10.0	421.3	-	-	-	-	-
453+00	0.50	5.0	478.8	-	867	26.7	7.6	25.1
	0.16	10.0	306.4	-	-	-	-	-
573+00	0.42	5.0	402.2	-	265	29.4	7.1	25.2
	0.20	10.0	383.0	-	-	-	-	-
575+50	0.50	5.0	478.8	CH; GP	513	25.3	7.4	24.5
	0.32	10.0	612.8	-	-	-	-	-
578+00	0.52	5.0	497.9	-	395	26.9	7.2	25.1
	0.32	10.0	612.8	-	-	-	-	-
579+50	0.75	5.0	718.1	CH; slf	495	24.2	7.2	25.8
	0.28	10.0	536.2	-	-	-	-	-
583+00	0.59	5.0	564.9	-	1083	26.7	7.5	25.1
	0.36	10.0	689.4	-	-	-	-	-